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TECHNICAL REPORT

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Dynamic characteristics of inverter-based resources in bulk power systems – Part 3: Fast frequency response and frequency ride-through from inverter-based resources during severe frequency disturbances

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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DYNAMIC CHARACTERISTICS OF INVERTER-BASED RESOURCES IN BULK POWER SYSTEMS –

Part 3: Fast frequency response and frequency ride-through from inverter-based resources during severe frequency disturbances

FOREWORD

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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 Report 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/standardsdev/publications.

A list of all parts in the IEC 63401 series, published under the general title *Dynamic characteristics of inverter-based resources in bulk power systems*, 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- withdrawn, or
- revised.

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INTRODUCTION

Primary frequency response (PFR) denotes the autonomous reaction of system resources to change in frequency. In most power systems, the main contributor to PFR is the governor response of synchronous generation. In the systems with less synchronous generators, the system inertia is relatively low and PFR capability is relatively weak and slow, so the system frequency tends to change dramatically in severe power imbalance disturbances, which will trigger under-frequency load shedding (UFLS) or OPC (over speed protection control) of synchronous generators possibly. Therefore, it is an effective coping method to introduce some new frequency responses in the systems with high penetration of inverter-based resources.

This document studies fast frequency response (FFR) as a potential mitigation option in maintaining grid security during severe frequency disturbances. Broadly, FFR is some kind of rapid injection of electrical power from inverter-based resources or relief of loads that helps arrest the decline of system frequency during severe disturbances.

DYNAMIC CHARACTERISTICS OF INVERTER-BASED RESOURCES IN BULK POWER SYSTEMS –

Part 3: Fast frequency response and frequency ride-through from inverter-based resources during severe frequency disturbances

1 Scope

This part of IEC 63401, which is a Technical Report, provides an insight into the various forms of fast frequency response and frequency ride-through techniques that involve inverter-based generation sources (mainly wind and PV) in a bulk electrical system.

This document first focuses on extracting the clear definition of FFR from different references around the world, while studying the mechanism of FFR acting on system frequency and the unique features of FFR. It then compares various kinds of frequency response and demonstrates the relationship among synchronous inertia response, fast frequency response, and primary frequency response. Several system needs and conditions where FFR is suitable are identified. This document also focuses on the performance objectives, practicality and capabilities of various non-synchronous resources, and discusses the test methods for verifying FFR capability at different levels. Finally, it focuses on the ROCOF issues and on the robust performances of FFR.

2 Normative references

There are no normative references in this document.