

# SONI Limited

## Modelling Requirements

### Grid Code Amendments Consultation Paper

It is proposed to amend the Grid Code by adding in the text in blue and by deleting the text in red strikethrough.

#### PLANNING CODE

##### PC6.3 Data to be provided

PC6.3.1 The planning data required under the **PC** from **Users** (other than the **DNO**) is allocated to one of two categories:-

- (a) **Standard Planning Data;** or
- (b) **Detailed Planning Data.**

PC6.3.2 Listings of **Standard Planning Data**, required in every case and **Detailed Planning Data**, required in certain cases, are set out in Appendix A to this **PC** (in the case of **Users**, other than the **DNO**, connected to the **Transmission System**) and Appendix B to this **PC** (in the case of **Users** connected to the **Distribution System**) and Appendix D to this PC (in the case of Users as defined in PC.D2.1). Listings of planning data required from the **DNO** are set out in Appendix C to this **PC**. In either case, the data must be supplied in the format set out in the **Data Registration Code**.

PC6.3.3 In relation to the submission of data on a routine annual basis, **Standard Planning Data** in every case, and **Detailed Planning Data** if required by the **TSO**, by reasonable notice in advance of the submission ("reasonableness" being judged in this context by reference to the amount of time which it may take to collate the required data), shall (unless there has been no change from the data submitted the previous time, in which case the provisions of PC6.1.4 shall apply) be submitted to the **TSO** annually by **Users** in the following categories:-

- (a) **Generators** in respect of all transmission connected **Power Stations**;
- (b) **Suppliers**;
- (c) all **Large Demand Customers**.
- (d) **Generators** in respect of **CDGUs** and **Controllable WFPSs** connected to the **Distribution System**.

PC6.3.4 Planning data, by reasonable notice in advance of the submission ("reasonableness" being judged in this context by reference to the amount of time which it may take to collate the required data), shall (unless there has been no change from the data submitted the previous time, in which case the provisions of PC6.1.4 shall apply) be submitted to the **TSO** annually by the **DNO** in respect of **Independent Generating Plant** connected to the **Distribution System**.

PC6.3.5 **Standard Planning Data** shall be provided by **Users** (other than the **DNO**) at the time that they notify the **TSO** of any significant changes to their **System** or operating regime. **Detailed Planning Data** shall be provided by **Users** (other than the **DNO**) in these circumstances if required by the **TSO**.

PC6.3.6 PC7 deals with what is required pursuant to the **Grid Code** for applications for new or modified arrangements for connection to the **Transmission System** or use of the **All Island Transmission Networks**.

## APPENDIX A

### PLANNING DATA REQUIREMENTS FOR USERS (OTHER THAN THE DNO) CONNECTED TO THE TRANSMISSION SYSTEM ONLY

#### PC.A1 INTRODUCTION

PC.A1.1 This Appendix specifies the **Standard** and **Detailed Planning Data** to be submitted to the **TSO** by **Users** (other than the **DNO**) connected to the **Transmission System** only pursuant to PC6 and PC7.

#### PART 1

#### PC.A2 STANDARD PLANNING DATA

##### PC.A2.1 CONNECTION SITE AND USER SYSTEM DATA

###### PC.A2.1.1 General

All **Users** shall provide the **TSO** with the details as specified in sub sections PC.A2.1.2 and ~~PC.A2.1.3~~ to [PC.A2.1.4](#) relating to their **User System**.

###### PC.A2.1.2 User System Layout

Single line diagrams of existing and proposed arrangements of main connections and primary distribution systems showing equipment ratings and if available numbering and nomenclature.

###### PC.A2.1.3 Short Circuit Infeed

- (a) The maximum 3-phase short circuit current infeed into the **Transmission System**.
- (b) The minimum zero sequence impedance of the **User System** at the point of connection with the **Transmission System**.

###### [PC.A2.1.4 Modelling Data](#)

The **User** in respect of its **Plant** and **Apparatus** must submit modelling data to the **TSO** as specified by the **TSO** in **PC Appendix D**.

The modelling data submitted to the **TSO** is for **System** planning and operational purposes. It is not intended to restrict the scope of any **Ancillary Service** agreements which the Generator may enter into with the **TSO**.

