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

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www.energynetworks.org

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This form should be used by Customers connecting any generating plant to the Distribution Network Operator (DNO) Distribution Network. Customers with generating plant are known as Generators in distribution network documentation and will be referred to as such in this document.

The form should be used by Generators connecting a new Generating Unit, or modifying plant in an existing Power Generating Facility. Note that Generating Units may comprise Electricity Storage plant and hence a Customer connecting Electricity Storage plant to the DNO Distribution Network is a Generator.

It is possible to connect almost any Power Generating Module[1] to the Distribution Network. In order for the connection to meet the requirements of a new Generator and the existing Customers it is important to ensure the new connection is properly designed and compliant with Engineering Recommendation G99. This means there is a need for information to be exchanged between you as the Generator and the local DNO. The Planning Code and Data Registration Code of the Distribution Code sets out the obligations on the Generator and DNO to exchange data as part of the design process and lists the data items that may need to be exchanged. The purpose of this application form is to simplify and clarify this data exchange process.

- If the rating of the Power Generating Module that you are applying to connect is 16 A per phase or less, you will probably be able to connect it using the far simpler connection process for Micro-generators complying with Engineering Recommendation G98.

- If the rating of the Power Generating Module that you are applying to connect is greater than 16 A per phase and less than 17 kW (or less than 50 kW three phase), you will probably be able to connect it using the connection process complying with Engineering Recommendation G99 and using Form A.1 in Engineering Recommendation G99.

This Application Form is for all other Generators and is in five parts.

Generators should have sufficiently developed their plans to at least an outline level of detail, and be able to demonstrate their project's readiness to be built, before submitting a completed application form. As part of the connection application, Generators should provide the the information set out below and referenced further in the appropriate part of this application form.

- The heads of terms of an agreement with the landowner (where required);
- A site layout plan which clearly shows all land relevant to the application;
- A detailed engineering design plan; and
- A preliminary project timeline.

Failure to provide the information required to complete this formwill result in delays to the DNO providing a connection offer

The terms used in this form are aligned with those in Engineering Recommendation G99. Engineering Recommendation G99 contains a complete set of definitions and is available from the ENA website. This Application Form should be used for all Type A Power Generating Modules > 50 kW and all Type B, Type C and Type D Power Generating Modules. This Application Form will form part of the Power Generating Module Document (PGMD) for Type B, Type C and Type D Power Generating Modules. The PGMD is completed throughout the connection process and finalised before the DNO issues a Final Operational Notification

1 Either a Synchronous Power Generating Module or a Power Park Module (made up of Generating Unit(s) which may comprise Electricity Storage plant)

Types of Power Generating Module are defined in Engineering Recommendation G99 and repeated below:

Type A: A Power Generating Module with a Connection Point below 110 kV and a Registered Capacity (ie rating) of 0.8 kW or greater but less than 1 MW.

Type B: A Power Generating Module with a Connection Point below 110 kV and Registered Capacity of 1 MW or greater but less than 10 MW.

Type C: A Power Generating Module with a Connection Point below 110 kV and a Registered Capacity of 10 MW or greater but less than 50 MW.

Type D: A Power Generating Module with a Connection Point at, or greater than, 110 kV; or with a Connection Point below 110 kV and with Registered Capacity of 50 MW or greater.

Parts 1 to 4

These parts are required at the connection application stage to collate the initial data that the DNO requires to assess the connection application. In most cases this information should be sufficient for the DNO to complete the connection design and make a connection offer. The information sought for Type B, Type C and Type D Power Generating Modules will be fairly comprehensive at this initial stage, with less data required initially for Type A PGMs.

Initial data can be estimated values, where necessary, as this can be updated as the actual and/or final values become known.

Complete Type A data and any updates to initial assumed data must be provided before synchronising.

Part 5

In some cases the DNO will require further information which is detailed in Part 5 of this application form to complete the connection design. The DNO will advise you if such information is required.

Guidance on completing the application form

The minimum information you should initially submit to the DNO is Parts 1, 2, 3 and 4 of this application form.

The application forms can be downloaded from the ENA website and when completed they should be sent to your local DNO. Their contact details can be found by following the link below, along with a postcode search facility to find out who your local DNO is:

http://www.energynetworks.org/info/faqs/who-is-my-network-operator.html

The following section provides an overview of the information required to complete each part of the application form, which is divided into the following sections:

Part 1	Contact details, location and operational information	Initial submission
Part 1a	Supplementary contact details	Initial submission
Part 2	Power Generating Facility general data	Initial submission
Part 3	Power Generating Module model data	Initial submission
Part 3 Section 1a	Summary of the new Generating Units that comprise the Power Generating Module	Initial submission
Part 3 Section 1b	Summary of the existing Generating Units that comprise the Power Generating Module	Initial submission
Part 3 Section 2	Generating Unit data	Initial submission
Part 4a	Synchronous Power Generating Modules	Types B, C, D initial submission; Type A prior to synchronising
Part 4b	Power Park Module model data: Fixed speed induction Generating Units	
Part 4c	Power Park Module model data: Doubly fed induction Generating Units	
Part 4d	Power Park Module model data: Series inverter connected Generating Units	
Part 4e	Power Park Module model data: Electricity Storage plant	
Part 4f	Transformer information	
Part 5	Additional data which may be required by the DNO	Prior to synchronising

Part 1

This part of the application form is in two sections. Part 1 enables you to provide:

- Contact details for you and your consultant (if you have one).
- The location of your Power Generating Module.

Part 1a enables you to provide supplementary contact details for the Generator, Generating Unit installer and Electricity Storage plant installer, if applicable.

This data should be provided at the initial submission stage.

Part 2

Part 2 enables you to provide:

- Details of the import and export requirements for your site. It is important to make sure that you consider the import requirements for any load that you have on your site in addition to the export from the generation plant.
- Information about the fault level contribution from the Power Generating Facility at the Connection Point, although you do not need to provide this information here if more detailed fault level information is provided in Part 3 of the application form.

This data should be provided at the initial submission stage.

Parts 3 & 4

These parts of the application form require details about the Power Generating Modules being connected.

Part 4 of the application form seeks detailed information about the different power generation technology which will comprise the facility, including Electricity Storage. The relevant section of Part 4 of the form should be completed for each different type of Generating Unit.

The relevant section should be completed at the initial submission for Types B, C and D.

If there are any items on the application form that you are unsure about, it would be worth contacting the company you are arranging to buy your generation plant from as they should be able to provide some of the more technical information. If you are unable to provide some of the technical details for example if you have not yet decided who to buy your generation plant from, you must provide suitable data from a proposed generation supplier, you must also clearly indicate on the application form which data is estimated. You will need to confirm this data as soon as possible and always before the Power Generating Module is commissioned.

The application form enables you to provide detailed technical information about the generation plant you are applying to connect. It is split into six sections. The first five sections relate to particular types of Power Generating Module. You only need to complete the section relating to the type of Power Generating Module that you are applying to connect ie. Part 4a, 4b, 4c, 4d or 4e. Use one form for each type of Generating Unit. Part 4e enables you to provide additional information about Electricity Storage plant. Part 4f enables you to provide information about any transformers that you plan to use.

Each section should be copied as many times as required for the plant being connected. This data should be provided at the initial submission stage, and must be updated prior to commissioning.

Applications for Generating Units that are to be operated in infrequent short-term parallel mode do not need to provide data about voltage control or frequency response. It should be noted that due to different technical requirements a Generating Unit purchased and connected to operate in infrequent short-term parallel mode may not be suitable to be connected in long-term parallel mode in the future. If it is likely that the Generating Unit will be required to operate in long-term parallel mode in the future, this should be considered from the outset.

Part 5

Part 5 of this form enables you to provide additional data that may be required by the DNO prior to issue of the Final Operational Notification.

Version Control – please continue as required

The Standard Application Form is used as an iterative document, developed as your connection and commission process develops. When you formally resubmit this application form to the DNO (eg with additional or updated information), you should use this page to note the issue number, date of submission and any notes on changes, in order to maintain version control.

