GUIDELINE: RATE OF CHANGE OF FREQUENCY SENSITIVE EQUIPMENT

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1. INTRODUCTION

1.1. Purpose and Scope

1.1.1. As part of the Wholesale Electricity Market's (WEM) transition to Security-Constrained Economic Dispatch (SCED) a range of Essential System Services (ESS) will replace the existing suite of Ancillary Services. RoCoF Control Service is new service introduced as part of the Frequency Co-Optimised Essential System Services (FCESS) for the provision of Inertia.

1.1.2. The RoCoF Control Service has two functions:

   (a)   To ensure that the Rate of Change of Frequency is restricted to below the Safe RoCoF Limit; and

   (b)   To ensure that minimum Frequency requirements are maintained by allowing a trade-off between the amount of reserve required and the amount of inertia on the power system.

1.1.3. Cost recovery for the RoCoF Control Service is from RoCoF Causers, identified by their RoCoF Ride-Through Capability i.e. the ability to withstand up to a specified level of frequency change over 500 milliseconds. Those Facilities with a RoCoF Ride-Through Capability that is below the RoCoF Ride-Through Cost Recovery Limit will be deemed causers of the RoCoF Control Service and will need to contribute to recovery of the costs of the service.

1.1.4. The RoCoF Ride-Through Cost Recovery Limit is determined by AEMO in accordance with the FCESS Accreditation WEM Procedure and must be set at least 0.25 Hz over 500 milliseconds higher than the RoCoF Safe Limit (currently 0.25 Hz over 500 milliseconds). It also cannot exceed the RoCoF Upper Limit, which is the worst case RoCoF determined by AEMO in accordance with the FCESS Accreditation WEM Procedure.
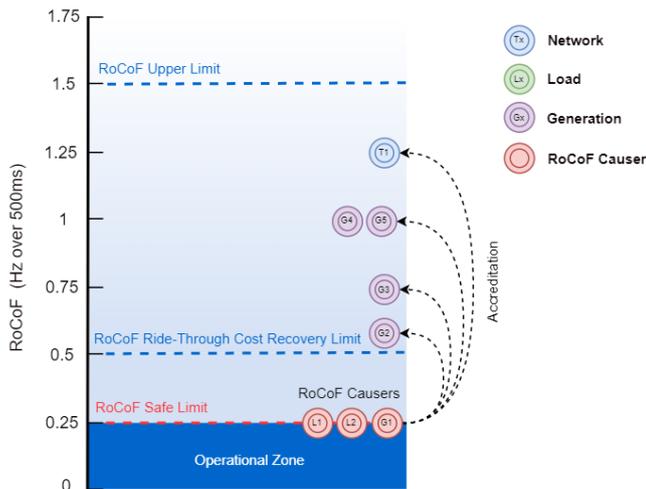
Figure 1   RoCoF Ride-Through Cost Recovery Limit

1.1.5.   The RoCoF Upper Limit and RoCoF Ride-Through Cost Recovery Limit are published on the WEM Webiste.

1.1.6.   Market Participants and Network Operators can seek accreditation for their Facility in accordance with paragraph 11.2 of the Frequency Co-Optimised Essential System Services Accreditation WEM Procedure. This accreditation can be supported by the following information:

   (a)   for a Facility with a Registered Generator Performance Standard, confirmation that the Market Participant wishes to use the RoCoF for which the Facility can maintain Continuous Uninterrupted Operation over 1 second as specified under that Registered Generator Performance Standard, as the basis for Accreditation;

   (b)   evidence that the Facility has maintained Continuous Uninterrupted Operation under a range of RoCoF events that demonstrate the ability of that Facility to ride through in accordance with the RoCoF Ride-Through Capability that the Market Participant is seeking Accreditation for; or

   (c)   an engineering report, derived from an engineering study, that must contain details of the results and methodology of that engineering study.

1.1.7.   This RoCoF Sensitive Equipment List provides guidance to Market Participants and Network Operators for identifying equipment forming part of their Facility which may require assessment for RoCoF Ride-Through due to their sensitivity to RoCoF.

