Distributed Generation Owner/Operator Forum

Wednesday 24th May 2023







Regen is an independent centre of energy expertise with a mission to accelerate the transition to a zero carbon energy system.

Two of our strategic goals:



A roadmap to a net zero power system by 2035 with policies to drive a fourfold increase in renewable generation and effective markets for flexibility.



Energy and digital infrastructure ready to connect and operate the EV chargers, heat pumps, storage and renewable power generation required in a zero-carbon energy system.

Distributed Generation Owner Operator Forum

Core objective:

Provide an opportunity for NGED and distributed generation owners/operators to communicate, tackle arising issues and contribute to improved processes.

Key topics:

- Network outages and constraints, and how to improve their forecasting and mitigation.
- Ongoing work programmes.
- Development of the DSO and its implications for connected generation.

discussion on this to follow...

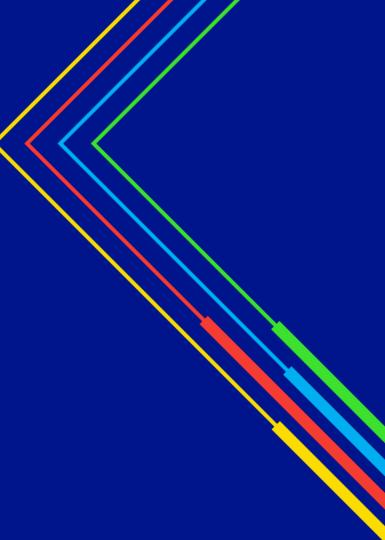
Agenda

13:30	Arrival and networking
14:00	Welcome and introductions
	Bruce Bardsley, Energy Analyst, Regen
14:10	Update on NGED outages and constraints, Generation Portal update
	Danielle Greedy, Control Support engineer, NGED
14:30	Overview of the DSO's work
	Joe Davey, DSO Energy Management Centre Engineer, NGED
14:50	Break
15:00	Reconvene
15:05	G99 Compliance - Submission Expectations
	Will Topping, Primary System Design Engineer, NGED
15:30	Open questions & discussion of aims of the group
16:00	Event End

Outages, Constraints & Generation Portal

Danielle Greedy, Control Support engineer 24/05/2023

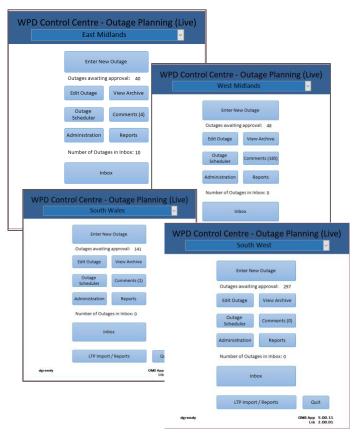




Conventional Outage Season (end of March – end of October).

Current Number of Planned Outages per License Area (Approved, Provisional & Submitted);

South West – 501
 South Wales – 394
 East Midlands – 758
 West Midlands – 607



Ad-hoc Outage Planning Process

Common reasons for these outages include post-fault maintenance, tree cutting, replacement of D poles...

Outage submitted by Local Area Engineer and appears in Outage Management System Inbox. Outages cannot be submitted with less than six weeks notice.

If outage is required within six weeks, local area must gain approval from their Distribution Manager, and then contact the relevant Outage Planner to discuss the outage request.

Inbo	ox of C	Outages from Dis	trict (Live	e)					Q ⊅				
Im	port and Open	Import Only											
🛛 Add 👻	Import ID 👻	Outage Name	✓ Requestor ✓	Start Date 👻	End Date 🕞	Date Created 🔹	Work -	Toga 👻	Schedule	✓ ERTS D ✓	ERTS Ni 🕶 El	RTS Strat 🗸	Daily 👻
	611065	Grendon - Northampton 2 132kV	Gibson, Stever	28/06/2023 08:30:00	30/06/2023 16:00:00	16/05/2023	Reason for new outage: Outage			3 hrs	4 hrs		
	611161	Grendon - Northampton East 132kV	Gibson, Stever	03/07/2023 08:30:00	14/07/2023 16:00:00	16/05/2023	**** REQUIRED OUTAGE DATES			3 hrs	N/A		
	611162	Grendon - 132KV Reserve Bar 1	Gibson, Stever	03/07/2023 08:30:00	07/07/2023 16:00:00	16/05/2023	Reason for new outage: Outage			4 hrs	6 hrs		
	611166	Grendon - 132KV Reserve Bar 1	Gibson, Stever	28/06/2023 08:30:00	30/06/2023 10:00:00	16/05/2023	Reason for new outage: New ou			4 hrs	6 hrs		
	611167	Grendon - 132KV Main Bar 1	Gibson, Stever	30/06/2023 10:30:00	30/06/2023 16:00:00	16/05/2023	Reason for new outage: Outage			Swg Time	e N/A		
	611168	Grendon - 132KV Reserve Bar 1	Gibson, Stever	18/07/2023 08:30:00	01/09/2023 15:00:00	16/05/2023	Reason for new outage: Requet			Swg Time	swg Time		

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2. Outage imported by Outage Planner.

