RfG

Online PSS and Excitation Controller Testing

[Insert Unit Name]

Insert Unit

Version 0.1



Contents

[1 DOCUMENT Version History 3](#_Toc84854276)

[2 Introduction 4](#_Toc84854277)

[3 Abbreviations 6](#_Toc84854278)

[4 Unit DATA 7](#_Toc84854279)

[5 SONI Grid Code references 9](#_Toc84854280)

[6 site Safety requirements 10](#_Toc84854281)

[7 Test descRiption and pre conditions 10](#_Toc84854282)

[7.1 Purpose of the Test 10](#_Toc84854283)

[7.2 Pass Criteria 12](#_Toc84854284)

[7.3 Instrumentation and Onsite Data Trending 12](#_Toc84854285)

[7.4 Initial Conditions 13](#_Toc84854286)

[8 Test Steps 14](#_Toc84854287)

[8.1 Step Response Tests at No Load (Open Circuit Response) 14](#_Toc84854288)

[8.1.1 Load Set point = No Load, Generator Voltage Reference Step Change = 0.5% 14](#_Toc84854289)

[8.1.2 Load Set point = No Load, Generator Voltage Reference Step Change = 1% 14](#_Toc84854290)

[8.1.1 Load Set point = No Load, Generator Voltage Reference Step Change = 2% 15](#_Toc84854291)

[8.2 Step Response Tests at Minimum Load 16](#_Toc84854292)

[8.2.1 Load Set point = Minimum Load, Generator Voltage Reference Step Change = 0.5% 16](#_Toc84854293)

[8.2.2 Load Set point = Minimum Load, Generator Voltage References Step Change = 1% 17](#_Toc84854294)

[8.2.3 Load Set point = Minimum Load, Generator Voltage References Step Change = 2% 18](#_Toc84854295)

[8.2.4 Load Set point = Minimum Load, Transmission Plant Energisation 19](#_Toc84854296)

[8.3 Step Response Tests at 100% of Registered Capacity 20](#_Toc84854297)

[8.3.1 Step Change 0.5% in Generator Voltage Reference, Load Set point = 100% RC 20](#_Toc84854298)

[8.3.2 Step Change 1% in Generator Voltage Reference, Load Set point = 100% RC 20](#_Toc84854299)

[8.3.3 Step Change 2% in Generator Voltage Reference, Load Set point = 100% RC 21](#_Toc84854300)

[8.3.4 Transmission Plant Energisation, Load Set point = 100% RC 21](#_Toc84854301)

**DISCLAIMER:**

This Document contains information (and/or attachments) which may be privileged or confidential. All content is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient please be aware that any disclosure, copying, distribution or use of the contents of this message is prohibited. If you suspect that you have received this Document in error please notify SONI or its subsidiaries immediately. SONI and its subsidiaries do not accept liability for any loss or damage arising from the use of this document or any reliance on the information it contains or the accuracy or up to date nature thereof. Use of this document and the information it contains is at the user’s sole risk. In addition, SONI and its subsidiaries strongly recommend that any party wishing to make a decision based on the content of this document should not rely solely upon data and information contained herein and should consult SONI or its subsidiaries in advance.

Further information can be found at: <http://www.soni.ltd.uk/legal/>

1. **DOCUMENT 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 |  | SONI |

# Introduction

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

Any alterations of the PSS settings require approval of the TSO in advance of implementation. Proposed setting changes made to the PSS shall be supported with relevant studies from the Unit for verification. Confirmation from the TSO shall be sought by the Unit 4 weeks in advance of testing.

The PSS test may be carried out in conjunction with Reactive Power capability and excitation limiter testing and AVR droop and response .

The Power System Stabiliser response test is applicable for generating plant where a power system stabiliser (PSS) has been installed and switched on by the Generator. The PSS tests are carried out as part of the AVR on load response. The test is performed at various operating points of the generator which would include as a minimum, rated load at lagging (rated), unity and leading power factors. The purpose of the test is to evaluate the capability of the excitation system with the PSS in operation to provide adequate damping for power oscillations (typically in the range of 0.2 to 3 Hz) caused by ‘dynamic’ instability of the power system.

The test is carried out by perturbing the system through the excitation system (e.g. step injection) or through the power system (e.g. transformer taps, power flow changes).

All yellow sections must be filled in before the test procedure will be approved. All grey sections must 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@soni.ltd.uk](mailto: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 CHCC as required;
4. Mitigate issues arising during the test and report on system incidents.

