

TECHNICAL REPORT



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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CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references	9
3 Terms, definitions and abbreviated terms	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	9
4 Definition of fast frequency response (FFR).....	11
4.1 General.....	11
4.2 Existing usage of term FFR.....	11
4.2.1 FFR in Australia and Texas	11
4.2.2 FFR and synthetic inertia in European Network of Transmission System Operators for Electricity (ENTSO-E)	15
4.2.3 FFR and synthetic inertia in EirGrid/SONI.....	16
4.2.4 The enhanced frequency response and enhanced frequency control capability in the UK.....	18
4.2.5 FFR in North American Electric Reliability Council (NERC) and North America	18
4.3 Definition of FFR given by CIGRE JWG C2/C4.41.....	18
4.4 Recommended definition of fast frequency response (FFR)	19
4.4.1 Clear definition	19
4.4.2 Impact mechanism on system frequency.....	19
4.5 Description of the relationship among synchronous inertia response, fast frequency response, and primary frequency response.....	20
4.5.1 Relationship between synchronous inertia response and fast frequency response	20
4.5.2 Relationship between fast frequency response and primary frequency response	21
4.5.3 Relationship between synchronous inertia response and primary frequency response	21
5 System needs and conditions where fast frequency response is warranted.....	22
5.1 Higher ROCOF and lower nadir.....	22
5.1.1 General	22
5.1.2 Higher ROCOF	23
5.1.3 Worse nadir	24
5.1.4 Simulation study	25
5.1.5 Blackout in Great Britain power grid on 9 August 2019	26
5.2 Large fluctuation of system frequency in power system operation	29
5.2.1 General	29
5.2.2 Frequency regulation scheme	29
5.2.3 Relatively large load fluctuation	30
5.2.4 Relatively weak and slow PFR.....	30
6 Performance objectives for fast frequency response from inverter-based resources	31
6.1 The response time of FFR.....	31
6.2 The response characteristics and maximum response capacity of FFR	32
6.3 Test performance for renewable generator equipped with fast frequency response in China.....	34
6.3.1 General	34

6.3.2	Engineering construction	34
6.3.3	Test practice and performance	35
7	Available technologies, controls, and tuning considerations for fast frequency response and primary frequency response.....	35
7.1	Available technologies for fast frequency response	35
7.1.1	Technology capabilities for FFR service.....	35
7.1.2	Wind turbines	36
7.1.3	Solar PV	37
7.1.4	Battery energy storage	38
7.1.5	HVDC	40
7.2	Available controls for fast frequency response	41
7.2.1	General	41
7.2.2	Additional FFR control for grid-following converter.....	41
7.2.3	Grid-forming converter control	42
7.3	Tuning considerations for fast frequency response and primary frequency response.....	44
8	Test methods for verifying turbine-level or plant-level fast frequency response capability	45
8.1	General.....	45
8.2	Selection of test equipment.....	45
8.3	Test wiring method.....	45
8.4	Selection of measuring conditions.....	46
8.5	Step frequency disturbance test.....	47
8.6	Slope frequency disturbance test	47
8.7	Actual frequency disturbance simulation test.....	48
8.8	Actual frequency disturbance simulation test.....	48
9	Rate-of-change-of-frequency (ROCOF) definition and withstand capability for high ROCOF conditions.....	49
9.1	Definition of rate of change of frequency (ROCOF)	49
9.2	Ride-through (withstand) capability for high ROCOF conditions	51
10	Test specifications for high ROCOF conditions	53
10.1	Performance specification	53
10.1.1	Effective and operating ranges	53
10.1.2	Accuracy related to the characteristic quantity	53
10.1.3	Start time for rate of change of frequency (ROCOF) function	54
10.1.4	Accuracy related to the operate time delay setting	54
10.1.5	Voltage input	54
10.2	Functional test methodology	55
10.2.1	General	55
10.2.2	Determination of steady-state errors related to the characteristic quantity	55
10.2.3	Determination of the start time.....	63
10.2.4	Determination of the accuracy of the operate time delay.....	65
10.2.5	Determination of disengaging time.....	66
11	Modelling capabilities and improvements to dynamic models for fast frequency response and related high ROCOF conditions	67
11.1	General.....	67
11.2	Dynamic models for fast frequency response and related high ROCOF conditions	68
11.2.1	Dynamic models of whole power systems	68

