National Grid Electricity Distribution

Distributed Generation Owner/Operator Forum

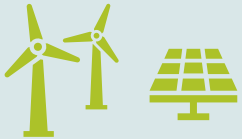
Wednesday 24th May 2023

nationalgrid

regen
transforming energy

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

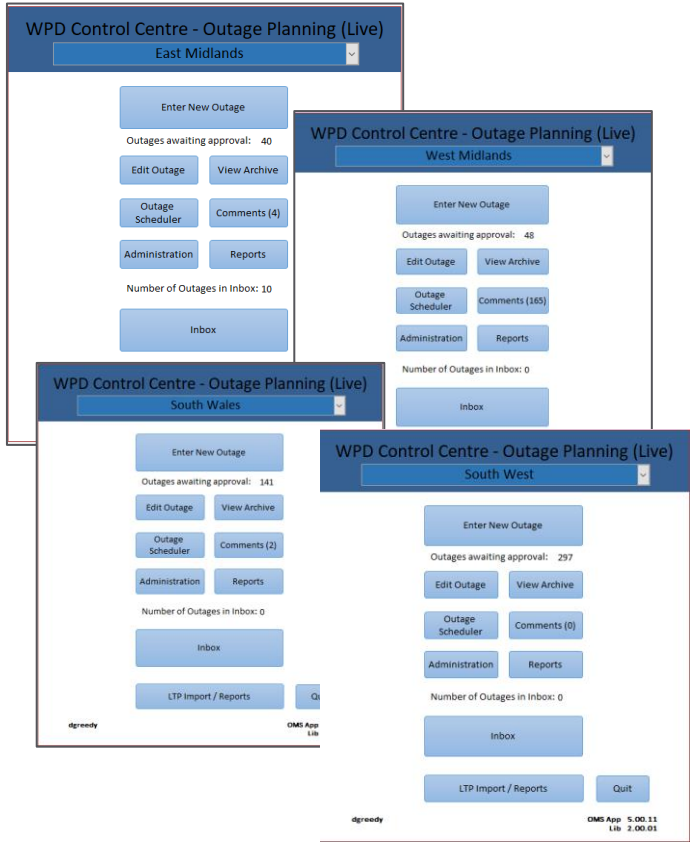
nationalgrid

National Grid Electricity Distribution Outages 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



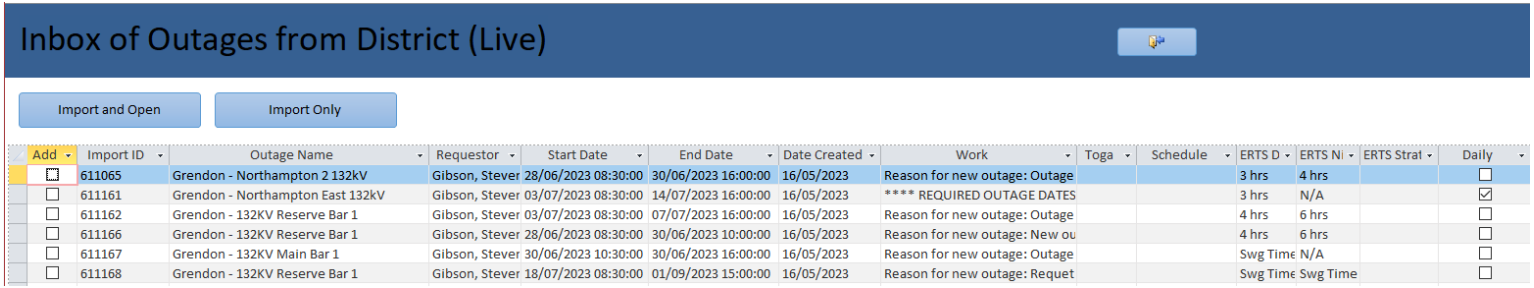
National Grid Electricity Distribution Outages 2023

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.


Inbox of Outages from District (Live)

Import and Open | Import Only

Add	Import ID	Outage Name	Requestor	Start Date	End Date	Date Created	Work	Toga	Schedule	ERTS D	ERTS Ni	ERTS 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	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		☐

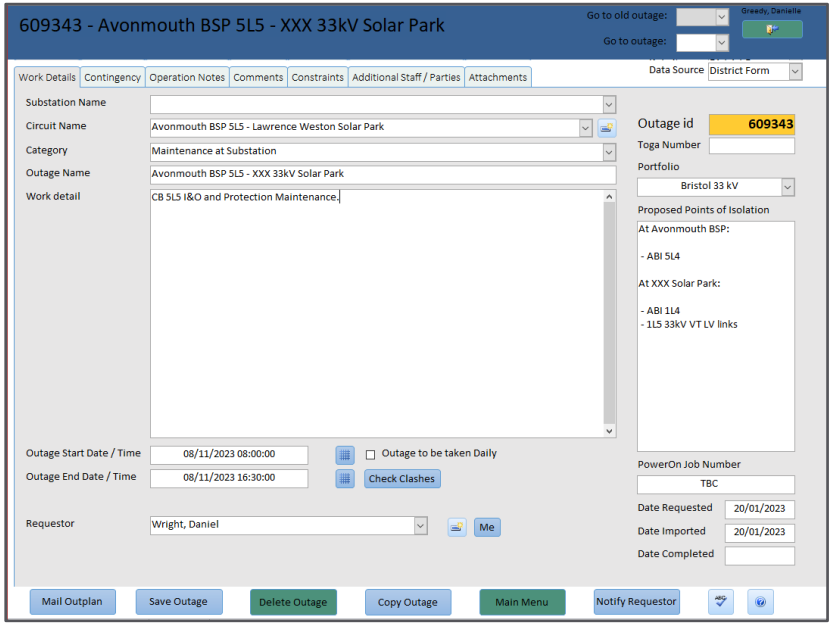
National Grid Electricity Distribution Outages 2023

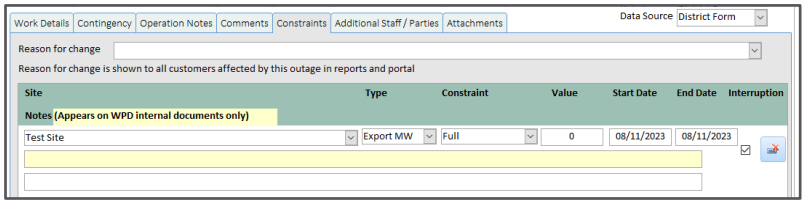
2. Outage imported by Outage Planner.

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.





National Grid Electricity Distribution Outages 2023

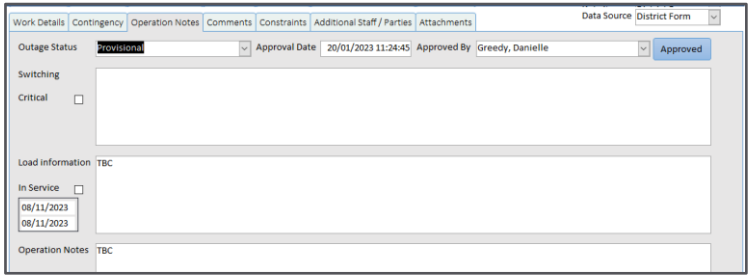
2. Outage Marked as Provisional.

