

Update report Stakeholder feedback template:

AEMO Review of technical requirements for connection

Stakeholders making a submission on the recommendations set out in the AEMO draft report may use the below template to provide feedback. Please consider the confidentiality disclaimer at the end of this document.

Stakeholder: Caterpillar, Electric Power Division

Schedule 5.2 Conditions for Connection of Generators

NER Schedule 5.2 issue	Schedule 5.2 (Generators) – feedback on revised recommendations and relevant draft NER amendments
NER S5.2.1 – Outline of requirements	
Application of Schedule 5.2 based on plant type instead of registration category and extension to synchronous condensers	<ul style="list-style-type: none"> It is proposed to classify synchronous generators (as Small- and Large Generators) based on their individual unit capacity (MW) instead of the aggregated plant capacity. Synchronous generators are autonomous units (an indivisible set) which can generate electrical energy such that the frequency of the generated voltage, the generator speed and the frequency of network voltage are in a constant ratio and thus in synchronism. These units can be started and stopped independently; therefore, should be considered individually in determining the classification as Small- or Large Generators.
NER S5.2.5.1 – Reactive power capability	
Voltage range for full reactive power requirement	<ul style="list-style-type: none"> Synchronous generators (alternators) offer a large over-excited operating range, up to +0.75 Q/Pmax at <u>rated active power</u> (Pmax) but are constrained in their under-excited operating range owing to voltage stability and stator heating. On the other hand, inverter capabilities at <u>rated active power</u> (Pmax) in the over-excitation range are constrained owing to over-current capabilities of the inverter switches. It is proposed to limit the Q-requirements from ±0.395 to ±0.33 Q/Pmax (±0.95 power factor) to avoid over-sizing of alternators and inverters. The NAS can be used to agree on larger Q-ranges. It proposed to add a figure, with the voltage axis as a percentage of the nominal grid voltage and the required reactive power as a percentage of the unit's nominal active power, showing the required voltage-reactive power "U-Q/Pmax" range. This figure would represent that reactive power capability of units is reduced with increase in voltage deviation.
Treatment of reactive power capability considering temperature derating	
Compensation of reactive power when units are out of service	<ul style="list-style-type: none"> This requirement can influence the design of AC filters. A project-specific study (at the plant-level) is required to confirm the proposed 0.5% voltage variation. It is therefore proposed to move this requirement under the AAS standard and allow for relaxation in the NAS/MAS (Negotiated/Minimum Access Standard).
S5.2.5.7, S5.2.5.8, S5.2.5.13	
Simplifying small connections	<p>General comments: It is proposed to simplify and make the MAS (Minimum Access Standard) requirements exhaustive for Small Generators. This will help OEMs design and test for the base level requirements. Any non-exhaustive requirements or requirements higher than the MAS are proposed to be given under the NAS or AAS.</p>

NER Schedule 5.2 issue	Schedule 5.2 (Generators) – feedback on revised recommendations and relevant draft NER amendments
	<ul style="list-style-type: none"> • S5.2.4 - It is proposed to provide relaxation of simulation model requirements (RMS/EMT) for Small Generators. Block diagram representation of Small Generators, using common standards (IEEE, IEC, etc.), can be provided on request. • S5.2.5.4 - Please see the comments below for “S5.2.5.4” (MAS proposal: 70% to 80% for 0.7 seconds after T(uv)). • S5.2.5.5 - It is proposed that the current MAS which states that the fault ride-through capabilities for synchronous generators are agreed with the system operator, be moved under NAS. MAS of 30% Un (residual voltage) for 150 ms is proposed for Small Generators. • S5.2.5.5 - Multiple fault ride-through (MFRT) requirements: It proposed to relax the MFRT for Small Generators considering the MAS proposed above. • S5.2.5.5 – NAS: “...the reactive current contribution of a schedule 5.2 plant to the extent it comprises synchronous production units or synchronous condensers may be limited to 250% of the maximum continuous current maximum continuous current”. Reactive current contribution of synchronous generators is a natural response which depends on the grid- and on-site conditions. Restricting the fault current to a lower value for stringent faults requires extensive plant-level studies and solutions. It is proposed to relax (remove) this requirement for Small Generators. • S5.2.5.13 - It is understood that the voltage and reactive power requirements (settling time, PSS, etc.) are for Large Generators and not for Small Generators. If not the case, it is proposed to: <ul style="list-style-type: none"> – Provide a settling time requirement of greater than 10 s for Small Generators, – Provide relaxation of PSS (power system stabiliser) requirements for Small Generators, – Only require reactive power or power factor modes for Small Generators; current NAS: “...Network Service Provider and AEMO will nominate one or more control modes to be implemented...”.
NER S5.2.5.2 – Quality of electricity generated	
Reference to plant standard	
NER S5.2.5.4 – Generating system response to voltage disturbances	
Overvoltage requirements for medium voltage and lower connections	<ul style="list-style-type: none"> • Currently both the AAS and MAS require "continuous uninterrupted operation where a power system disturbance causes the voltage to vary within 70% to 80% of normal voltage nominal voltage at the connection point for a period of <u>at least 2 seconds</u> after T(uv)." It is proposed to relax the <u>MAS</u> requirement as "continuous uninterrupted operation where a power system disturbance causes the voltage to vary within 70% to 80% of normal voltage nominal voltage at the connection point for a period of <u>less than or equal to 0.7 seconds</u> after T(uv). "
Requirements for overvoltages above 130%	<ul style="list-style-type: none"> • The current set of requirements are understood as the peak voltages seen from network surges and is given for the purpose of insulation coordination. It is requested to clarify if there are specific unit level requirements.
Clarification of continuous uninterrupted operation (CUO) in the range 90% to 110% of normal voltage	<ul style="list-style-type: none"> • A linear reduction in the corners of the U-Q/Pmax (voltage-reactive power) profile is allowed as mentioned in NER S5.2.5.1. It is therefore proposed to consider NER S5.2.5.1 conditions as part of this CUO range.
NER S5.2.5.5 – Generating system response to disturbances following contingency events	
Definition of end of a disturbance for multiple fault ride through	<ul style="list-style-type: none"> • It is proposed to relax the fault ride through (FRT) requirement, from 430 ms to 150 ms, for synchronous generators to consider the multiple fault ride through (MFRT) scenarios. There is a high risk of pole-slipping for synchronous generators as the fault clearing time increases. The proposed 150 ms is the fault clearance time for medium- and high voltage grids as given in most European grid code documents (Ref: EU 2016/631 alias NC-RfG and EN 50549).
Number of faults with 200 ms between them	
Reduction of fault level below minimum level for which the plant has been tuned	