APPENDIX B  
PLANNING DATA REQUIREMENTS FOR USERS CONNECTED TO THE DISTRIBUTION SYSTEM

PC.B1. INTRODUCTION

PC.B1.1 This Appendix specifies the **Standard** and **Detailed Planning Data** to be submitted to the **TSO** by **Generators** pursuant to PC6 and PC7 in respect of **CDGUs** and **Controllable WFPSs** connected to the **Distribution System** and, with respect to PC.B3.3.2, **Aggregators** with respect to **Generating Units** connected to the **Distribution System**.

PART 1

PC.B.2 STANDARD PLANNING DATA

PC.B2.1 CONNECTION SITE AND USER SYSTEM DATA

PC.B2.1.1 General

All **Users** shall provide the **TSO** with the details as specified in sub section [B2.1.2](#) [PC.B2.1.2](#) and [PC.B2.1.3](#) relating to their **User System**.

PC.B2.1.2 Short Circuit Infeed

- (a) The maximum 3-phase short circuit current infeed into the **Distribution System**.
- (b) The minimum zero sequence impedance of the **User System** at the point of connection with the **Distribution System**.

[PC.B2.1.3](#) Modelling Data

[The User in respect of its Plant and Apparatus must submit modelling data to the TSO as specified by the TSO in PC Appendix D.](#)

[The modelling data submitted to the TSO is for System planning and operational purposes. It is not intended to restrict any Ancillary Service agreements.](#)

APPENDIX D

Modelling Requirements for Users

[PC.D1](#) INTRODUCTION

[PC.D1.1 This Appendix specifies the modelling data to be submitted to the TSO by Users connected to or applying for a new or modified connection to the Transmission System or Distribution System pursuant to PC6.3.2.](#)

[PC.D2](#) MODELLING REQUIREMENTS FOR USERS

[PC.D2.1](#) Scope

[This Appendix applies to Users which, in this Appendix means:-](#)

- (a) **Generators** with respect to **Generating Units** connected to or seeking a new or modified connection to the **Transmission System**;
- (b) **Generators** with respect to **CDGUs** and **Controllable WFPSs** connected to or seeking a new or modified connection to the **Distribution System**,
- (c) **Large Demand Customers**; and
- (d) **Interconnector Owners**.

#### PC.D2.2 General

All **Users** shall provide the **TSO** with suitable and accurate dynamic models in order for the **TSO** to assess the impact of the connection on the transient performance, security and stability of the **System**.

The dynamic models submitted by the **User** shall be representative of the **Users Plant** and **Apparatus** at the **Connection Point**. Dynamic models must be single lumped models, scalable for different levels of **Active Power** and **Reactive Power** at the **Connection Point**. All dynamic models must take into account all communication, controller and processing delays of the **Users Plant** and **Apparatus**. If all **Generating Units** contained within the **Users Plant** and **Apparatus** are not identical, the model shall account for this by accurately representing the overall performance of the **Users Plant** and **Apparatus** at the **Connection Point**.

#### PC.D3 MODEL CAPABILITIES

All **Users** shall provide dynamic models which are representative of the **Users Plant** and **Apparatus** at the **Connection Point**. The dynamic models shall represent the **Users Plant** and **Apparatus** in balanced, root mean-square, positive phase-sequence, time domain studies and three phase electromagnetic transient and harmonic studies.

Balanced, root mean-square positive sequence time-domain dynamic models shall be able to calculate the variation of **Active Power** and **Reactive Power** of the **Users Plant** and **Apparatus** due to variations in **Frequency** and **Voltage** at the **Connection Point**. Dynamic models shall include all electrical and mechanical phenomena that impact on the **Active Power** and/or **Reactive Power** of the **Users Plant** and **Apparatus**. These dynamic models shall be able to demonstrate sub-transient, transient and synchronous dynamic performance up to and including **Primary Operating Reserve** and **Secondary Operating Reserve** timeframes or longer if post-event steady state conditions have not been achieved.