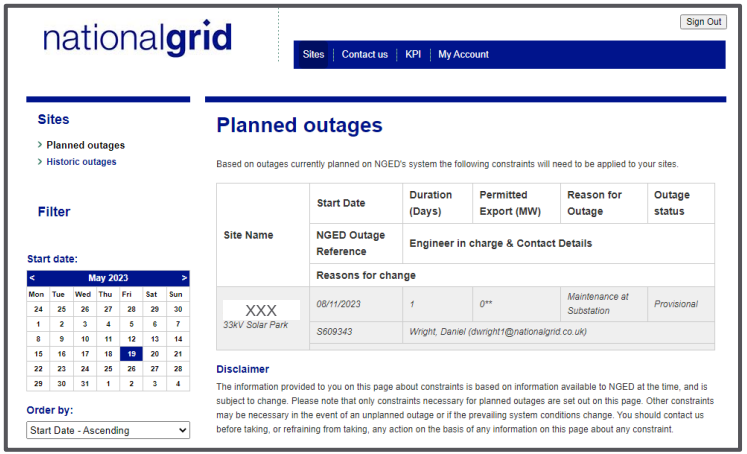
Once a quick clash check has been carried out, the Outage Planner will mark the outage request as ‘Provisional’.

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.





National Grid Electricity Distribution Outages 2023

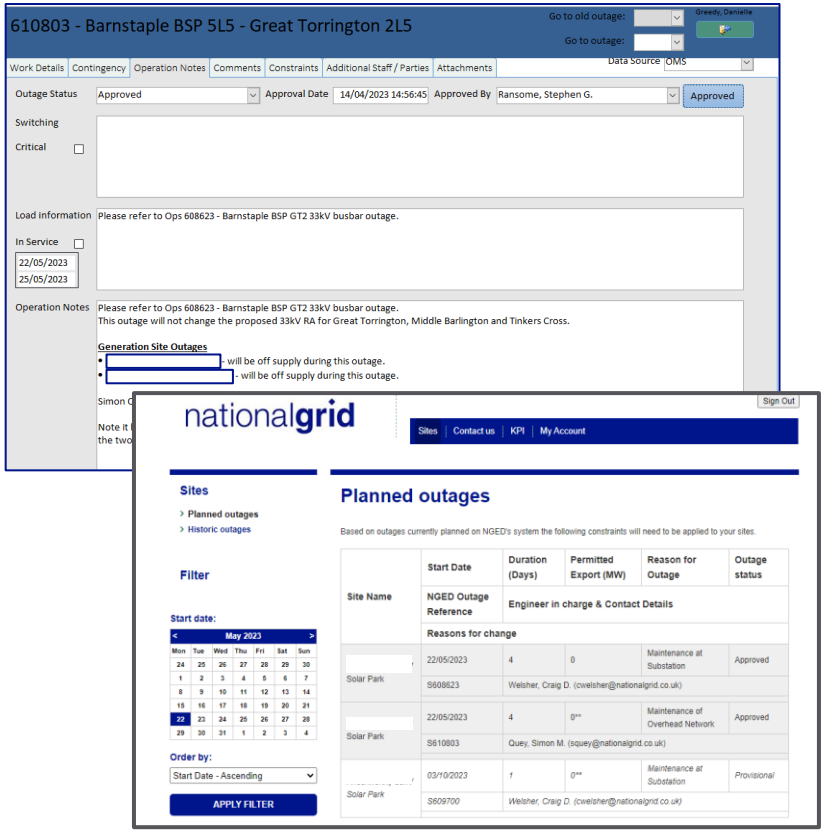
3. Outage Approval Process

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’.

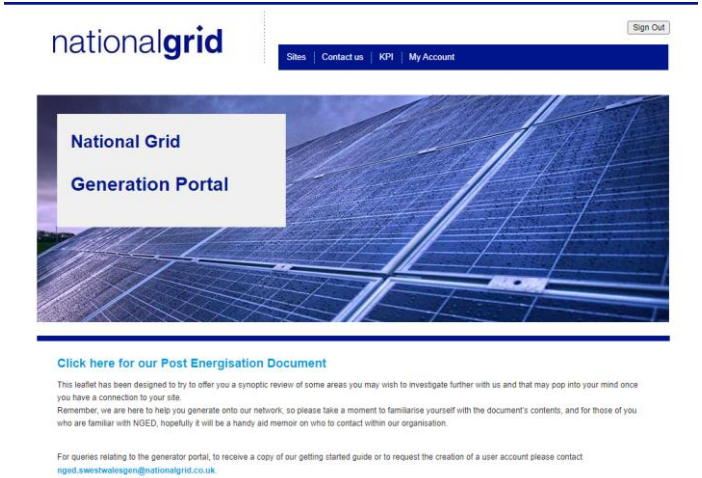
This will be reflected on the Generation Portal and an email notification will be generated to inform customer of a change to a site associated with their account.

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



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.



