Registered Characteristics

[Insert Unit Name]

Version 0.1



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# IPP TEST PROCEDURE VERSION History

|  |
| --- |
| **Document Revsion History** |
| **Revision**  | **Date** | **Comment** | **Name** | **Company** |
| 0.1 | Xx/xx/xxxx | XX | User | User |
|  |  |  |  |  |
| 1.0 | Xx/xx/xxxx | Revised to Major version for onsite testing and signoff |  | EirGrid |

1. **Introduction**

The Unit must submit the latest version of this test procedure as published on the EirGrid website[[1]](#footnote-1).

This test forms an appendix to the Operational Certificate for which a generator is obliged to update the connection agreement as appropriate based on tested values. If any requirements are unclear, or if there is an issue please contact generator\_testing@eirgrid.com.

It is expected that the Generator provides Diagrams and Graphs with clear legend and formatting and updated models as required. Such information shall be included within the appendix to this document.

# Abbreviations

AGC Automatic Generator Control

HV High Voltage

LV Low Voltage

Mvar Mega Volt Ampere – reactive

MW Mega Watt

NCC National Control Centre

TSO Transmission System Operator

# Unit DATA

|  |  |
| --- | --- |
| Unit name | Unit to Specify |
| Associated 110 kV Station | Unit to Specify |
| Unit connection point | Unit to Specify(*i.e.* T121 HV bushings) |
| Unit connection voltage | Unit to Specify |
| Registered Capacity | Unit to Specify |
| Contracted MEC | Unit to Specify |
| Installed Plant | Unit to Specify |
| Primary Fuel Type | Unit to Specify |
| Secondary Fuel Type | Unit to Specify |

# Grid Code References

PC.A4: Generator Data Requirements

 PC.A4.1 General Details

 PC.A4.3 Generator Operating Characteristics and Registered Data

 PC.A4.4 Generator Parameters

 PC.A4.5 Excitation System

 PC.A4.6 Speed Governor System

PC.A4.7 Control Devices (including Power System Stabilisers) and Protection Relays

 PC.A4.8 Environmental Impact

 PC.A4.9 Pumped Storage

 PC.A4.11 Generator Transformer

 PC.A4.12 Generator Forecast Data

# Requirements

## PC.A4.1 General Details

Each Generator shall submit to EirGrid detailed information as required to plan, design, construct and operate the Transmission System.

|  |  |
| --- | --- |
| Station Name | Unit to Specify |
| Number of Generating units | Unit to Specify |
| Primary Fuel Type / Prime Mover (e.g. gas, hydro etc.) | Unit to Specify |
| Secondary Fuel Type (e.g. oil) | Unit to Specify |
| Generation Export Connection Capacity Required (MW) | Unit to Specify |

## PC.A4.3 Generator Operating Characteristics and Registered Data

Minimum requirements for generator operating conditions are specified in the **Connection Conditions.**

|  |  |  |
| --- | --- | --- |
| **Description** | **Type** | **Provided** |
| For thermal plant, provide a functional block diagram of the main plant components, showing boilers, alternators, any heat or steam supplies to other processes etc. Indicate whether single shaft or separate shaft. | Diagram | Yes/No |
| Capability Chart showing full range of operating capability of the generator including thermal and excitation limits | Diagram | Yes/No |
| Open Circuit Magnetisation Curves | Graph | Yes/No |
| Short Circuit characteristic | Graph | Yes/No |
| Zero power factor curve | Graph | Yes/No |
| V curves | Diagram | Yes/No |

For each individual unit, on Primary Fuel and on Secondary Fuel where applicable, fill in the following:

|  |  |
| --- | --- |
| Unit Number | Unit to Specify  |
| Registered Capacity (MW) | Unit to Specify |
| Fuel  | Unit to Specify |