The three-phase electromagnetic transient model shall include all material aspects of the **Users Plant** and **Apparatus** that affect the symmetrical and asymmetrical voltage and current outputs from the **Users Plant** and **Apparatus**. The model shall represent phenomena that materially affect the **Voltage** and **Frequency** on the **System** over timeframes of sub-cycle up to 500 cycles including, but not limited to, switching electronic devices, transformer saturation and equipment energisation.

#### PC.D4 MODEL DOCUMENTATION AND SOURCE CODE

Users shall provide the TSO with appropriate balanced, root mean-squared positive-phase sequence time domain models and three-phase electromagnetic transient models in accordance with this Grid Code. The User shall provide sufficient information to the TSO including but not limited to, Laplace diagrams so that in the event of future software environment changes or version updates the dynamic models can be redeveloped. All dynamic models must be accompanied with appropriate documentation with sufficient detail as specified by the TSO (such agreement not to be unreasonably withheld or delayed).

The User shall provide information including but not limited to, a full description of the model structure, inputs/outputs and clear instructions on model initialisation and use and should be based on standard library models in a software package as specified by the TSO. The User shall provide a description of the controller's functionality of all levels of control on the Users Plant and Apparatus, along with manufacturer details, version and operation manual. The User may also provide the TSO with detailed model source code. The dynamic models shall be provided in a software format as specified by the TSO.

The TSO may, when necessary to ensure the proper operation of its complete system representation or to facilitate its understanding of the results of a dynamic simulation, request additional information concerning the model, which may include model documentation or source code of one or more routines in the model. The User shall comply with such request without delay.

#### PC.D5 CONFIDENTIALITY

The dynamic models, supporting documentation and associated data are provided to the TSO in order to carry out its duties to meet its Licence and Grid Code obligations. In that regard, the TSO is entitled to share the dynamic models, supporting documentation and associated data with third parties, including but not limited to the Other TSO and DNO to perform co-ordinated operational and/or planning studies. Where such data is shared with third parties working for/with the TSO, this data will be shared and protected under the confidentiality conditions of the Licence.

It is the responsibility of the User to provide the dynamic models, supporting documentation and associated data to the TSO. Where it is not possible for the User to provide the dynamic models, supporting documentation and associated data to the TSO, the TSO will accept the dynamic models, supporting documentation and associated data from a third party manufacturer. The TSO will only accept this information from a third party manufacturer provided the third party manufacturer agrees to enter into the TSOs standard confidentiality agreement for Users. In the event the third party manufacturer is unable to enter into the TSOs standard confidentiality agreement, the User shall be responsible for the provision of the dynamic models, supporting documentation and associated data to the TSO.

#### PC.D6 PROVISION OF INFORMATION

At all times the TSO shall be in possession of an up to date full and accurate parameter listing of the Users Plant and Apparatus. This parameter listing must include all operational control functionality, including Frequency, Voltage and all the Users Plant and Apparatus parameters relating to the control and operation of the Users Plant and Apparatus.

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The **User** shall provide the dynamic models, supporting documentation and associated data as **Standard Planning Data** in accordance with PC.A2.1.4 and PC.B2.1.3 and in any case must be submitted at least six months prior to energisation of the **Users Plant** and **Apparatus**.

#### PC.D7      VALIDATION

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The dynamic models provided to the **TSO** must be validated. The **TSO** must be satisfied that responses shown by the dynamic models under simulation conditions are representative of the **Users Plant** and **Apparatus** under equivalent conditions.

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Prior to energisation of the **Users Plant** and **Apparatus** the **User** shall provide type test results to show that the responses shown by the dynamic models are representative of the **Users Plant** and **Apparatus** under laboratory test conditions.

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Post **Commissioning/Acceptance Testing** the **User** shall complete dynamic simulations using the dynamic models such that responses shown by the dynamic models can be compared against measurements from **Commissioning/Acceptance Testing** to ensure the model responses are representative of the **Users Plant** and **Apparatus**. Tests may include but are not limited to steady state reactive capability, **Voltage** control & **Reactive Power** stability, low **Voltage** ride through, high **Voltage** ride through, low **Frequency** response and high **Frequency** response. If these tests show the dynamic models are not representative of the **Users Plant** and **Apparatus**, the **User** shall provide updated dynamic models, supporting documentation and associated data to ensure the responses shown by the dynamic models are representative of the responses shown by **Users Plant** and **Apparatus** during **Commissioning/Acceptance Testing**.