nationalgrid

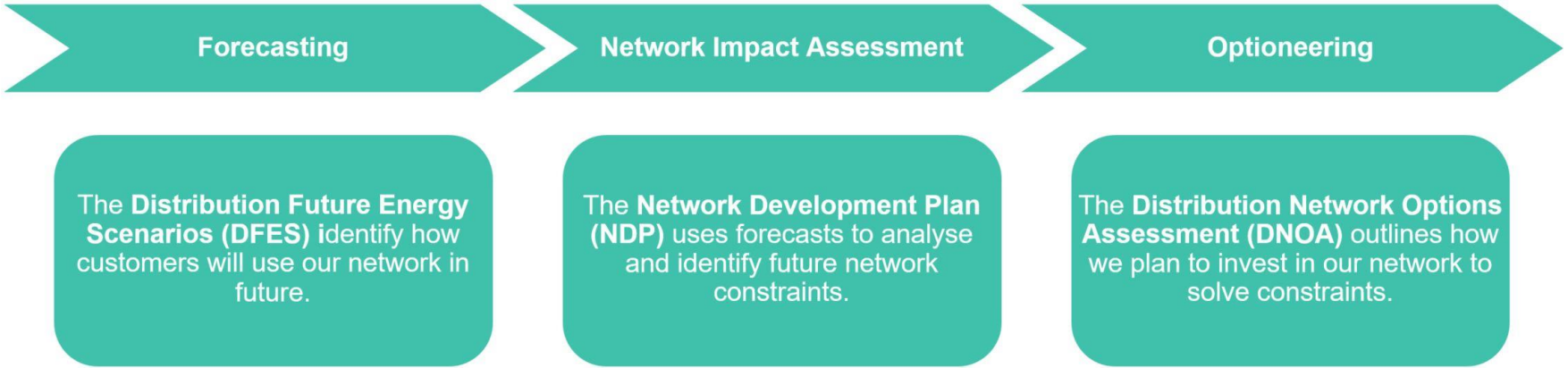
Update from the DSO team

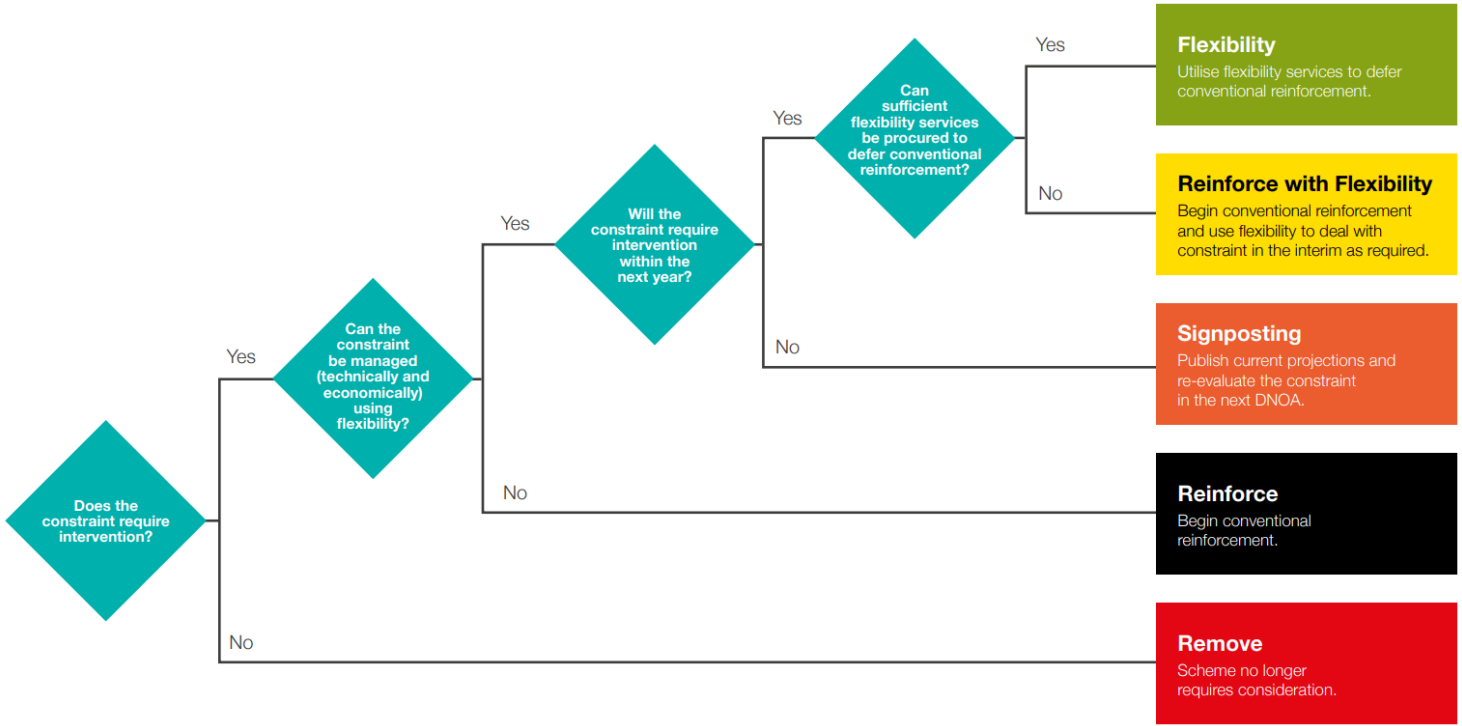
Joe Davey, DSO Energy Management Centre Engineer
24/05/2023

nationalgrid

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.


Does the constraint require intervention?
Yes
Can the constraint be managed (technically and economically) using flexibility?
Yes
Will the constraint require intervention within the next year?
Yes
Can sufficient flexibility services be procured to defer conventional reinforcement?
Yes
Flexibility
Utilise flexibility services to defer conventional reinforcement.
No
Reinforce with Flexibility
Begin conventional reinforcement and use flexibility to deal with constraint in the interim as required.
No
Signposting
Publish current projections and re-evaluate the constraint in the next DNOA.
No
Reinforce
Begin conventional reinforcement.
No
Remove
Scheme no longer requires consideration.

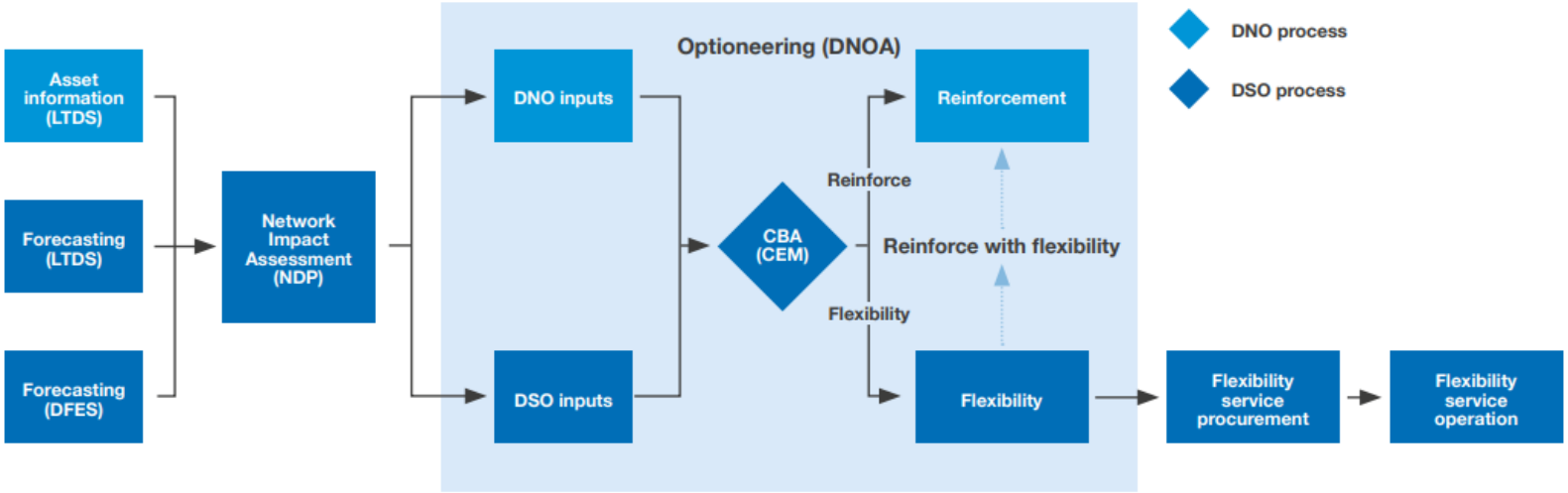
Investment Decisions from February 2023 DNOA

- **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.

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.



nationalgrid

Break, back in 10

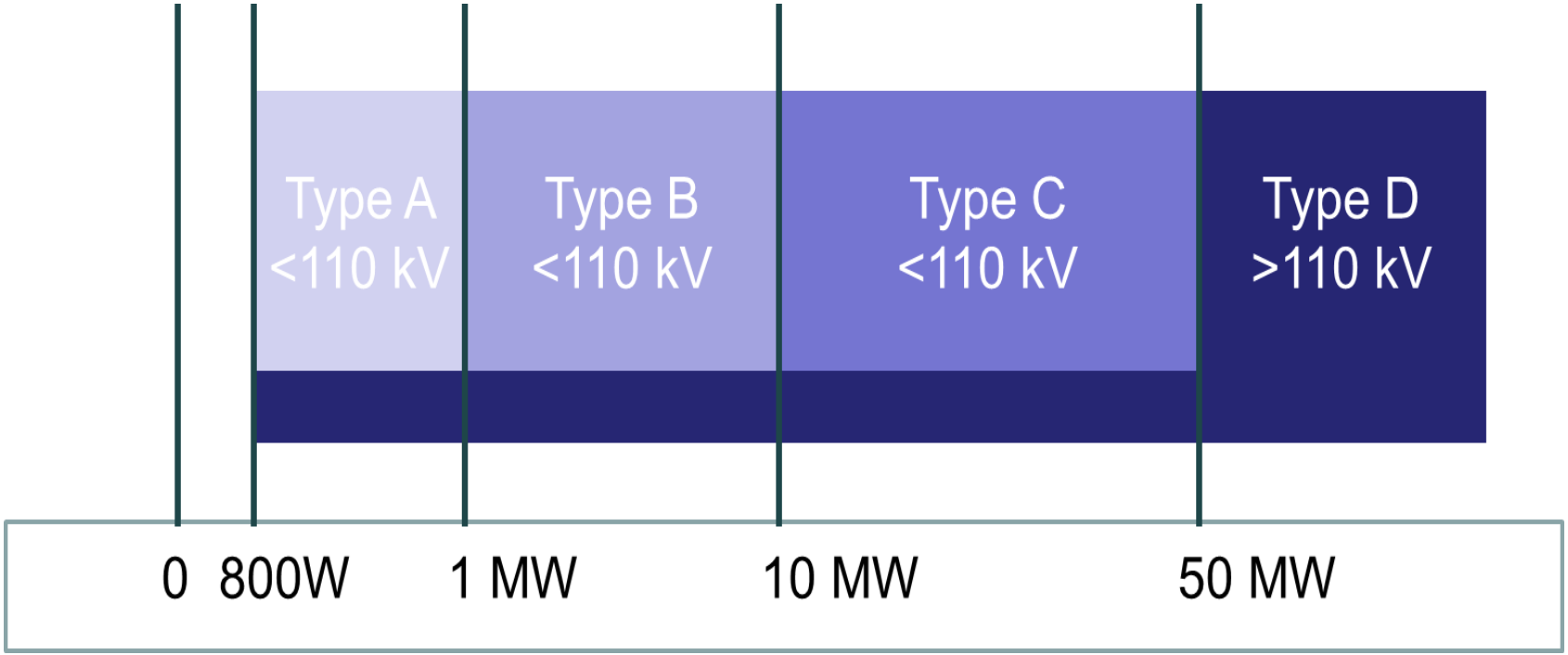
NGED G99 Compliance - Submission Expectations