Note: your initial submission should be as close to accurate as possible, to demonstrate project readiness.

Issue #

Date

Issue #

Date

Note re amendment

Issue #

Date

Note re amendment

Issue #

Date

Note re amendment

Part 1

To be completed for all new connections

Applicant's Details

Please provide all the information requested in this part 1, unless otherwise stated in the question.

Company Name

Company Registered No.

Postal Address

Contact Name

Email Address

Telephone No.

Consultant or Agent's Details (if applicable)

Consultants Name

Postal Address

Contact Name

Email Address

Telephone No.

Power Generating Facility location and operation (see note 1)

Power Generating Facility name

Site Postal Address or attach a site boundary plan (Red line boundary 1:500)
Please insert the file name of the attachment here

For generation applications comprising 1MW of Registered Capacity or more of new generation (unless the DNO notifies you of a lower threshold), please attach a letter of authority (LoA) for an agreement giving exclusive option to the relevant land and the heads of terms (HoT) for such an agreement. If you own and/or have sole title to the land a LoA (and HoT) is not required, but please confirm your rights here. (In order to allow for competition in connections, where an Independent Connection Provider is applying on behalf of an end user, you must provide the above from the end user and confirmation you are working on behalf of them). Please insert the file name of the attachment here.

Please attach a site layout plan which clearly shows all land relevant to the application in accordance with the LoA (and HoT) provided, including the red line boundary and the asset location within the red line boundary, if not already included in full on the site boundary plan attached above. Please insert the file name of the attachment here.

Please attach a detailed engineering design plan which clearly shows all land in the application in accordance with the LoA (and HoT) provided (where applicable) - including red-line boundaries, if not already included in the site boundary plan above. Please insert the file name of the attachment here.

Details of technology (eg Solar, Wind, Biomass, Diesel/CHP, Electricity Storage)

Is this a new site or an existing site where an extension is proposed?
(Data about existing sites should be submitted in Part 3)

◯ New ◯ Existing

Details of any existing Connection Agreements held by the Generator at or in the vicinity of the proposed or existing Connection Point

Details of any existing Import MPAN (for any existing import metering system)

Details of any existing Export MPAN (for any existing export metering system)

For applications comprising 1MW of Registered Capacity or more of new generation (unless the DNO notifies you of a lower threshold), please provide **a preliminary** project **timeline**. See Note 1.

Connection Point (OS grid ref or description)

Preferred Connection Point voltage

V

Single line diagram of any on-site existing or proposed electrical plant or, where available, operation diagrams. Note: the diagram(s) must match the data provided in Sections 3 and 4. Discrepancies will cause delays in processing the application or for it to be rejected. Please insert the file name of the attachment here.

Please indicate whether you are making an application for non-contestable connection services, or for both contestable and non-contestable connection services. (see Note 2)

◯ Non-contestable connection services only

◯ Contestable and non-contestable connection services

Please indicate whether you require a Budget Estimate or Formal Quote

◯ Budget Estimate

◯ Formal Quote

If you already have an estimate or quotation, please attach it. Please enter the file name of the attachment here.

Note 1 – A suitable **preliminary** project **timeline** will typically detail when the following activities are planed to start and finish. More or less detail may be required dependent on the particular nature and circumstances of the project:

- Feasibility Study: demonstration of the project's viability.
- Project Plan Development: a detailed project plan including timelines, milestones, resources.
- Risk Management Plan: potential risks and mitigation strategies.
- Resource Allocation: assigned resources and responsibilities.
- Regulatory Compliance: demonstration of how all regulatory requirements are identified and planned for.

The ENA and the DNOs publish more detailed guidance from time to time on the minimum necessary information to support an application, particularly in relation to:

- heads of terms;
- site plan details;
- the detailed engineering design plan;
- the **preliminary** project **timeline**.

A copy of this guidance can be obtained from the DNO.

Part 1a – additional contact details

Generator Details

If the Applicant is also the Generator then there is no need to complete this section

Generator Name

Company Registered No.

Postal Address

Contact Name

Email Address

Telephone No.

Installer Details (if applicable)

Installer Name

Postal Address

Contact Name

Email Address

Telephone No.

Point of Contact for the DNO

Select as appropriate

- ◯ Applicant
- ◯ Generator
- ◯ Installer
- ◯ Consultant or Agent

Note 2 – Non-contestable work comprise tasks that the DNOs need to undertake to maintain co-ordination and control of their networks.

Contestable work comprise tasks that are open to competition and can be undertaken by the DNO or by an Independent Connection Provider.

Further information about Contestable and Non-contestable work can be found in the ENA Distributed Generation Connection Guide, Standard conditions of the Electricity Distribution Licence: Condition 15 and Section 16 of the Electricity Act.

Part 2

To be completed for all Power Generating Facilities

Site import/export requirements (see Note 3)

Firm export requirements:

		◯ kW
Maximum Active Power export	.	◯ MW
Maximum Reactive Power export	.	◯ kVAr
Maximum Reactive Power import	.	◯ MVAr

Non-firm export requirements:

		◯ kW
Maximum Active Power export	.	◯ MW
Maximum Reactive Power export	.	◯ kVAr
Maximum Reactive Power import	.	◯ MVAr

Firm import requirements:

		◯ kW
Maximum Active Power import	.	◯ MW
Maximum Reactive Power import	.	◯ kVAr
Maximum Reactive Power export	.	◯ MVAr

Non-firm import requirements:

		◯ kW
Maximum Active Power import	.	◯ MW
Maximum Reactive Power import	.	◯ kVAr
Maximum Reactive Power export	.	◯ MVAr

If you have opted for a Formal Quote, please answer the following question:

Where network capacity is limited, a flexible or curtailable connection, which involves operational constraints, may be available. Please contact your DNO for further information on flexible or curtailable connections.

Based on information provided by your DNO, please indicate your preferred type of connection:

◯ Constrained connection (discussion with DNO required)

◯ Unconstrained connection

What level of security is required for the connection to the local network? (see Note 4)

The DNO will assume a single circuit connection to the Power Generating Facility is required unless otherwise stated below. Options include:

- ◯ Two* circuits – main and standby; standby manually switched
- ◯ Two* circuits – main and standby; standby switched automatically
- ◯ Two* circuits – parallel operation (with unit protection)
- ◯ Other (please describe)

*In some cases more than two circuits may be provided.

Total Site maximum fault current contribution (you may prefer to provide the required information in Part 3 - see Note 5)

Peak asymmetrical short circuit current at 10ms (ip) for a 3φ short circuit fault at the Connection Point		kA
RMS value of the initial symmetrical short circuit current (Ik") for a 3φ short circuit fault at the Connection Point		kA
RMS value of the symmetrical short circuit current at 100ms (Ik(100)) for a 3φ short circuit fault at the Connection Point		kA

Power Generating Module interface arrangements (see Note 6)

Means of connection, disconnection and synchronising between the DNO and the Generator. This information must include a relevant diagram.
Please insert file name of attachment. Please ensure you submit this information otherwise your application will be delayed.

Note 3 – This section relates to operating conditions when the Power Generating Facility is exporting Active Power. The Active Power export and associated maximum Reactive Power export and/or import should be stated for operation at Registered Capacity taking into account:

i) the Active Power export and Reactive Power export and import will be dependent on any connected demand at the facility; this may vary over time and the maximum export and / or import values should be stated.

ii) if the Power Generating Facility is providing a commercial service which means it will be operating at a power factor less than that required to be technically compliant with G99, the maximum Reactive Power export and/or import at the lowest power factor should be stated.

The firm import or export requirements relate to the capacity available under network intact conditions. Non-firm capacities which might be available under outage conditions should be discussed with the DNO.

Note 4 – This question relates to the connection from your Power Generating Facility to the DNOs network.

Single circuit connection means that if there is a planned outage or unplanned outage (ie a fault) of the connection assets the Power Generating Facility will be disconnected until the connection assets are returned to service.

Standby manually switched means that if there is a planned outage or unplanned outage (ie a fault) of the connection assets the Power Generating Facility will be disconnected until manual or remote switching is carried out.