Quick clash detection is carried out to check if proposed outage dates are feasible. If not, outage request will be marked as 'Refused' and sent back to requestor with request for alternative dates.

If circuit in question is already planned to be on outage on a different date, Outage Planner will mark the outage as 'Queried' and ask requestor if works can be combined to reduce number of outages.

Outage Planner will also check if circuit requested for outage has any Generator Curtailment / Interruptions associated with it and populate as shown below.

Work Details Contingency Operation Notes Comments	Constraints Additional Staff / Parties	Attachments	Dat	a Source District Fo	orm 🗸
Reason for change					~
Reason for change is shown to all customers affected by the	is outage in reports and portal				
Site	Туре	Constraint	Value Start	Date End Date	Interruption
Notes (Appears on WPD internal documents only)					
Test Site	Export MW	Full 🗸	0 08/1	1/2023 08/11/20	23

609343 - Avonr	nouth BSP 5L5 - XXX 33kV Solar Park	Go to old Go to e	outage: V Greedy, Danielle
Work Details Contingency	Operation Notes Comments Constraints Additional Staff/Parties Attachments		Data Source District Form 🗸
Substation Name Circuit Name Category Outage Name Work detail	Avonmouth BSP 5L5 - Lawrence Weston Solar Park Maintenance at Substation Avonmouth BSP 5L5 - XXX 33kV Solar Park CB 5L5 I&O and Protection Maintenance.		Outage id 609343 Toga Number Portfolio Bristol 33 kV V Proposed Points of Isolation At Avonmouth BSP: - ABI 51.4 At XXX Solar Park: - ABI 114 - 115 33kV VT LV links
Outage Start Date / Time Outage End Date / Time Requestor	08/11/2023 08:00:00 Image: Check Clashes 08/11/2023 16:30:00 Image: Check Clashes Wright, Daniel Image: Me	×	PowerOn Job Number TBC Date Requested 20/01/2023 Date Imported 20/01/2023 Date Completed
Mail Outplan	Save Outage Delete Outage Copy Outage Main M	1enu Notify F	lequestor 🦃 🛞

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2. Outage Marked as Provisional.

Once a quick clash check has been carried out, the Outage Planner will mark the outage request as 'Provisional'.

Once overnight functions have run) the outage request will appear on the DG Portal for the site which is affected.

This is the best time to check / query the outage at your site and check if you have any work to undertake at your site that you can plan for the same time as our works.

We will also check if there is any maintenance due at the site and endeavour to undertake these works at the same time where possible.

Work Details	Contingency	Operation Notes	Comments	Constraints	Additional Staff / Partie	s Attachments	Data Source District Form
Outage State	us Provisi	onal	~	Approval Date	e 20/01/2023 11:24:4	Approved By	Greedy, Danielle Y Approved
Switching							
Critical							
Load inform	ation TBC						
08/11/2023 08/11/2023							
Operation N	_						
operation N	iotes IBC						

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Sites > Planned outages > Historic outages							Planned Based on outages cu	outages)'s system the fol	lowing constraints will I	need to be applied to y	rour sites.
Filter								Start Date	Duration (Days)	Permitted Export (MW)	Reason for Outage	Outage status
Star	t dat						Site Name	NGED Outage Reference	Engineer in	charge & Contact	Details	
<		М	ay 20	23		>		Reasons for cha	nge			
Mon	Tue	Wed			Sat	Sun		08/11/2023	1	0**	Maintenance at	Provisional
24	25	26	27	28	29	30	XXX	00/11/2023	1	0	Substation	Frovisional
1	2	3	4	5	6	7	33kV Solar Park	S609343	Wright, Daniel	(dwright1@nationalgr	id.co.uk)	
8 15	9 16	10	11	12 19	13 20	14						
15	16 23	24	18	19	20	21	Disclaimer					
29	30	31	1	20	3	4		ded to you on this page	about constraints	is based on informatio	e evelleble te NCED e	t the time, and is
	er by			•		-	subject to change. Ple	ded to you on this page ease note that only cons the event of an unplanne	traints necessary	for planned outages a	e set out on this page	Other constraints

3. Outage Approval Process

4-6 Weeks before Outage Start date, Outage Planner will assess the network / undertake appropriate studies and Approve outage.

At this point, outage request will change from 'Provisional' to 'Approved'.

This will be reflected on the Generation Portal and an email notification will be generated to inform customer of a change to a site associated with their account.

Once outage is 'Approved', all staff / materials have been organised & the outage wouldn't be moved unless there is a network fault / emergency.