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

nationalgrid

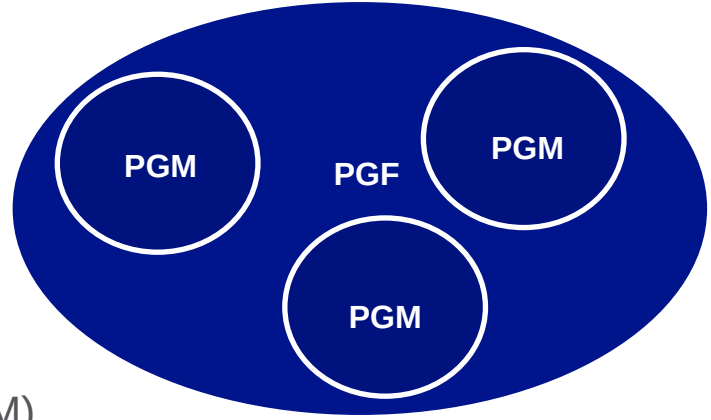
Contents page

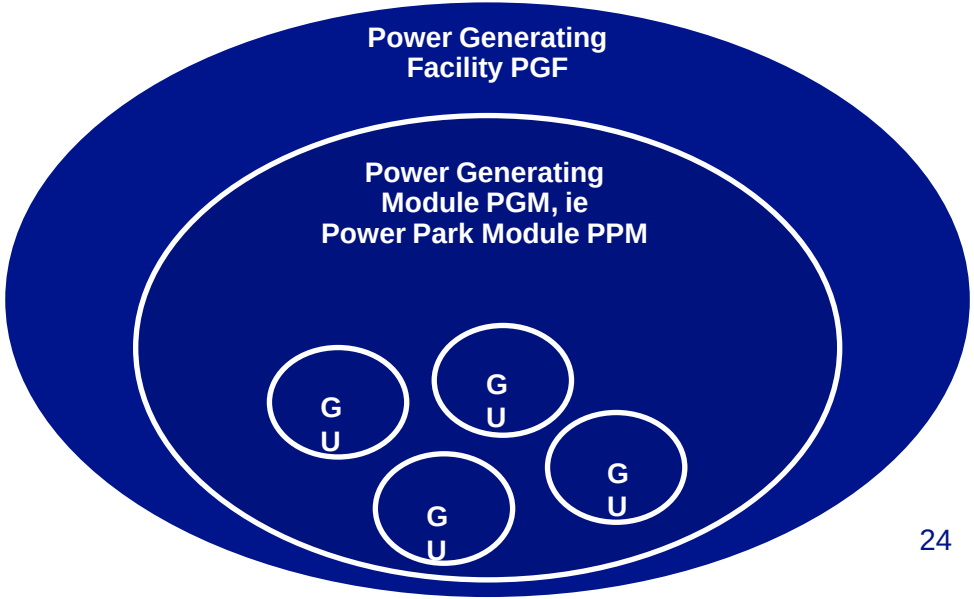
G99 Classification



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



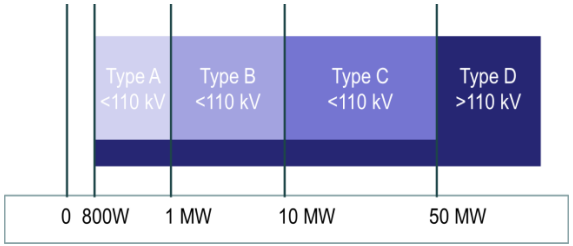


G99 Compliance Process

Forms	Type B	Type C & D
Standard Application Form	✓	✓
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

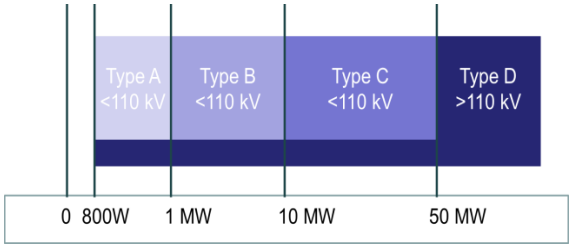


G99 Compliance Process

Forms	Type B	Type C & D
Standard Application Form	✓	✓
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

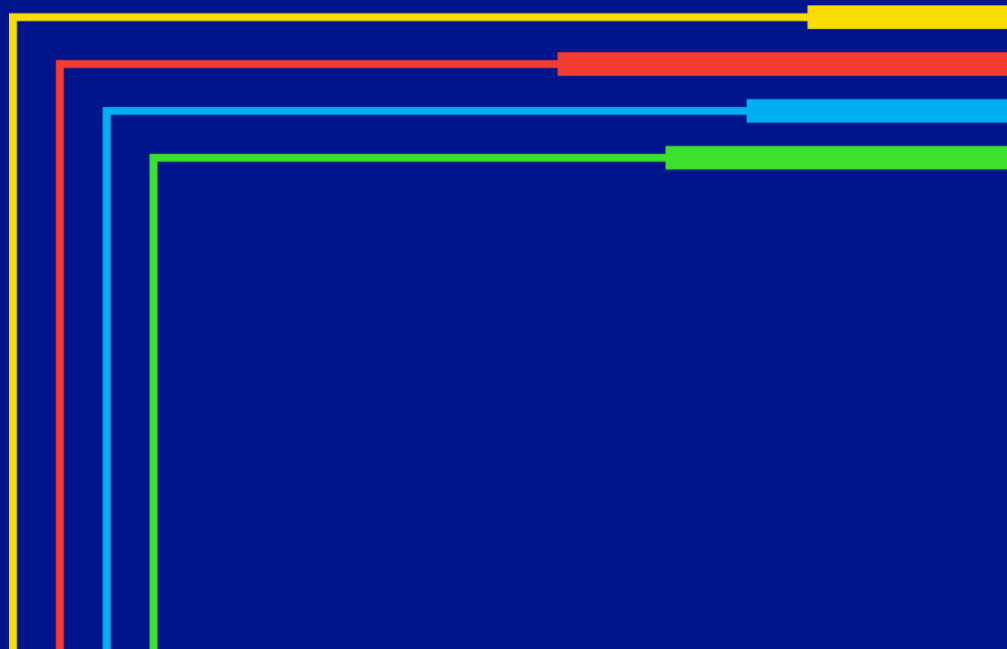
- Simulations
- Manufacturers Information
- Type Verification



Electricity Distribution

1

Submission Format



nationalgrid

Power Generating Module Document (PGMD)

Compliance Statement (B2-1 or C2-1)

- Live Document
- Evidence behind compliance certificates required

Form C2-1 Part 2 - Compliance Requirements for Power Park Module				Response	
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)	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 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)	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	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 change of frequency specified in 13.2.2	IS	MI, TV	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

Power Generating Module Document (PGMD)