Standby automatically switched means that if there is a planned outage or unplanned outage (ie a fault) of the connection assets the Power Generating Facility will be disconnected for a short period of time whilst automatic switching is carried out.

Parallel operation (with unit protection) means that if there is a planned outage or unplanned outage (ie a fault) of the connection assets the Power Generating Facility will continue to be able to export without interruption.

This information will be used by the DNO when assessing your application. Actual requirements for operating conditions such as the Power Generating Module operating mode and power factor will be agreed as part of the Connection Offer.

Registered Capacity can apply to:

i) a Power Generating Facility. This is the total maximum Active Power capacity of the Power Generating Module(s) in the Power Generating Facility, minus the power consumed by the generation process. For a Power Generating Facility with no other site demand you should take account of the requirement to produce Reactive Power at the Connection Point which will mean considering other equipment such as transformers and cables connecting the Generating Units to the Connection Point. For a Power Generating Facility embedded in a private network with demand it is recommended that you discuss the requirement for the production of Reactive Power with the DNO. Hence the Registered Capacity (kW) will generally be less the than Apparent Power (kVA).

ii) a Power Generating Module. This is the maximum Active Power capacity of the Generating Unit(s) comprising the Power Generating Module, minus the power consumed by the generation process. It needs to take account of the requirement to produce Reactive Power at the Connection Point. Hence the Registered Capacity (kW) will generally be less than the Apparent Power (kVA).

Where a Power Generating Module comprises inverters, the maximum Active Power capacity of the Generating Unit(s) is the lesser of the Inverter(s) rating or the rating of the energy source.

Note 5 – The DNO needs to assess your application with respect to the fault contribution your equipment will make to their network. Your Power Generating Modules and any induction motors will contribute fault current if there is a fault on the network. The amount of fault current at the Connection Point depends on the characteristics of your Power Generating Modules, induction motors and the impedance of your network (transformers, cables and overhead lines).

Engineering Recommendation G74, ETR 120 and IEC 60909 provide guidance on fault current data. Additionally, fault current contribution data shall be provided in the form of detailed graphs, waveforms and/or tables. Induction motors can contribute to the peak asymmetrical short circuit current at 10ms. If the fault current contribution is solely from Generating Units then this information need not be provided where detailed fault level contribution / impedance data is provided for each Generating Unit in Part 3 of this application form. Please ensure you make clear where and at what voltage the fault current contribution is estimated.

Note 6 – The interface arrangements need to be agreed and implemented between the User and DNO before energisation. This is detailed in Paragraph 6.4.2 of Engineering Recommendation G99. This information must include a diagram.

Part 3

To be completed for all Type A, Type B, Type C and Type D Power Generating Modules

Part 3 Section 1a -
summary of the new Generating Units that comprise the Power Generating Module

Part 3 Section 1b -
summary of the existing Generating Units that comprise the Power Generating Module

Part 3 Section 2 -
Generating Unit data

Part 3 Section 1a - summary of the new Generating Units that comprise the Power Generating Module The second section of Part 3 should be completed for each different Generating Unit. (See Note 7)

Power Generating Module general data

Name(s) / identifiers of Power Generating Modules. Where the Power Generating Module contains components or products that are type tested, include the type test reference numbers here.

Will any Generating Unit operate in island mode? ◯ Yes ◯ No

Will any Generating Unit supply electricity to on-site load? ◯ Yes ◯ No

Will the Generating Unit operate solely in infrequent short-term parallel operation mode ◯ Yes ◯ No

	Number of Generating units	Type of prime movers	Energy Source Availability (see Note 8)	Energy Source and Technology Type (see Note 9)
Synchronous Power Generating Module			◯ Intermittent ◯ Non-intermittent	
Fixed speed induction Generating Unit			◯ Intermittent ◯ Non-intermittent	
Double fed induction Generating Unit			◯ Intermittent ◯ Non-intermittent	
Series inverter connected Generating Unit			◯ Intermittent ◯ Non-intermittent	
Electricity Storage Generating Unit			◯ Intermittent ◯ Non-intermittent	
Other (please specify			◯ Intermittent ◯ Non-intermittent	

Part 3 Section 1b - summary of any existing Generating Units that comprise the Power Generating Module

Power Generating Module general data

Name(s) / identifiers of Power Generating Modules. Reference the Engineering Recommendation under which the Power Generating Modules were connected (eg G83, G59, G98, G99)

Does any Generating Unit operate in island mode? ◯ Yes ◯ No

Does any Generating Unit supply electricity to on-site load? ◯ Yes ◯ No

	Number of Generating units	Type of prime movers	Energy Source Availability (see Note 8)	Energy Source and Technology Type (see Note 9)
Synchronous Power Generating Module			◯ Intermittent ◯ Non-intermittent	
Fixed speed induction Generating Unit			◯ Intermittent ◯ Non-intermittent	
Double fed induction Generating Unit			◯ Intermittent ◯ Non-intermittent	
Series inverter connected Generating Unit			◯ Intermittent ◯ Non-intermittent	
Electricity Storage Generating Unit			◯ Intermittent ◯ Non-intermittent	
Other (please specify			◯ Intermittent ◯ Non-intermittent	

Note 7 - Synchronous Power Generating Modules are generally synonymous with Generating Unit in EREC G99 except certain cases, such as a Combined Cycle Gas Turbine (CCGT) Module for example. A CCGT Module can be comprised of a number of Generating Units.

A Power Generating Facility may be made up of a number of Synchronous Power Generating Modules.

Asynchronous or Inverter connected Power Generating Modules are defined as Power Park Modules in EREC G99 and are typically comprised of several Generating Units connected together.

A Power Generating Facility could comprise several Synchronous Power Generating Modules and one Power Park Module. The exception to this is when new plant is being connected to a Power Generating Facility where there are Power Generating Modules which were connected under EREC G83 or EREC G59 and EREC G99 should be referred to for more detailed consideration of this.

Note 8 - Intermittent and Non-intermittent Generation is defined in EREP 130 as follows:

Intermittent Generation: Generation plant where the energy source for the prime mover cannot be made available on demand.

Non-intermittent Generation: Generation plant where the energy source for the prime mover can be made available on demand.

Note 9 - Energy Source & Technology Type

Please select combination of Energy Source and Technology Type from the list below. For example, a solar PV array would be R11 and a gas turbine would be I3.

If the Generating Units are part of a CHP scheme, “CHP” should be included with the code numbers.

If the Generating Unit is part of a Vehicle to Grid Electric Vehicle “V2G” should be included with the code numbers.

	Energy Source (Note 9)
A	Advanced Fuel (produced via gasification or pyrolysis of biofuel or waste)
B	Biofuel - Biogas from anaerobic digestion (excluding landfill & sewage)
C	Biofuel - Landfill gas
D	Biofuel - Sewage gas
E	Biofuel - Other
F	Biomass
G	Fossil - Brown coal/lignite
H	Fossil - Coal gas
I	Fossil - Gas
J	Fossil - Hard coal
K	Fossil - Oil
L	Fossil - Oil shale
M	Fossil - Peat
N	Fossil - Other
O	Geothermal
P	Hydrogen
Q	Nuclear
R	Solar
S	Stored Energy (all stored energy irrespective of the original energy source)
T	Waste
U	Water (flowing water or head of water)
V	Wind
W	Other (Please detail energy source as applicable)

