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.

**GLOSSARY**

|  |  |
| --- | --- |
| **Model** | A dynamic representation of a **User’s** **Plant** and **Apparatus** in a software format as specified by the **TSO**. |

**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**.

PC6.3.4Planning 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.A1INTRODUCTION

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 **User** 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 the scope of any **Ancillary Service** agreements which the **User** may enter into with the **TSO**.

APPENDIX D

Modelling Requirements for **Users**

PC.D1INTRODUCTION

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.D2MODELLING REQUIREMENTS FOR **USERS**

PC.D2.1 Scope

This Appendix applies to **Users** which, in this Appendix means:-

1. **Generators** with respect to **Generating** **Units** connected to or seeking a new or modified connection to the **Transmission** **System**;
2. **Generator** with respect to **CDGU’s** and **Controllable** **WFPSs** connected to or seeking a new or modified connection to the **Distribution** **System**,
3. **Large** **Demand** **Customers**; and
4. **Interconnector** **Owners**.

PC.D2.2 General

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

The **Models** submitted by the **User** shall be representative of the **Users** **Plant** and **Apparatus** at the **Connection** **Point**. All **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 **Models** which are representative of the **Users Plant** and **Apparatus** at the **Connection** **Point**. The **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.

The balanced, root mean-square positive sequence time-domain **Model** shall be able to calculate how quantities, including but not limited to; **Active** **Power** and **Reactive** **Power** of the **Users Plant** and **Apparatus** vary due to changes in **Frequency** and voltage at the **Connection** **Point**. The **Model** shall include all electrical and mechanical phenomena that impact on the **Active** **Power** and/or **Reactive** **Power** of the **Users Plant** and **Apparatus** for sub-transient, transient and synchronous dynamics up to and including **Primary** **Operating** **Reserve** and **Secondary** **Operating** **Reserve** timeframes or when post-event steady state conditions have 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 50 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 an appropriate balanced, root mean-squared positive-phase sequence time domain **Model** and a three-phase electromagnetic transient **Model** in accordance with this **Grid** **Code**. The **TSO** requires that sufficient information be provided by the **User** to allow for **Models** to be redeveloped in the event of future software environment changes or version updates. All **Models** shall be accompanied with appropriate documentation with sufficient detail as specified and deemed complete 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 functionality, Laplace diagrams or other suitably understandable information. 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 choose to provide the **TSO** with **Model** source code. The **Models** shall be provided in a software format as specified by the **TSO**. Alternatively, the **User** may provide an unambiguous reference to a standard open-source **Model**, such as a standard IEEE **Model**, or to a **Model** previously submitted to the **TSO** provided this **Model** accurately reflects the **Users** **Plant** and **Apparatus** at the **Connection** **Point**.

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 undue delay.

PC.D5 CONFIDENTIALITY

The **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 **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 **Models**, supporting documentation and associated data to the **TSO**. Where it is not possible for the **User** to provide the **Models**, supporting documentation and associated data to the **TSO**, the **TSO** will accept the **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 **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**.

The **User** shall provide the **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

The **Models** provided to the **TSO** must be validated. The **TSO** must be satisfied that behaviour shown by the **Model** under simulation conditions is representative of the **Users** **Plant** and **Apparatus** under equivalent conditions.

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

Post **Commissioning/Acceptance** **Testing** the **User** shall complete dynamic simulations using the **Models** such that responses shown by the **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 **Models** are not representative of the **Users** **Plant** and **Apparatus,** the **User** shall provide updated **Models**, supporting documentation and associated data to ensure the responses shown by the **Models** is representative of the responses shown by **Users** **Plant** and **Apparatus** during **Commissioning/Acceptance Testing**.

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**.

In the event the **TSO** identifies that the response of the **Models** are not representative of the **Users** **Plant** and **Apparatus**, the **TSO** shall notify the **User**. The **User** shall provide the revised **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**, or as otherwise agreed with the **TSO**.