NER Schedule 5.2 issue		Schedule 5.2 (Generators) – feedback on revised recommendations and relevant draft NER amendments	
Active power recovery after a fault			
Rise time and settling time for reactive current injection			
Commencement of reactive current injection			
Clarity on reactive current injection volume and location and consideration of unbalanced voltages		<ul style="list-style-type: none"> It is requested to add (example) graphs showing the response of asynchronous units (inverters) for changes in positive- and negative sequence component of the grid voltage respectively. 	
Metallic conducting path			
Reclassified contingency events			
NER S5.2.5.7 – Partial load rejection			
Application of minimum generation to energy storage systems			
Clarification of meaning of CUO for NER S5.2.5.7			
NER S5.2.5.8 – Protection of generating systems from power system disturbances			
Emergency over-frequency response		<p>The revised recommendations include:</p> <ul style="list-style-type: none"> “AAS - reflecting a proportional response”: Further clarification on the term “proportional response” is requested. Also, certain prime movers of synchronous generators (genset, turbines) are constrained in their speed of active power response. Therefore, it is proposed to specify a droop range for the response as 16.67% – 100% rated power (Pmax) per Hertz and a maximum ramp rate as 20% Pmax/minute. “NAS - ...specifically including rapid reduction by 50% by means other than tripping”: It is requested to clarify that the response can saturate (settle) at the minimum operating level before a 50% Pmax reduction is achieved. Also, a maximum ramp rate of 20% Pmax/minute is proposed here. 	
NER S5.2.5.10 – Protection to trip plant for unstable operation			
Requirements for stability protection on asynchronous generating systems		<ul style="list-style-type: none"> The given set of AAS and MAS are non-exhaustive, and it is requested to add tables or flow-charts showing the requirements. <u>For the MAS</u>, an exhaustive set of requirements including tables with the min/max configuration settings and default thresholds are requested. It is also proposed to allow for additional development time where there are project-specific protection requirements. 	
NER S5.2.5.13 – Voltage and reactive power control			
Voltage control at unit level and slow setpoint change			
Realignment of performance requirements to optimise power system performance over expected fault level (system impedance) range – Voltage control		<ul style="list-style-type: none"> MAS: It is proposed to allow a settling time of greater than 10 s for reactive power (Q) and power factor changes. Q-response of synchronous generators are influenced by grid- and onsite conditions/components, which include the grid- strength, harmonics, asymmetry and OLTCs. 	
Materiality threshold on settling time error band and voltage settling time for reactive power and power factor setpoints			

NER Schedule 5.2 issue		Schedule 5.2 (Generators) – feedback on revised recommendations and relevant draft NER amendments
Clarification of when multiple modes of operation are required		
Impact of a generating system on power system oscillation modes		
Definition – continuous uninterrupted operation		
Recognition of frequency response mode, inertial response and active power response to an angle jump		

Schedule 5.3a Conditions for connection of MNSPs

Issue		Schedule 5.3a (HVDC links) – feedback on revised recommendations and relevant draft NER amendments
NER S5.3a.1a Introduction to the schedule		
Alignment of schedule with plant-type rather than registration category		
NER S5.3a.8 – Reactive power capability		
Reactive power		
NER S5.3a.13 – Market network service response to disturbances in the power system		
Voltage disturbances		
Frequency disturbances		
Fault ride through requirements		
NER S5.3a.4 – Monitoring and control requirements		
Remote monitoring and protection against instability		
New standards		
Voltage control		
Active power dispatch		

Multiple Schedules

Issue	Multiple schedules – feedback on revised recommendations and relevant draft NER amendments
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NER Multiple clauses

References to superseded standards	
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NER structural amendments

Issue	NER structural amendments – feedback on revised recommendations and relevant draft NER amendments
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NER structural amendments

Drafting principles	
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Proposed approach	
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Consequential amendments

Issue	Consequential amendments – feedback on revised recommendations and relevant draft NER amendments
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Definitions

Definitions changes	
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Technical changes

Incorporating synchronous condensers	
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Additions to information provision	
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Relevant system – in relation to small plants exempt from some requirements	
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S5.2.5.8 Over-frequency emergency generation reduction requirements	
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S5.2.5.8 Protection settings and relationship to ride through clauses	
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S5.2.5.8 Conditions for which the plant may trip and recording of conditions	
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Issue	Consequential amendments – feedback on revised recommendations and relevant draft NER amendments
S5.2.5.8 Network Service Provider liability	
S5.2.5.11 Minimum operating level	
S5.2.5.11 Response direction for bidirectional units taking power from the system	
Drafting changes	
Drafting changes	

Confidentiality disclaimer

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