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Through **Monitoring**, the **TSO** shall ensure that models submitted by the **User** remain representative of the **Users Plant** and **Apparatus** throughout the operational lifetime of the **Users Plant** and **Apparatus**.

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In the event the **TSO** identifies that the response of the dynamic models are not representative of the **Users Plant** and **Apparatus**, the **TSO** shall notify the **User**. The **User** shall provide the revised dynamic models, supporting documentation and associated data whose response is representative of the **Users Plant** and **Apparatus** as soon as reasonably practicable, but in any case no longer than 30 **Business Days** after notification of the noncompliance by the **TSO**.

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In the event of the **User** modifying hardware/software which materially affects the control and/or operation of the **Users Plant** and **Apparatus**, the **User** shall provide the **TSO** with updated dynamic models, supporting documentation and associated data to enable the **TSO** to assess the impact of the modification of the **Users Plant** and **Apparatus** on the **System**. The **User** shall not implement any hardware/software modifications to the **Users Plant** and **Apparatus** without prior agreement with the **TSO**.

#### PC.D8      SOFTWARE ENVIRONMENT

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The **User** must provide models in software packages as specified by the **TSO**. The **TSO** shall inform the **User** of the required software version, computer platform, compiler version and model usability guidelines etc. upon request and shall be published on the **TSO** website. The **TSO** may, from time to time, request the **User** to provide updated models which are compatible with changes in the **TSO**'s computing environment. The **User** shall ensure such updated models are provided without undue delay and in any case in a timeframe agreed between the **User** and the **TSO**. The **User** shall provide models in

[the software formats as outlined in this Grid Code, as published on the TSO website or in such other formats as may be agreed between the User and the TSO.](#)

[All models, irrespective of software format, shall be accompanied by a sample case such that the model can be tested before being integrated into the System model in the respective software environment. The sample case should include the Users Plant and Apparatus up to the Connection Point connected via a suitable impedance to an infinite bus.](#)

## SCHEDULE 5

### DATA REGISTRATION CODE

#### USERS SYSTEM DATA

The data listed in this Schedule 5 is required to be provided by:-

- (i) a **User** (and by proposed **Users** applying for a **Connection Agreement**) in connection with applications for new or modified arrangements for connections to or use of the **NI System**;
- (ii) a **User** who has requested a **Statement of System Capacity** as referred to in PC5.2;
- (iii) a **User** at the time it notifies the **TSO** of any significant changes to its **System** or operating regime; and
- (iv) the categories of **User** specified in PC6.3.3 on a routine annual basis by the end of calendar week 52 of each year.

