

# Generic Compliance for Power Parks

(Paper by Jonathan Horne, National Grid)

## Introduction

1. Power Park Modules are generally comprised of a large number of identical Power Park Units. Within manufacturing tolerances, the performance of a specific Power Park Unit type is normally reasonably constant from unit to unit which ever site they are installed on. It is therefore possible to register various aspects of this performance and the associated data once, and then reference this data for some or all of the sites which use this particular type of equipment. This should reduce the volume of work required by Users, Power Park Unit manufacturers and for National Grid. In addition it will provide a route for detailed data that Power Park Unit manufacturers regard as commercially sensitive to be sent directly to National Grid without publication to the User(s).
2. To this end, National Grid is proposing a generic compliance process. To achieve this, the Grid Code additions appended to this paper are put forward by National Grid.

## Background

3. The generic compliance process allows manufacturers to work directly with National Grid in order to exchange information and evidence of compliance without data passing through the project chain. Figures 1 to 3 illustrate the differences in the two processes. Figure 1 demonstrates the conventional process where the data flow is always via the power station or power park developer.



Figure 1 – The conventional compliance process data route

4. Figure 2 shows the one time process to fill the equipment 'type' register. It may be that information only comes from the manufacturer although a developer may be involved by providing site test opportunities. The data will comprise of a report on one or more of the aspects outlined below.

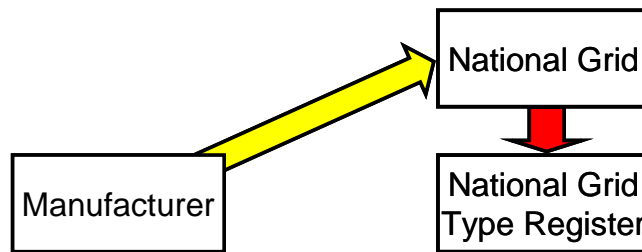


Figure 2 – The Type Register is filled with a selection of generic data

5. Figure 3 illustrates the process for referencing and using 'generic' data. Each project can, where appropriate, reference information held in the National Grid Type Register substituting information that they are required to submit before connecting to the GB transmission system and in lieu of some aspects of Grid Code testing. Developers will not have access to this information from National Grid and the only requirement is to obtain the correct reference from the manufacturer. If no relevant or insufficient data is held in the Type Register then the data must be provided in full by the developer.

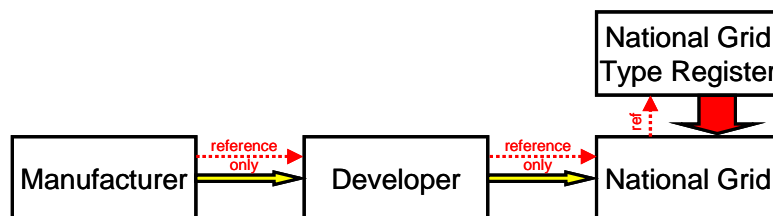


Figure 3 – The generic data is referenced but cannot be seen by the developer. There will still be some requirement for site specific data.

6. Data submitted by developers under the Data Registration Code (Grid Code) is protected by the confidentiality agreement contained in the Connection and Use of System Code (CUSC) and System Operator Transmission Owner Code (STC). This does not explicitly cover generic data sent from manufacturers directly to National Grid as it does not necessarily relate to a specific project. It is therefore necessary for manufacturers to sign a confidentiality agreement with National Grid prior to any exchange of information.
7. While generators may not see the Type Registered information they must ensure that the correct reference is used as the same provisions will apply to this data as a normal DRC submission. The Type Register reference given by the Power Park Unit manufacturer will contain the following; manufacturer name, Power Park Unit type, date and report version number. The user should then reference the document in the appropriate place for example in lieu of fault ride through studies, assuming a suitable fault ride through report has been submitted, the user can enter the following sentence in the User Data Library;
 

*"This information has been submitted generically to National Grid and can be found in the National Grid Type Register under document reference 'manufacturerX\_10MWturbine type1\_22Aug08\_reportver001"*

## Principles in Drafting

8. The proposed drafting covers the following areas:
  - (a) How the generators reference the information held in the Type Register.

