

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

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

**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<sup>1</sup> 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 form will 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

<sup>1</sup> 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:

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

## Part 1

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**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

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**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

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**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**

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**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 an outline project plan. 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.

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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 outline project plan will typically detail when the following activities are planned 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 outline project plan.

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:

Maximum Active Power export

 . 

kW

MW

Maximum Reactive Power export

 . 

kVAr

Maximum Reactive Power import

 . 

MVAr

### Non-firm export requirements:

Maximum Active Power export

 . 

kW

MW

Maximum Reactive Power export

 . 

kVAr

Maximum Reactive Power import

 . 

MVAr

### Firm import requirements:

Maximum Active Power import

 . 

kW

MW

Maximum Reactive Power import

 . 

kVAr

Maximum Reactive Power export

 . 

MVAr

### Non-firm import requirements:

Maximum Active Power import

 . 

kW

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 ( $i_p$ ) for a 3 $\phi$  short circuit fault at the Connection Point

 kA

RMS value of the initial symmetrical short circuit current ( $I_k''$ ) for a 3 $\phi$  short circuit fault at the Connection Point

 kA

RMS value of the symmetrical short circuit current at 100ms ( $I_k(100)$ ) for a 3 $\phi$  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.

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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 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	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Fixed speed induction Generating Unit	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Double fed induction Generating Unit	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Series inverter connected Generating Unit	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Electricity Storage Generating Unit	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Other (please specify)	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>

## 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	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Fixed speed induction Generating Unit	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Double fed induction Generating Unit	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Series inverter connected Generating Unit	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Electricity Storage Generating Unit	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>
Other (please specify)	<input type="text"/>	<input type="text"/>	<input type="radio"/> Intermittent <input type="radio"/> Non-intermittent	<input type="text"/>

**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 <sub>2</sub> )
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.

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**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 (p) for a 3 $\phi$  short circuit fault at the Generating Unit terminals  kA

RMS value of the initial symmetrical short circuit current (Ik'') for a 3 $\phi$  short circuit fault at the Generating Unit terminals  kA

RMS value of the symmetrical short circuit current at 100ms (Ik(100)) for a 3 $\phi$  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)	<input style="width: 150px; height: 20px;" type="text"/>	V
Rated terminal current (Generating Unit)	<input style="width: 150px; height: 20px;" type="text"/>	A
Generating Unit Registered Capacity	<input style="width: 150px; height: 20px;" type="text"/>	MW
Generating Unit apparent power rating (to be used as base for generator parameters)	<input style="width: 150px; height: 20px;" type="text"/>	MVA
Generating Unit rated Active Power (gross at generator terminals)	<input style="width: 150px; height: 20px;" type="text"/>	MW
Generating Unit minimum Active Power (minimum generation)	<input style="width: 150px; height: 20px;" type="text"/>	MW

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

Maximum Reactive Power export (lagging)	<input style="width: 150px; height: 20px;" type="text"/>	MVAr
Maximum Reactive Power import (leading)	<input style="width: 150px; height: 20px;" type="text"/>	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	<input style="width: 150px; height: 20px;" type="text"/>	kA
RMS value of the initial symmetrical short circuit current (Ik'') for a 3φ short circuit fault at the Generating Unit terminals	<input style="width: 150px; height: 20px;" type="text"/>	kA
RMS value of the symmetrical short circuit current at 100ms (Ik(100)) for a 3φ short circuit fault at the Generating Unit terminals	<input style="width: 150px; height: 20px;" type="text"/>	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?

