Dynamic Model Specifications for Users

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Foreword

This Document has been prepared by EirGrid and SONI to describe to Users the usability guidelines and software specifications that shall be employed for dynamic models provided to the TSOs as part of the Grid Code requirements for model provision.

The Grid Code modifications have proposed the updating of requirements for Users of the Transmission System in Ireland and Users connected to or applying for a new or modified connection to the Transmission System or Distribution System in Northern Ireland. Clause PC.A8.8/PC.D8 specifies that Users shall provide dynamic models of the Users Plant in the software environment specified by the TSOs. This document aims to outline the software environments that the TSOs require and also the specific usability guidelines to be considered when submitting the Users models. The document is intended to be read in conjunction with Grid Code. Terms used in the document are in line with those specified in the Grid Code.

The document has been prepared, solely, for the assistance of existing and prospective Users connecting directly to the Transmission System in Ireland and any User connected to or wishing to apply for a new or modified connection to the Transmission System or Distribution System in Northern Ireland. In the event of dispute, the Grid Code will take precedence over these notes. This document may be modified from time to time to reflect changes in the Grid Code or the TSOs modelling requirements.

For any queries in relation to Grid Code compliance or specific questions in relation to modelling please contact the relevant TSO.

Introduction

This document is to be used in conjunction with the Ireland and Northern Ireland Grid Codes and is designed to supplement the specifications outlined in clause PC.A8/PC.D for dynamic models.

Users applying for connection to the Transmission System must provide the TSOs with relevant dynamic models and supporting documentation. This document provides guidelines on usability standards for models provided by the User to the TSOs and also specifies the software formats for the User models. The TSOs may amend the content of this document from time to time and will publish the document with any updates on the TSOs' website.

The specifications for dynamic models outlined in this document are applicable to all Users irrespective of technology type. Users should adhere to these guidelines when developing models of their Plant which will be submitted to the TSO. It is intended that the specifications described in this document are sufficient however the TSO may require further model revision in some cases in order to integrate the Users model into the TSOs' full system model. In this event the User may need to resubmit the model to address the issues that may arise.

In the event that changes in the software versions employed by the TSOs results in the Users model ceasing to function appropriately, it is the responsibility of the User to update and resubmit the model of the Users Plant. The TSOs will update and publish this document with any changes to the software environment on the TSOs' website.

Software Environment

As specified in Grid Code clause PC.A8/PC.D, the User must provide models suitable for balanced, root mean-square, positive phase-sequence, time-domain studies and three-phase, electromagnetic transient simulations. The models are to be provided in software formats as defined by the TSOs. Details of the required software formats, current software versions, computer platform, compiler version etc, are specified by the TSOs in this document. The TSOs may from time to time update these specifications and request that the models be updated to be compatible with changes in the TSOs' computing environment. Each User shall ensure that such updated models are provided without undue delay or in any event, within 30 Business Days of the date of the request. Changes in the software format requirements for models outlined in this document shall be subject to the Grid Code revision process defined in GC.7. Specifications for models provided in each of the software environments required by the TSOs are described in the following sections.

Siemens PTI PSS/e

The models provided for Siemens PTI PSS/E shall be capable of representing the behaviour of the Users Plant in balanced, root mean square positive phase sequence time domain studies as outlined in Grid Code clause PC.A8.2/PC.D5.The models shall be compiled using standard PSS/E library models or where required, user defined models written in Fortran or FLECS code. Where user defined models have been submitted the User must provide the TSO with the relevant documentation for the model. Pre-compiled black box models of the User's Plant must be accompanied with the appropriate documentation which may include model source code.

External software or automation routines to initialise and integrate the model are unacceptable. Where information provided in the models is designated as confidential the User shall provide the models in accordance with Grid Code clause PC.A8.4/PC.D5. Models in PSS/E format shall include DYRE files, compiled user models and associated documentation in accordance with Grid Code clause PC.A8.3/PC.D4. Models must not require a simulation time step of less than 5ms. The model shall be compatible with PSS/E v32.

DIgSILENT PowerFactory

The models provided for DIgSILENT PowerFactory must be compatible with all simulation methods within the package including balanced, root mean-square and three-phase electromagnetic transient studies as outlined in Grid Code clause PC.A8.2/PC.D3. The models shall be compiled using standard PowerFactory library models or where required user defined models written in DSL code including all blocks, frames, types and elements. Where user defined models have been submitted the User must provide the TSO with the relevant documentation for the model. Pre-compiled black box models of the User's Plant must be accompanied with the appropriate documentation which may include model source code.