- (b) What Grid Code requirements National Grid will consider Type Registering.

Note that this proposal does not cover the detailed requirements which Power Park Unit manufacturers seeking Type Registration must complete. As the Power Park Unit manufacturers are not party to the Grid Code, this information will be made available separately.

#### Areas for Type Registration

- 9. National Grid suggest that the following areas are suitable for Type Registration with the aim of demonstrating some or all of the relevant aspects of Grid Code compliance.

- (a) Fault Ride Through capability
- (b) Reactive Capability
- (c) Voltage Control
- (d) Frequency Control
- (e) Power Park Module mathematical model
- (f) Fault in-feed contribution (Schedule 14 DRC)

A detailed application of each is given in the attached drafting. The manufacturer may chose to complete one or more of the above mentioned areas. In each case the manufacturer should submit a detailed report to National Grid for approval and consequent submission into the Type Register.

#### Recommendation

- 10. The working group is asked to consider:
  - (a) The principle of Type Registration for Power Park Units
  - (b) The suggested additions to the Connection Conditions
  - (c) The suggested additions to the Data Registration Code
  - (d) The suggested additions to the Planning Code

## **DRAFT GRID CODE CHANGES FOR GENERIC COMPLIANCE FOR POWER PARKS - TYPE REGISTRATION**

### **Changes to the Connection Conditions**

#### **Add a new Paragraph CC.4.4**

#### **Power Park Unit GC Type Registration**

CC.4.4 **NGET** may grant full or partial **GC Type Registered** status to individual designs of **Power Park Unit** subject to receipt and approval of various forms of information from the **Power Park Unit** manufacturers. A **Generator** with a new **Power Station** containing **GC Type Registered Power Park Units** may reference the **GC Type Register** to assist in demonstrating compliance of the entire **Power Park Module**. **NGET** will determine whether or not the referenced information is appropriate and sufficient for complete or partial demonstration of compliance with the relevant **Grid Code** provisions. **NGET** will inform the **Generator** if the reference provided is not appropriate and/or if any additional information is required.

The process to be followed by the manufacturer to enable a **Power Park Unit** to be **GC Type Registered** in respect of a specific **Grid Code** requirement must be agreed by **NGET**. However, the provisions of CC.4.4.1 to CC.4.4.4 indicate the areas where **GC Type Registration** is possible and the type of process which will need to be followed to achieve partial or full **GC Type Registration**.

CC.4.4.1 **GC Type Registration** is possible for **Power Park Units** only in respect of the following requirements of the **Grid Code**:

- (a) Fault Ride Through capability **CC.6.3.15**
- (b) Reactive Capability **CC.6.3.2**
- (c) Voltage Control **CC.6.3.6, CC.6.3.8, CC.A.7**
- (d) Frequency Control **CC.6.3.6, CC.6.3.7, CC.A.3**
- (e) Power Park Module mathematical model **PC.A.5.4.2**
- (f) Fault in-feed contribution **PC.A.5.X**

Items (a), (b), (c), (d) correspond to actual **Power Park Unit** tests as detailed in CC.4.4.2. Items (e) and (f) correspond to simulation studies as detailed in CC.4.4.3.

CC.4.4.2 **GC Type Registration** will be in respect of a specific technical requirement of the **Grid Code**. To achieve **GC Type Registration** for the items referred to at CC.4.4.1 (a), (b), (c), (d) a series of tests and data submissions will be developed to demonstrate the performance characteristics of a single **Power Park Unit** in respect of the areas outlined

below. Details of these tests and submissions are to be agreed between the **Power Park Unit** manufacturer and **NGET** and may consist of one or more of the following;

- (a) Fault ride through type testing
- (b) Reactive range type testing
- (c) Voltage control type testing
- (d) Frequency control type testing