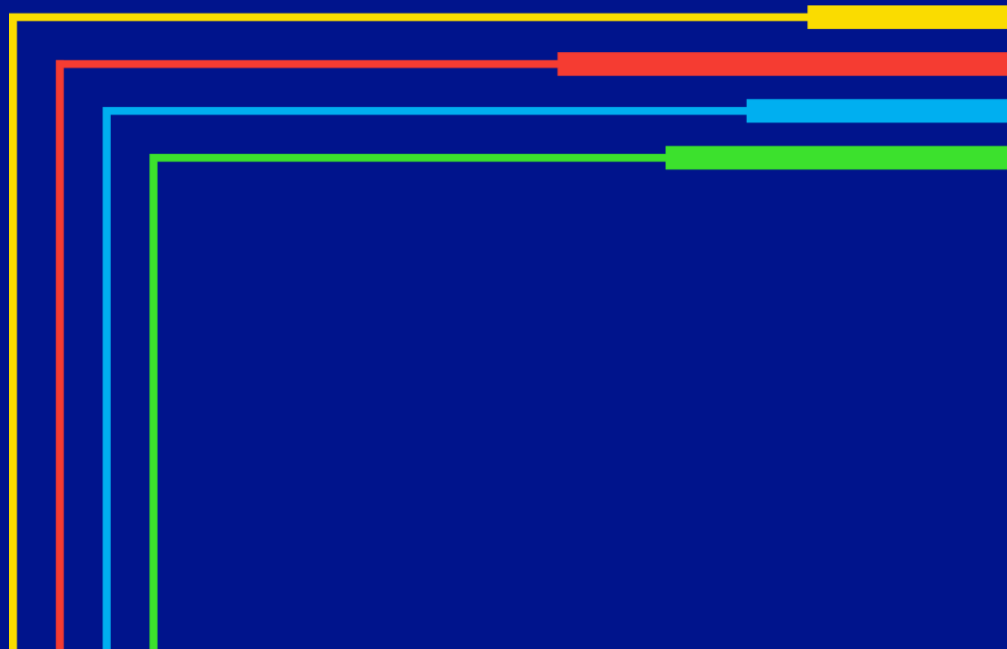
Compliance and Commissioning Test Requirements (B2-2 or C2-2)

- 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

Electricity Distribution

2

Simulation Submission



nationalgrid

Simulation Submission

Power Quality

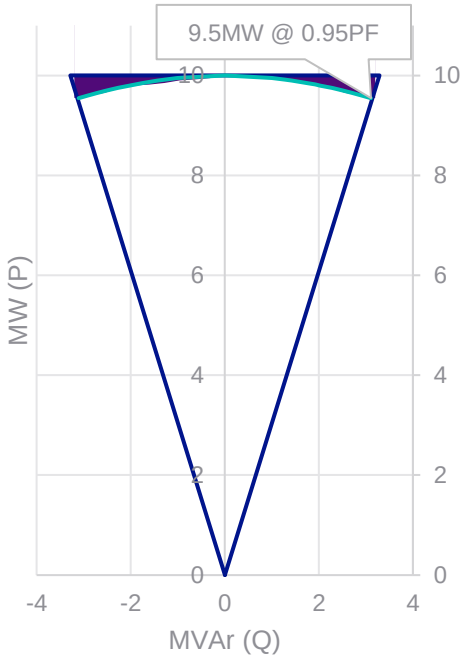
- Connections must comply with P28, P29 & G5/5
- Please refer to NGED's policy ST:SD6F/2 (available from the NGED Tech Info Website). See Appendix B & C of this policy for Connection Guides.

Simulation Submission

Reactive Power Capability

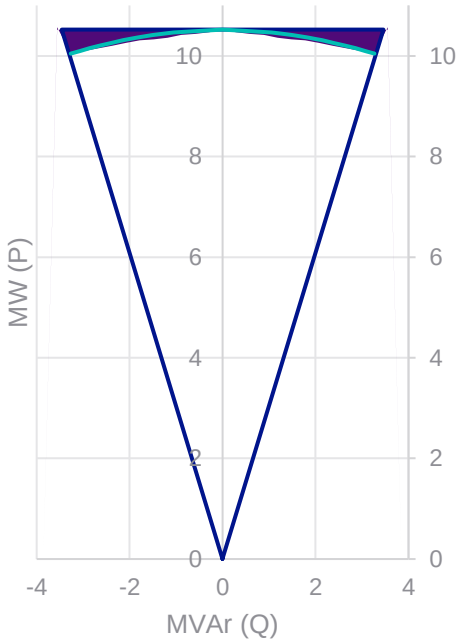
- Registered Capacity must be calculated with fixed operating power factor taken into consideration
- Figure 1 represents a site that can only export 10MW at any power factor. The shaded area represents the output that this site is unable to achieve, but which is required under G99.
- Figure 2 represents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

Figure 1: 10MW @ Unity



10MW @ Unity 9.5MW @ 0.95 p.f.

Figure 2: 10 MW @ 0.95 leading



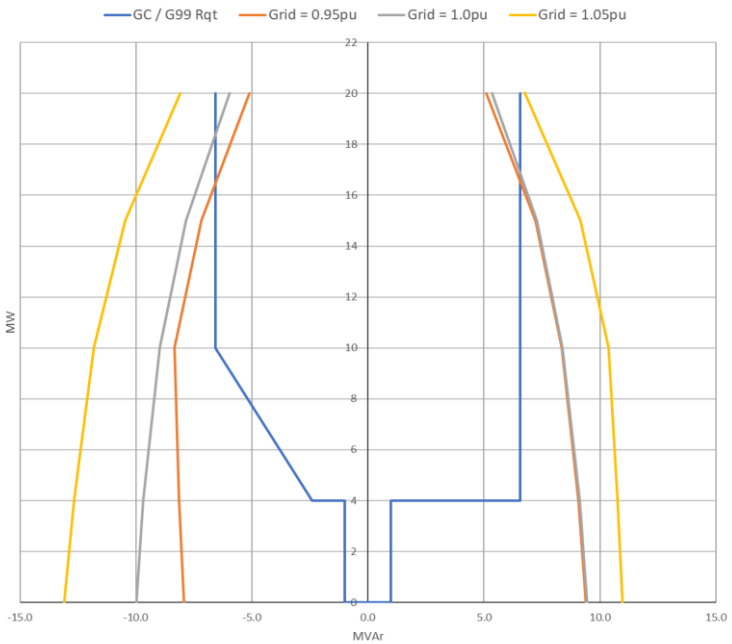
10.52MW @ Unity 10MW @ 0.95 p.f.

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.