0002 Paract	anlo PCD	EI E	<u> </u>	root	Torr	ington 21	-	Go	to old outage:	~	Greedy, Dani	elle
0803 - Barnst	apie BSP	515	- Gr	eat	Torr	ington 2L:	,		Go to outage:	~	*	
Details Contingency	Operation Notes	Com	ments	Constr	raints /	Additional Staff / Pa	arties Attachments		Data S	ource OMS		~
age Status Approve	2d		~ 1	Approv	al Date	14/04/2023 14:5	6:45 Approved By	Ransome, Ste	phen G.		Approved	1
thing												1
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information Please r	efer to Ops 60862	23 - Bar	rnstaple	e BSP G	T2 33kV	/ busbar outage.						
vice												
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ation Notes Please re	efer to Ops 60862	23 - Bar	rnstaple	e BSP G	T2 33kV	/ busbar outage.						
							, Middle Barlington a	nd Tinkers Cro	ss.			
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NGED DG Portal Update

- Currently portal built on a platform that will no longer be supported from January 2024.
- NGED's web developers planning to start rebuild on new platform from May 2023 (meeting organised for next week) with testing to begin October 2023.
- Work is underway to look at incorporating 11kV outages in the new portal.
- Any suggestions to improve / add to the portal welcomed.



Click here for our Post Energisation Document

This leaflet has been designed to try to offer you a synoptic review of some areas you may wish to investigate further with us and that may pop into your mind once you have a connection to your site.

Remember, we are here to help you generate onto our network, so please take a moment to familiarise yourself with the document's contents, and for those of you who are familiar with NGED, hopefully it will be a handy aid memoir on who to contact within our organisation.

For queries relating to the generator portal, to receive a copy of our getting started guide or to request the creation of a user account please contact. nged.swestwatesgen@nationalgrid.co.uk

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Update from the DSO team

Joe Davey, DSO Energy Management Centre Engineer 24/05/2023

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Ofgem's DSO Baseline Expectations

Planning and network development

• Plan efficiently in the context of uncertainty, taking account of whole system outcomes, and promote planning data availability

Network operation

- Promote operational network visibility and data availability
- Facilitate efficient dispatch of distribution flexibility services

Market development

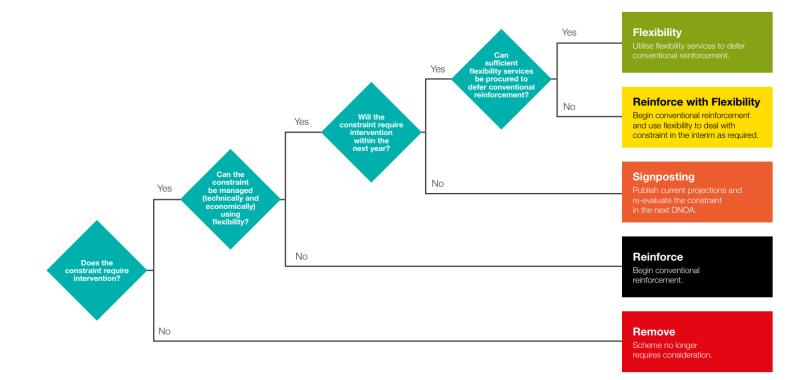
- Provide accurate, user-friendly and comprehensive market information
- Embed simple, fair and transparent rules and processes for procuring distribution flexibility services

Forecasting

Network Impact Assessment

Optioneering

The Distribution Future Energy Scenarios (DFES) identify how customers will use our network in future. The Network Development Plan (NDP) uses forecasts to analyse and identify future network constraints. The Distribution Network Options Assessment (DNOA) outlines how we plan to invest in our network to solve constraints.



Investment Decisions from February 2023 DNOA

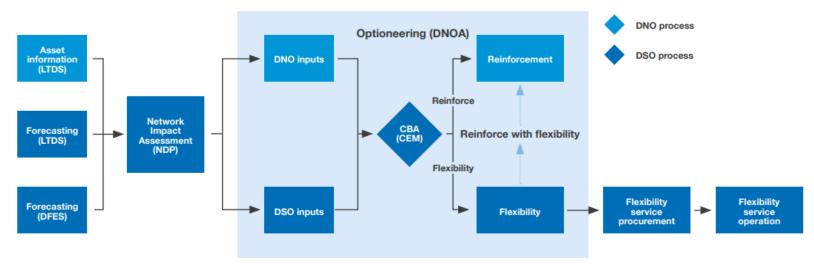
- 121 unique schemes assessed
- 42 in the East Midlands
- 18 in the West Midlands
- 19 in South Wales
- 42 in the South West

Assessed potential reinforcement schemes with a combined cost of over £398 million.