|  |  |  |
| --- | --- | --- |
| **Operating Characteristics** | **Units** | **Actual** |
| Normal Maximum Continuous Generation Capacity (per Registered Capacity test) | MW | Unit to Specify |
| Normal Maximum Continuous Export Capacity (per Registered Capacity test) | MW | Unit to Specify |
| Primary Fuel Switchover Output | MW | Unit to Specify |
| Secondary Fuel Switchover Output | MW | Unit to Specify |
| Power Station auxiliary load (per Registered Capacity test) | MW | Unit to Specify |
| Power Station auxiliary load (per Registered Capacity test) | Mvar | Unit to Specify |
| Maximum (Peaking) Generating Capacity | MW | Unit to Specify |
| Maximum (Peaking) Export Capacity | MW | Unit to Specify |
| Normal Minimum Continuous Generating Capacity (per Minimum Load test) | MW | Unit to Specify |
| Normal Minimum Continuous Export Capacity (per Minimum Load test) | MW | Unit to Specify |
| Generator Rating | MVA | Unit to Specify |
| Normal Maximum Lagging Power Factor | Mvar | Unit to Specify |
| Normal Maximum Leading Power Factor | Mvar | Unit to Specify |
| Governor Droop |  | Unit to Specify |
| Forbidden zones | MW | Unit to Specify |
| Terminal Voltage adjustment range | kV | Unit to Specify |
| Short Circuit Ratio |  | Unit to Specify |
| Rated Stator Current | Amps | Unit to Specify |
| Number of available hours of running at Registered Capacity from on-site fuel storage stocked to its full capacity |  | Unit to Specify |
| Time to synchronise from warm | Hour | Unit to Specify |
| Time to synchronise from cold | Hour | Unit to Specify |
| Minimum up-time | Hour | Unit to Specify |
| Minimum down-time | Hour | Unit to Specify |
| Normal loading rate | MW/min | Unit to Specify |
| Normal deloading rate | MW/min | Unit to Specify |
| Can the generator start on each fuel | Yes/No | Unit to Specify |
| Ability to change fuels on-load | Yes/No | Unit to Specify |
| Available modes (lean burn, etc.) |  | Unit to Specify |
| Time to change modes on-load | Minute | Unit to Specify |
| Control range for **AGC** operation | MW | Unit to Specify |
| Other relevant operating characteristics not otherwise provided |  | Unit to Specify as applicable |

|  |  |  |
| --- | --- | --- |
| **Reserve Capability** | **Units** | **Actual** |
| Primary Spinning Reserve | MW | Unit to Specify |
| Secondary Spinning Reserve | MW | Unit to Specify |
| Tertiary Reserve 1 | MW | Unit to Specify |
| Tertiary Reserve 2 | MW | Unit to Specify |
| Reserve Capability of Generator in different operating modes: |
| Unit co-ordinating | MW | Unit to Specify |
| Turbine follow | MW | Unit to Specify |
| Recirculation | MW | Unit to Specify |
| Base Load | MW | Unit to Specify |
| Other | MW | Unit to Specify |
| Reserve when unit is off load | MW | Unit to Specify |

**CCGT Installation Matrix**

Delete references to CCGT as appropriate.

This matrix is a look up table determining which **CCGT Unit** will be operating at any given MW **Dispatch** level. This information will be applied for planning purposes and for scheduling, **Dispatch** and control purposes as covered in the **SDC**s unless by prior agreement with the **TSO.**

As an example of how the matrix might be filled out, consider a sample unit with a total capacity of 400 MW made up of two 150 MW combustion turbines and one 100 MW steam turbine. In this case, the following ranges might be specified

0 MW to 50 MW GT1

50 MW to 170 MW GT1 and ST

170 MW to 400 MW GT1 and GT2 and ST

Please insert MW ranges and tick the boxes to indicate which units are synchronised to deliver each MW range at the following atmospheric conditions: Temperature 10°C, Pressure 1.01 bar and 70% Humidity.

|  |  |
| --- | --- |
| **CCGT INSTALLATION** | **CCGT UNIT AVAILABLE** |
| **OUTPUT USABLE** | 1st GT | 2nd GT | 3rd GT | 1st ST | 2nd ST | 3rd ST |
|  | **OUTPUT USABLE** |
| **Unit MW Capacity** →  | Unit to Specify e.g. 150 | Unit to Specify 150 | Unit to Specify - | Unit to Specify 100 | Unit to Specify - | Unit to Specify - |
|

|  |
| --- |
| **Total MW Output Range ↓** |

 |  |
| **[ ] MW to [ ] MW** | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify |
| **[ ] MW to [ ] MW** | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify |
| **[ ] MW to [ ] MW** | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify |
| **[ ] MW to [ ] MW** | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify |
| **[ ] MW to [ ] MW** | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify |
| **[ ] MW to [ ] MW** | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify | Unit to Specify |