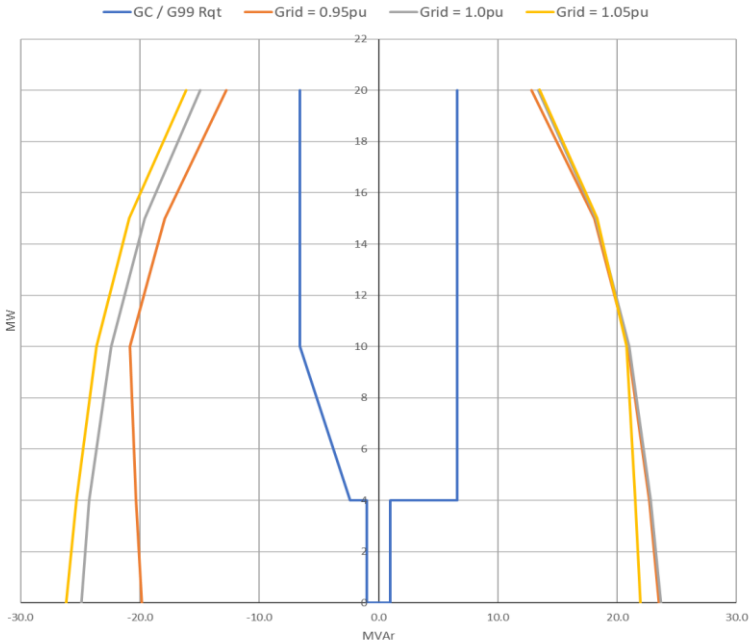
Simulation Submission

Reactive Power Capability

Not compliant



Compliant



Simulation Submission

Reactive Power Capability

Figure 3-1 - Full PQ Reactive Capability

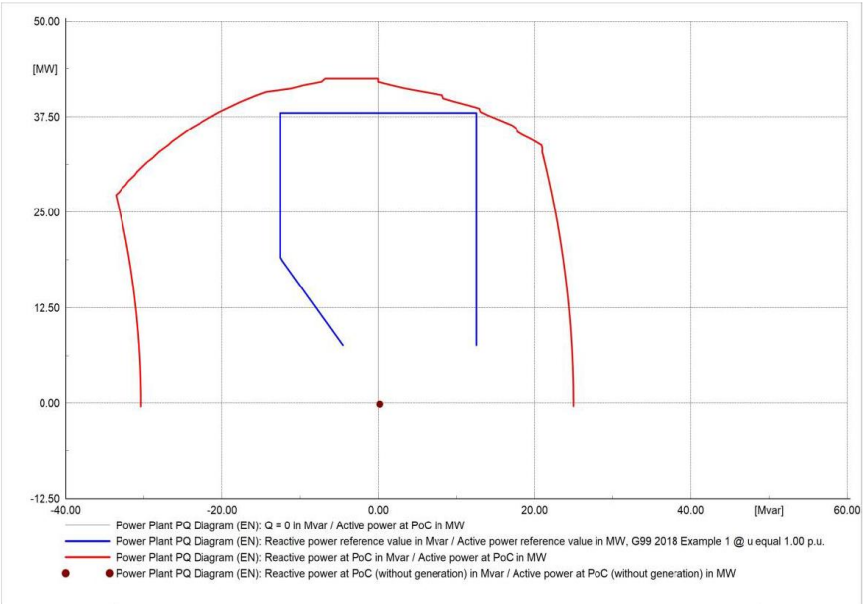


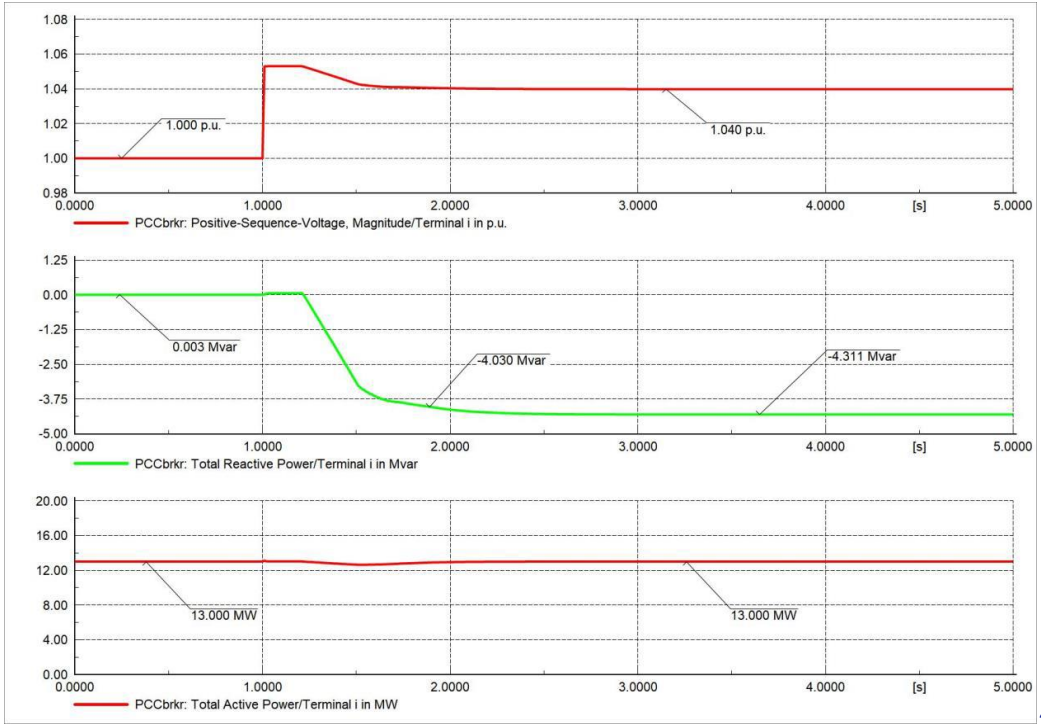
Figure 3-2 Full VQ Capability Diagram

Simulation Submission

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



Simulation Submission

Confirmation of frequency range of operation

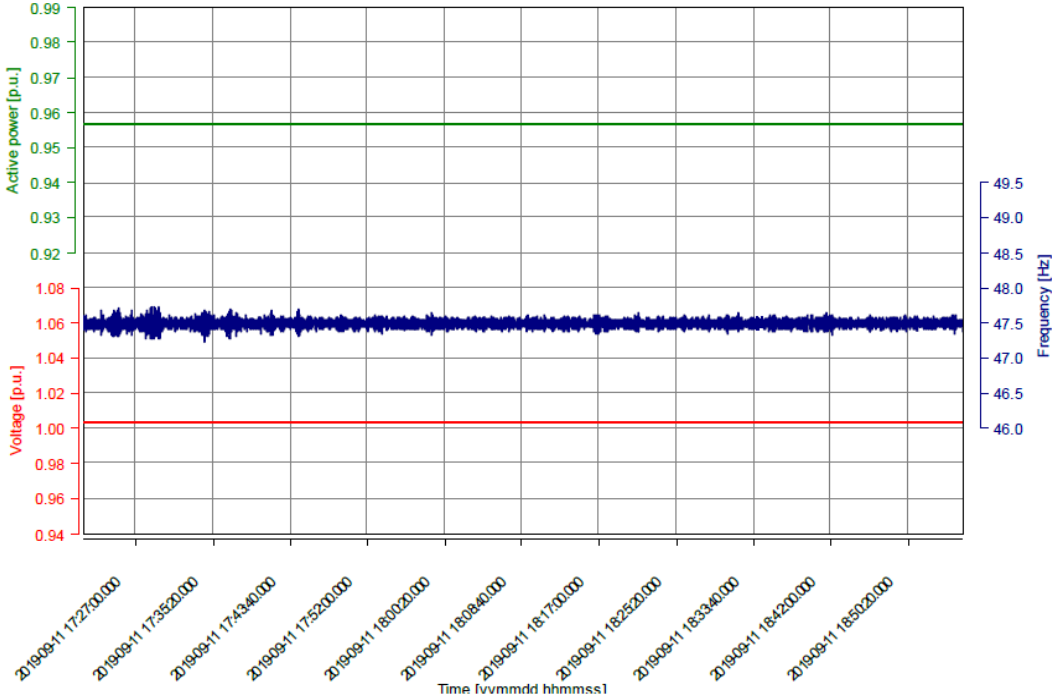


Figure 20 Test 2; 96% load at 47.5Hz and 100% voltage, duration: 90min

Simulation Submission

LFSM-O & U (and FSM as required)

Sufficient annotation to show:

