Steady-State Reactive Power (SSRP)

System Services Test Procedure

Interconnector

Unit Name

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# Document Version History

Revision 3.0 published 12th November 2019

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Version** | **Date** | **Comment** | **Name** | **Company** |
| 0.1 | Insert Date | Minor version (v0.1) - First submission for review and approval | Insert Name | Unit Company Name |
| 1.0 | Insert Date | Revised to version 1.0 following approval by EirGrid, SONI.  | Insert Name | Unit Company Name |

# Introduction

The Unit shall submit the latest version of this test procedure as published on the EirGrid or SONI websites[[1]](#footnote-1).

All yellow sections shall be filled in before the test procedure will be approved. All grey sections shall be filled in during testing. If any test requirements or steps are unclear, or if there is an issue with meeting any requirements or carrying out any steps, please contact generator\_testing@eirgrid.com or  generator\_testing @soni.ltd.uk

On the day of testing, suitably qualified technical personnel are required on site to assist in undertaking the tests. The personnel shall have the ability to:

1. Set up and disconnect the control system and instrumentation as required;
2. Ability to fully understand the Unit’s function and its relationship to the System;
3. Liaise with NCC, CHCC as required;
4. Mitigate issues arising during the test and report on system incidents.

The availability of personnel at NCC, CHCC will be necessary in order to initiate the necessary instructions for the test. NCC, CHCC will determine:

1. If network conditions allow the testing to proceed.
2. Which tests will be carried out
3. When the tests will be carried out.

On completion of this test, the following shall be submitted to generator\_testing@eirgrid.com or  generator\_testing @soni.ltd.uk:

|  |  |
| --- | --- |
| **Submission** | **Timeline** |
| A scanned copy of the test procedure, as completed and signed on site on the day of testing | 1 working day |
| Test data in CSV or Excel format | 1 working day |
| Test report | 10 working days |

# Abbreviations

NCC National Control Centre

CHCC Castlereagh House Control Centre

SSRP Steady-State Reactive Power

MVAr Mega Volt Ampere – reactive

MW Mega Watt

TSO Transmission System Operator

MEC Maximum Export Capacity

MIC Maximum Import Capacity

kV kilovolt

Hz Hertz – unit of frequency

SVC Static Var compensator

Qrange, Import  Maximum MVAr range (leading and lagging) at the connection point when importing.

Qrange, Export  Maximum MVAr range (leading and lagging) at the connection point when exporting.

Prange, Import Active power range (from Registered MW Minimum to Registered MW Maximum) at the connection point when exporting.

Prange, Export Active power range (from Registered MW Minimum to Registered MW Maximum) at the connection point when exporting.

PMax Export Registered Export Capacity (MW) at connection point.

PMin Export Minimum Export Load (MW) at connection point.

PMax Import Registered Import Capacity (MW) at connection point.

PMin Import Minimum Import Load (MW) at connection point.

QMax, Import Maximum Lagging MVAr achieved at the connection point when importing.

QMax, Export Maximum Lagging MVAr achieved at the connection point when exporting.

QMin, Import Minimum Leading MVAr achieved at the connection point when importing.

QMin, Export Minimum Leading MVAr achieved at the connection point when exporting.

# Unit DATA

|  |  |
| --- | --- |
| Unit test coordinator | Unit to Specify Name, Company and contact details. |
| Unit name | Name:\_\_\_\_\_\_\_\_\_ |
| Unit connection point | HV Bushings of T101 in XX 110kV station |
| Unit connection voltage | \_\_\_\_\_\_\_\_kV |
| Interconnector registered import capacity | \_\_\_\_\_\_\_\_\_\_\_MW |
| Interconnector registered export capacity | \_\_\_\_\_\_\_\_\_\_\_MW |
| Interconnector minimum import load | \_\_\_\_\_\_\_\_\_\_\_MW |
| Interconnector minimum export load | \_\_\_\_\_\_\_\_\_\_\_MW |
| Contracted MEC | \_\_\_\_\_\_\_\_\_\_\_MW |
| Contracted MIC | \_\_\_\_\_\_\_\_\_\_\_MW |
| Installed plant | Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_MVA Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_MW |
| Mode of operation  | Import / ExportSVC |

Interconnector shall insert Active and Reactive Power Capability (PQ) chart for Import and Export Modes.

