

Distributed ReStart



Draft DER Functional Requirements

Procurement and Compliance



In partnership with:



nationalgridESO

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1 Draft functional requirements for Distribution Restoration Zone (DRZ)



What do we want to do?

- ✓ Energise distribution network (primarily 33kV then below) independent of grid infeed.
- ✓ Block load demand pick up (while maintaining $f > 47.5\text{Hz}$)
- ✓ Use all available DER (including intermittent) to 'grow' the power island.
- ✓ Control the f & V + stable network
- ✓ Ensure network faults are detected and cleared.
- ✓ Facilitate energising of higher voltage networks (132kV, 275kV & 400kV)

1.1 What services do we need from DER to achieve a DRZ?

The total requirements for each DRZ will be site specific (depending on the scope of the DRZ and capability of DER within), but will consist of the following:

Technical Services	Requirement	Potential Providers	Comments
Anchor generator (or power pack)	Essential	Synchronous generator, or other technology with required capability. A single point of connection is required with the DNO network.	Only one anchor gen is required per DRZ.
Top up services			
Fast MW Control	Potential	Battery, loadbank, flywheel, generator, & others.	May be required to supplement technical capability of anchor gen e.g. enhance block loading.
Inertia	Potential	Synchronous generator, synchronous compensator (an inherent response is required without any measurement delays), & others.	Increase frequency stability of the DRZ and /or allow greater demand blocks to be picked up.
Frequency Control	Potential	Synchronous generator, converter-based sources with appropriate control, & others.	May be required to support the anchor generator to maintain the frequency within limits during normal operation.
Voltage Control	Potential	Wind farm, solar, battery, synchronous gen, Statcom, SVC, & others.	May be required to enhance Mvar capability of DRZ to

			expand the island/energise to a higher voltage.
Short Circuit Level	Potential	Synchronous generator, synchronous compensator & others.	Increase DRZ fault level to facilitate protection operation at higher voltage levels.
Energy (MWh)	Potential	Schedulable MW - Synchronous generator (additional to the anchor), Intermittent resources (constrained and controlled by a set point), demand side management, & others.	Enhance capability of DRZ to restore demand above capacity of anchor generator.

1.2 Anchor Generator

Technical requirements

Category: Time to connect

Proposed DER Requirement	≤8h
Proposed DER Definition	<p>Time taken from instruction from the relevant system operator to start up the Black Start plant from shutdown without the use of external power supplies.</p> <p>Instruction to start up may be up to 72hrs after a black out.</p> <p>Energise up to the DNO statutory point of connection.</p> <p>Ability to operate at full speed no load for four hours (without connection to the DNO network).</p> <p>Connected to DNO at 33kV or 11kV (transforming directly to a higher voltage).</p>
Comments	<p>Exact capability to be declared.</p> <p>Confirm if loadbank required for FSNL operation.</p>

Category: Voltage Control

Proposed DER Requirement	<p>Ability to provide continuous steady state control of the voltage with a set point and slope characteristic</p> <p>(if required).</p>
Proposed DER Definition	<p>Voltage control device as defined in Engineering Recommendation G99 (applicable to Type C & D generators).</p> <p>Ability to create a voltage source (independent of the DNO network) and control the voltage within acceptable limits during energisation/block loading (+/- 10%).</p>
Comments	<p>During a Black Start event the anchor generator will need to maintain voltage (within limits) when creating, maintaining and expanding a DRZ.</p>

Category: Frequency Control

Proposed DER Requirement	A fast-acting proportional frequency control-device is required.
Proposed DER Definition	Frequency control device as defined in Engineering Recommendation G99 (applicable to Type C&D generators). The ability to manage frequency level when block loading (47.5Hz-52.0Hz). Fast acting frequency control device capable of being operated in isochronous mode or with a set point and droop setting if required.
Comments	

Category: Block Loading Size

Proposed DER Requirement	estimated $\geq 2\text{MW}$ (site specific depending on DRZ)
Proposed DER Definition	Capacity to accept instantaneous loading of demand blocks and maintain the frequency within the 47.5Hz to 52Hz range.
Comments	Exact capability to be declared.

Category: Reactive Capability

Proposed DER Requirement	Minimum of 0.95 leading and 0.95 lagging power factor at the point of connection.
Proposed DER Definition	Ability to absorb Mvars (leading power factor) to energise part of the network whilst active power is zero.
Comments	Numerical (Mvar) leading and lagging values to be declared.

Category: Sequential Start Ups

Proposed DER Requirement	≥ 3
Proposed DER Definition	Ability to perform at least three sequential start-ups.
Comments	Time required between sequential start-ups to be declared.

Category: Short Circuit Level (SCL)

Proposed DER Requirement	$\geq 1 \times \text{DER MVA rating (at } t \geq 1\text{s)}$
Proposed DER Definition	Injection of reactive current during a disturbance. SCL measured at DNO point of connection.

Comments	DRZ feasibility study to determine if DER SCL is sufficient to be the anchor DER.
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Category: DRZ Specific Technical Requirements

Proposed DER Requirement	To be confirmed based on specific DRZ requirements.
Proposed DER Definition	Technical requirements on an anchor DER specific to a DRZ in order to facilitate the restoration process.
Comments	DRZ feasibility study to confirm.