DATA DESCRIPTION	UNITS	DATA CATEGORY
<p><a href="#"><u>Modelling Data</u></a>  <a href="#"><u>Modelling data of the Users Plant and Apparatus at the Connection Point in accordance with PC.A2.1.4 and PC.B2.1.3</u></a>  <b>User System</b> layout</p> <p>Single line diagrams of existing and proposed arrangements of main <b>Plant</b> and <b>Apparatus</b> including:-</p> <ul style="list-style-type: none"> <li>(i) busbar layouts</li> <li>(ii) electrical circuitry (i.e. lines, cables, transformers, switchgear etc)</li> <li>(iii) phasing arrangements</li> <li>(iv) earthing arrangements</li> <li>(v) switching facilities</li> <li>(vi) operating voltages</li> <li>(vii) numbering and nomenclature</li> </ul> <p><u>Reactive Compensation Equipment</u></p> <p>For all independently switched reactive compensation equipment on the <b>User's System</b> at 11kV and above, other than power factor correction equipment associated directly with the <b>User's Plant</b> and <b>Apparatus</b>, the following information is required:-</p> <ul style="list-style-type: none"> <li>(i) type of equipment</li> <li>(ii) capacitive and/or inductive rating or its operating range in <b>MVar</b>/<b>Mvar</b></li> <li>(iii) details of any automatic control logic to enable operating characteristics to be determined</li> <li>(iv) the point of connection to the <b>User's System</b> in terms of electrical location and voltage</li> </ul> <p><u>Short Circuit Infeed to the NI System</u></p> <p>The total short circuit infeeds calculated in accordance with good industry practice into the <b>NI System</b> from the <b>User System</b> at the <b>Connection Point</b> as follows:-</p> <ul style="list-style-type: none"> <li>(i) maximum 3-phase short circuit infeed including infeeds from any <b>Generating Plant</b> forming part of the <b>User's System</b></li> <li>(ii) additional maximum 3-phase short circuit infeed from induction motors via the <b>User's System</b></li> <li>(iii) minimum zero sequence impedance of the <b>User's System</b> at the <b>Connection Point</b></li> </ul> <p><u>Lumped System Susceptance</u></p> <p>Details of equivalent lumped network susceptance of the <b>User's System</b> at nominal <b>Frequency</b> back to the connection with the <b>NI System</b>. This should include any shunt reactors which are an integrated part of a cable system and which are not normally in or out of service independently of the cable (i.e. they</p>	<p style="text-align: center;">Mvar</p> <p style="text-align: center;">MVA</p> <p style="text-align: center;">MVA</p> <p style="text-align: center;">% on 100</p> <p style="text-align: center;">% on 100</p>	<p style="text-align: center;"><a href="#"><u>SPD</u></a></p> <p style="text-align: center;"><b>SPD/DPD</b></p> <p style="text-align: center;"><b>DPD</b></p> <p style="text-align: center;"><b>DPD</b></p> <p style="text-align: center;"><b>DPD</b></p> <p style="text-align: center;"><b>SPD/DPD</b></p> <p style="text-align: center;"><b>SPD/DPD</b></p> <p style="text-align: center;"><b>DPD</b></p> <p style="text-align: center;"><b>DPD</b></p> <p style="text-align: center;"><b>DPD</b></p> <p style="text-align: center;"><b>DPD</b></p>

are regarded as part of the cable). It should not include:-

- (i) independent reactive compensation plant connected to the **User's System**; or
- (ii) any susceptance of the **User's System** inherent in the **Active and Reactive Power Demand** data given under PC.A.3.2

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<u>Interconnection Impedance</u>		
For <b>User</b> interconnections which operate in parallel with the <b>NI System</b> and equivalent single impedance (resistance, reactance and shunt susceptance) of the parallel <b>User System</b> . If the impedance is, in the reasonable opinion of the <b>TSO</b> , low, the more detailed information in the equivalent or active part of the parallel <b>User System</b> may be requested.	% on 100	<b>DPD</b>
<u>Demand Transfer Capacity</u>		
Where the same <b>Demand</b> may be supplied from alternative <b>NI System</b> points of supply, the proportion of <b>Demand</b> normally fed from each <b>NI System</b> supply point and the arrangements (manual or automatic) for transfer under planned /fault <b>Outage</b> conditions shall be provided. Where the same <b>Demand</b> is supplied from different <b>User</b> supply points, then this information should be provided to all parties.		<b>DPD</b>
<u>System Data</u>		
Each <b>User</b> with an existing or proposed <b>User System</b> connected at <b>High Voltage</b> shall provide the following details relating to that <b>High Voltage System</b> :		
(i) circuit parameters for all circuits:-		
rated voltage	kV	<b>DPD</b>
operating voltage	kV	<b>DPD</b>
positive phase sequence reactance	% on 100	<b>DPD</b>
positive phase sequence resistance	% on 100	<b>DPD</b>
positive phase sequence susceptance	% on 100	<b>DPD</b>
zero phase sequence reactance	% on 100	<b>DPD</b>
zero phase sequence resistance	% on 100	<b>DPD</b>
zero phase sequence susceptance	% on 100	<b>DPD</b>
(ii) Interconnecting transformers between the <b>User's</b> higher voltage system and the <b>User's</b> primary voltage system:-		
rated MVA	MVA	<b>DPD</b>
voltage ratio		<b>DPD</b>
winding arrangement		<b>DPD</b>
positive sequence reactance (max, min, and nominal tap)	% on MVA	<b>DPD</b>
positive sequence resistance (max, min, and nominal tap)	% on MVA	<b>DPD</b>
zero sequence reactance	% on MVA	<b>DPD</b>
tap changer range	+% to -%	<b>DPD</b>
tap changer step size	%	<b>DPD</b>
tap changer type: on <b>Load</b> or off circuit		<b>DPD</b>
(iii) Switchgear, including circuit breakers, switch disconnectors and isolators on all circuits connected to the <b>Connection Point</b> including those at <b>Power Stations</b> :-		
rated voltage	kV	<b>DPD</b>
operating voltage	kV	<b>DPD</b>
rated short circuit breaking current, 3-phase	kA	<b>DPD</b>
rated short-circuit breaking current, 1-phase	kV	<b>DPD</b>
rated load-breaking current, 3-phase	kA	<b>DPD</b>
DATA DESCRIPTION	UNITS	DATA CATEGORY
rated load-breaking current, 1-phase	kA	<b>DPD</b>
rated short-circuit marking current, 3-phase	kA	<b>DPD</b>