The PQ chart shall include the capability of the unit for the applicable voltage range:

For Ireland:

* 400kV system: 350kV to 420kV
* 220kV system: 200kV to 245kV
* 110kV system: 99kV to 123kV

For Northern Ireland:

* 275kV System: 247.5kV to 302.5kV
* 110kV System: 99kV to 121kV



# System Services

The definitions referenced in this document are for indicative purposes only. In the event of inconsistency between the definitions in this document and those in the DS3 System Services Agreement, the definitions in the DS3 System Services Agreement shall prevail.

## Steady-State Reactive Power

SSRP is defined as the dispatchable reactive power range (QRange) in MVAr that can be provided across the full range of active power output (PRange).

##  Reactive Power Factor calculation

$$RP Factor= \frac{Power Output Range \left(P\_{Range}\right) across which reactive power can be provided}{Registered Capacity}$$

$$SRP Volume= Q\_{Range} x RP Factor$$



Figure : Example graph showing the P and Q ranges. Min Load is shown as the bottom blue line (Pmin).

# Site safety requirements

The following is required for the EirGrid, SONI witness to attend site:

|  |  |
| --- | --- |
| Personal Protective Equipment Requirements1. Site Safety boots
2. Hard Hat with chin strap
3. Hi Vis
4. Arc Resistive clothing
5. Safety Glasses
6. Gloves
7. Safe Pass
 | 1. Yes / No
2. Yes / No
3. Yes / No
4. Yes / No
5. Yes / No
6. Yes / No
7. Yes / No
 |
| Site Induction requirements | Yes / No (If Yes, Unit to specify how and when the induction shall carried out) |
| Any further information | Unit to specify |

# Test Purpose and pre conditions

## Test Purpose

This test is to demonstrate the capability of the reactive power curve for the unit. The test will verify the following values:

1. Import Mode
2. PMin Import, QMin Leading
3. PMax Import , QMin Leading
4. PMax Import , QMax Lagging
5. PMin Import, QMax Lagging
6. Export Mode
7. PMin Export, QMin Leading
8. PMax Export , QMin Leading
9. PMax Export , QMax Lagging
10. PMin Export, QMax Lagging

## Pre Conditions

Should “No” be answered to any of the following, contact the EirGrid, SONI Test Coordinator and agree next steps in advance of making any corrective actions.

|  |  |  |
| --- | --- | --- |
| **No.** | **Conditions** | **Check on day of test** |
| 1 | Test Profiles have been submitted and approved by near time. | Yes/No |
| 2 | Frequency Response mode On / Off. | Yes/No |
| 3 | Unit is on load and stable in agreement with NCC, CHCC. | Yes/No |
| 4 | Normal start up support auxiliary systems are aligned and in service. | Yes/No |
| 5 | Grid Connected Transformer Tap range | Tap range: \_\_\_\_ to \_\_\_\_ |
| 6 | Size of MVAr step changes agreed with NCC/ CHCC Transmission Desk (*e.g.* 5 MVAr) | \_\_\_\_ MVAr |
| 7 | Required signals, as described in section 8 are available. | Yes/No |

# Instrumentation and onsite data trending

All of the following trends shall be recorded by the Unit during the test. Failure to provide any of these trends will result in test cancellation.