External software or automation routines to initialise and integrate the model are unacceptable. Where information provided in the models is designated as confidential the User shall provide the models in accordance with Grid Code clause PC.A8.4/PC.D5. Models in PowerFactory format shall include DSL code, compiled user models and associated documentation in accordance with Grid Code clause PC.A8.3/PC.D4. Models must not require a simulation time step of less than 0.1ms. The model shall be compatible with PowerFactory v15.0.

Optional Software: PowerTech DSA Tools TSAT

In addition to the software formats described above the TSOs also utilise PowerTech DSA Tools TSAT. The TSOs will therefore accept models of the Users Plant in this format in addition to the formats listed above if the User has models in this format available. The User is not obliged under the Grid Code requirements to provide this format but shall provide it if it is available.

The models provided for PowerTech DSA Tools TSAT shall be capable of representing the behaviour of the Users Plant in balanced, root mean square positive phase sequence time domain studies as outlined in Grid Code clause PC.A8.2/PC.D3.The models shall be compiled using standard TSAT library models or where required user defined models written in UDM code. Where user defined models have been submitted the User must provide the TSO with the relevant documentation for the model. Pre-compiled black box models of the User's Plant must be accompanied with the appropriate documentation which may include model source code.

External software or automation routines to initialise and integrate the model are unacceptable. Where information provided in the models is designated as confidential the User shall provide the models in accordance with Grid Code clause PC.A8.4/PC.D5. Models in TSAT format shall include dynamic data files, compiled user models and associated documentation in accordance with Grid Code clause PC.A8.3/PC.D4. Models must not require a simulation time step of less than 5ms. The model shall be compatible with TSAT v12.

Model Usability Guidelines

All models provided to the TSO must be usable. Models shall be intuitive, practical and not cause simulation problems. Models shall be suitable for inclusion in automated software.
The practical usability considerations include but are not limited to the following;

- Model technical parameters shall be consistent with the real physical values and the actual performance of the Plant. This information shall be provided either on the appropriate per unit base or in physical units.
- The model shall be consistent and understandable. For example, in the case of an Interconnector, the model shall include a HVDC line with associated power electronics and auxiliary equipment. It is unacceptable to represent an Interconnector as two unrelated generators.
- The parameter ranges of the model (e.g. real and reactive power limits and range of allowable operating voltages) shall be consistent between load-flow and dynamic models and shall be representative of the actual Users Plant.
  - The User shall specify the allowable operating ranges for the model of the User's Plant. This shall include real and reactive power limits and allowable voltage ranges. These limits shall be consistent with the limits for the actual Plant.
  - Both the load-flow and dynamic models shall solve provided that the Plant is operated within these ranges, including operation at the limit of the parameter range (e.g. operating at max reactive power).
  - The combined load-flow and dynamic model shall solve without the need for manual intervention. It is unacceptable for models to require manual adjustment before the simulation will solve or solve without warnings. The models shall account for loss adjustment between the load-flow and dynamic cases.
  - The model shall be self contained. The combined load-flow and dynamic model shall solve without the need to run external software routines that adjust parameters in either the load-flow case or the dynamic case or both.
- Certain types of equipment do not function correctly at low short circuit levels. In addition, certain models do not correctly represent the behaviour of their equipment at low short circuit levels. The model documentation shall clarify the range of short circuit levels for which the model is expected to perform to expected equipment behaviour. If it is the case that the model will not represent performance problems under a range of network conditions at the connection point, then the User shall address this by providing a supplementary model for specific conditions. All information on the model capabilities shall be addressed in the model documentation provided to the TSO.
- The model shall not fill the progress monitoring files with content that is not relevant to monitoring the technical behaviour of the dynamic simulation. It is not acceptable to include legal disclaimers in the progress monitoring files. Models shall not spuriously report to the monitoring file during normal operation. Models that experience instability during simulation should report to the progress monitoring file.
- Models shall interface with the host software in a manner that is consistent with the behaviour of standard library models.
  - Models shall report standard variables including Active Power for the duration of the simulation.
  - In the case where the User's Plant trips during simulation, the relevant models shall set the flag that indicates that the User's Plant has tripped.
- It is not acceptable for the model to crash catastrophically and provide no documentary evidence as to why the simulation failed.