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

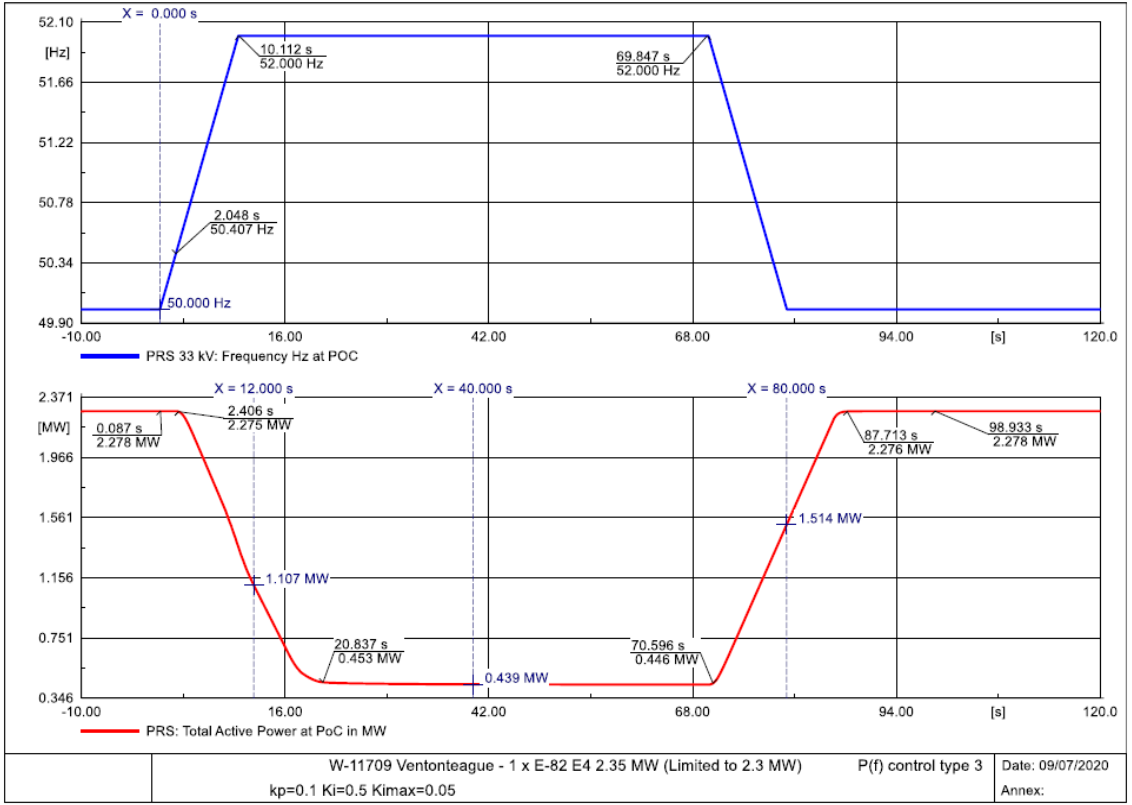


Figure 3.3-2 Power (MW) and Frequency (Hz) at POC during the injection ramp of +2Hz

Simulation Submission

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

Simulation Submission

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

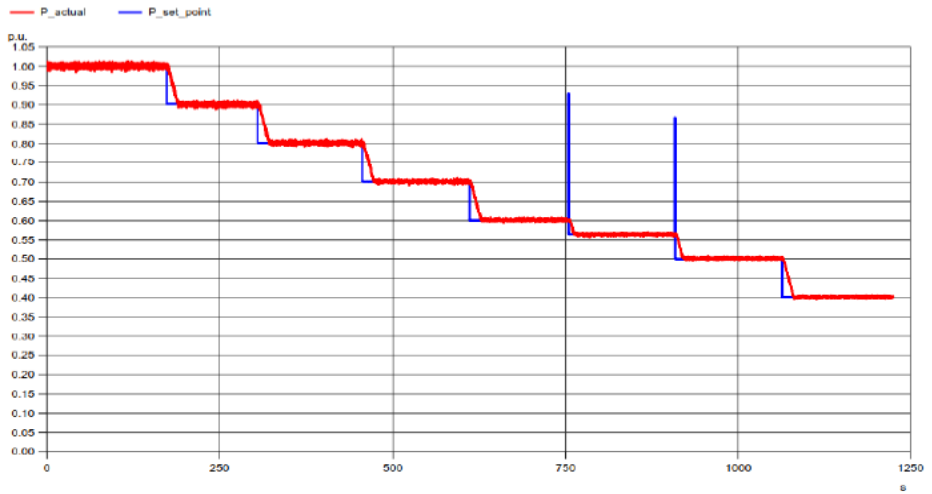


Figure 10 Active Power Setpoint and measured Active Power [2]

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

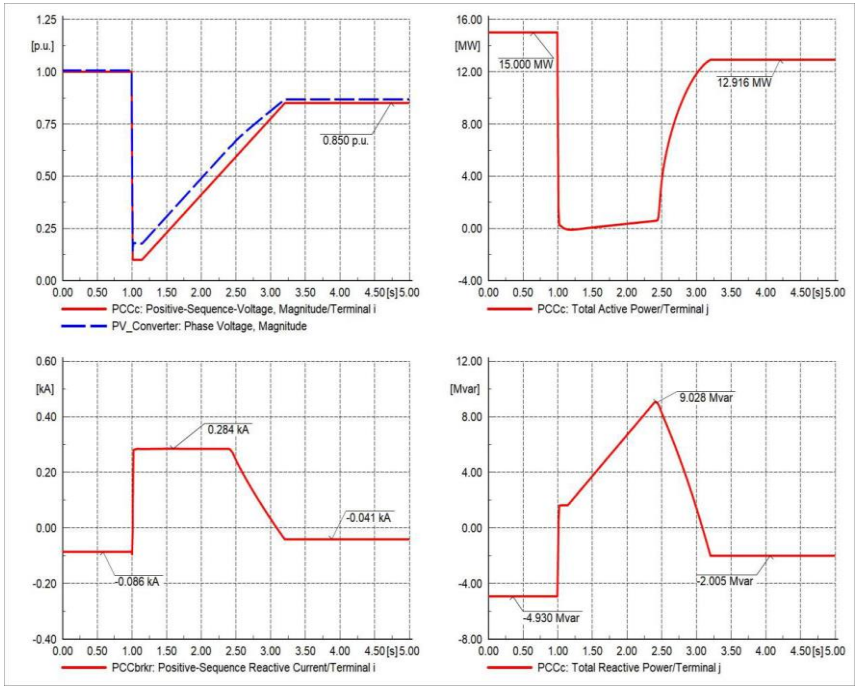
Simulation Submission

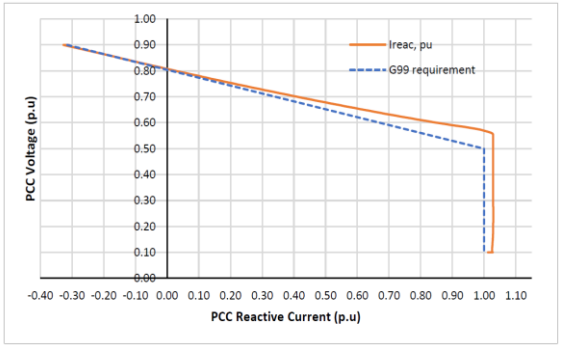
Cyber Security Requirements

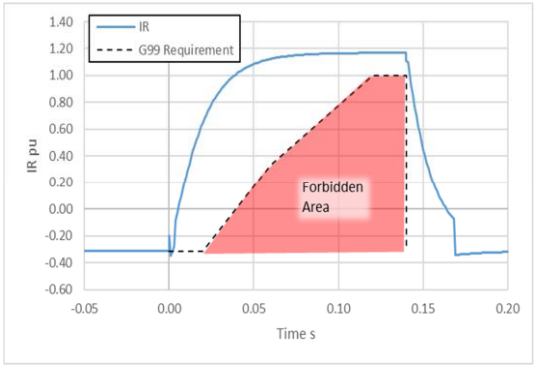
- ETSI EN 303 645;
- Relevant aspects of PAS 1879 “Energy smart appliances – Demand side response operation – Code of practice”;
- Relevant aspects of “Distributed Energy Resources – Cyber Security Connection Guidance” published by BEIS and the ENA;
- Any other relevant standard that has been incorporated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