Total schemes assessed	121
Flexibility	36
Reinforce	24
Reinforce with flexibility	24
Signposting	22
Remove	15

The strategic network planning process

NGED's overall DNOA process from forecasting through to procurement is shown in the figure below. This process is carried out every six months to look forward and identify which constraints should have services procured to help mitigate them, as well as looking backwards to ensure they continue to provide value.



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Break, back in 10

NGED G99 Compliance -Submission Expectations

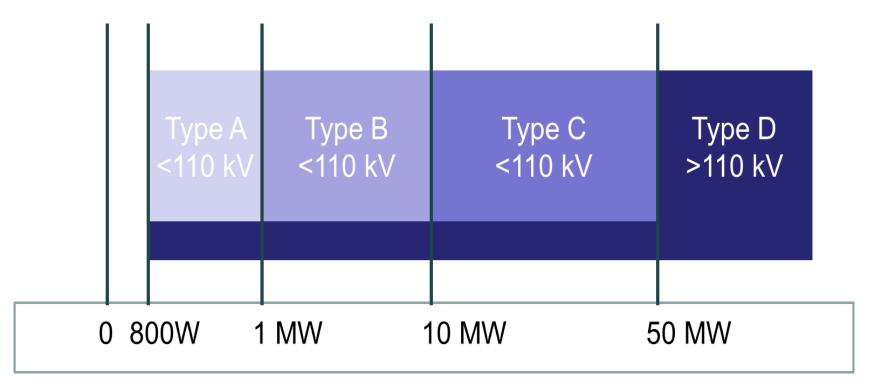
William Topping, Primary System Design Engineer 24/05/2023

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Contents page

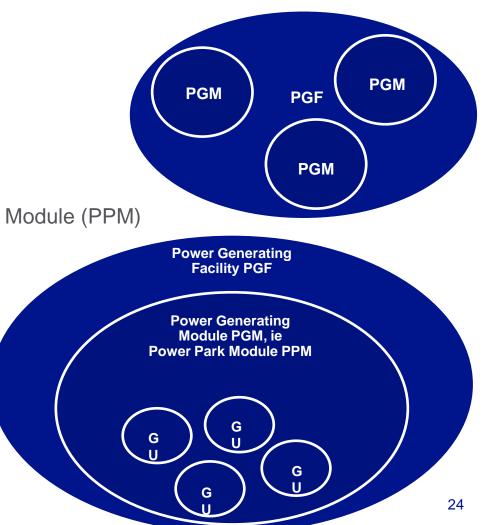
01	G99 Submission Format
02	Simulation Submission
03	Test Procedure
04	Other Requirements

G99 Classification



G99 Classification

- Power Generating Facility
 - A Sync PGM or Group of PPMs
- Power Generating Module
 - Asynchronous Generator = Power Park Module (PPM)
 - Synchronous Generator = Sync PGM
- Power Park Modules
 - Generating Units

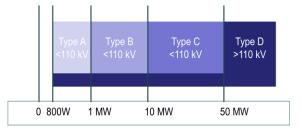


G99 Compliance Process

Forms	Туре В	Type C & D
Standard Application Form	√	4
Power Generating Module Document (PGMD)	B2-1	C2-1
Site Compliance and Commissioning test requirements	B2-2	C2-2
Installation Document	B3	C3

PGMD Evidence Types

- Simulations
- Manufacturers Information
- Type Verification

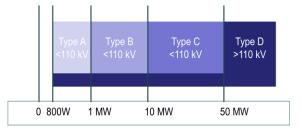


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PGMD Evidence Types

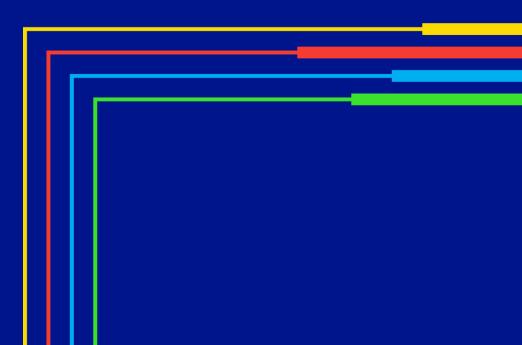
- Simulations
- Manufacturers Information
- Type Verification





Submission Format

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Power Generating Module Document (PGMD)

Compliance Statement (B2-1 or C2-1)