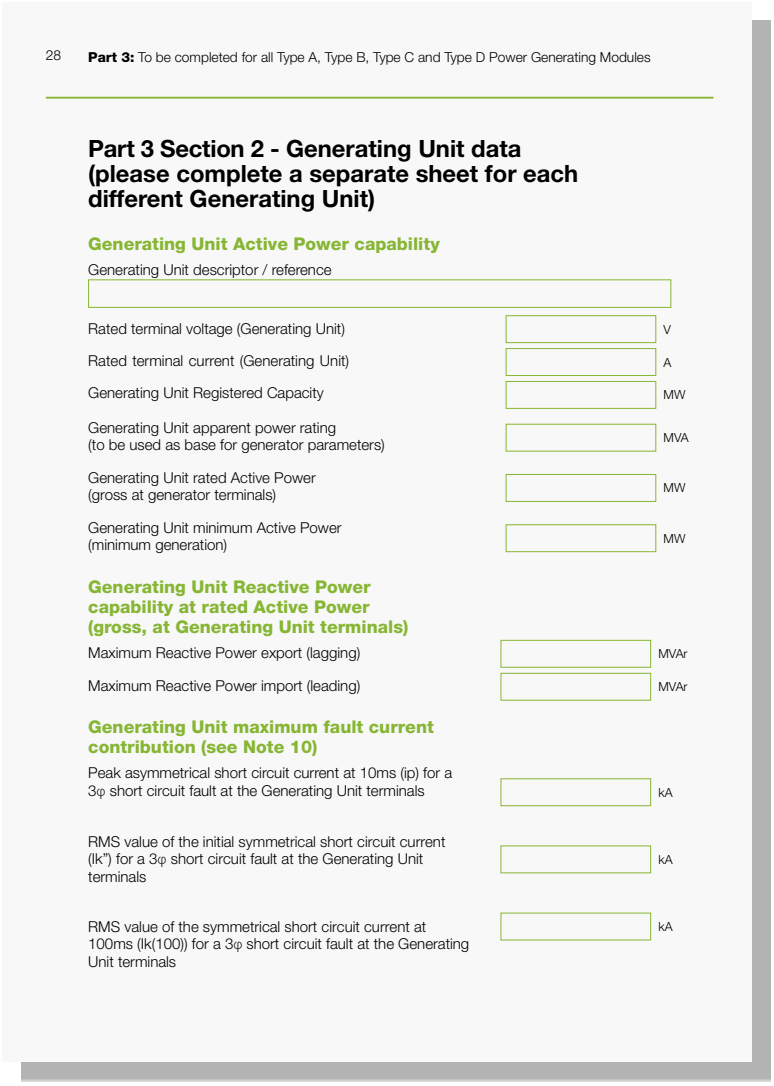
	Energy Conversion Technology (Note 9)
1	Engine (combustion / reciprocating)
2	Fuel Cell
3	Gas turbine (OCGT)
4	Geothermal power plant
5	Hydro - Reservoir (not pumped)
6	Hydro - Run of river
7	Hydro - Other
8	Interconnector
9	Offshore wind turbines
10	Onshore wind turbines
11	Photovoltaic
12	Steam turbine (thermal power plant)
13	Steam-gas turbine (CCGT)
14	Tidal lagoons
15	Tidal stream devices
16	Wave devices
17	Storage - Chemical - Ammonia
18	Storage - Chemical - Hydrogen
19	Storage - Chemical - Synthetic Fuels
20	Storage - Chemical - Drop-in Fuels
21	Storage - Chemical - Methanol
22	Storage - Chemical - Synthetic Natural Gas
23	Storage - Electrical - Supercapacitors
24	Storage - Electrical - Superconducting Magnetic ES (SMES)
25	Storage - Mechanical - Adiabatic Compressed Air

	Energy Conversion Technology (Note 9)
26	Storage - Mechanical - Diabatic Compressed Air
27	Storage - Mechanical - Liquid Air Energy Storage
28	Storage - Mechanical - Pumped Hydro
29	Storage - Mechanical - Flywheels
30	Not Used
31	Not Used
32	Not Used
33	Storage - Electrochemical Classic Batteries - Lead Acid
34	Storage - Electrochemical Classic Batteries - Lithium Polymer (Li-Polymer)
35	Storage - Electrochemical Classic Batteries - Metal Air
36	Storage - Electrochemical Classic Batteries - Nickle Cadmium (Ni-Cd)
37	Storage - Electrochemical Classic Batteries - Sodium Nickle Chloride ($NaCL_2$)
38	Storage - Electrochemical Classic Batteries - Lithium Ion (Li–ion)
39	Storage - Electrochemical Classic Batteries - Sodium Ion (Na–ion)
40	Storage - Electrochemical Classic Batteries - Lithium Sulphur (Li-S)
41	Storage - Electrochemical Classic Batteries - Sodium Sulphur (Na-S)
42	Storage - Electrochemical Classic Batteries - Nickle – Metal Hydride (Ni-MH)
43	Storage - Electrochemical Flow Batteries - Vanadium Red-Oxide
44	Storage - Electrochemical Flow Batteries - Zinc – Iron (Zn –Fe)
45	Storage - Electrochemical Flow Batteries - Zinc – Bromine (Zn –Br)
46	Storage - Other
47	Other (Please detail energy conversion technology as applicable)

Part 3 Section 2 - Generating Unit data

Please complete a separate sheet for each different Generating Unit

If you are connecting more than one different Generating Unit you should complete a separate Part 3 Section 2 form for each different Generating Unit. Master versions of the Part 3 Section 2 form are separately available for this purpose.



28 **Part 3:** To be completed for all Type A, Type B, Type C and Type D Power Generating Modules

Part 3 Section 2 - Generating Unit data (please complete a separate sheet for each different Generating Unit)

Generating Unit Active Power capability

Generating Unit descriptor / reference

Rated terminal voltage (Generating Unit)		V
Rated terminal current (Generating Unit)		A
Generating Unit Registered Capacity		MW
Generating Unit apparent power rating (to be used as base for generator parameters)		MVA
Generating Unit rated Active Power (gross at generator terminals)		MW
Generating Unit minimum Active Power (minimum generation)		MW

Generating Unit Reactive Power capability at rated Active Power (gross, at Generating Unit terminals)

Maximum Reactive Power export (lagging)		MVAr
Maximum Reactive Power import (leading)		MVAr

Generating Unit maximum fault current contribution (see Note 10)

Peak asymmetrical short circuit current at 10ms (ip) for a 3φ short circuit fault at the Generating Unit terminals		kA
RMS value of the initial symmetrical short circuit current (Ik") for a 3φ short circuit fault at the Generating Unit terminals		kA
RMS value of the symmetrical short circuit current at 100ms (Ik(100)) for a 3φ short circuit fault at the Generating Unit terminals		kA

Part 3 Section 2 - Generating Unit data (please complete a separate sheet for each different Generating Unit)

Generating Unit Active Power capability

Generating Unit descriptor / reference

Rated terminal voltage (Generating Unit)		V
Rated terminal current (Generating Unit)		A
Generating Unit Registered Capacity		MW
Generating Unit apparent power rating (to be used as base for generator parameters)		MVA
Generating Unit rated Active Power (gross at generator terminals)		MW
Generating Unit minimum Active Power (minimum generation)		MW

Generating Unit Reactive Power capability at rated Active Power (gross, at Generating Unit terminals)

Maximum Reactive Power export (lagging)		MVAr
Maximum Reactive Power import (leading)		MVAr

Generating Unit maximum fault current contribution (see Note 10)

Peak asymmetrical short circuit current at 10ms (ip) for a 3φ short circuit fault at the Generating Unit terminals		kA
RMS value of the initial symmetrical short circuit current (Ik") for a 3φ short circuit fault at the Generating Unit terminals		kA
RMS value of the symmetrical short circuit current at 100ms (Ik(100)) for a 3φ short circuit fault at the Generating Unit terminals		kA

Impedance data for fault current contribution calculations (see Note 10)

Are there any transformers between the Generating Unit and the Connection Point? ◯ Yes ◯ No

Number of Generating Units connected to the transformer _____ Number

Rated apparent power of the transformer _____ MVA

Positive sequence reactance of the transformer _____ per unit

For sites with significant other impedance (multiple transformers, cables or overhead lines) between the Generating Unit and the Connection Point sketch of site detailing generator connection and impedances provided ◯ Sketch ◯ SLD

This information can be detailed on the single line diagram (SLD) provided in Part 1. If submitting additional information, please state the file name below:

_____

Note 10 - See Engineering Recommendation G74, ETR 120 and IEC 60909 for guidance on fault current data. Additionally, fault current contribution data may be provided in the form of detailed graphs, waveforms and/or tables.

