Steady-State Reactive Power (SSRP)

System Services Test Report

Synchronous Machine

Unit Name

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# Document Version History

Revision 3.0 published 12th November 2019

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| --- | --- | --- | --- | --- |
| **Version** | **Date** | **Comment** | **Name** | **Company** |
| 0.1 | Insert date | Minor version (v0.1) - First submission for review and approval | Insert name | Insert company |
| 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 report template as published on the EirGrid or SONI websites[[1]](#footnote-2).

The report shall be developed for technical and non-technical readers and shall follow the agreed test programme. The report is submitted to generator\_testing@eirgrid.com or  generator\_testing@soni.ltd.uk as appropriate.

Submission of this document is required if a Unit does not have and existing SSRP DS3 System Services Contract or is making changes or updates to any of the effected parameters.

To complete the report, the Unit shall have either:

1. Recorded active and reactive power data as per the test procedure agreed with EirGrid, SONI; or
2. Performance Data showing full reactive power capability.

Any issue with meeting any requirements or completing this report, please contact generator\_testing@eirgrid.com or  generator\_testing@soni.ltd.uk as appropriate.

# Abbreviations

SSRP Steady-State Reactive Power

MVAr Mega Volt Ampere – reactive

MW Mega Watt

TSO Transmission System Operator

MEC Maximum Export Capacity

RPM Revolutions per Minute

kV kilovolt

Hz Hertz – unit of frequency

AVR Automatic Voltage regulation

Qrange Reactive Power range from full leading to full lagging defined by PMax and PMin

Prange Active Power range from PMax to Pmin

PMax Registered Capacity

PMin Minimum power output

QMax Maximum Lagging MVAr that can be delivered over the full Prange

QMin Minimum Leading MVAr that can be delivered over the full Prange

# 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 |
| Unit Fuel Type(s)  | Primary:\_\_\_\_\_\_\_\_\_ Secondary:\_\_\_\_\_\_\_\_\_ |
| Registered Capacity / Maximum Continuous Rating | \_\_\_\_\_\_\_\_\_\_\_MW |
| Minimum Load Minimum Generation | \_\_\_\_\_\_\_\_\_\_\_MW\_\_\_\_\_\_\_\_\_\_\_MW |
| Contracted MEC | \_\_\_\_\_\_\_\_\_\_\_MW |
| Installed Plant | Name: \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_MVA Name: \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_MW  |
| House Load  | \_\_\_\_\_\_\_\_\_\_\_MW |
| Is the AVR fully commissioned and functional? | Yes/No |
| AVR Droop Setting | \_\_\_\_\_\_\_% |

# 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

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

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

For dispatchable synchronous condensers and loads RP Factor = 1.



Figure 1: Example graph showing the P and Q ranges. Min Load is shown as the bottom blue line (Pmin).

# Assessment

Prange is the MW range from Minimum Load to Registered Capacity

Qmin is the maximum leading MVAr the unit can absorb over Prange. Qmax is the maximum lagging MVAr the unit can produce over Prange.

Qmin and Qmax are based on reactive power measured at the generator terminals.



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

# Results

## Summary

Testing was completed on [DATE].

*[Insert comment on the results, highlighting any issues encountered in performing the test or in analysing the results].*

*[Insert Report summary]*

*[Include any relevant test notes here, relating to how the test was carried out or to any specific conditions encountered during the test.]*

*[Abnormal behaviour in the data (spikes, dips, unusual vibrations, etc.) shall be noted and documented. The reasons behind these shall be detailed along with any corrective actions taken and what its effects are on the unit and/or the result. If possible a clear graph of the issue should also be presented]*

[*Insert a full graph of the results showing the full reactive power capability of the unit*, *all relevant values shall be displayed, such as the full Q range (x-axis) and the full P range (y-axis). Each corner point must also have its value clearly labelled; the chart shall also have the theoretical values shown, conventional PQ chart shall include the OEL and UEL limiters. A full table of values supporting these graphs shall be included also.]*

## Table of results

|  |  |
| --- | --- |
| **Point** | **Value** |
| Registered capacity, full lagging(PMax, QMax) | \_\_\_\_\_\_\_\_\_MW, \_\_\_\_\_\_\_MVAr |
| Registered capacity, full leading(PMax, QMin) | \_\_\_\_\_\_\_\_\_MW, \_\_\_\_\_\_\_MVAr |
| Minimum Load/ Minimum Generation, full lagging(PMin, QMax) | \_\_\_\_\_\_\_\_\_MW, \_\_\_\_\_\_\_MVAr |
| Minimum Load/ Minimum Generation, full leading(PMin, QMin) | \_\_\_\_\_\_\_\_\_MW, \_\_\_\_\_\_\_MVAr |
| Sync Comp mode, full leading | \_\_\_\_\_\_\_\_\_MW, \_\_\_\_\_\_\_MVAr |
| Sync Comp mode full lagging | \_\_\_\_\_\_\_\_\_MW, \_\_\_\_\_\_\_MVAr |

## System Services Values

Mode: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (e.g. combined / open half cycle etc.) (Add additional tables as required for each mode

|  |  |  |
| --- | --- | --- |
| **Reading** | **Value** | **Comment** |
| Registered Capacity, (NI) Maximum Continuous Rating | \_\_\_\_\_\_MW |  |
| P range | \_\_\_\_\_\_\_MW to \_\_\_\_\_MW |  |
| Q range | \_\_\_\_\_\_MVAr to \_\_\_\_\_\_\_MVAr |  |
| RP factor  |  | Insert Calculation and value per Section 6.2  |
| SRP volume |  | Insert Calculation and value as per Section 6.2 |
| Q range in Sync Comp mode | \_\_\_\_\_\_MVAr to \_\_\_\_\_\_\_MVAr |  |
| RP factor in Sync Comp mode |  | Insert Calculation and value per Section 6.2 |

## Graphs of results

[*Insert a full graph of the results showing the full reactive power capability of the unit*, *all relevant values shall be displayed, such as the full Qrange (x-axis) and the full P range (y-axis). Each corner point shall also have its value clearly labelled; the chart shall also have the theoretical values shown, conventional PQ chart shall include the OEL and UEL limiters. A full table of values supporting these graphs shall be included also].*

[*Include any relevant test notes here, relating to how the test was carried out or any specific conditions encountered during this test*].



Figure 3: Example graph of a unit’s reactive power capability

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

<http://www.soni.ltd.uk/> [↑](#footnote-ref-2)