1.2.   Definitions and interpretation

1.2.1.   In this document:

   (a)   terms that are capitalised, but not defined, have the meaning given in the WEM Rules, or for terms not defined in the WEM Rules, the Frequency Co-optimised Essential System Services Accreditation WEM Procedure.

   (b)   to the extent that this document is inconsistent with the WEM Rules or WEM Procedures, the WEM Rules or WEM Procedures prevail to the extent of the inconsistency;

(c)   a reference to the WEM Rules, or WEM Procedures, includes any associated forms required or contemplated by the WEM Rules or WEM Procedures; and

(d)   words expressed in the singular include the plural and vice versa.

Table 1   Definitions

Term	Definition
PV	photovoltaic
RoCoF	Rate of Change of Frequency
STATCOM	Static Synchronous Compensators
SVC	Static VAr Compensators

1.3.   Related documents

Table 2   Related documents

Reference	Title	Location
WEM Rules	Wholesale Electricity Market Rules	Energy Policy WA Website
FCESS WEM Procedure	WEM Procedure: Frequency Co-Optimised Essential System Services Accreditation	WEM Website
Other	Advisory on Equipment Limits associated with High RoCoF	NEM Website

2.   ROCOF SENSITIVE EQUIPMENT

2.1.1.   The equipment identified in this document is informed by a report prepared by GE Energy Consulting (Advisory on Equipment Limits associated with High RoCoF). It is recommended that Market Participants and Network Operators review this document and for any relevant equipment, consider the causes of sensitivity to RoCoF and likely impacts to a Facility for which they are seeking accreditation.

2.2.   Gas and Steam Turbines

2.2.1.   Market Participants and Network Operators should consider the RoCoF Ride-Through Capability of all Gas and Steam Turbines forming part of a Facility for which that Market Participant or Network Operator is seeking accreditation. Consideration should be given to the following:

(a)   any issues with lean gas blowout under high RoCoF Events (upward);

(b)   compressor surge;

(c)   power system stabilisers; and

(d)   operation of anti-islanding.

2.3. Power Electronics

2.3.1. Market Participants and Network Operators should consider the RoCoF Ride-Through Capability of all Power Electronics forming part of a Facility for which that Market Participant or Network Operator is seeking accreditation. Consideration should be given to the following:

(a) inverters (battery energy storage systems, solar PV, Type 3 and 4 wind turbines, Static Synchronous Compensators (STATCOM));

(b) operation of anti-islanding; and

(c) control schemes for grid-following (phase locked loop or equivalent).

2.4. Static VAr Compensators (SVC's)

2.4.1. Market Participants and Network Operators should consider the RoCoF Ride-Through Capability of all Static Var Compensators (SVC's) forming part of a Facility for which that Market Participant or Network Operator is seeking accreditation. Consideration should be given to control schemes for grid-following (Phase Locked Loop or equivalent).

2.5. Wind Turbines

2.5.1. Market Participants and Network Operators should consider the RoCoF Ride-Through Capability of all wind turbines forming part of a Facility for which that Market Participant or Network Operator is seeking accreditation. Consideration should be given to the following:

(a) type 3 and 4 wind turbines should assess control schemes for grid-following (phase locked loop or equivalent) and any turbine torque associated with high RoCoF; and

(b) induction type wind turbines should assess protection devices associated with high current and torque associated with high RoCoF.

2.6. Relays

2.6.1. Market Participants and Network Operators should consider the sensitivity of the following relay types:

(a) electro-mechanical relay:

   (i) capability of Electro-Mechanical relays to operate under elevated RoCoF; and

(b) digital relays:

   (i) settings should be confirmed to be appropriate for the specified RoCoF Ride-Through Capability

2.7. Protection Schemes

2.7.1. Market Participants and Network Operators should consider whether protection schemes are set to operate safely for specified RoCoF Ride-Through Capability, with particular attention to any RoCoF protection relays (capability and settings).