- Live Document
- Evidence behind compliance certificates required

Form C2-1 P	art 2 - Compliance Requirements for Power I	Park Module		Response					
G99 Reference		Stage Requeste		Compliance: Y = Yes (Compliant); O = Outstanding Submission; UR = Unresolved Issue; N = No (Non-Compliant)	Generator's Statement (Provide document references with any additional comments)				
13.5	Reactive Power capability Confirm compliance with Section 13.5 by carrying out simulation study in accordance with C.7.3 and by submission of a report	IS, ION	S, MI	Y (01/05/2023)	Customer (01/04/2023): See "Reactive Power Capability Study v1" page 3 for compliance NGED (01/05/2023): Approved				
13.4	Voltage Control and Reactive Power IS, ION S, MI Stability Confirm compliance with Section 13.4 by carrying out simulation study in accordance with C.7.4 and by submission of a report Simulation study in accordance Simulation study in accordance		Y (01/05/2023)	Customer (01/03/2023): See "Generator A Simulation Studies v1" page 15 for compliance NGED (15/03/2023): Please provide more detailed annotation Customer (01/04/2023): See updated report NGED (01/05/2023): Approved					
13.2				O (01/05/2023)	Customer (01/04/2023): See "Generator A Simulation Studies v1" page 6 for compliance NGED (01/05/2023): Submission does not meeting G99 requirements, please provide full results				
	G99 Reference 13.5 13.4	G99 Reference Compliance Requirement of the Power Generating Module 13.5 Reactive Power capability Confirm compliance with Section 13.5 by carrying out simulation study in accordance with C.7.3 and by submission of a report 13.4 Voltage Control and Reactive Power Stability Confirm compliance with Section 13.4 by carrying out simulation study in accordance with C.7.4 and by submission of a report 13.2 Confirm that the plant and apparatus is capable of continuing to operate in the frequency ranges specified in 13.2.1 and to withstand the rate of	G99 Reference Compliance Requirement of the Power Generating Module Submission Stage 13.5 Reactive Power capability Confirm compliance with Section 13.5 by carrying out simulation study in accordance with C.7.3 and by submission of a report IS, ION 13.4 Voltage Control and Reactive Power Stability Confirm compliance with Section 13.4 by carrying out simulation study in accordance with C.7.4 and by submission of a report IS, ION 13.2 Confirm that the plant and apparatus is capable of continuing to operate in the frequency ranges specified in 13.2.1 and to withstand the rate of IS	Reference Generating Module Stage Requested (and / or) 13.5 Reactive Power capability Confirm compliance with Section 13.5 by carrying out simulation study in accordance with C.7.3 and by submission of a report IS, ION S, MI 13.4 Voltage Control and Reactive Power Stability Confirm compliance with Section 13.4 by carrying out simulation study in accordance with C.7.4 and by submission of a report IS, ION S, MI 13.2 Confirm that the plant and apparatus is capable of continuing to operate in the frequency ranges specified in 13.2.1 and to withstand the rate of IS MI, TV	G99 Reference Compliance Requirement of the Power Generating Module Submission Stage Evidence Requested (and / or) Compliance: Y = Yes (Compliant); O = Outstanding Submission; UR = Unresolved Issue; N = No (Non-Compliant) 13.5 Reactive Power capability Confirm compliance with Section 13.5 by carrying out simulation study in accordance with C.7.3 and by submission of a report IS, ION S, MI Y (01/05/2023) 13.4 Voltage Control and Reactive Power Stability Confirm compliance with Section 13.4 by carrying out simulation study in accordance with C.7.4 and by submission of a report IS, ION S, MI Y (01/05/2023) 13.2 Confirm that the plant and apparatus is capable of continuing to operate in the frequency ranges specified in 13.2.1 and to withstand the rate of IS MI, TV				

Power Generating Module Document (PGMD)

Compliance and Commissioning Test Requirements (B2-2 or C2-2)

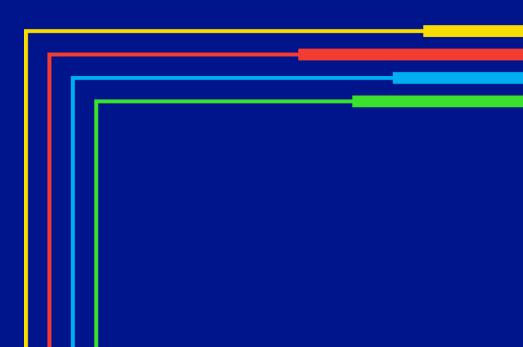
- All additional on-site tests to be detailed in "Any other comments"
- For Type C & D connections:
- Test schedule to be submitted 28 days ahead of date of tests
- A minimum of 2 site witnessing visits is generally needed



2

Simulation Submission

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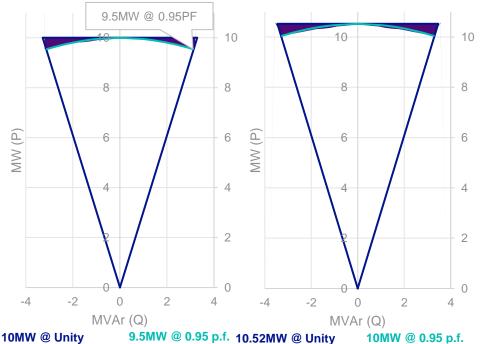
Power Quality

- Connections must comply with P28, P29 & G5/5
- Please refer to NGED's policy ST:SD6F/2 (available from the NGED Tech Info Website). See Appendix B & C of this policy for Connection Guides.