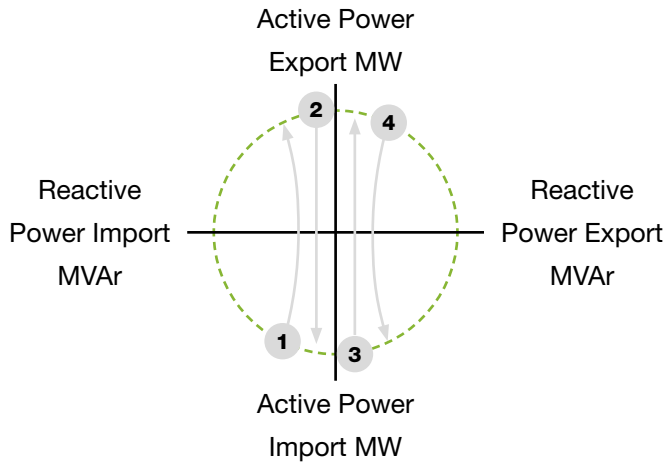
Yes

No

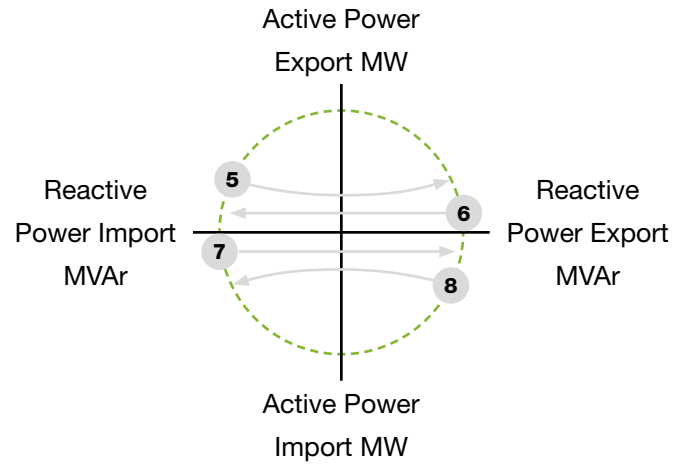
If yes please provide further details below

## 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
<input type="text"/>	<input type="text"/>	<input type="radio"/> MVAr Import	<input type="radio"/> MVAr Export	<input type="text"/>

##### Final values

MW Export	MVAr		
<input type="text"/>	<input type="text"/>	<input type="radio"/> MVAr Import	<input type="radio"/> MVAr Export

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

##### Initial values:

MW Export	MVAr			MW/s
<input type="text"/>	<input type="text"/>	<input type="radio"/> MVAr Import	<input type="radio"/> MVAr Export	<input type="text"/>

##### Final values

MW Import	MVAr		
<input type="text"/>	<input type="text"/>	<input type="radio"/> MVAr Import	<input type="radio"/> MVAr Export

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

#### Initial values:

MVAr Import	MW			MVAr/s
<input type="text"/>	<input type="text"/>	<input type="radio"/> MW Import	<input type="radio"/> MW Export	<input type="text"/>

#### Final values

MVAr Export	MW		
<input type="text"/>	<input type="text"/>	<input type="radio"/> MW Import	<input type="radio"/> MW Export

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

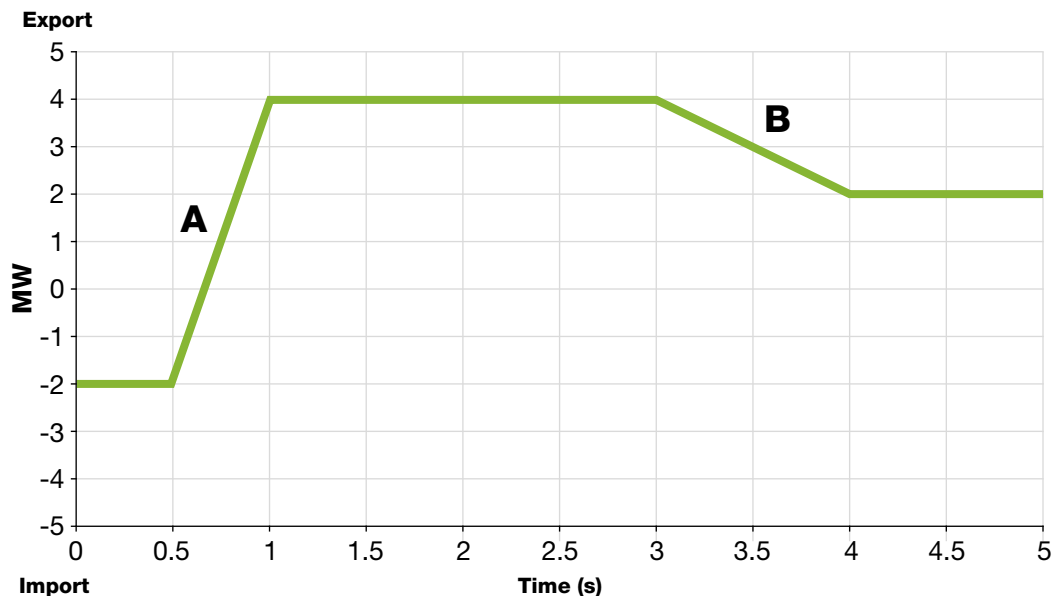
#### Initial values:

MVAr Export	MW			MVAr/s
<input type="text"/>	<input type="text"/>	<input type="radio"/> MW Import	<input type="radio"/> MW Export	<input type="text"/>

#### Final values

MVAr Import	MW		
<input type="text"/>	<input type="text"/>	<input type="radio"/> MW Import	<input type="radio"/> MW Export

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



### A - Example of ramp which transitions from import to export

$$\text{Ramp rate (Positive)} = (2+4) \text{ MW} / 0.5\text{sec} = 12 \text{ MW per sec}$$

$$\text{Total power swing} = (2+4) \text{ MW} = 6 \text{ MW}$$

### B - Example of ramp during export

$$\text{Ramp rate (Negative)} = (4-2) \text{ MW} / 1 \text{ sec} = 2 \text{ MW per sec}$$

$$\text{Total power swing} = (4-2) \text{ MW} = 2 \text{ MW}$$

**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.**

## 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.

**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	<input type="text"/> s	<input type="text"/> s
Direct-axis sub-transient – saturated	<input type="text"/> s	<input type="text"/> s
Direct-axis transient – unsaturated	<input type="text"/> s	<input type="text"/> s
Direct-axis transient – saturated	<input type="text"/> s	<input type="text"/> s