If you are providing the Generating Unit maximum fault current contribution it is necessary to provide any other significant site impedance data to enable the DNO to calculate the fault current contribution from the Generating Unit(s) at the Connection Point. A diagram marked with the transformer and circuit resistance and reactance must be provided. This can be in ohms or per unit. If provided in per unit the base should be stated. This can be provided per metre together with the total circuit length, or for the total circuit length.

If you are connecting a facility which involves more than one voltage level please ensure you submit a diagram with details in respect of each Power Generating Module and transformer. Please ensure you make clear where and at what voltage the fault current contribution is estimated.

Additional data for Generating Units incorporating Electricity Storage

Storage device capacity _____ MWh

Does the storage form part of a CHP scheme? ◯ Yes ◯ No

Please describe the operational mode (eg frequency response, generation arbitrage)

For the intended control mode or to meet a specific commercial service are there any known technical or operational requirements? For example the scheme may be required to operate at a Power Factor other than which might be required by the DNO as measured at the Connection Point?

Please provide details below

For applications for 1MW of Registered Capacity or more of new generation (unless the DNO notifies you of a lower threshold), please attach the expected profile of power flows (active and reactive) at the Connection Point for a 24 hour period in normal operation. Where appropriate the DNO will use the profile to design the proposed connection. Please state the file name below.

Commercial Storage Services

Name of the commercial service being provided and name of the company the service is being provided to (eg NESO)

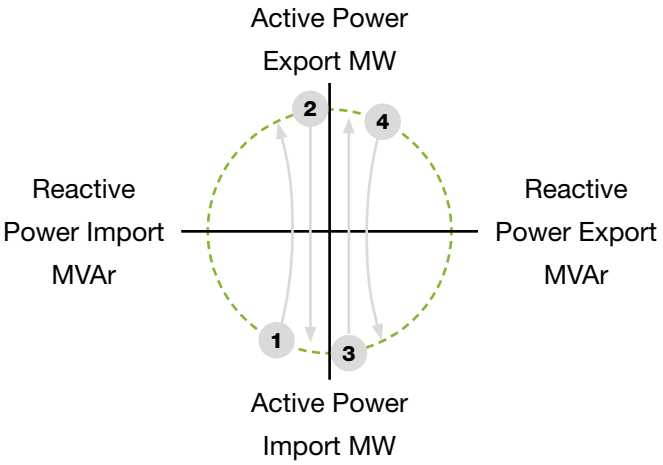
If the commercial service is being provided via a third party, the contact details for the third party service operator (eg an aggregator)

Is this a service which involves co-ordinated response with other Electricity Storage plant either on the Distribution Network, Transmission System, Private Network or aggregator? ◯ Yes ◯ No

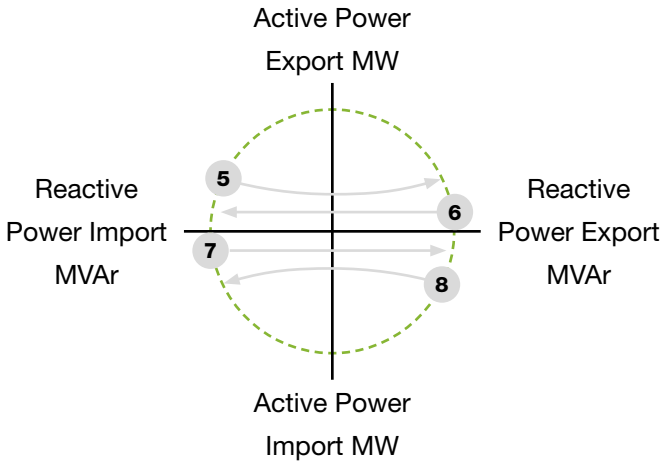
If yes please provide further details below

Diagrammatical representation of example active power swings

Active power swings



Reactive power swing



These diagrams assume the other vector (MW or MVAr) does not change during the power swing.

A more onerous condition, from a voltage step change perspective, occurs when the power factor is maintained and both vectors change from one operational mode to the other. In this case the swing would move diagonally between quadrants.

Additional data for Generating Units incorporating Electricity Storage

Active and Reactive Power swing requirements (refer to diagram for example numbering) (see Note 11)

Change from Import Active Power to Export Active Power (swing 1 and / or 3)

Initial values:

MW Import	MVAr			MW/s
		○ MVAr Import	○ MVAr Export	

Final values

MW Export	MVAr		
		○ MVAr Import	○ MVAr Export

Change from Export Active Power to Import Active Power (swing 2 and / or 4)

Initial values:

MW Export	MVAr			MW/s
		○ MVAr Import	○ MVAr Export	

Final values

MW Import	MVAr		
		○ MVAr Import	○ MVAr Export

Change from Import Reactive Power to Export Reactive Power (swing 5 and / or 7)

Initial values:

MVAr Import	MW			MVAr/s
		◯ MW Import	◯ MW Export	

Final values

MVAr Export	MW		
		◯ MW Import	◯ MW Export

Change from Export Reactive Power to Import Reactive Power (swing 6 and / or 8)

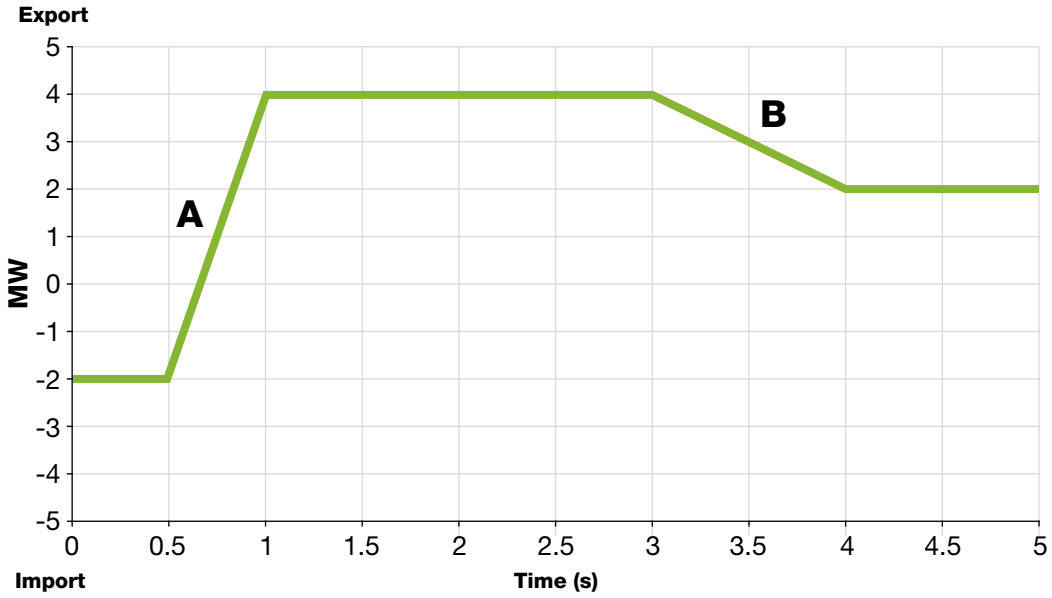
Initial values:

MVAr Export	MW			MVAr/s
		◯ MW Import	◯ MW Export	

Final values

MVAr Import	MW		
		◯ MW Import	◯ MW Export

Example of Ramp Rate / Total Power Swing (Change in MW)



A - Example of ramp which transitions from import to export

Ramp rate (Positive)	= (2+4) MW / 0.5sec	= 12 MW per sec
Total power swing	= (2+4) MW	= 6 MW

B - Example of ramp during export

Ramp rate (Negative)	= (4-2) MW / 1 sec	= 2 MW per sec
Total power swing	= (4-2) MW	= 2 MW

Note 11 – System design studies will be undertaken in accordance with Engineering Recommendation P28 to assess the worst case voltage step change based on the worst case power swing of both Active Power and Reactive Power required by the Customer. It is recognised that the design and operation of the Electricity Storage System may mean that these parameters will not all change simultaneously and to ensure that the connection design meets the Customer's requirements an accurate representation the Electricity Storage Plant operation must be detailed here.