Figure 1: 10MW @ Unity

Reactive Power Capability

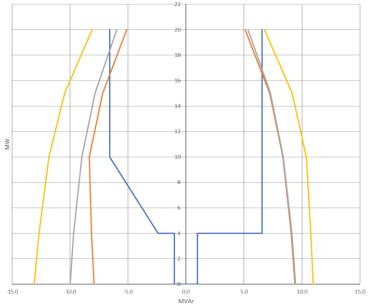
- Registered Capacity must be calculated with fixed operating power factor taken into consideration
- Figure 1 represents a site that can only export 10MW at any power factor. The shaded area represents the output that this site is unable to achieve, but which is required under G99.
- Figure 2 represents a site that is able to export 10.52MW at any power factor. Therefore it is able to achieve the 0.95 leading power factor at 10MW.

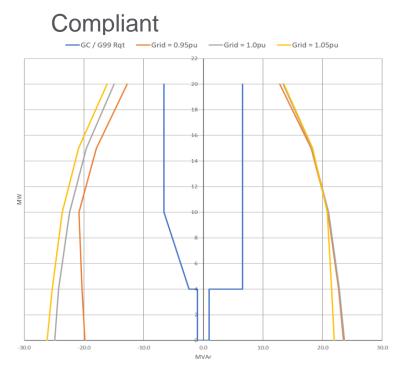


The site in Figure 1 should submit a Registered Capacity of 9.5MW to be compliant and Figure 2 will have a Registered Capacity of 10MW.

Reactive Power Capability

Not compliant



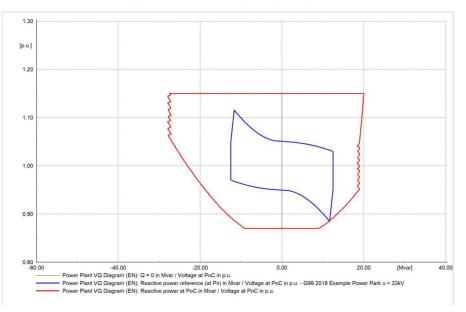


Reactive Power Capability

50.00 [MW] 37.50 25.00 12.50 0.00 -12.50 -40.00 -20.00 0.00 20.00 40.00 [Mvar] 60.00 Power Plant PQ Diagram (EN): Q = 0 in Mvar / Active power at PoC in MW Power Plant PQ Diagram (EN): Reactive power reference value in Mvar / Active power reference value in MW. G99 2018 Example 1 @ u equal 1.00 p.u. _ - Power Plant PQ Diagram (EN): Reactive power at PoC in Mvar / Active power at PoC in MW · Power Plant PQ Diagram (EN): Reactive power at PoC (without generation) in Mvar / Active power at PoC (without generation) in MW •

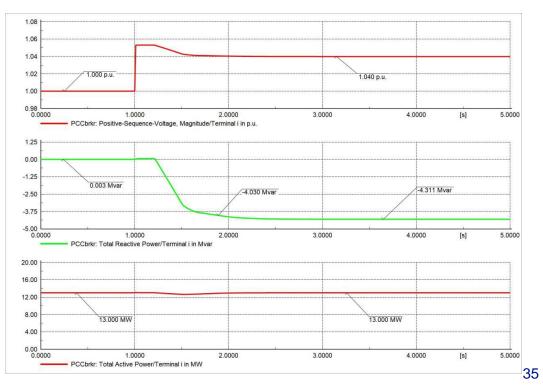
Figure 3-1 - Full PQ Reactive Capability

Figure 3-2 Full VQ Capability Diagram

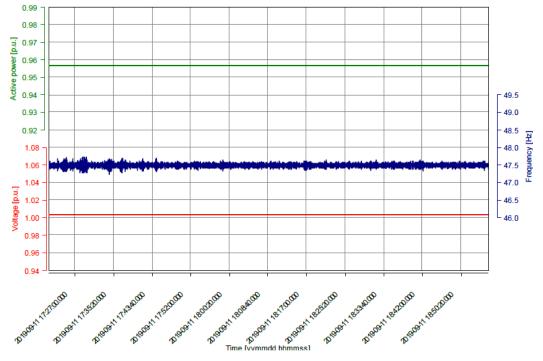


Voltage Control and Reactive Power Stability

- Meet requirements of C.5.4 as well as C.7.4
- Demonstrate compliance at Connection Point, taking account of internal network impedance



Confirmation of frequency range of operation



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Figure 20 Test 2; 96% load at 47.5Hz and 100% voltage, duration: 90min

LFSM-O & U (and FSM as required)