**NGET** may wish to witness some or all of these tests.

- CC.4.4.3 To achieve **GC Type Registration** for the items referred to at CC.4.4.1 (e) and (f) **NGET** and the **Power Park Unit** manufacturer will need to agree a series of simulations and data submissions which are suitable for entry into the **GC Type Register** in relation to either or both of the following areas;
- (a) A mathematical model of the **Power Park Unit** and associated control systems in line with the requirements outlined in PC.A.5.4.2. In addition the performance of this model should be validated against test results including faults, voltage steps and frequency changes as is deemed to be appropriate by **NGET**.
  - (b) Simulations illustrating the fault in-feed characteristics of a single **Power Park Unit** to various balanced and unbalanced faults.
- CC.4.4.4 In order to be considered for **GC Type Registration** in respect of CC.4.4.2 and CC.4.4.3, the **Power Park Unit** manufacturer should submit a report to **NGET** outlining the details and results as appropriate for its consideration. Each report should have an appropriate reference including manufacturer name, type of report as outlined in CC.4.4.1, **Power Park Unit** type, date and report version number.
- CC.4.4.5 **NGET** will, following submission of all required reports and data confirm to the **Power Park Unit** manufacturer in writing whether or not the **Power Park Unit** has achieved **GC Type Registration** in respect of the relevant **Grid Code** requirement.
- CC.4.4.6 **GC Type Registration** does not guarantee **Grid Code** compliance for any **Power Park Module** but does indicate that the **Power Park Unit** is capable of achieving **Grid Code** compliance in the appropriate area. Tests may be required to be undertaken by the **Generator** to confirm that the performance of the **User's Plant** and **Apparatus** aligns with the data held by **NGET** in respect of the **GC Type Register**. Any **Generator** considering relying upon **GC Type Registration** for any aspect of its **Plant** and **Apparatus** is advised to contact **NGET** to discuss the suitability of the relevant **GC Type Registration** to its project to determine if the information held in the **GC Type Register** is appropriate and sufficient in each case.
- CC.4.4.7 Where a **Generator** wishes to make use of a **GC Type Registration**, it shall insert the relevant **GC Type Register** reference in the appropriate place in the **DRC** data submission and / or in the **User Data Library**. A **GC**

**Type Register** reference will be considered by **NGET** in place of the following;

(a) **DRC** data submissions;

- (i) A mathematical model suitable for representation of the entire **Power Park Module** as per CCxxx. For the avoidance of doubt only for the relevant sections as specified in PCxxx apply. Site specific parameters will still need to be submitted by the **Generator**.
- (ii) **DRC** Schedule 14 full site specific fault in-feed information (PCxxx). For the avoidance of doubt this option still requires a complete **DRC** schedule 5 submission.

(b) Fault simulation studies;

**NGET** will no longer require Fault Ride Through simulation studies to be conducted as per CCxxx provided that;

- (i) Relevant **Power Park Unit** data is held in the **GC Type Register**, and
- (ii) For each type and duration of fault as detailed in CCxxx, the expected minimum retained voltage is greater than the corresponding minimum voltage achieved and successfully ridden through in the **GC Type Registered** Fault Ride Through report.

(c) Reduced commissioning testing;

Where a **Power Park Unit** has been **GC Type Registered** for one or more of the following

- (i) Reactive range
- (ii) Voltage control
- (iii) Frequency control

**NGET** may agree a reduced program of compliance testing depending on the **GC Type Registration** and the control methodology in operation at the **Generator's** site. This should be discussed and agreed between **NGET** and the **Generator**.

CC.4.4.8

It is the responsibility of the **User** to ensure that the correct **GC Type Register** reference is received from the **Power Park Unit** manufacturer. **NGET** may contact the **Power Park Unit** manufacturer directly to ensure that the correct **GC Type Register** reference is used. If **NGET** believe the reference is incorrect or the referenced data is inappropriate then permission to use the **GC Type Register** data may be refused.