**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  %

**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 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  MVA

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 LFISM-O (All Types, see Note 13)  %

Frequency response Droop setting in LFISM-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

**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  MVA

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)**

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 50464-2)

**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

Positive sequence reactance at principal tap  per unit

Positive sequence resistance at principal tap  per unit

Positive sequence reactance at maximum tap  per unit

Zero sequence reactance  per unit

Zero sequence resistance  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 ( $X_d$ ) – unsaturated

 per unit

Synchronous ( $X_d$ ) – saturated

 per unit

#### Time constants:

	Open circuit time constant	Short circuit time constant
Direct-axis sub-transient – unsaturated	<input type="text"/> s	<input type="text"/> s
Direct-axis sub-transient – saturated	<input type="text"/> s	<input type="text"/> s
Direct-axis transient – unsaturated	<input type="text"/> s	<input type="text"/> s
Direct-axis transient –saturated	<input type="text"/> s	<input type="text"/> 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

MVA<sub>r</sub>

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	<input type="text"/>	kVAr
20%	<input type="text"/>	kVAr
40%	<input type="text"/>	kVAr
60%	<input type="text"/>	kVAr
80%	<input type="text"/>	kVAr
100%	<input type="text"/>	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	<input type="text"/>	MW- MVar
Active power and reactive power import during switching operations eg '6 to 4 pole' change-over	<input type="text"/>	MW- MVar
Under voltage protection setting & time delay	<input type="text"/> Per Unit V	<input type="text"/> 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

MVA<sub>r</sub>

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 C &  
D only (see Note 14) If yes, please insert the file name  
of the attachment here

Yes

No

Total effective inertia constant  
(generator and prime mover)

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 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

MVA<sub>r</sub>

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 (see Note 14)  
If yes, please insert the file name of the attachment here

Yes

No

Total effective inertia constant at rated speed  
(generator and prime mover)

MWsec/  
MVA

AVR / excitation model attached  
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 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

MVA<sub>r</sub>

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

**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)

---

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

MVA<sub>r</sub>

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)

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)

## 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)	<input type="text"/>	MW
Maximum Reactive Power export	<input type="text"/>	MVAr
Maximum Reactive Power import	<input type="text"/>	MVAr

## Part 5b

### Power Generating Facility Maximum fault current contribution – additional information

Short circuit time constant $T''$ corresponding to the change from $I_{k''}$ to $I_{k(100)}$	<input type="text"/>	s
Positive sequence X/R ratio at the instant of fault	<input type="text"/>	number
Short circuit ratio	<input type="text"/>	number

## Part 5c

### Synchronous Power Generating Module additional data

#### Quadrature axis reactances

Sub-transient ( $X''_q$ ) – unsaturated	<input type="text"/>	per unit
Sub-transient ( $X''_q$ ) – saturated	<input type="text"/>	per unit
Transient ( $X'_q$ ) – unsaturated	<input type="text"/>	per unit
Transient ( $X'_q$ ) – saturated	<input type="text"/>	per unit
Synchronous ( $X_q$ ) – unsaturated	<input type="text"/>	per unit
Synchronous ( $X_q$ ) – saturated	<input type="text"/>	per unit

**Quadrature axis time constants.**

	Open circuit time constant	Short circuit time constant
Quadrature-axis sub-transient – unsaturated	<input type="text"/> s	<input type="text"/> s
Quadrature-axis sub-transient – saturated	<input type="text"/> s	<input type="text"/> s
Quadrature-axis transient – unsaturated	<input type="text"/> s	<input type="text"/> s
Quadrature-axis transient – saturated	<input type="text"/> s	<input type="text"/> s

**Other**

Stator leakage reactance (unsaturated)	<input type="text"/>	per unit
Zero sequence resistance (earthed star only, including any neutral earthing resistance)	<input type="text"/>	per unit
Zero sequence reactance (earthed star only, including any neutral earthing reactance)	<input type="text"/>	per unit
Negative sequence resistance	<input type="text"/>	per unit
Negative sequence reactance	<input type="text"/>	per unit
Rated field current	<input type="text"/>	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	<input type="text"/>	
Potier reactance (only required if the saturation factor is available)	<input type="text"/>	per unit
Saturation factor (pu field current to produce 1.2pu terminal voltage on open circuit)	<input type="text"/>	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 $P_{60}$	<input type="text"/>	MW
Maximum measured Active Power $P_{0.2}$	<input type="text"/>	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