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Data Trending and Recording** | **Resolution** | **Check On Day Of Test** |
| 1 | Active power at Connection (MW) | Unit to specify, 1s or as agreed with TSO | Yes/No |
| 2 | Reactive power at Connection point (MW) | Unit to specify, 1s or as agreed with TSO | Yes/No |
| 3 | System Voltage  | Unit to specify, 1s or as agreed with TSO | Yes/No |
| 4 | System Frequency | Unit to specify, 1s or as agreed with TSO | Yes/No |
| 5 | Other signals as required by the unit or by generator\_testing@eirgrid.com or  generator\_testing @soni.ltd.uk. | Unit to specify | Yes/No |
| 6 | Alarm/Event page | Screenshot alarms/events for duration of the test.  |
| 7 | Generator Overview Screen | Screenshot at appropriate milestones during the test i.e. Before, during at regular intervals and after test from generator overview page on DCS |

# Test Steps

The sequence of the tests may vary due to system conditions and shall be agreed and updated within the procedure based on EirGrid, SONI feedback.

## PMin Import, QMin Leading

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 8. |  |  |
| 2 | Unit operator contacts NCC, CHCC and requests permission to begin test and a dispatch instruction to [insert PMin Import]MW.. |  | Import Capacity: \_\_\_\_ MW |
| 3 | Unit operator receives instruction, dispatches the Unit to [insert PMin Import]MW and allows the Unit to stabilise for 10 mins. |  |  |
| 4 | With the Unit at [insert PMin Import] the Unit operator contacts NCC, CHCC and requests permission to adjust the Leading (exporting) MVARs to the rated value for the Interconnector. The Unit Operator shall allow the Unit to stabilise for each change of state. |  | Agreed MVAr steps agreed with NCC, CHCC:\_\_\_\_\_\_\_\_\_\_Achieved Max Lagging MVAr: \_\_\_\_\_\_\_\_ |
| 5 | With the Unit is stabilised at maximum lagging (exporting) MVARs and [insert PMin Import]MW, run for a minimum of 30 minutes. |  | Start time: \_\_\_\_\_End time: \_\_\_\_\_\_ |
| 6 | Unit operator contacts NCC, CHCC and informs them that the test is completed.Unit operator agrees MVAr dispatch with NCC, CHCC before proceeding to the next test.  |  |  |
| 7 | Unit operator ends data recording for all trends noted in section 8. |  |  |

## PMax Import, QMin Leading

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | Unit operator begins data recording for all trends noted in Section 8. |  |  |
| 2 | Unit operator contacts NCC, CHCC and requests permission to begin test and a dispatch instruction to Maximum MW Import. |  | Registered Import Capacity: \_\_\_\_ MW |
| 3 | Unit operator receives instruction, dispatches the Unit to Maximum MW Import and allows the Unit to stabilise for 10 mins. |  |  |
| 4 | With the Unit at Registered Capacity the Unit operator contacts NCC, CHCC and requests permission to adjust the Leading (importing) MVARs to the rated value for the Interconnector. The Unit Operator shall allow the Unit to stabilise for each change of state. |  | Agreed MVAr steps agreed with NCC, CHCC:\_\_\_\_\_\_\_\_\_\_Achieved Max Import Power: \_\_\_\_\_\_Achieved Min Leading MVAr: \_\_\_\_\_\_\_\_ |
| 5 | With the Unit stabilised at maximum Leading (importing) MVARs and Registered Capacity, run for a minimum of 30 minutes. |  | Start time: \_\_\_\_\_End time: \_\_\_\_\_\_ |
| 6 | Unit operator contacts NCC, CHCC and informs them that the test is completed. |  |  |
| 7 | Unit operator ends data recording for all trends noted in section 8. |  |  |

