Future Security and Resilience: Common Quality Technical Group (FSR CQTG)

Meeting 11: 16 April 2025

ELECTRICITY AUTHORITY
TE MANA HIKO

Voltage support and Fault ride through

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Voltage support Code amendment

- Require an embedded generating station to actively import or export reactive power as is necessary to maintain a constant voltage at the embedded generating station's point of connection to a distribution network, if all of the following conditions hold:
  1) the embedded generating station is connected to the distribution network at the same nominal voltage as the voltage of the electrical busbar—
     i. at which a transmission network owner has agreed to provide services to the distributor, and
     ii. that is electrically closest to the embedded generating station
  2) the embedded generating station exports 10MW or more of electricity to the distribution network
  3) the distributor that operates the distribution network has not directed the embedded generating station to operate in an alternative voltage control mode to accommodate conditions on the distribution network
  4) for an embedded generating station commissioned prior to 1 July 2026, the embedded generating station can comply with the requirement.

Fault ride through Code amendment

- Lower, to 10MW of exported electricity, the threshold for any generating station to be excluded by default from complying with the fault ride through requirements in clauses 8.25A and 8.25B of the Code, provided that for generating stations commissioned prior to 1 July 2026 the generating station can comply with the requirement

Benefits

- Power system less prone to frequency / voltage disturbances &, in extreme cases, AUFLS events
- Linked with managing risk of disturbances & sympathetic tripping, the proposal may:
  - reduce instantaneous reserve system operator procures
  - potentially reduce system operator constraining dispatch of active power (for reactive power provision / absorption)
- Defer, & possibly avoid, relatively more expensive investment in transmission & distribution network-related voltage management assets
- Relatively more power system active power transfer capacity
- Reduced risk of electrical equipment being damaged or mal-operating (including consuming relatively more energy because of higher voltages)
- Reduced risk of power quality issues (eg, flicker)

Costs – Voltage support

- Higher energy (active power) losses for generating stations subject to the proposal's requirements, from producing reactive power to keep voltage constant
  - NewPower: this cost could be $26,000 annually for 1 MVAr of reactive power, for a particular inverter
  - **Question**: What is the generator's upfront capital cost?
  - **Question**: What are the upfront and ongoing costs of substitutes?
- Oversizing of synchronous machines / inverters to deliver desired active power
  - **Question**: What are the upfront and ongoing costs?
- No incremental compliance costs – modelling requirements aligned with relevant distributor's

Costs – Fault ride through

- Compliance costs
  - Manawa Energy – this cost could be $40,000–$80,000 per generating unit
  - Is a proportionate-based approach to compliance possible for fault ride through?
  - **Question**: What might be the range of compliance costs under a proportionate-based approach to compliance for FRT?

Clause 8.23

Defer amendments for now?

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Code drafting

8.23 Voltage support AOPOs

(1) Each **generator** with a **point of connection** to the **grid** must at all times ensure that its **assets—**

(a) when the voltage at its **grid injection point** is within the applicable range of nominal voltage, are capable of exporting (over excited) when ~~**synchronised**~~ **electrically connected** and subject to an **offer** or a **reserve offer** ~~made available for **dispatch** by the **system operator**~~, a minimum net **reactive power** which is 50% of the maximum continuous **MW** output power as measured at the following **generating unit** terminals:

Nominal **grid** voltage (kV)	Voltage range for which **reactive power** is required			
	Minimum (kV)		Maximum (kV)	
220	198	-10.0%	242	10.0%
110	99	-10.0%	121	10.0%
66	62.7	-5.0%	69.3	5.0%
50	47.5	-5.0%	52.5	5.0%
33	31.35	-5.0%	34.65	5.0%
22	21.45	-2.5%	22.55	2.5%
11	10.725	-2.5%	11.275	2.5%

(b) when the voltage at its **grid injection point** is within the applicable range of nominal voltage, are capable of importing (under excited) when ~~**synchronised**~~ **electrically connected** and subject to an **offer** or a **reserve offer** ~~made available for **dispatch** by the **system operator**~~, a minimum net **reactive power** which is 33% of the maximum continuous **MW** output power as measured at the **generating unit** terminals as set out below:

Nominal **grid** voltage (kV)	Voltage range for which **reactive power** is required			
	Minimum (kV)		Maximum (kV)	
220	209	-5.0%	242	10.0%
110	104.5	-5.0%	121	10.0%
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(c) when **synchronised**, continuously operate in a manner that supports voltage and voltage stability on the **grid** in compliance with the **technical codes**.

Code drafting

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Clause 8.23: Point of compliance

- System operator reviewing Policy Statement
  - Clause 114 (*Generator Asset Capability Assessment, Voltage*)
- System operator considering proposed clarifications
  - Measure reactive power support at grid injection point (HV side of transformer) rather than at generating unit terminals
- Original (2001) thinking behind clause 8.23 was to require a generator's reactive power capability at the grid injection point
- However, point of reference moved to generating unit terminals, to be consistent with:
  - Then-current international practice, and
  - Standard design of generating plant

Clause 8.23: Point of compliance

- Clause 8.23 may no longer:
  - Align with current practices, and/or
  - Accommodate emerging technology
- Various overseas jurisdictions specify reactive power requirement at connection point (eg, AEMO, EirGrid, FERC) rather than at generating unit terminals (NESO)
- Wind and solar PV generating unit terminals not so near to the grid
  - Clause 8.23 doesn't consider notional aggregation point for this type of generation
- Any proposed change to point of compliance may require:
  - Investigation on changing the reactive power support capability percentages (ie, +50% / -33%), and
  - The voltage range at which this support is required