## **Changes to the Planning Conditions**

### **Insertion of an additional paragraph at the start of PC.A.2.5.5.7**

PC.A.2.5.5.7 Where a **Type Registered Power Park Unit** is employed, the **User** may opt to state the **Type Register** reference as an alternative to the provision of data in accordance with this PC.A.2.5.5.7. For the avoidance of doubt, all other data provision pursuant to the **Grid Code** shall still be provided including a Single Line Diagram (PC.A.2.2) and those data pertaining thereto.

[Rest of PC.A.2.5.5.7 continues as current Grid Code text...]

### **Amendment of PC.A.5.4.2 as shown in track changes below.**

PC.A.5.4.2 The following **Power Park Unit**, **Power Park Module** and **Power Station** data should be supplied in the case of a **Power Park Module** not connected to the **Total System** by a **DC Converter**:

Where a **Type Registered Power Park Unit** is employed, the **User** may opt to state the **Type Register** reference as an alternative to the provision of data in accordance with PC.A.5.4.2 except for:

- (1) the section marked thus # at sub paragraph (b); and
- (2) all of the harmonic and flicker parameters required under sub-paragraph (h); and
- (3) all of the site specific model parameters relating to the voltage or frequency control systems required under sub-paragraphs (d) and (e).

which must be provided by the **User** in addition to the **Type Register** reference.

#### **(a) Power Park Unit model**

A mathematical model of each type of **Power Park Unit** capable of representing its transient and dynamic behaviour under both small and large disturbance conditions. The model shall include non-linear effects and represent all equipment relevant to the dynamic performance of the **Power Park Unit** as agreed with **NGET**. The model shall be suitable for the study of balanced, root mean square, positive phase sequence time-domain behaviour, excluding the effects of electromagnetic transients, harmonic and sub-harmonic frequencies.

The model shall accurately represent the overall performance of the **Power Park Unit** over its entire operating range including that which is inherent to the **Power Park Unit** and that which is achieved by use of supplementary control systems providing either continuous or stepwise control. Model resolution should be sufficient to accurately represent **Power Park Unit** behaviour both in response to operation of transmission system protection and in the context of longer-term simulations.

The overall structure of the model shall include:

- (i) any supplementary control signal modules not covered by (c), (d) and (e) below.

- (ii) any blocking, deblocking and protective trip features that are part of the **Power Park Unit** (e.g. “crowbar”).
- (iii) any other information required to model the **Power Park Unit** behaviour to meet the model functional requirement described above.

The model shall be submitted in the form of a transfer function block diagram and may be accompanied by dynamic and algebraic equations.

This model shall display all the transfer functions and their parameter values, any non wind-up logic, signal limits and non-linearities.

The submitted **Power Park Unit** model shall have been validated and this shall be confirmed by the **Generator**. The validation shall be based on comparing the submitted model simulation results against measured test results. Validation evidence shall also be submitted and this shall include the simulation and measured test results. The latter shall include appropriate short-circuit tests. In the case of an **Embedded Medium Power Station** not subject to a **Bilateral Agreement** the **Network Operator** will provide **NGET** with the validation evidence if requested by **NGET**.

(b) **Power Park Unit** parameters

- \* Rated MVA
- \* **Rated MW**
- \* Rated terminal voltage
- \* Average site air density ( $\text{kg/m}^3$ ), maximum site air density ( $\text{kg/m}^3$ ) and minimum site air density ( $\text{kg/m}^3$ ) for the year Year for which the air density is submitted
- Number of pole pairs
- Blade swept area ( $\text{m}^2$ )
- Gear box ratio

Mechanical drive train

For each **Power Park Unit**, details of the parameters of the drive train represented as an equivalent two mass model should be provided. This model should accurately represent the behaviour of the complete drive train for the purposes of power system analysis studies and should include the following data items:-

- Equivalent inertia constant (MWsec/MVA) of the first mass (e.g. wind turbine rotor and blades) at minimum, synchronous and rated speeds
- Equivalent inertia constant (MWsec/MVA) of the second mass (e.g. generator rotor) at minimum, synchronous and rated speeds
- Equivalent shaft stiffness between the two masses (Nm/electrical radian)

Additionally, for **Power Park Units** that are induction generators (e.g. squirrel cage, doubly-fed) driven by wind turbines:

- \* Stator resistance
- \* Stator reactance
- \* Magnetising reactance.
- \* Rotor resistance.(at starting)
- \* Rotor resistance.(at rated running)
- \* Rotor reactance (at starting)
- \* Rotor reactance (at rated running)

Additionally for doubly-fed induction generators only:

The generator rotor speed range (minimum and maximum speeds in RPM)

The optimum generator rotor speed versus wind speed submitted in tabular format

Power converter rating (MVA)

The rotor power coefficient ( $C_p$ ) versus tip speed ratio ( $\lambda$ ) curves for a range of blade angles (where applicable) together with the corresponding values submitted in tabular format. The tip speed ratio ( $\lambda$ ) is defined as  $\Omega R/U$  where  $\Omega$  is the angular velocity of the rotor, R is the radius of the wind turbine rotor and U is the wind speed.

The electrical power output versus generator rotor speed for a range of wind speeds over the entire operating range of the **Power Park Unit**, together with the corresponding values submitted in tabular format.

The blade angle versus wind speed curve together with the corresponding values submitted in tabular format.

#The electrical power output versus wind speed over the entire operating range of the **Power Park Unit**, together with the corresponding values submitted in tabular format.

Transfer function block diagram, including parameters and description of the operation of the power electronic converter and fault ride through capability (where applicable).

For a **Power Park Unit** consisting of a synchronous machine in combination with a back to back **DC Converter**, or for a **Power Park Unit** not driven by a wind turbine, the data to be supplied shall be agreed with **NGET** in accordance with PC.A.7.

- (c) Torque / speed and blade angle control systems and parameters

For the **Power Park Unit**, details of the torque / speed controller and blade angle controller in the case of a wind turbine and power limitation functions (where applicable) described in block diagram form showing transfer functions and parameters of individual elements.

- (d) Voltage/**Reactive Power/Power Factor** control system parameters

For the **Power Park Unit** and **Power Park Module** details of voltage/**Reactive Power/Power Factor** controller (and **PSS** if fitted) described in block diagram form showing transfer functions and parameters of individual elements.

- (e) **Frequency** control system parameters

For the **Power Park Unit** and **Power Park Module** details of the **Frequency** controller described in block diagram form showing transfer functions and parameters of individual elements.

- (f) Protection

Details of settings for the following protection relays (to include): Under **Frequency**, over **Frequency**, under voltage, over voltage, rotor over current, stator over current, high wind speed shut down level.

- (g) Complete **Power Park Unit** model, parameters and controls

An alternative to PC.A.5.4.2 (a), (b), (c), (d), (e) and (f), is the submission of a single complete model that consists of the full information required under PC.A.5.4.2 (a), (b), (c), (d), (e) and (f) provided that all the information required under PC.A.5.4.2 (a), (b), (c), (d), (e) and (f) individually is clearly identifiable.

- (h) Harmonic and flicker parameters

When connecting a **Power Park Module**, it is necessary for **NGET** to evaluate the production of flicker and harmonics on **NGET** and **User's Systems**. At **NGET's** reasonable request, the **User** (a **Network Operator** in the case of an **Embedded Power Park Module** not subject to a **Bilateral Agreement**) is required to submit the following data (as defined in IEC 61400-21 (2001)) for each **Power Park Unit** expressed at the Common Collector Busbar:-

Flicker coefficient for continuous operation.

Flicker step factor.

Number of switching operations in a 10 minute window.

Number of switching operations in a 2 hour window.

Voltage change factor.