Resilience requirements

Category: Service Availability

Proposed DER Requirement	≥90%
Proposed DER Definition	The ability to deliver the contracted Black Start service over 90 per cent of each year of providing a black Start service. Note: It is the responsibility of the provider to demonstrate its service availability.
Comments	A Black Start could happen at any time thus a high service availability is required.

Category: Resilience of Supply, Black Start Service

Proposed DER Requirement	≥72h up to 120h
Proposed DER Definition	When instructed to Black Start, the minimum time the provider will deliver continuous output at 90% rated capacity.
Comments	Exact capability to be declared.

Category: Resilience of Supply, Black Start Auxiliary Units

Proposed DER Requirement	120h
Proposed DER Definition	Run continuously for a maximum of 5 days in order to: 1) Maintain the generator declared 'Time to connect' availability for up to 72 hours after a black out 2) Maintain the generator house loads for the declared time in the 'Resilience of supply, Black Start service.'
Comments	Provider to determine the fuel supply required.

1.3 Top Up Service Requirements

Technical requirements

Category: Fast MW Control

Proposed DER Requirement

- <200ms provide available MWs, sustained for at least 15 minutes with gradual reduction toward preferred operating position, and/or
- <200ms provide available MWs, sustained for at least 10 seconds with gradual reduction toward preferred operating position,
and/or
- Active power output reduction in response to a change in system frequency above a certain value (value and required rate of reduction to be confirmed)
and/or
- Active power output increase in response to a system frequency below a certain value (value and required rate of increase to be confirmed). This will only be required if output has been constrained below the maximum output power.

Proposed DER Definition

Deliver rapid MW response triggered by a local frequency measurement or on receipt of an external control request (which will change the set point at an agreed ramp rate).

Comments

This response will support the anchor maintain DRZ frequency in the event that the anchor generator alone cannot restore frequency within limits. As an example, this response could be required if a DER tripped, or if additional sub second MW support is required to energise demand.

Category: Inertia

Proposed DER Requirement

The generator should state what inertia is available.

Proposed DER Definition

The inertial response should be provided by an inherent response without any measurement delays.

(For synthetic inertia refer to 'Fast MW Control'.)

Comments

DRZ feasibility study to confirm what (if any) the inertia requirements will be (e.g. this may be required to increase the block load pick up capability within the DRZ).

Category: Frequency Control

Proposed DER Requirement

Provide frequency sensitive control of active power.

Proposed DER Definition

Frequency control capability as defined in Engineering Recommendation G99 (applicable to Type C & D generators).

All frequency response requirements are applicable including LFSM-O, LFSM-U and FSM.

Comments	This response will support the anchor generator to maintain the frequency within limits during normal operational.
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Category: Voltage Control

Proposed DER Requirement	Provide continuous steady state control of the voltage at point of connection.
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Proposed DER Definition	<p>Voltage control capability as defined in Engineering Recommendation G99 (applicable to Type C & D generators).</p> <p>As specified in G99 the voltage control should be provided with a droop characteristic.</p> <p>The voltage setpoint should be adjustable by an external control system.</p> <p>If voltage control cannot be provided, it may be acceptable to provide a Mvar set point controlled by an external signal.</p>
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Comments	The DER will support the anchor generator maintain voltage within limits during events such as energisation of the distribution/transmission network and block loading.
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Category: Short Circuit Level (SCL)

Proposed DER Requirement	$\geq 1 \times \text{DER MVA rating}$
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Proposed DER Definition	<p>Injection of reactive current during a disturbance.</p> <p>SCL measured at DNO point of connection.</p>
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Comments	To increase DRZ fault level if anchor generator alone doesn't provide minimum acceptable fault level.
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Category: Energy (MWh)

Proposed DER Requirement	Generate or consume MW on instruction from an external control system, deliver within 10 seconds of request.
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Proposed DER Definition	<p>DER reports the maximum and minimum range of MW output which can be delivered if requested.</p> <p>Intermittent output is acceptable and will be controlled by a set point (a suitable constraint value will be given).</p>
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Comments	The DER will support the anchor generator deliver MW to the DRZ and energise more demand.
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All Top Up Service providers will be required to provide the stated resilience levels.

Category: Resilience

Proposed DER Requirement	<ul style="list-style-type: none">● Maintain the availability of the control and communications with the DER site for up to 72 hours after a blackout before any DNO supplies (EHV, HV or LV) are restored. ¹● When instructed to Black Start the service will be available for a minimum duration of 72 hours (exact capability to be declared).● The contracted Black Start service will be available a minimum of 90% of the year (exact availability to be declared).
Proposed DER Definition	¹ Declare the time to provide availability of the top up service after the DNO main connection has been restored (indicate if this time is dependent upon the length of time after the blackout before the DNO HV supply is restored)
Comments	<p>While the main connection to the DER will be restored as soon as practical, it may be up to 72 hours after a blackout before the connection is restored and the DER will have to be resilient for this time period in order to then provide the required service.</p> <p>The Top Up Services will require to available up to the 'resilience of supply' capability of the anchor generator.</p>

1.4 What we would like feedback on:

- Are the proposed services inclusive of legacy/existing technology?
- Are the proposed services cost effective to provide?
- Have we set the bar right? Is it too high or too low?
- Are there any technical services missing which could be provided to assist a DRZ?
- Are they technology agnostic/neutral?