## PC.A4.4 Generator Parameters

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Symbol** | **Units** | **Actual** |
| Direct axis Synchronous reactance |  | % on rating | Unit to Specify |
| Direct axis Transient reactance saturated |  | % on rating | Unit to Specify |
| Direct axis Transient reactance unsaturated |  | % on rating | Unit to Specify |
| Sub-transient reactance unsaturated |  | % on rating | Unit to Specify |
| Quad axis Synchronous reactance |  | % on rating | Unit to Specify |
| Quad axis Transient reactance unsaturated |  | % on rating | Unit to Specify |
| Negative Phase Sequence Synchronous reactance |  | % on rating | Unit to Specify |
| Zero Phase sequence reactance |  | % on rating | Unit to Specify |
| Turbine generator Inertia constant for entire rotating mass | H | MW s/MVA | Unit to Specify |
| Stator resistance | Ra | % on rating | Unit to Specify |
| Stator Leakage reactance | XL | % on rating | Unit to Specify |
| Poiter reactance | XP | % on rating | Unit to Specify |

|  |  |  |  |
| --- | --- | --- | --- |
| **Generator Time Constraints** | **Symbol** | **Units** | **Actual** |
| Direct axis open Circuit Transient | Tdo’ | sec | Unit to Specify |
| Direct axis open Circuit sub-Transient | Tdo’’ | sec | Unit to Specify |
| Quad axis open Circuit Transient | Tqo’ | sec | Unit to Specify |
| Quad axis open Circuit sub-Transient | Tqo’’ | sec | Unit to Specify |
| Direct axis short Circuit Transient | Td’ | sec | Unit to Specify |
| Direct axis short Circuit sub-Transient | Td’’ | sec | Unit to Specify |
| Quad axis short Circuit Transient | Tq’ | sec | Unit to Specify |
| Quad axis short Circuit sub-Transient | Tq’’ | sec | Unit to Specify |

## PC.A4.5 Excitation System

Fill in the following parameters **or** supply a Laplace-domain control block diagram in accordance with IEEE standard excitation models (or as otherwise agreed with the **TSO**) completely specifying all time constants and gains to fully explain the transfer function from the compensator or generator terminal voltage and field current to generator field voltage.

|  |  |  |  |
| --- | --- | --- | --- |
| **Description** | **Symbol** | **Units** | **Actual** |
| Excitation system type (AC or DC) |  | Text | Unit to Specify |
| Excitation feeding arrangement (solid or shunt) |  | Text | Unit to Specify |
| Excitation system Filter time constant | Tr | sec | Unit to Specify |
| Excitation system Lead time constant | Tc | sec | Unit to Specify |
| Excitation system Lag time constant | Tb | sec | Unit to Specify |
| Excitation system Controller gain | Ka |  | Unit to Specify |
| Excitation system controller lag time constant | Ta | sec | Unit to Specify |
| Excitation system Maximum controller output | Vmax | p.u. | Unit to Specify |
| Excitation system minimum controller output | Vmin | p.u. | Unit to Specify |
| Excitation system regulation factor | Kc |  | Unit to Specify |
| Excitation system rate feedback gain | Kf |  | Unit to Specify |
| Excitation system rate feedback time constant | Tf | sec | Unit to Specify |

## PC.A4.6 Speed Governor System

|  |  |  |
| --- | --- | --- |
| **Description** | **Type** | **Provided** |
| Supply a Laplace-domain control block diagram in accordance with IEEE standard prime mover models for thermal and hydro units (or as otherwise agreed with EirGrid) completely specifying all time constants and gains to fully explain the transfer function for the governor in relation to frequency deviations and setpoint operation.  | Diagram | Yes/No |

##  PC.A4.7 Control Devices (Including Power System Stabilisers) and Protection

|  |  |  |
| --- | --- | --- |
| **Description** | **Type** | **Provided** |
| Please supply any additional Laplace domain control diagrams for any outstanding control devices or special protection relays in the generating unit, which automatically impinge on its operating characteristics within 30 seconds following a system disturbance and which have a minimum time constant of at least 0.02 seconds. | Diagram | Yes/No |