## PMax import, QMax lagging

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | Unit operator begins data recording for all trends noted in Section 8. |  |  |
| 2 | Unit operator contacts NCC, CHCC and requests permission to begin test and a dispatch instruction to Maximum MW Import Capacity. |  | Registered Import Capacity: \_\_\_\_ MW |
| 3 | Unit operator receives instruction, dispatches the Unit to Maximum MW Import Capacity and allows the Unit to stabilise for 10 mins. |  |  |
| 4 | With the Unit at Registered Capacity the Unit operator contacts NCC, CHCC and requests permission to adjust the Lagging (exporting) MVARs to the rated value for the Interconnector. The Unit Operator shall allow the Unit to stabilise for each change of state. |  | Agreed MVAr steps agreed with NCC, CHCC:\_\_\_\_\_\_\_\_\_\_Achieved Max Import Power: \_\_\_\_\_\_\_\_MWAchieved Max Lagging MVAr: \_\_\_\_\_\_\_\_MVAr |
| 5 | With the Unit is stabilised at maximum Lagging (exporting) MVARs and Registered Capacity, run for a minimum of 30 minutes. |  | Start time: \_\_\_\_\_End time: \_\_\_\_\_\_ |
| 6 | Unit operator contacts NCC, CHCC and informs them that the test is completed. |  |  |
| 7 | Unit operator ends data recording for all trends noted in section 8. |  |  |

## PMin Import, QMax Lagging

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | Unit operator begins data recording for all trends noted in Section 8. |  |  |
| 2 | Unit operator contacts NCC, CHCC and requests permission to begin test and a dispatch instruction to [insert PMin Export]MW. |  | Import Capacity: \_\_\_\_ MW |
| 3 | Unit operator receives instruction, dispatches the Unit to [insert PMin Export]MW and allows the Unit to stabilise for 10 mins. |  |  |
| 4 | With the Unit at Minimum Load Capacity, the Unit operator contacts NCC, CHCC and requests permission to adjust the Leading (importing) MVARs to the rated value for the Interconnector.The Unit Operator shall allow the Unit to stabilise for each change of state. |  | Agreed MVAr steps agreed with NCC, CHCC:\_\_\_\_\_\_\_\_\_\_Achieved Min Active Power: \_\_\_\_\_\_Achieved Max Lagging MVAr: \_\_\_\_\_\_\_\_ |
| 5 | With the Unit is stabilised at maximum Leading (importing) MVARs and Registered Capacity, run for a minimum of 30 minutes. |  | Start time: \_\_\_\_\_End time: \_\_\_\_\_\_ |
| 6 | Unit operator contacts NCC, CHCC and informs them that the test is completed. |  |  |
| 7 | Unit operator ends data recording for all trends noted in section 8. |  |  |

## PMin Import, QMin Leading

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 8. |  |  |
| 2 | Unit operator contacts NCC, CHCC and requests permission to begin test and a dispatch instruction to 0 MW Import Capacity. |  | Import Capacity: \_\_\_\_ MW |
| 3 | Unit operator receives instruction, dispatches the Unit to [insert PMin import]MW and allows the Unit to stabilise for 10 mins. |  |  |
| 4 | With the Unit at 0 MW Import Capacity the Unit operator contacts NCC, CHCC and requests permission to adjust the Leading (exporting) MVARs to the rated value for the Interconnector. The Unit Operator shall allow the Unit to stabilise for each change of state. |  | Agreed MVAr steps agreed with NCC, CHCC:\_\_\_\_\_\_\_\_\_\_Achieved Max Lagging MVAr: \_\_\_\_\_\_\_\_ |
| 5 | With the Unit is stabilised at maximum lagging (exporting) MVARs and 0 MW Import Capacity, run for a minimum of 30 minutes. |  | Start time: \_\_\_\_\_End time: \_\_\_\_\_\_ |
| 6 | Unit operator contacts NCC, CHCC and informs them that the test is completed.Unit operator agrees MVAr dispatch with NCC, CHCC before proceeding to the next test.  |  |  |
| 7 | Unit operator ends data recording for all trends noted in section 8. |  |  |