Current Injection at each harmonic for each **Power Park Unit** and for each **Power Park Module**

\* Data items marked with an asterisk are already requested under part 1, PC.A.3.3.1, to facilitate an early assessment by **NGET** as to whether detailed stability studies will be required before an offer of terms for a **CUSC Contract** can be made. Such data items have been repeated here merely for completeness and need not, of course, be resubmitted unless their values, known or estimated,

**Changes to the DRC**

**Pages 9 to 11 (inclusive) of Schedule 1 of the DRC shall be amended as shown in track changes.**

DATA DESCRIPTION	UNITS	DATA CAT.	POWER PARK UNIT (OR POWER PARK MODULE, AS THE CASE MAY BE)						
			G1	G2	G3	G4	G5	G6	STN
<b>Power Park Module Rated MVA</b> <b>Power Park Module Rated MW</b> *Performance Chart of a at <b>Power Park Module</b> at the connection point * <b>Output Usable</b> (on a monthly basis)	MVA MW  MW	<b>SPD+</b> <b>SPD+</b> <b>SPD</b>  <b>SPD</b>	(see <b>OC2</b> for specification)  (except in relation to <b>CCGT Modules</b> when required on a unit basis under the <b>Grid Code</b> , this data item may be supplied under Schedule 3)						
Number & Type of <b>Power Park Units</b> within each <b>Power Park Module</b> <u>In the case of a <b>Type Registered Power Park Unit</b> subject to <b>NGET's</b> agreement, the <b>Type Register</b> reference may be given as an alternative to completion of the following sections of this Schedule 1 to the end of page 11 with the exception of the sections marked thus # below .</u>	<b>Type Registered Reference</b>	<b>SPD+</b>							
<b>Power Park Unit Model</b> - A validated mathematical model in accordance with PC.5.4.2 (a)	Transfer function block diagram and algebraic equations, simulation and measured test results	<b>DPD</b>							
<b>Power Park Unit Data</b> (where applicable) Rated MVA <b>Rated MW</b> Rated terminal voltage Site minimum air density Site maximum air density Site average air density Year for which air density data is submitted Number of pole pairs Blade swept area Gear box ratio Stator Resistance. Stator Reactance. Magnetising Reactance Rotor Resistance (at starting). Rotor Resistance (at rated running) Rotor Reactance (at starting). Rotor Reactance (at rated running) Equivalent inertia constant of the first mass (e.g. wind turbine rotor and blades) at minimum speed Equivalent inertia constant of the first mass (e.g. wind turbine rotor and blades) at synchronous speed Equivalent inertia constant of the first mass (e.g. wind turbine rotor and blades) at rated speed Equivalent inertia constant of the second mass (e.g. generator rotor) at minimum speed Equivalent inertia constant of the second mass (e.g. generator rotor) at synchronous speed Equivalent inertia constant of the second mass (e.g.	MVA MW V kg/m <sup>3</sup> kg/m <sup>3</sup> kg/m <sup>3</sup>  m <sup>2</sup>  % on MVA % on MVA % on MVA % on MVA % on MVA % on MVA % on MVA MW secs / MVA MW secs / MVA MW secs / MVA MW secs / MVA MW secs / MVA MW secs / MVA MW secs / MVA MW secs / MVA	<b>SPD+</b> <b>SPD+</b> <b>SPD+</b> <b>SPD+</b> <b>SPD+</b> <b>SPD+</b> <b>DPD</b> <b>DPD</b> <b>DPD</b> <b>SPD+</b> <b>SPD+</b> <b>DPD</b> <b>DPD</b> <b>SPD</b> <b>SPD+</b> <b>SPD+</b> <b>SPD+</b> <b>SPD+</b> <b>SPD+</b> <b>SPD+</b> <b>SPD+</b>							

DATA DESCRIPTION	UNITS	DATA CAT.	POWER PARK UNIT (OR POWER PARK MODULE, AS THE CASE MAY BE)						
			G1	G2	G3	G4	G5	G6	STN
generator rotor) at rated speed Equivalent shaft stiffness between the two masses	MVA Nm / electrical radian	<b>SPD+</b>							