## PC.A4.8 Environmental Impact

|  |  |  |
| --- | --- | --- |
|  |  | **Value** |
| CO2 | tonne CO2 / tonne fuel | Unit to Specify |
|  | Unit CO2 removal efficiency | Unit to Specify |
| SO2 | tonne SO2 / tonne fuel | Unit to Specify |
|  | Unit SO2 removal efficiency | Unit to Specify |
| NOX | tonne NOX / exported MWh curve | Unit to Specify |

##  PC.A4.9 Pumped Storage

Delete references to Pumped Storage as appropriate.

|  |  |  |
| --- | --- | --- |
|  | **Units** | **Value** |
| Reservoir Capacity | MWh pumping | Unit to Specify |
| Max Pumping Capacity | MW | Unit to Specify |
| Min Pumping Capacity | MW | Unit to Specify |
| Efficiency (generating/pumping ratio) | % | Unit to Specify |

## PC.A4.11 Generator Transformer

|  |  |  |
| --- | --- | --- |
|  | **Units** | **Value** |
| Number of windings |  | Unit to Specify |
| Vector Group |  | Unit to Specify |
| Rated current of each winding | Amps | Unit to Specify |
| Transformer Rating | MVATrans | Unit to Specify |
| Transformer nominal LV voltage | kV | Unit to Specify |
| Transformer nominal HV voltage | kV | Unit to Specify |
| Tapped winding |  | Unit to Specify |
| Transformer Ratio at all transformer taps |  | Unit to Specify |
| Transformer Impedance at all taps[[2]](#footnote-2)1 | % on rating MVATrans | Unit to Specify |
| Transformer zero sequence impedance at nominal tap | Ohm | Unit to Specify |
| Earthing Arrangement including neutral earthing resistance & reactance |  | Unit to Specify |
| Core construction (number of limbs, shell or core type) |  | Unit to Specify |
| Open circuit characteristic | Graph | Unit to Specify |

## PC.A4.12 Generator Forecast Data[[3]](#footnote-3)

### PC.A4.12.1 Expected Maintenance Requirements

|  |  |  |
| --- | --- | --- |
|  | **Unit** | **Number** |
| Expected Maintenance Requirements | Weeks/Year | Unit to Specify |

### PC.A4.12.2 Forecast Availability of Registered Capacity

|  |  |  |  |
| --- | --- | --- | --- |
| **Availability of Registered Capacity** | **Reason** | **Available Exported MW** | **Time %** |
| Registered Capacity | Unit to Specify | Unit to Specify | Unit to Specify |
| Restricted Rating | Unit to Specify | Unit to Specify | Unit to Specify |
| Forced Outage Probability | Unit to Specify | Unit to Specify | Unit to Specify |
| Total | Unit to Specify |

Reasons for restricted rating might include poor fuel, loss of mill, loss of burners, hydro flow restrictions, etc.

### PC.A4.12.3 Energy Limitations

|  |  |  |
| --- | --- | --- |
|  | **Units** | **Value** |
| Daily |  | Unit to Specify |
| Weekly  |  | Unit to Specify |
| Monthly |  | Unit to Specify |
| Annual |  | Unit to Specify |

### PC.A4.12.4 Hydro Expected Monthly GWh

|  |  |  |
| --- | --- | --- |
|  | **Units** | **Value** |
| January | GWh | Unit to Specify |
| February | GWh | Unit to Specify |
| March | GWh | Unit to Specify |
| April  | GWh | Unit to Specify |
| May | GWh | Unit to Specify |
| June | GWh | Unit to Specify |
| July | GWh | Unit to Specify |
| August | GWh | Unit to Specify |
| September | GWh | Unit to Specify |
| October | GWh | Unit to Specify |
| November | GWh | Unit to Specify |
| December | GWh | Unit to Specify |

Delete references to Hydro as appropriate

# appendix

Unit to provide diagrams, graphs and supplementary information as required.

1. <http://www.eirgridgroup.com/library/index.xml> [↑](#footnote-ref-1)
2. 1 For Three Winding Transformers the HV/LV1, HV/LV2 and LV1/LV2 impedances together with associated bases shall be provided. [↑](#footnote-ref-2)
3. <http://www.eirgridgroup.com/library/index.xml> [↑](#footnote-ref-3)