rated short-circuit making current, 1-phase	kA	DPD
<b><u>Protection Data</u></b>		
The following information relates only to <b>Protection</b> which can trip or intertrip or close any <b>Connection Point</b> circuit breaker or any the <b>TSO</b> circuit breaker:-		
(i) a full description, including estimated settings, for all relays and <b>Protection</b> systems installed or to be installed on the <b>User's System</b> ;		DPD
(ii) a full description of any auto-reclose facilities installed or to be installed on the <b>User's System</b> , including type and time delays;		DPD
(iii) a full description, including estimated settings, for all relays and <b>Protection</b> systems installed or to be installed on the <b>Generating Unit Generator Transformer</b> , station transformer and their associated connections;		DPD
(iv) for <b>Generating Units</b> having (or intended to have) a circuit breaker on the circuit leading to the <b>Generator Terminals</b> , at the same voltage, clearance times for electrical faults within the <b>Generating Unit</b> zone; and		DPD
(v) the most probable fault clearance time for electrical faults on the <b>User's System</b>	m/Sec	DPD
<b><u>Earthing Arrangements</u></b>		
Full details of the means of permanently connecting the <b>User System</b> to each, including impedance values.		
<b><u>Transient Overvoltage Assessment Data</u></b>		
When requested by the <b>TSO</b> , each <b>User</b> is required to submit estimates of the surge impedance parameters present and forecast of its <b>User System</b> with respect to the <b>Connection Point</b> and to give details of the calculations carried out. The <b>TSO</b> may further request information on physical dimensions of electrical equipment and details of the specification of <b>Apparatus</b> directly connected to the <b>Connection Point</b> and its means of <b>Protection</b> .		
<b><u>User's System Demand (Active and Reactive Power)</u></b>		
Forecast daily <b>Demand</b> profiles net of the output profile of all <b>Generating Plant</b> directly connected to the <b>User's System</b> in time marked half hours throughout the day as follows:-		
(a) peak day on the <b>User's System</b>	MW/Mvar	SPD/DPD
(b) day of peak <b>Demand (Active Power)</b>	MW	DPD
(c) day of minimum <b>Demand (Active Power)</b>	MW	DPD
<b><u>User Customer Demand Management Data</u></b>		
The potential reduction in <b>Demand</b> available from the <b>User</b> in <b>MW</b> and <b>MVA</b> r, the notice required to put such reduction into effect, the maximum acceptable duration of the reduction in hours and the permissible number of reductions per annum.		
<b><u>Conversion Factor Data</u></b>		
The figures described as "fixed unit load" and "unit load scalar" under the <b>TSC</b> , which are the figures submitted by a <b>Generator</b> or an <b>Intermediary</b> on its behalf pursuant to the "net output function" provisions of the <b>TSC</b> .		
<b><u>Additional Conversion Factor Data</u></b>		
For Kilroot and Ballylumford <b>Power Stations</b> , the different configurations at which the <b>Power Stations</b> may operate and which can affect the <b>Conversion Factors</b> , such configurations being submitted in the form set out at PC.A3.3.12.		