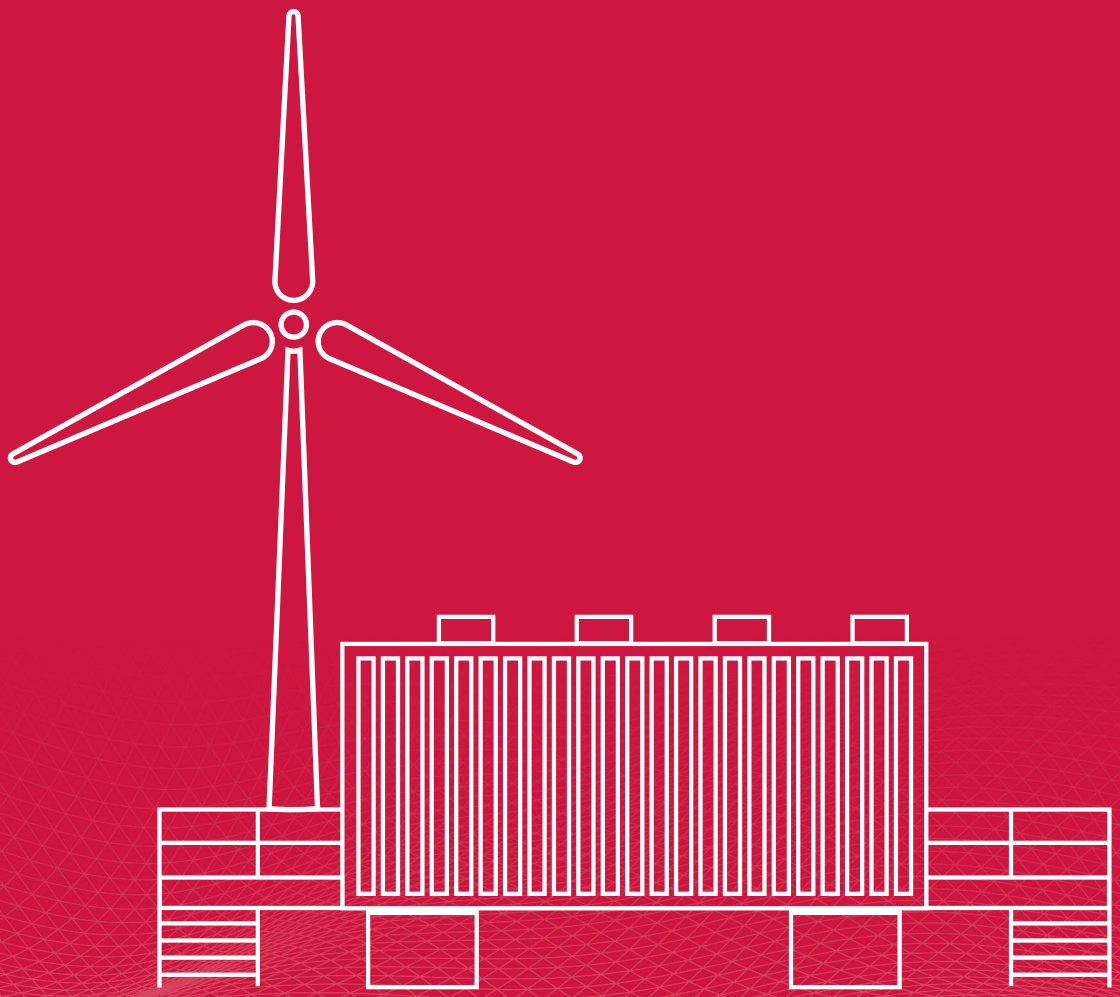
NORTHERN POWERGRID



Technical Guidance Note

Hybrid Connection Arrangements

1. Scope

1.1 This guidance note applies to Hybrid Connections within the Northern Powergrid Licence Area. It focuses on larger capacity connections that require a connection voltage at 11kV and above.

2. Introduction

2.1 This document has been prepared in response to feedback from our customers asking for guidance on Hybrid Connections within the Northern Powergrid Licence Area.

2.2 Distributed Generation is a reference to Power Generating Modules (PGM) embedded within a Distribution Networks Operators (DNOs) electrical network as oppose to a direct connection to the National Grid (NGET) Supergrid Transmission Network.

2.3 The purpose of the embedded generation is twofold. In the first instance a customer may install generation within their site, based on their individual electrical needs, to reduce their energy demand from an electricity supplier, and reduce their overall energy bills. In the second instance the embedded generation connection may have a role to actively support the GB electricity network through commercial contracts.

3. Generation in the Northern Powergrid Licence Area

3.1 Existing PGMs connected to the Northern Powergrid system include synchronous machines, primarily driven by fossil fuels in the form of oil or gas, but also burning waste material or biomass. The asynchronous/inverter connected devices include wind, solar PV and Battery Energy Storage Systems (BESS).

3.2 Historically, our experience of generation enquiries typically consisted of a request to connect a single type of generation device at a particular site. However, emerging experience is evolving and we are now seeing requests for more complex combinations of generation types on the same site. These requests for the connection of different combinations of generating units are termed 'Hybrid Generation Connections'.

3.3 Northern Powergrid does not have any issues with the concept of equipping sites with combinations of generation types, provided all the relevant technical, commercial and legal requirements are met. A number of documents are already available on the Northern Powergrid website (hyperlinks at the end of this document) to help customers to understand the policies and procedures we use in the technical design of PGM connections.

4. Specific issues with Hybrid Connections

4.1 There are a number of things we need to understand at the outset to ensure the design we prepare ultimately achieves the customer's requirements.