DATA DESCRIPTION	UNITS	DATA CAT.	POWER PARK UNIT (OR POWER PARK MODULE, AS THE CASE MAY BE)						
			G1	G2	G3	G4	G5	G6	STN
Minimum generator rotor speed (Doubly Fed Induction Generators)	RPM	SPD+							
Maximum generator rotor speed (Doubly Fed Induction Generators)	RPM	SPD+							
The optimum generator rotor speed versus wind speed	tabular format	DPD							
Power Converter Rating (Doubly Fed Induction Generators)	MVA	SPD+							
The rotor power coefficient ( $C_p$ ) versus tip speed ratio ( $\lambda$ ) curves for a range of blade angles (where applicable)	Diagram + tabular format	DPD							
The electrical power output versus generator rotor speed for a range of wind speeds over the entire operating range of the <b>Power Park Unit</b> .	Diagram + tabular format	DPD							
The blade angle versus wind speed curve	Diagram + tabular format	DPD							
<del>#</del> The electrical power output versus wind speed over the entire operating range of <b>the Power Park Unit</b> .	Diagram + tabular format	DPD							
Transfer function block diagram, parameters and description of the operation of the power electronic converter including fault ride through capability (where applicable).	Diagram	DPD							
For a <b>Power Park Unit</b> consisting of a synchronous machine in combination with a back to back <b>DC Converter</b> , or for a <b>Power Park Unit</b> not driven by a wind turbine, the data to be supplied shall be agreed with <b>NGET</b> in accordance with PC.A.7.									

DATA DESCRIPTION	UNITS	DATA CAT.	POWER PARK UNIT (OR POWER PARK MODULE, AS THE CASE MAY BE)						
			G1	G2	G3	G4	G5	G6	STN
Torque / Speed and blade angle control systems and parameters	Diagram	<b>DPD</b>							
For the <b>Power Park Unit</b> , details of the torque / speed controller and blade angle controller in the case of a wind turbine and power limitation functions (where applicable) described in block diagram form showing transfer functions and parameters of individual elements. # Voltage/ <b>Reactive Power/Power Factor</b> control system parameters	Diagram	<b>DPD</b>							
# For the <b>Power Park Unit</b> and <b>Power Park Module</b> details of <b>Voltage/Reactive Power/Power Factor</b> controller (and <b>PSS</b> if fitted) described in block diagram form including parameters showing transfer functions of individual elements. # <b>Frequency</b> control system parameters	Diagram	<b>DPD</b>							
# For the <b>Power Park Unit</b> and <b>Power Park Module</b> details of the <b>Frequency</b> controller described in block diagram form showing transfer functions and parameters of individual elements.	Diagram	<b>DPD</b>							
As an alternative to PC.A.5.4.2 (a), (b), (c), (d), (e) and (f), is the submission of a single complete model that consists of the full information required under PC.A.5.4.2 (a), (b), (c), (d) (e) and (f) provided that all the information required under PC.A.5.4.2 (a), (b), (c), (d), (e) and (f) individually is clearly identifiable.	Diagram	<b>DPD</b>							
# Harmonic Assessment Information  (as defined in IEC 61400-21 (2001)) for each <b>Power Park Unit expressed at the Common Collector Busbar</b> :-									
# Flicker coefficient for continuous operation		<b>DPD</b>							
# Flicker step factor		<b>DPD</b>							
# Number of switching operations in a 10 minute window		<b>DPD</b>							
# Number of switching operations in a 2 hour window		<b>DPD</b>							
# Voltage change factor		<b>DPD</b>							
# Current Injection at each harmonic for each	Tabular	<b>DPD</b>							

<b>Power Park Unit</b> and for each <b>Power Park Module</b>	format								
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**Schedule 14 of the DRC shall be amended as shown in track changes.**

**DATA REGISTRATION CODE**

**Fault infeeds from Power Park Modules**

A submission is required for the whole **Power Park Module** and for each **Power Park Unit** type or equivalent. The submission shall represent operating conditions that result in the maximum fault infeed. The fault current from all motors normally connected to the **Power Park Unit's electrical system** shall be included. The fault infeed shall be expressed as a fault current at the terminals of the **Power Park Unit**, or the **Common Collection Busbar** if an equivalent **Single Line Diagram** and associated data as described in PC.A.2.2.2 is provided, and the **Grid Entry Point**, or **User System Entry Point** if **Embedded**, for a fault at the **Grid Entry Point**, or **User System Entry Point** if **Embedded**.