Simulation Submission

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



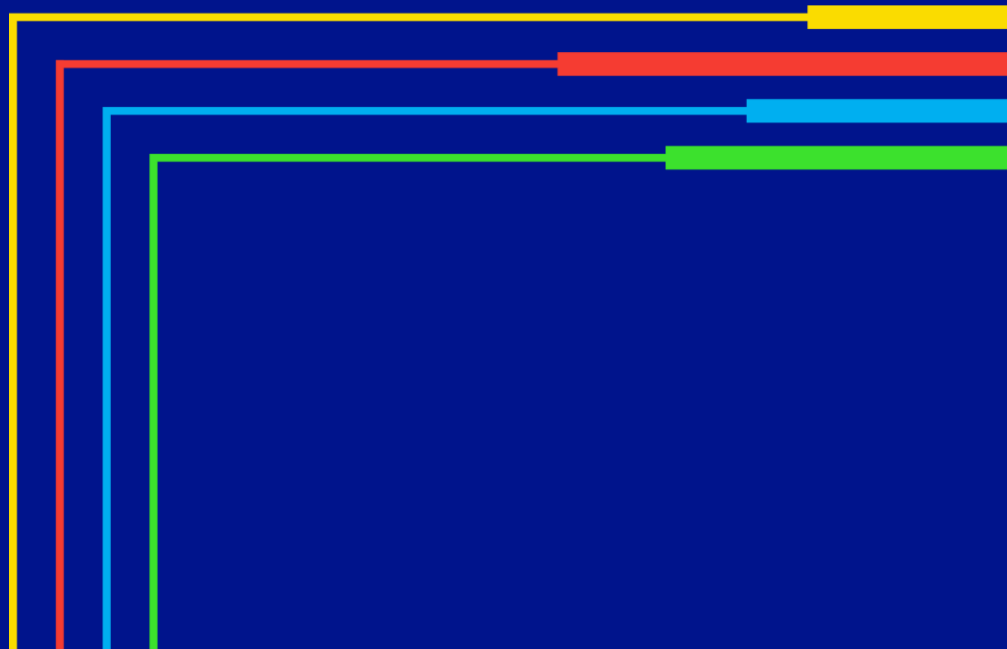




Electricity Distribution

3

Test Procedure



nationalgrid

Test Procedure

NGED Allowances

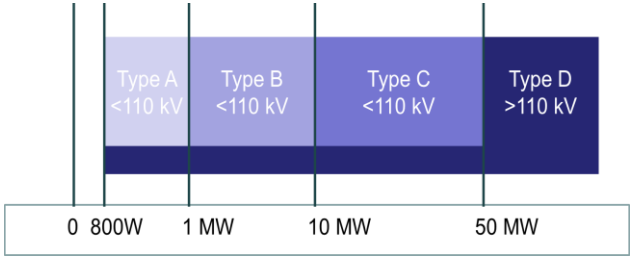
- Up to 6 months allows for weather dependant tests
- ION format used for all connection Types where external factors limit the completion of compliance. An end date must be agreed
- Results from all other tests to be provided along with B2-2 or C2-2 form or comments put at the end of the document.

Test Procedure

Tests required

Tabular evidence and graphs expected for:

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



Test Procedure

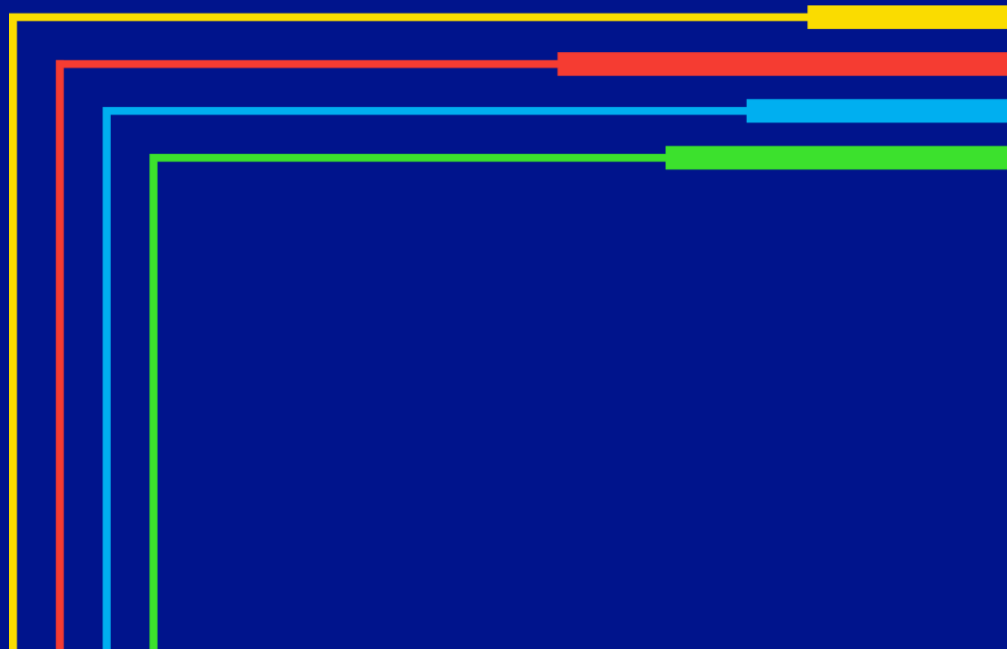
Dynamic System Monitoring

- 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

Electricity Distribution

4

Other requirements



nationalgrid

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

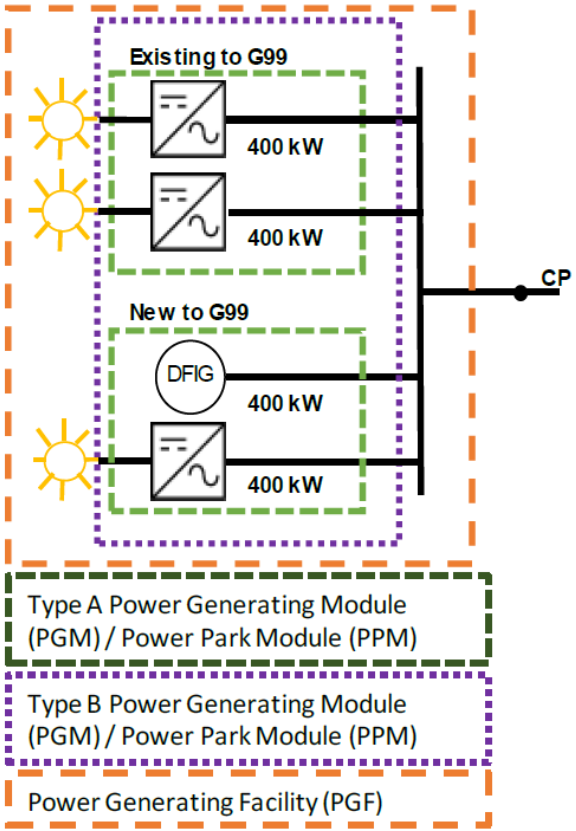
Loss of Mains intertrips

- 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



ENA Engineering Recommendation G99 Type A
Issue 1 Amendment 9 2022
Page 288

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 27/04/19 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 RfG agreed process, be EREC G99 compliant. In this case had the **DNO** witnessed the commissioning it would have been picked up earlier.
2	EREC G59 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.	×	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 RfG.

nationalgrid

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:

- **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?

Upcoming forums

September (Date TBC) Online

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

Regen contacts

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

Emma Madray, **emadray@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