Sufficient annotation to show:

- Response above 50.4Hz
- Confirm droop setting
- 2 second response

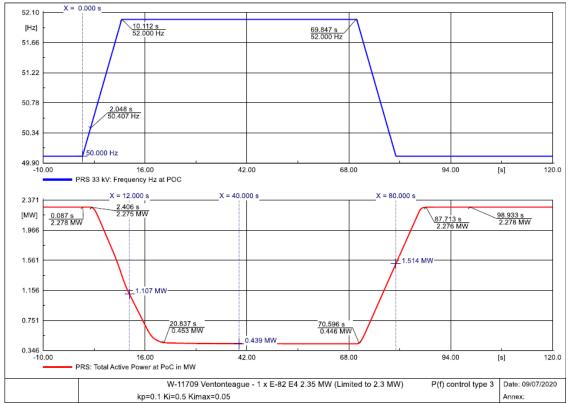


Figure 3.3-2 Power (MW) and Frequency (Hz) at POC during the injection ramp of +2Hz

Confirmation of compliance with minimum frequency response requirements

- Generator must demonstrate compliance with both LFSM and FSM regardless of which mode the site will operate in
- Tests required for C.10 are anticipated to be similar to those in C.8.6 & C.9.5 with the exception that the step frequency change is 0.5Hz rather than 2Hz

Ability to follow Active Power set point

- Submission must state or show ability to follow a 4-20mA input.
- Can be shown at testing stage but NGED's preference is for design stage

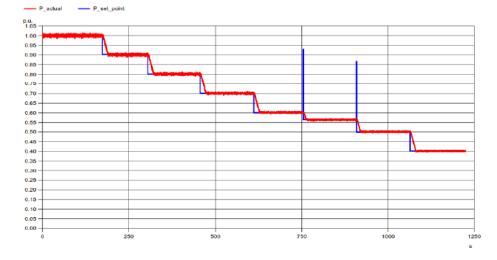


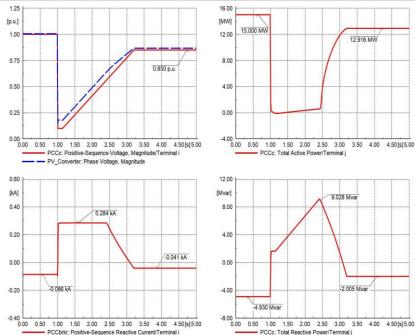
Figure 10 Active Power Setpoint and measured Active Power [2]

The turbine can reduce the active power to an externally given limit. This limit can be adjusted:

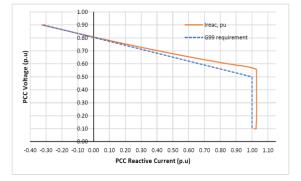
- In steps (e.g. 70%, 50%, 30%, 0%) on 4 digital inputs in the turbine
- as analog value from 0-10V or 4-20mA in the turbine
- over Ethernet according IEC 870-5-104

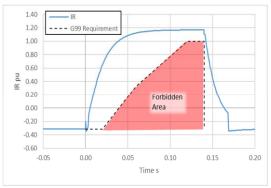
Cyber Security Requirements

- ETSI EN 303 645;
- Relevant aspects of PAS 1879 "Energy smart appliances Demand side response operation – Code of practice";
- Relevant aspects of "Distributed Energy Resources Cyber Security Connection Guidance" published by BEIS and the ENA;
- Any other relevant standard that has been incorporated in the design of the Power Generating Module.



Fault Ride through (and Fast Fault Current Injection as required)



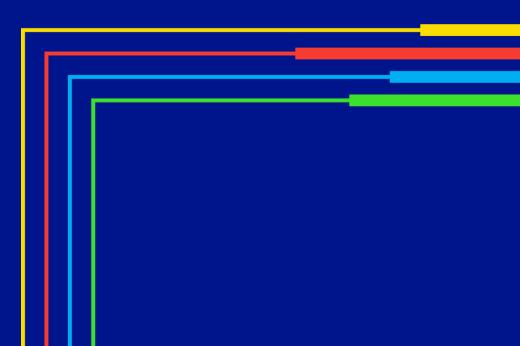


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Test Procedure



Test Procedure

NGED Allowances

- Up to 6 months allows for weather dependant tests
- ION format used for all connection Types where external factors limit the completion of compliance. An end date must be agreed
- Results from all other tests to be provided along with B2-2 or C2-2 form or comments put at the end of the document.