## Pmax Export, Qmin leading

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | Unit operator begins data recording for all trends noted in Section 8. |  |  |
| 2 | Unit operator contacts NCC, CHCC and requests permission to begin test and a dispatch instruction to Registered MW Export. |  | Export Capacity: \_\_\_\_ MW |
| 3 | Unit operator receives instruction, dispatches the Unit to Registered MW Export and allows the Unit to stabilise for 10 mins. |  |  |
| 4 | With the Unit at Registered Capacity the Unit operator contacts NCC, CHCC and requests permission to adjust the Leading (importing) MVARs to the rated value for the Interconnector. The Unit Operator shall allow the Unit to stabilise for each change of state. |  | Agreed MVAr steps agreed with NCC, CHCC:\_\_\_\_\_\_\_\_\_\_Achieved Max Export Power: \_\_\_\_\_\_Achieved Min Leading MVAr: \_\_\_\_\_\_\_\_ |
| 5 | With the Unit stabilised at Minimum Leading (importing) MVARs and Registered Capacity, run for a minimum of 30 minutes. |  | Start time: \_\_\_\_\_End time: \_\_\_\_\_\_ |
| 6 | Unit operator contacts NCC, CHCC and informs them that the test is completed. |  |  |
| 7 | Unit operator ends data recording for all trends noted in section 8. |  |  |

## Pmax Export, Qmax Lagging

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | Unit operator begins data recording for all trends noted in Section 8. |  |  |
| 2 | Unit operator contacts NCC, CHCC and requests permission to begin test and a dispatch instruction to Registered MW Export. |  | Export Capacity: \_\_\_\_ MW |
| 3 | Unit operator receives instruction, dispatches the Unit to Registered MW Export and allows the Unit to stabilise for 10 mins. |  |  |
| 4 | With the Unit at Registered Capacity the Unit operator contacts NCC, CHCC and requests permission to adjust the Lagging (Exporting) MVARs to the rated value for the Interconnector. The Unit Operator shall allow the Unit to stabilise for each change of state. |  | Agreed MVAr steps agreed with NCC, CHCC:\_\_\_\_\_\_\_\_\_\_Achieved Max Export Power: \_\_\_\_\_\_Achieved Max Lagging MVAr: \_\_\_\_\_\_\_\_ |
| 5 | With the Unit stabilised at maximum Lagging (Exporting) MVARs and Registered Capacity, run for a minimum of 30 minutes. |  | Start time: \_\_\_\_\_End time: \_\_\_\_\_\_ |
| 6 | Unit operator contacts NCC, CHCC and informs them that the test is completed. |  |  |
| 7 | Unit operator ends data recording for all trends noted in section 8. |  |  |

## PMin Import, QMax Lagging

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | Unit operator begins data recording for all trends noted in Section 8. |  |  |
| 2 | Unit operator contacts NCC, CHCC and requests permission to begin test and a dispatch instruction to [insert PMin import]MW. |  | Import Capacity: \_\_\_\_ MW |
| 3 | Unit operator receives instruction, dispatches the Unit to 0 MW Export Capacity and allows the Unit to stabilise for 10 mins. |  |  |
| 4 | With the Unit at Minimum Load Capacity, the Unit operator contacts NCC, CHCC and requests permission to adjust the Leading (importing) MVARs to the rated value for the Interconnector.The Unit Operator shall allow the Unit to stabilise for each change of state. |  | Agreed MVAr steps agreed with NCC, CHCC:\_\_\_\_\_\_\_\_\_\_Achieved Min Active Power: \_\_\_\_\_\_Achieved Max Lagging MVAr: \_\_\_\_\_\_\_\_ |
| 5 | With the Unit is stabilised at maximum Leading (importing) MVARs and Registered Capacity, run for a minimum of 30 minutes. |  | Start time: \_\_\_\_\_End time: \_\_\_\_\_\_ |
| 6 | Unit operator contacts NCC, CHCC and informs them that the test is completed. |  |  |
| 7 | Unit operator ends data recording for all trends noted in section 8. |  |  |

# Comments and Sign-off

|  |
| --- |
| **Comments:**  |
| Unit Witness signoff that this test has been carried out according to the test procedure, above.Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date / Time: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| EirGrid, SONI Witness signoff that this test has been carried out according to the test procedure, above.Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date / Time: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

1. <http://www.eirgridgroup.com/>

<http://www.soni.ltd.uk/> [↑](#footnote-ref-1)