4.2 The mix of technologies is important as they will have different performance characteristics - up to ten times rating fault level contribution for synchronous plant, whilst at the other end of the scale, other types will contribute slightly above rating to fault level. It should be noted that plant that is only used for offsetting onsite demand will contribute fully to network fault level and this must be taken into account during the design modelling phase.

4.3 We also need to understand your operating regime. For example, you may have an arrangement where you use any surplus generation over your contracted export level, or internal site demand, to charge a BESS system used for enhanced or fast frequency response. If the two systems can be interlocked to prevent simultaneous parallel operation with our distribution network, then we can keep fault level and step change down and potentially provide a cheaper overall connection without the need for reinforcement.

4.4 An important aspect associated with BESS is that the demand element must be assessed against EREC P2 in terms of Security of Supply. For a non-firm connection, (e.g. usually a single circuit to the customer's intake substation) the connection to the customer will be exempt, but the impact of the demand element of the BESS must be taken into consideration beyond the Point of Common Coupling with other customers.

4.5 In some cases the commercial contracts for the individual elements of a site may require discreet independent metering. This is between the customer and the meter operator to resolve. It is possible that any issues could be resolved by the addition of a further metering circuit breaker at the customer's site to separate the generation by type, and this is something Northern Powergrid is prepared to consider to achieve a solution. This will require additional floor space in the metering substation, something that you may wish to consider when establishing a new site is laying it out for future expansion with adequate floor space for additional metering circuit breakers within the switchroom.

5. Constraints and curtailment

5.1 Hybrid Generation sites are subject to the same constraints and curtailment as all other generation sites. We will discuss these aspects with you to identify if a flexible connection could offer a cheaper solution. One point to note for all sites; when an existing site is used as a platform to add additional generation units we have to assess the impact of the additional generating units in terms of thermal, voltage step change and fault level on our distribution network, and a full stability study may be required before energisation of the additional generating units is permitted.

6. Making an application with Northern Powergrid

6.1 When considering a Hybrid Connection, Northern Powergrid customers can make use of our monthly connections surgeries or contact our engineers direct for upfront guidance. When you are ready to make your application our preference is that you use the Electricity Network Association (ENA) application form:

Connection of Power Generating Modules to Distribution Networks in accordance with EREC G99

6.2 The rationale behind this requirement is that the ENA form provides a consistent model across the UK, allowing customers to provide consistent data across geographically dispersed sites and is designed to be compliant with the requirements of EREC G99. In addition, the design of this application form is such that it is capable of supporting an application for more than one type of generating unit.

6.3 The application form asks for an individual sheet for each different generating unit in part 3 and in part 4 has specific pages for:

- synchronous power generating modules;
- fixed speed induction generating units,
- doubly fed induction generating units,
- series inverter connected generation units,
- electricity storage plant, and;
- a sheet for the unit transformers to be used on site.

Image 1: ENA Application Form

7. Links to useful Northern Powergrid documents

7.1 The following is a list of quick hyperlinks to documents that will be of use to anyone seeking to make a Hybrid Connection application. These documents are all available on the Northern Powergrid website.

- IMP 001 007 001: Battery Storage System Guidance Document
- IMP 001 007: Code of Practice for the Economic Development of Distribution Systems with Distributed Generation
- IMP 001 016: Code of Practice for the Application of Active Network Management Schemes
- IMP 001 909: Code of Practice for Distribution System Parameters

8. Links to useful ENA documents

- EREC G99 application form
- EREC G99/1-3 (2018)
- Application form multiple sheets

9. Other ENA documents

9.1 To access these documents please contact the ENA directly www.energynetworks.org

— EREC P28 'Planning Limits for Voltage Fluctuations'

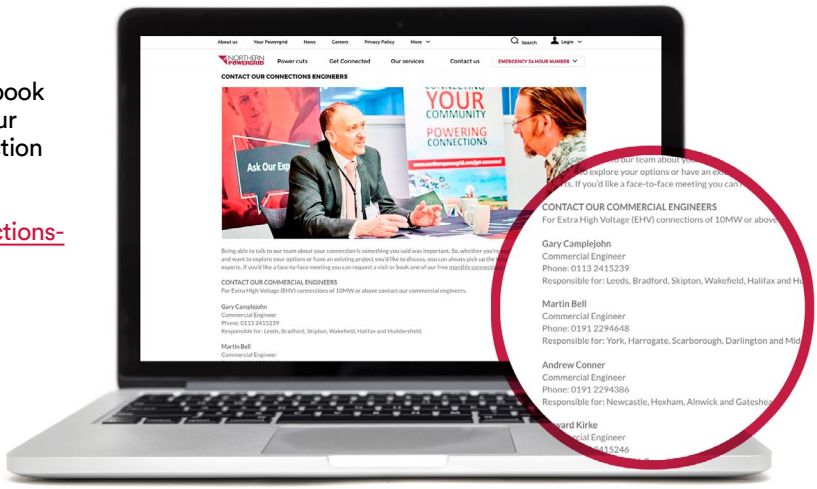
— EREC P2 'Security of Supply'

— EREC G5/4 'Planning Limits for Harmonic Voltage Distortion'

10. Support

10.1 Customers requiring pre-application support can book one of our monthly connections surgeries or call our engineers direct. Contact details for all our connection engineers can be found at:

- www.northernpowergrid.com/contact-our-connections-engineers



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Contact us

0800 011 3433

getconnected@northernpowergrid.com

www.northernpowergrid/getconnected