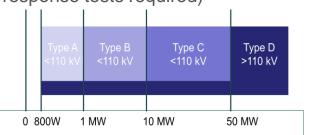
Test Procedure

Tests required

Tabular evidence and graphs expected for:

- Schedule of tests
- Excitation System Open Circuit Step Response Tests
- Open & Short Circuit Saturation Characteristics
- Excitation System On-Load Tests
- Output Power with falling frequency
- Voltage Control Tests
- Reactive Capability Tests
- Frequency Response Tests (system islanding and step response tests required)
- Model Validation
- Dynamic System Monitoring

(Sync PGM) (Sync PGM) (Sync PGM) (Sync PGM) (PPM)



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Test Procedure

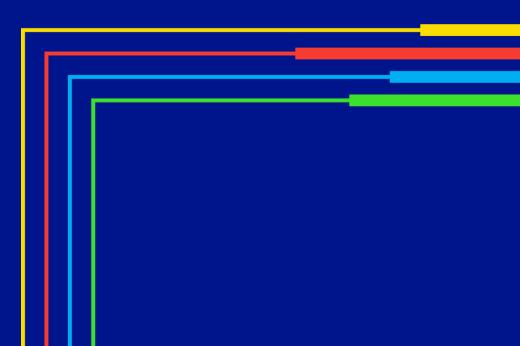
Dynamic System Monitoring

- The trigger for recording data must be operated and demonstration of recording of relevant data provided.
- NGED also require power quality metering to be installed at Type C & D PGMs
- In general customers will not have access to NGED's instrument transformers



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Other requirements



Other requirements

Simulation Model

NGED accept PSSE, IPSA, Power Factor or CIM CGMES v3.0.

The simulation model must include:

- Full generator real and reactive capability curve
- Sufficient AVC parameters to allow the dynamic and steady state reactive power performance and power factor control
- Fault infeed data/short circuit impedances

Other requirements

Loss of Mains intertrips

- Rate of Change of Frequency (RoCoF) protection is not used for Type D connections.
- NGED will use intertrips for Type D connections and a bespoke design will be carried out per connection.

Other requirements

Replanting/Adding new plant

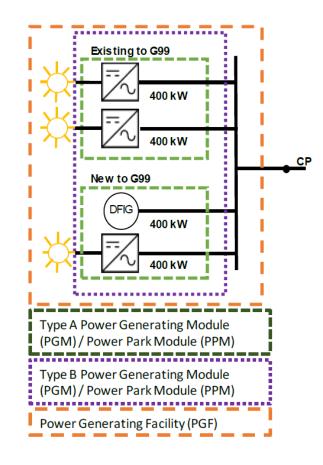
- All new plant must be compliant with G99
- Like for like replacement can remain under G59
- Any alterations are working towards the whole site being G99 compliant

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A.6 Scenario examples in respect of the application of EREC G59 and EREC G99 to new or modified sites after 27/04/19

These scenarios present examples in respect of connection to new sites or modifications to existing sites, as well as considering whether a modification to an existing **Power Generating Module** would be considered to be substantial and therefore compliance with this EREC G99 would be required.

	Scenario	DNO position	EREC G99?	Rationale
1	Small PGM (ie a few hundred kW or less connected where DNO has waived witnessing) connected post 2/104/19 under EREC G59 DNO becomes aware on receipt of Commissioning Forms from Generator.	The DNO gives notice to the Generator to make the PGM compliant with EREC G99 within a reasonable time (6 months).	*	Any new PGM should, unless compliant with the RtG agreed process, be EREC G99 compliant. In this case had the DNO withressed the commissioning it would have been picked up earlier.
2	EREC GS9 phased installation with a Connection Agreement for the capacity of the whole site (all PPMs), where the full capacity is built in a single build spanning 27/04/19. Contracts for the major plant placed before 17/05/18. (Not where the site is effectively complete but at a lower Registered Capacity than in the Connection Agreement – see scenario 3).	Connection under EREC G59 is permitted.	x	This is effectively a single site that just happens to be constructed across the 27/04/19 date – but the arrangements are all compliant with the RIG.



Discussion on aims



Core objective:

Provide an opportunity for NGED and distributed generation owners/operators to communicate, tackle arising issues, and contribute to improved processes.

Key topics:

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- Network outages and constraints, and how to improve their forecasting and mitigation.
- Ongoing work programmes.
- Development of the DSO and its implications for connected generation.

How should this evolve?

Open Questions



...What topics do you want NGED to cover in future meetings?

... Any smaller queries for NGED to take away from this forum?





Any other business?



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Upcoming forums



Regen contacts

September (Date TBC) Online

Emma Madray, emadray@regen.co.uk

Bruce Bardsley, **bbardsley@regen.co.uk**

NGED contacts

South West & Wales

nged.swestwalesgen@nationalgrid.co.uk

East Midlands

nged.eastmidgen@nationalgrid.co.uk

West Midlands

nged.westmidgen@nationalgrid.co.uk

Any outage specific queries should go to the person responsible for undertaking the works. Their email address will be attached to the outage notification / available to view on the DG Portal under Planned Outage

22nd November 13:30 – 16:00, TLT Offices, Bristol