The outcome of the studies and hence the possible need for network reinforcement is dependent on the change in magnitude and direction of both Active Power and Reactive Power. It should be noted that the Connection Agreement will be based on the values provided in this form and if the Electricity Storage Plant owner wishes to change the operating arrangements in the future, it will be necessary for them to formally request a Modification to their Connection Agreement so that the DNO can assess the capacity of the distribution system to accommodate the revised operating regime.

Part 4

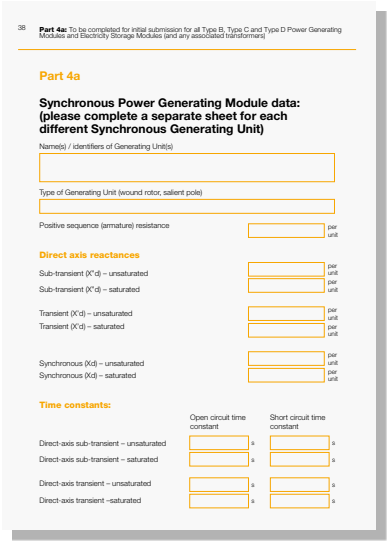
To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

The provision of Type A information may be delayed but must be provided prior to synchronisation.

Part 4: To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Please complete a separate sheet for each different Generating Unit

There are Part 4 forms for each type of Generating Unit category. If you are connecting more than one different Generating Unit of the same category (eg two different sized synchronous Generating Units) then you must complete a separate Part 4 form for each different Generating Unit. Master versions of the Part 4 form (Parts 4a, 4b, 4c, 4d, 4e and 4f) are separately available for this purpose.



38 **Part 4a:** To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Part 4a

Synchronous Power Generating Module data: (please complete a separate sheet for each different Synchronous Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Type of Generating Unit (wound rotor, salient pole)

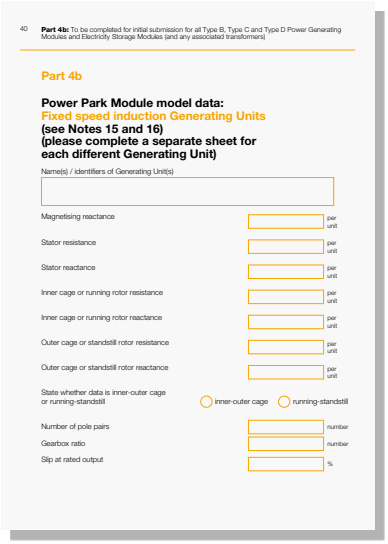
Positive sequence (armature) resistance — per unit

Direct axis reactances

Sub-transient (X"d) – unsaturated — per unit
Sub-transient (X"d) – saturated — per unit
Transient (X'd) – unsaturated — per unit
Transient (X'd) – saturated — per unit
Synchronous (Xd) – unsaturated — per unit
Synchronous (Xd) – saturated — per unit

Time constants:

	Open circuit time constant	Short circuit time constant
Direct-axis sub-transient – unsaturated	s	s
Direct-axis sub-transient – saturated	s	s
Direct-axis transient – unsaturated	s	s
Direct-axis transient –saturated	s	s



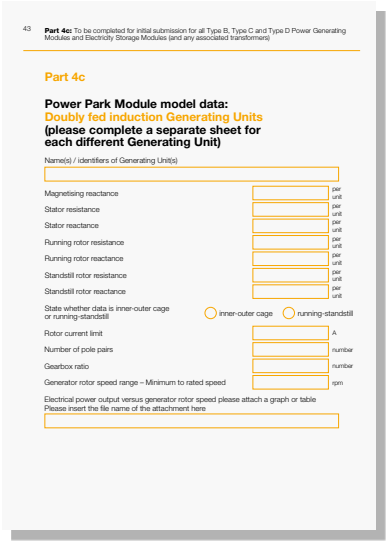
40 **Part 4b:** To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Part 4b

Power Park Module model data:
Fixed speed induction Generating Units
(see Notes 15 and 16)
(please complete a separate sheet for each different Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Magnetising reactance — per unit
Stator resistance — per unit
Stator reactance — per unit
Inner cage or running rotor resistance — per unit
Inner cage or running rotor reactance — per unit
Outer cage or standstill rotor resistance — per unit
Outer cage or standstill rotor reactance — per unit
State whether data is inner-outer cage or running-standstill — ◯ inner-outer cage ◯ running-standstill
Number of pole pairs — number
Gearbox ratio — number
Slip at rated output — %



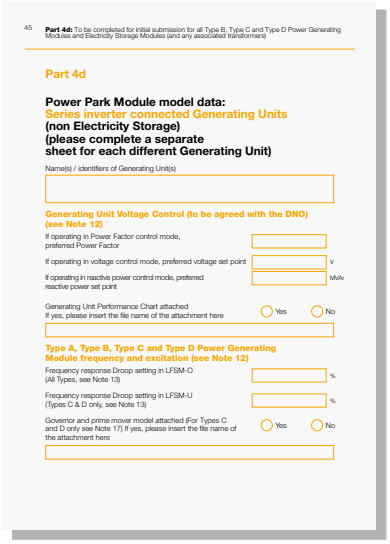
43 **Part 4c:** To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Part 4c

Power Park Module model data:
Doubly fed induction Generating Units
(please complete a separate sheet for each different Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Magnetising reactance — per unit
Stator resistance — per unit
Stator reactance — per unit
Running rotor resistance — per unit
Running rotor reactance — per unit
Standstill rotor resistance — per unit
Standstill rotor reactance — per unit
State whether data is inner-outer cage or running-standstill — ◯ inner-outer cage ◯ running-standstill
Rotor current limit — A
Number of pole pairs — number
Gearbox ratio — number
Generator rotor speed range – Minimum to rated speed — rpm
Electrical power output versus generator rotor speed please attach a graph or table
Please insert the file name of the attachment here



45 **Part 4d:** To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Part 4d

Power Park Module model data:
Series inverter connected Generating Units
(non Electricity Storage)
(please complete a separate sheet for each different Generating Unit)

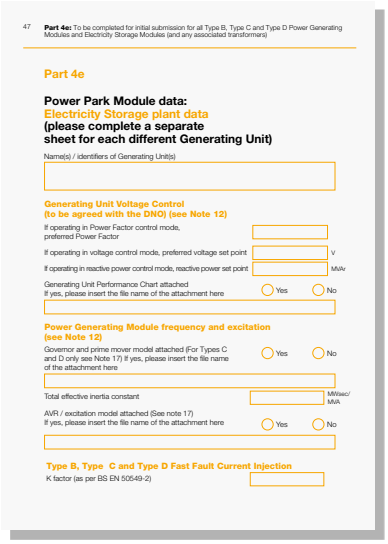
Name(s) / identifiers of Generating Unit(s)

Generating Unit Voltage Control (to be agreed with the DNO) (see Note 12)

If operating in Power Factor control mode, preferred Power Factor
If operating in voltage control mode, preferred voltage set point — V
If operating in reactive power control mode, preferred reactive power set point — MVAr
Generating Unit Performance Chart attached — ◯ Yes ◯ No
If yes, please insert the file name of the attachment here

Type A, Type B, Type C and Type D Power Generating Module frequency and excitation (see Note 12)

Frequency response Droop setting in LFSM-O (All Types, see Note 13) — %
Frequency response Droop setting in LFSM-U (Types C & D only, see Note 13) — %
Governor and prime mover model attached (For Types C and D only see Note 17) If yes, please insert the file name of the attachment here — ◯ Yes ◯ No



47 **Part 4e:** To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Part 4e

Power Park Module data:
Electricity Storage plant data
(please complete a separate sheet for each different Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Generating Unit Voltage Control (to be agreed with the DNO) (see Note 12)

