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Grid code compliance assessment methods for grid connection of renewable energy power plants

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Grid code compliance assessment methods for grid connection of renewable energy power plants

FOREWORD

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IEC TS 63102 has been prepared by subcommittee 8A: Grid Integration of Renewable Energy Generation, of IEC technical committee 8: System Aspects of Electrical Energy Supply. It is a Technical Specification.

This second edition cancels and replaces the first edition published in 2021. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) in terms of scope, wind and PV power plants are replaced by the renewable energy power plants that includes wind power plants, PV power plants and hybrid power plants. Oscillation and grid adaptability are added in the assessment scope;
b) Clause 5 optimizes the descriptions of compliance field testing, compliance simulation, HIL simulation and compliance monitoring assessment methods, and recommends corresponding assessment methods according to different phases of renewable energy power plants and various assessment items;

c) Clause 6 supplements compliance field test methods for reactive power capability assessment;

d) Clause 7 adds synthetic inertia response and voltage slope control to control performance assessment, adjusts recommended contents for field testing and HIL simulation, improves applicable conditions and reference procedures of assessment methods, and updates illustrative charts and figures;

e) Clause 8 adds cascaded under and over voltage ride-through assessment cases, and refines simulation procedures and requirements for simulation results;

f) Clause 9 incorporates compliance simulation and monitoring methods into power quality assessment;

g) oscillation assessment is newly introduced, adopting combined time-domain and frequency-domain simulation as well as monitoring methods, with the consideration of renewable energy power plants connected to grid via HVDC;

h) grid adaptability assessment is newly supplemented, specifically covering the following withstand capability, such as voltage unbalance factor, flicker and harmonics, phase angle jump and grid strength;

i) Annex A adds topological structure examples of renewable energy power plants, compliance simulation setup, and improves contents including HIL simulation setup, monitoring of electrical performance and harmonics simulation.

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

Draft	Report on voting
8A/233/DTS	8A/247/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.

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.

1 Scope

This document highlights the recommended technical methods of grid code compliance assessment of renewable energy (RE) power plants connected to the grid, including wind power plants, photovoltaic (PV) power plants, and hybrid power plants. Hybrid power plants refer to wind/PV power plants equipped with energy storage systems or combined power plants based on wind, PV, and energy storage. The electrical behaviour of RE power plants in this document includes the operating area, control performance, fault ride-through capability, power quality, oscillation, and grid adaptability.

Compliance assessment is the process of determining whether the electrical behaviour of RE power plants meets the specific technical requirements in grid codes or technical regulations. The assessment methods include compliance field test, compliance simulation, hardware-in-the-loop (HIL) simulation and compliance monitoring. The input for compliance assessment includes relevant supporting documents, test results, validated simulation models, controller hardware, and continuous monitoring data. This document focuses exclusively on assessment methods from a technical perspective. It does not address certification-related procedures.

This document is applicable to RE power plants connected to the electrical power grid.

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 60050-415, *International Electrotechnical Vocabulary - Part 415: Wind turbine generator systems*

IEC 61400-21-1, *Wind energy generation systems - Part 21-1: Measurement and assessment of electrical characteristics - Wind turbines*

IEC 61400-21-2:2023, *Wind energy generation systems - Part 21-2: Measurement and assessment of electrical characteristics - Wind power plants*

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

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[2] *Scaling up variable renewable power*, The role of grid codes. International Renewable Energy Agency (2016)

IEC TR 61000-3-6, *Electromagnetic compatibility (EMC) - Part 3-6: Limits - Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems*

IEC TR 61000-3-7, *Electromagnetic compatibility (EMC) - Part 3-7: Limits-Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems*

IEC TR 61400-21-3, *Wind energy generation systems - Part 21-3: Measurement and assessment of electrical characteristics - Wind turbine harmonic model and its application*

IEC 61400-27-1, *Wind energy generation systems - Part 27-1: Electrical simulation models - Generic models*

IEC 61400-27-2, *Wind energy generation systems - Part 27-2: Electrical simulation models - Model validation*

IEC 61400-25-1, *Wind energy generation systems - Part 25-1: Communications for monitoring and control of wind power plants- Overall description of principles and models*

IEC TS 62910, *Utility-interconnected photovoltaic inverters - Test procedure for low voltage ride-through measurements*

IEC TS 63217, *Utility-interconnected photovoltaic inverters - Test procedure for over voltage ride-through measurements*

IEC TS 63406, *Generic RMS simulation models of inverter-based generators for power system dynamic analysis*

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