In the event of the **User** modifying hardware/software which affects the control and/or operation of the **Users** **Plant** and **Apparatus**, the **User** shall provide the **TSO** with updated **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

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, namely software version and/or compiler version. 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 defined by the **TSO**. Changes in the software format requirements for **Models** shall be subject to the **Grid** **Code** amendments process defined in GC.6.5 and the **TSO** **Licence**.

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.

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| --- | --- | --- |
| DATA DESCRIPTION | UNITS | DATA CATEGORY |
| Modelling Data  Modelling data of the **Users** **Plant** and **Apparatus** at the **Connection** **Point** in accordance with PC.A2.1.4 and PC.B2.1.3  **User System** layout  Single line diagrams of existing and proposed arrangements of main **Plant** and **Apparatus** including:- |  | **SPD**  **SPD/DPD** |
| (i) busbar layouts  (ii) electrical circuitry (i.e. lines, cables, transformers, switchgear etc)  (iii) phasing arrangements  (iv) earthing arrangements  (v) switching facilities  (vi) operating voltages  (vii) numbering and nomenclature |  |  |
| Reactive Compensation Equipment  For all independently switched reactive compensation equipment on the **User's System** at 11kV and above, other than power factor correction equipment associated directly with the **User's Plant** and **Apparatus**, the following information is required:- |  |  |
| (i) type of equipment |  | **DPD** |
| (ii) capacitive and/or inductive rating or its operating range in **MVAr** | **Mvar** | **DPD** |
| (iii) details of any automatic control logic to enable operating characteristics to be determined |  | **DPD** |
| (iv) the point of connection to the **User's System** in terms of electrical location and voltage |  | **DPD** |
| Short Circuit Infeed to the **NI System** |  |  |
| The total short circuit infeeds calculated in accordance with good industry practice into the **NI System** from the **User System** at the **Connection Point**  as follows:- |  |  |
| (i) maximum 3-phase short circuit infeed including infeeds from any **Generating Plant** forming part of the **User's System** | MVA | **SPD/DPD** |
| (ii) additional maximum 3-phase short circuit infeed from induction motors via the **User's System** | MVA | **DPD** |
| (iii) minimum zero sequence impedance of the **User's System** at the **Connection Point** | % on 100 | **SPD/DPD** |
| Lumped System Susceptance |  |  |
| Details of equivalent lumped network susceptance of the **User's System** at nominal **Frequency** back to the connection with the **NI System**. 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 are regarded as part of the cable). It should not include:- | % on 100 | **DPD** |
| (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 |  |  |