Should actual data in respect of fault infeeds be unavailable at the time of the application for a **CUSC Contract** or **Embedded Development Agreement**, a limited subset of the data, representing the maximum fault infeed that may result from all of the plant types being considered, shall be submitted. This data will, as a minimum, represent the root mean square of the positive, negative and zero sequence components of the fault current for both single phase and three phase solid faults at the **Grid Entry Point** (or **User System Entry Point** if **Embedded**) at the time of fault application and 50ms following fault application. Actual data in respect of fault infeeds shall be submitted to **NGET** as soon as it is available, in line with PC.A.1.2

<u>DATA DESCRIPTION</u>	<u>UNITS</u>	<u>F.Yr.</u> <u>0</u>	<u>F.Yr.</u> <u>1</u>	<u>F.Yr.</u> <u>2</u>	<u>F.Yr.</u> <u>3</u>	<u>F.Yr.</u> <u>4</u>	<u>F.Yr.</u> <u>5</u>	<u>F.Yr.</u> <u>6</u>	<u>F.Yr.</u> <u>7</u>
Name of <b>Power Station</b>									
<b>Name of Power Park Module</b>									
<b>Power Park Unit type</b>									
<u>Where a <b>Type Registered Power Park Unit</b> is used, subject to <b>NGET's agreement</b>, completion of the following sections of this Schedule 14 is not required. State <b>Type Registered Reference</b>.</u>	<u><b>Type Registered Reference</b></u>								
A submission shall be provided for the contribution of the entire <b>Power Park Module</b> and each type of <b>Power Park Unit</b> or equivalent to the positive, negative and zero sequence components of the short circuit current at the <b>Power Park Unit</b> terminals, or <b>Common Collection Busbar</b> , and <b>Grid Entry Point</b> or <b>User System Entry Point</b> if <b>Embedded</b> for									

<p>(i) a solid symmetrical three phase short circuit  (ii) a solid single phase to earth short circuit  (iii) a solid phase to phase short circuit  (iv) a solid two phase to earth short circuit  at the <b>Grid Entry Point</b> or <b>User System Entry Point</b> if <b>Embedded</b>.</p> <p>If protective controls are used and active for the above conditions, a submission shall be provided in the limiting case where the protective control is not active. This case may require application of a non-solid fault, resulting in a retained voltage at the fault point.</p>									
<ul style="list-style-type: none"> <li>- A continuous time trace and table showing the root mean square of the positive, negative and zero sequence components of the fault current from the time of fault inception to 140ms after fault inception at 10ms intervals</li> <li>- A continuous time trace and table showing the positive, negative and zero sequence components of retained voltage at the terminals or <b>Common Collection Busbar</b>, if appropriate</li> <li>- A continuous time trace and table showing the root mean square of the positive, negative and zero sequence components of retained voltage at the fault point, if appropriate</li> </ul> <p>For <b>Power Park Units</b> that utilise a protective control, such as a crowbar circuit,</p> <ul style="list-style-type: none"> <li>- additional rotor resistance applied to the <b>Power Park Unit</b> under a fault situation</li> <li>- additional rotor reactance applied to the <b>Power Park Unit</b> under a fault situation.</li> </ul>	<p>Graphical and tabular</p> <p>kA versus s</p> <p>p.u. versus s</p> <p>p.u. versus s</p> <p>% on MVA</p> <p>% on MVA</p>								

Positive sequence X/R ratio of the equivalent at time of fault at the <b>Common Collection Busbar</b>									
Minimum zero sequence impedance of the equivalent at <b>Common Collection Busbar</b>									
<b>Active Power</b> generated pre-fault	MW								
Number of <b>Power Park Units</b> in equivalent generator									
Power Factor (lead or lag) Pre-fault voltage (if different from 1.0 p.u.) at fault point (See note 1)	p.u.								
Items of reactive compensation switched in pre-fault									

Note 1. The pre-fault voltage provided above should represent the voltage within the range 0.95 to 1.05 that gives the highest fault current