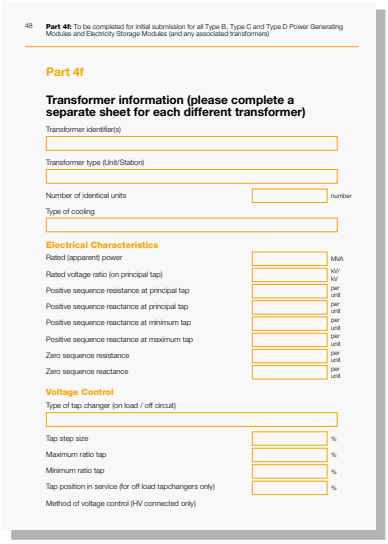
If operating in Power Factor control mode, preferred Power Factor
If operating in voltage control mode, preferred voltage set point — V
If operating in reactive power control mode, reactive power set point — MVAr
Generating Unit Performance Chart attached — ◯ Yes ◯ No
If yes, please insert the file name of the attachment here

Power Generating Module frequency and excitation (see Note 12)

Governor and prime mover model attached (For Types C and D only see Note 17) If yes, please insert the file name of the attachment here — ◯ Yes ◯ No
Total effective inertia constant — MWsec/MVA
AVR / excitation model attached (See note 17) If yes, please insert the file name of the attachment here — ◯ Yes ◯ No

Type B, Type C and Type D Fast Fault Current Injection

K factor (as per BS EN 50549-2)



48 **Part 4f:** To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Part 4f

Transformer information (please complete a separate sheet for each different transformer)

Transformer identifier(s)
Transformer type (Unit/Station)
Number of identical units — number
Type of cooling

Electrical Characteristics

Rated (apparent) power — MVA
Rated voltage ratio (on principal tap) — kV/kV
Positive sequence resistance at principal tap — per unit
Positive sequence reactance at principal tap — per unit
Positive sequence reactance at minimum tap — per unit
Positive sequence reactance at maximum tap — per unit
Zero sequence resistance — per unit
Zero sequence reactance — per unit

Voltage Control

Type of tap changer (on load / off circuit)
Tap step size — %
Maximum ratio tap — %
Minimum ratio tap — %
Tap position in service (for off load tapchangers only) — %
Method of voltage control (HV connected only)

Part 4a

Synchronous Power Generating Module data: (please complete a separate sheet for each different Synchronous Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Type of Generating Unit (wound rotor, salient pole)

Positive sequence (armature) resistance — per unit

Direct axis reactances

Sub-transient (X"d) – unsaturated — per unit

Sub-transient (X"d) – saturated — per unit

Transient (X'd) – unsaturated — per unit

Transient (X'd) – saturated — per unit

Synchronous (Xd) – unsaturated — per unit

Synchronous (Xd) – saturated — per unit

Time constants:

	Open circuit time constant		Short circuit time constant	
Direct-axis sub-transient – unsaturated		s		s
Direct-axis sub-transient – saturated		s		s
Direct-axis transient – unsaturated		s		s
Direct-axis transient –saturated		s		s

Generating Unit Voltage Control (to be agreed with the DNO) (see Note 12)

If operating in Power Factor control mode, preferred Power Factor

If operating in voltage control mode, preferred voltage set point — V

If operating in reactive power control mode, preferred reactive power set point — MVAr

Generating Unit Performance Chart attached
If yes, please insert the file name of the attachment here — ◯ Yes ◯ No

Power Generating Module frequency and excitation (see Note 12)

Frequency response Droop setting in LFSM-O (All Types, see Note 13) — %

Frequency response Droop setting in LFSM-U (Types C & D only, see Note 13) — %

Governor and prime mover model attached, Types B, C & D only (see Note 14) If yes, please insert the file name of the attachment here — ◯ Yes ◯ No

Inertia constant (Generating Unit and prime mover) (Types C & D only) — MWsec/MVA

AVR / excitation model attached (See Note 15)
If yes, please insert the file name of the attachment here — ◯ Yes ◯ No

Type C and Type D Power Generating Module additional frequency response (see Note 12)

Frequency response Droop setting in FSM (if applicable) — %

Frequency response mode — ◯ FSM ◯ LFSM

Part 4b

Power Park Module model data: Fixed speed induction Generating Units (see Notes 15 and 16) (please complete a separate sheet for each different Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Magnetising reactance		per unit
Stator resistance		per unit
Stator reactance		per unit
Inner cage or running rotor resistance		per unit
Inner cage or running rotor reactance		per unit
Outer cage or standstill rotor resistance		per unit
Outer cage or standstill rotor reactance		per unit
State whether data is inner-outer cage or running-standstill	◯ inner-outer cage ◯ running-standstill	
Number of pole pairs		number
Gearbox ratio		number
Slip at rated output		%

Shunt capacitance connected in parallel at % of rated output: Provide as values below or attach a graph

If attaching a graph, please insert the file name of the attachment here

Starting		kVAr
20%		kVAr
40%		kVAr
60%		kVAr
80%		kVAr
100%		kVAr

Active power and reactive power: Provide as values below or attach a graph

If attaching a graph, please insert the file name of the attachment here

Active power and reactive power import during start-up		MW-MVAr
Active power and reactive power import during switching operations eg '6 to 4 pole' change-over		MW-MVAr

Under voltage protection setting & time delay

	Per Unit V		s

Part 4b: To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Generating Unit Voltage Control (to be agreed with the DNO) (see Note 12)

If operating in Power Factor control mode, preferred Power Factor

If operating in voltage control mode, preferred voltage set point — V

If operating in reactive power control mode, preferred reactive power set point — MVAr

Generating Unit Performance Chart attached — ◯ Yes ◯ No

If yes, please insert the file name of the attachment here

Power Generating Module frequency and excitation (see Note 12)

Frequency response Droop setting in LFSM-O (All Types, see Note 13) — %

Frequency response Droop setting in LFSM-U (Types C & D only, see Note 13) — %

Governor and prime mover model attached, Types C & D only (see Note 14) — ◯ Yes ◯ No

If yes, please insert the file name of the attachment here

Total effective inertia constant (generator and prime mover) — MWsec/MVA

AVR / excitation model attached (See Note 15) — ◯ Yes ◯ No

If yes, please insert the file name of the attachment here

Type C and Type D Power Generating Module additional frequency response (see Note 12)

Frequency response Droop setting in FSM (if applicable) — %

Frequency response mode — ◯ FSM ◯ LFSM

Part 4c

Power Park Module model data: Doubly fed induction Generating Units (please complete a separate sheet for each different Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Magnetising reactance		per unit
Stator resistance		per unit
Stator reactance		per unit
Running rotor resistance		per unit
Running rotor reactance		per unit
Standstill rotor resistance		per unit
Standstill rotor reactance		per unit
State whether data is inner-outer cage or running-standstill	◯ inner-outer cage ◯ running-standstill	
Rotor current limit		A
Number of pole pairs		number
Gearbox ratio		number
Generator rotor speed range – Minimum to rated speed		rpm

Electrical power output versus generator rotor speed please attach a graph or table
Please insert the file name of the attachment here

Part 4c: To be completed for initial submission for all Type B, Type C and Type D Power Generating Modules and Electricity Storage Modules (and any associated transformers)

Generating Unit Voltage Control (to be agreed with the DNO) (see Note 12)

If operating in Power Factor control mode, preferred Power Factor

If operating in voltage control mode, preferred voltage set point — V

If operating in reactive power control mode, preferred reactive power set point — MVAr

Generating Unit Performance Chart attached — ◯ Yes ◯ No
If yes, please insert the file name of the attachment here

Type A, Type B, Type C and Type D Power Generating Module frequency and excitation (see Note 12)

Frequency response Droop setting in LFSM-O (All Types, see Note 13) — %

Frequency response Droop setting in LFSM-U (Types C & D only, see Note 13) — %

Governor and prime mover model attached (see Note 14) — ◯ Yes ◯ No
If yes, please insert the file name of the attachment here

Total effective inertia constant at rated speed (generator and prime mover) — MWsec/MVA

AVR / excitation model attached — ◯ Yes ◯ No
If yes, please insert the file name of the attachment here

Type C and Type D Power Generating Module additional frequency response (see Note 12)

Frequency response Droop setting in FSM (if applicable) — %

Frequency response mode — ◯ FSM ◯ LFSM

Part 4d

Power Park Module model data: Series inverter connected Generating Units (non Electricity Storage) (please complete a separate sheet for each different Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Generating Unit Voltage Control (to be agreed with the DNO) (see Note 12)