|  |  |  |
| --- | --- | --- |
| Interconnection Impedance  For **User** interconnections which operate in parallel with the **NI System** and equivalent single impedance (resistance, reactance and shunt susceptance) of the parallel **User System**. If the impedance is, in the reasonable opinion of the **TSO**, low, the more detailed information in the equivalent or active part of the parallel **User System** may be requested. | % on 100 | **DPD** |
| **Demand** Transfer Capacity  Where the same **Demand** may be supplied from alternative **NI System** points of supply, the proportion of **Demand** normally fed from each **NI System** supply point and the arrangements (manual or automatic) for transfer under planned /fault **Outage** conditions shall be provided. Where the same **Demand** is supplied from different **User** supply points, then this information should be provided to all parties. |  | **DPD** |
| **System** Data  Each **User** with an existing or proposed **User System** connected at **High Voltage** shall provide the following details relating to that **High Voltage System:** |  |  |
| (i) circuit parameters for all circuits:- |  |  |
| rated voltage | kV | **DPD** |
| operating voltage | kV | **DPD** |
| positive phase sequence reactance | % on 100 | **DPD** |
| positive phase sequence resistance | % on 100 | **DPD** |
| positive phase sequence susceptance | % on 100 | **DPD** |
| zero phase sequence reactance | % on 100 | **DPD** |
| zero phase sequence resistance | % on 100 | **DPD** |
| zero phase sequence susceptance | % on 100 | **DPD** |
| (ii) Interconnecting transformers between the **User's** higher voltage system and the **User's** primary voltage system:- |  |  |
| rated MVA | MVA | **DPD** |
| voltage ratio |  | **DPD** |
| winding arrangement |  | **DPD** |
| positive sequence reactance (max, min, and nominal tap) | % on MVA | **DPD** |
| positive sequence resistance (max, min, and nominal tap) | % on MVA | **DPD** |
| zero sequence reactance | % on MVA | **DPD** |
| tap changer range | +% to -% | **DPD** |
| tap changer step size | % | **DPD** |
| tap changer type: on **Load** or off circuit |  | **DPD** |
| (iii) Switchgear, including circuit breakers, switch disconnectors and isolators on all circuits connected to the **Connection Point** including those at **Power Stations**:- |  |  |
| rated voltage | kV | **DPD** |
| operating voltage | kV | **DPD** |
| rated short circuit breaking current, 3-phase | kA | **DPD** |
| rated short-circuit breaking current, 1-phase | kV | **DPD** |
| rated load-breaking current, 3-phase | kA | **DPD** |
| DATA DESCRIPTION | UNITS | DATA CATEGORY |
| rated load-breaking current, 1-phase | kA | **DPD** |
| rated short-circuit marking current, 3-phase | kA | **DPD** |
| rated short-circuit making current, 1-phase | kA | **DPD** |
| **Protection** Data |  |  |
| The following information relates only to **Protection** which can trip or intertrip or close any **Connection Point** circuit breaker or any the **TSO** circuit breaker:- |  |  |
| (i) a full description, including estimated settings, for all relays and **Protection** systems installed or to be installed on the **User's System**; |  | **DPD** |
| (ii) a full description of any auto-reclose facilities installed or to be installed on the **User's System**, including type and time delays; |  | **DPD** |
| (iii) a full description, including estimated settings, for all relays and **Protection** systems installed or to be installed on the **Generating Unit Generator Transformer,** station transformer and their associated connections: |  | **DPD** |
| (iv) for **Generating Units** having (or intended to have) a circuit breaker on the circuit leading to the **Generator Terminals,** at the same voltage, clearance times for electrical faults within the **Generating Unit** zone; and |  | **DPD** |
| (v) the most probable fault clearance time for electrical faults on the **User's System** | m/Sec | **DPD** |
| **Earthing** Arrangements |  |  |
| Full details of the means of permanently connecting the **User System** to each, including impedance values. |  | **DPD** |
| Transient Overvoltage Assessment Data |  |  |
| When requested by the **TSO**, each **User** is required to submit estimates of the surge impedance parameters present and forecast of its **User System** with respect to the **Connection Point** and to give details of the calculations carried out. The **TSO** may further request information on physical dimensions of electrical equipment and details of the specification of **Apparatus** directly connected to the **Connection Point** and its means of **Protection**. |  | **DPD** |
| **User's System Demand (Active** and **Reactive Power)**  Forecast daily **Demand** profiles net of the output profile of all **Generating Plant**  directly connected to the **User's System** in time marked half hours throughout the day as follows:- |  |  |
| (a) peak day on the **User's System** | **MW/Mvar** | **SPD/DPD** |
| (b) day of peak **Demand (Active Power)** | **MW** | **DPD** |
| (c) day of minimum **Demand (Active Power)** | **MW** | **DPD** |
| **User Customer Demand Management Data** |  |  |
| The potential reduction in **Demand** available from the **User** in **MW** and **MVAr**, 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. | **MW/Mvar**  + text | **DPD** |
| **Conversion Factor** Data  The figures described as “fixed unit load” and “unit load scalar” under the **TSC**, which are the figures submitted by a **Generator** or an **Intermediary** on its behalf pursuant to the “net output function” provisions of the **TSC**.  **Additional Conversion Factor** Data  For Kilroot and Ballylumford **Power Stations**, the different configurations at which the **Power Stations** may operate and which can affect the **Conversion Factors**, such configurations being submitted in the form set out at PC.A3.3.12. |  |  |