11.2.2	Simplification of dynamic models	73
11.3	Modelling improvements	75
	Bibliography.....	77
Figure 1	– Proposed response times by ERCOT as of 2014	12
Figure 2	– Time elements of FFR.....	14
Figure 3	– Impact mechanism on system frequency by FFR.....	20
Figure 4	– System frequency in response to a large generation trip	22
Figure 5	– Frequency characteristics under the same disturbance with various inverter-based resources penetration.....	26
Figure 6	– Frequency response in blackout in Great Britain power grid on 9 August 2019.....	27
Figure 7	– System frequency fluctuation under secondary frequency regulation due to load fluctuation in a grid.....	29
Figure 8	– Assignment of different modulations for quasi-steady-state frequency fluctuation.....	30
Figure 9	– Controlled contribution of electrical power provided by ROCOF-based FFR	33
Figure 10	– The controlled contribution of electrical power provided by deviation-based FFR	34
Figure 11	– Scheme of the transfer function of ROCOF-based FFR for grid-following converters.....	41
Figure 12	– Scheme of the transfer function of deviation-based FFR for grid-following converters.....	42
Figure 13	– Schematic of the droop control of deviation-based FFR for grid-forming converters.....	43
Figure 14	– Time elements of FFR.....	44
Figure 15	– Test wiring diagram.....	46
Figure 16	– Test slope curve for ROCOF-based FFR	48
Figure 17	– Schematic of increased ROCOF with increased renewable generation	50
Figure 18	– The response of IBRs for frequency slope change (change from 45 Hz to 55 Hz in 1 s).....	51
Figure 19	– The response of IBRs for frequency step change of 1 Hz	52
Figure 20	– Operate time and operate time delay setting	54
Figure 21	– Example of test method for positive ROCOF function	56
Figure 22	– Test method for measurement of reset value for ROCOF functions: example for positive ROCOF function	59
Figure 23	– Start time measurement of positive ROCOF function.....	63
Figure 24	– Operate time delay measurement of positive ROCOF.....	65
Figure 25	– Disengaging time measurement of ROCOF	66
Figure 26	– Second generation BPS renewable energy system (RES) modules	69
Figure 27	– Load modelling practices.....	70
Figure 28	– WECC CLM.....	72
Figure 29	– Electronically interfaced load model	72
Figure 30	– Distributed energy resource model.....	73
Figure 31	– The traditional SFR model.....	73
Figure 32	– Improved model in light of ROCOF-based FFR and deviation-based FFR.....	75

Figure 33 – Electrical power from wind turbines for different combinations of wind power control strategies under 20 % wind power penetration in system 76

Table 1 – Frequency response times of FFR..... 13

Table 2 – Frequency response in Great Britain power grid on 9 August 2019..... 29

Table 3 – Summary of response times in different countries and regions 31

Table 4 – Summary of response times for inverter-based resources 31

Table 5 – Typical ranges of control parameters of FFR..... 34

Table 6 – Inertia response and fast frequency regulation performance..... 35

Table 7 – Input and output of a data collection point 46

Table 8 – Test conditions for fast frequency response of renewable energy power plant 46

Table 9 – Stepped frequency disturbance test 47

Table 10 – Test conditions for actual frequency disturbance simulation 48

Table 11 – Example of effective and operating ranges for over- and under-frequency protection 53

Table 12 – Example of effective and operating ranges for ROCOF protection 53

Table 13 – Test points for ROCOF function..... 57

Table 14 – Reporting of ROCOF accuracy 58

Table 15 – Test points of reset value for ROCOF function..... 62

Table 16 – Reporting of the reset value for ROCOF function..... 63

Table 17 – Test points for minimum frequency protection function start time 64

Table 18 – Test points to measure operate time delay 65

Table 19 – Test points for accuracy of the operate time delay 66

Table 20 – Test points of disengaging time for ROCOF function 67

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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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.