If operating in Power Factor control mode, preferred Power Factor

If operating in voltage control mode, preferred voltage set point — V

If operating in reactive power control mode, preferred reactive power set point — MVAr

Generating Unit Performance Chart attached
If yes, please insert the file name of the attachment here — ◯ Yes ◯ No

Type A, Type B, Type C and Type D Power Generating Module frequency and excitation (see Note 12)

Frequency response Droop setting in LFSM-O (All Types, see Note 13) — %

Frequency response Droop setting in LFSM-U (Types C & D only, see Note 13) — %

Governor and prime mover model attached (For Types C and D only see Note 17) If yes, please insert the file name of the attachment here — ◯ Yes ◯ No

Total effective inertia constant [ ] MWsec/MVA

AVR / excitation model attached (see Note 17) ◯ Yes ◯ No

If yes, please insert the file name of the attachment here

[ ]

Type C and Type D Power Generating Module additional frequency response (see Note 12)

Frequency response Droop setting in FSM (if applicable) [ ] %

Frequency response mode ◯ FSM ◯ LFSM

Type B, Type C and Type D Fast Fault Current Injection

K factor (as per BS EN 50549-2) [ ]

Part 4e

Power Park Module data: Electricity Storage plant data (please complete a separate sheet for each different Generating Unit)

Name(s) / identifiers of Generating Unit(s)

Generating Unit Voltage Control (to be agreed with the DNO) (see Note 12)

If operating in Power Factor control mode, preferred Power Factor

If operating in voltage control mode, preferred voltage set point — V

If operating in reactive power control mode, preferred reactive power set point — MVAr

Generating Unit Performance Chart attached — Yes / No
If yes, please insert the file name of the attachment here

Power Generating Module frequency and excitation (see Note 12)

Governor and prime mover model attached (For Types C and D only see Note 17) — Yes / No
If yes, please insert the file name of the attachment here

Total effective inertia constant — MWsec/MVA

AVR / excitation model attached (See note 17) — Yes / No
If yes, please insert the file name of the attachment here

Type B, Type C and Type D Fast Fault Current Injection

K factor (as per BS EN 50549-2)

Part 4f

Transformer information (please complete a separate sheet for each different transformer)

Transformer identifier(s)

Transformer type (Unit/Station)

Number of identical units — number

Type of cooling

Electrical Characteristics

Rated (apparent) power		MVA
Rated voltage ratio (on principal tap)		kV/ kV
Positive sequence resistance at principal tap		per unit
Positive sequence reactance at principal tap		per unit
Positive sequence reactance at minimum tap		per unit
Positive sequence reactance at maximum tap		per unit
Zero sequence resistance		per unit
Zero sequence reactance		per unit

Voltage Control

Type of tap changer (on load / off circuit)

Tap step size		%
Maximum ratio tap		%
Minimum ratio tap		%
Tap position in service (for off load tapchangers only)		%

Method of voltage control (HV connected only)

Earthing Arrangements

Winding configuration (eg Dyn11) HV connected only

Method of earthing of high-voltage winding

Method of earthing of low-voltage winding

Note 12 – This information is not required for Power Generating Modules operating in infrequent short-term paralleling mode.

Note 13 – All Power Generating Modules must operate in Limited Frequency Sensitive Mode Over frequency (LFSM - O). FSM capability is mandatory for Type C and Type D. Generators may elect to operate their Power Generating Modules in Frequency Sensitive Mode as agreed in an Ancillary Service agreement with the National Electricity Transmission System Operator. All Type C and Type D Power Generating Modules must operate in Limited Frequency Sensitive Mode Under frequency (LFSM – U).

Note 14 – For Type B Power Generating Modules where the DNO considers that the stability and security of the network is at risk, and has advised the Generator accordingly, sufficient data should be provided in order to build up a suitable Power Generating Module dynamic model for analysis. Alternatively a 'Black Box' dynamic model of the Power Generating Module may be provided. All models should be suitable for the software analysis package used by the DNO. This data must be provided for Type C and D Power Generating Modules prior to final commissioning. Without this data the DNO cannot issue the Final Operational Notification.

Note 15 – Fixed speed induction generators may be represented by an equivalent synchronous data set.

Note 16 – Provide the data for each Fixed speed induction generation set based on the number of pole sets (ie two data sets for dual speed 4/6 pole machines).

Note 17 – Where the Power Generating Module (including Electricity Storage) comprises only static power electronic conversion, this data can be supplied, prior to final commissioning, as a mathematical model suitable for representation of the entire Power Park Module as per EREC G99 Annex B.4.4 or Annex C.7.4.5 as applicable.

Part 5

Additional data which may be required by the DNO before Final Operational Notification is issued

Part 5a

Total Power Generating Facility output at Minimum Generation (net of auxiliary loads)

Minimum Generation (minimum Active Power export)		MW
Maximum Reactive Power export		MVAr
Maximum Reactive Power import		MVAr

Part 5b

Power Generating Facility Maximum fault current contribution – additional information

Short circuit time constant T" corresponding to the change from Ik" to $Ik_{(100)}$		s
Positive sequence X/R ratio at the instant of fault		number
Short circuit ratio		number

Part 5c

Synchronous Power Generating Module additional data

Quadrature axis reactances

Sub-transient (X"q) – unsaturated		per unit
Sub-transient (X"q) – saturated		per unit
Transient (X'q) – unsaturated		per unit
Transient (X'q) – saturated		per unit
Synchronous (Xq) – unsaturated		per unit
Synchronous (Xq) – saturated		per unit

Quadrature axis time constants.

	Open circuit time constant		Short circuit time constant	
Quadrature-axis sub-transient – unsaturated		s		s
Quadrature-axis sub-transient – saturated		s		s
Quadrature-axis transient – unsaturated		s		s
Quadrature-axis transient – saturated		s		s

Other

Stator leakage reactance (unsaturated)		per unit
Zero sequence resistance (earthed star only, including any neutral earthing resistance)		per unit
Zero sequence reactance (earthed star only, including any neutral earthing reactance)		per unit
Negative sequence resistance		per unit
Negative sequence reactance		per unit
Rated field current		A

Field current open circuit saturation curve (from 50% to 120% of rated terminal voltage)
Please provide a graph and insert the file name of the attachment here

Potier reactance (only required if the saturation factor is available)		per unit
Saturation factor (pu field current to produce 1.2pu terminal voltage on open circuit)		per unit

Part 5d

Wind Turbine Power Park Module Output data

For wind turbines only - IEC 61400-21 (P_{60} and $P_{0.2}$)

Maximum measured Active Power P_{60}		MW
Maximum measured Active Power $P_{0.2}$		MW

Part 5e

Power Park Module model data: fixed speed induction Generating Units additional data

Inertia constant of the generator rotor		MWsec/ MVA
Inertia constant of the prime mover rotor		MWsec/ MVA
Equivalent shaft stiffness between the two masses		Nm/ Electrical radian

Describe method of adding star capacitance over operating range. If electronic power factor control (eg SVC) is installed, provide details of the operating range and characteristics eg pf or MVAr range - operating regime: constant or voltage set-point / slope and response times.

Part 5f

Power Park Module model data: Doubly fed induction Generating Units additional data

Inertia constant of the generator rotor at rated speed		MWsec/ MVA
Inertia constant of the prime mover rotor at rated speed		MWsec/ MVA
Equivalent shaft stiffness between the two masses		Nm/ Electrical radian

Part 5g

Power Park Module model data: Series inverter connected Generating Units (non Electricity Storage) additional data

Gearbox ratio		
Generator rotor speed range (minimum to rated speed)		rpm

Electrical power output versus generator rotor speed Please attach a graph or table Please insert the file name of the attachment here

Inertia constant of the generator rotor at rated speed		MWsec/ MVA
Inertia constant of the prime mover rotor at rated speed		MWsec/ MVA
Equivalent shaft stiffness between the two masses		Nm/ Electrical radian