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

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

On completion of this test, the following shall be submitted to [Generator\_Testing@soni.ltd.uk](mailto: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 |

**Note:**

**The NI Power System is a live, dynamic, constantly changing system on which major changes or disturbances can occur without warning. All testing has the potential to impact the NI Power System and must be treated as such.**

**Prior to testing taking place SONI Control Room must be informed as soon as practically possible. SONI Control Room Staff reserve the right to suspend any testing if it may have a detrimental impact on the NI Power System and/or prevailing system conditions call for it.**

**Tests must be undertaken in accordance with this procedure however should a test in the procedure:**

* **have potential for a detrimental impact on the NI Power System,**
* **result in damage to the Generator’s and/or TO’s Plant and Apparatus,**
* **does not adequately demonstrate Generator Plant performance,**

**an equivalent test procedure and/or demonstration of Generating Unit capability[[2]](#footnote-2) agreed between SONI and the Generator may be undertaken to validate Grid Code compliance.**

# Abbreviations

PSS Power System Stabiliser

kV kilovolt

RC Registered Capacity

MEC Maximum Export Capacity

UEL Under Excitation Limiter

OEL Over Excitation Limiter

AVR Automatic Voltage Regulation

CHCC Castlereagh House Control Centre

Mvar Mega Volt Ampere – reactive

MW Mega Watt

TSO Transmission System Operator

V Volt

A Amp

Hz Hertz

GCB Generator Circuit Breaker

# Unit DATA

|  |  |
| --- | --- |
| Unit test coordinator | Unit to Specify |
| Unit name | Unit to Specify |
| Associated Station | Unit to Specify |
| Unit connection point | Unit to Specify |
| Unit connection voltage | Unit to Specify |
| Generator voltage (kV) | Unit to Specify |
| Registered Capacity (RC) | Unit to Specify |
| Minimum Load | Unit to Specify |
| Contracted MEC | Unit to Specify |
| Under excitation limiter setting (include details of hysteresis as applicable) | Unit to Specify |
| Over excitation Limiter setting (include details of hysteresis as applicable) | Unit to Specify |

Unit to insert PQ chart for the Generator including Limiters

# SONI Grid Code references

|  |  |
| --- | --- |
| Grid Code Version: | Unit to specify |

CC.S1.1.3.3 A **Generating Unit** shall continuously control voltage at the **Connection Point** within its **Reactive Power** capability limits.

(f) with regard to the voltage control system;

(i) the parameters and settings of the components of the voltage control system shall be agreed between the **Generator** and the **TSO**;

(ii) the agreement referred to in (a) shall cover the specifications and performance of an automatic voltage regulator (AVR) with regard to steady-state and transient voltage control and the specifications and performance of the excitation control system. The latter shall include:

* + - bandwidth limitation of the output signal to ensure the highest frequency of response cannot excite torsional oscillations on other **Generating Units** connected to the **Power System**;
    - an underexcitation limiter to prevent the AVR from reducing the **Generation Units** excitation to a level which would endanger synchronous stability;
    - an overexciatation limiter to ensure that the alternator excitation is not limited to less than the maximum value that can be achieved whilst ensuring that the **Generating Unit** is operating within its design limits;
    - a stator current limiter; and
    - a power system stabiliser function to attenuate power oscillations, this will be assessed by the **TSO** on a case by case basis.

Glossary

|  |  |
| --- | --- |
| **Power System Stabiliser** | Device that injects a supplementary signal into the **AVR** (**Automatic Voltage Regulator**) in order to improve Power System damping. |
| **Automatic Voltage Regulator** | A continuously acting automatic closed loop control system acting on the excitation system so as to maintain a **Generation Unit's** terminal voltage at a desired setpoint |

# site Safety requirements

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

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

# Test descRiption and pre conditions

## Purpose of the Test

The purpose of this test is to demonstrate the PSS performance in response to step changes in AVR reference or to operational switching on the power system. The tests will also assess small signal performance of the excitation system.

The test involves operating the unit at no load, rated terminal voltage and speed and injecting a succession of AVR voltage reference step changes to record open circuit step response as well as bringing the unit to Minimum Load and 100% of Registered Capacity and injecting a succession of AVR voltage reference step changes and recording the oscillation of the generator MW while the PSS is OFF and the PSS is ON.

Correct PSS operation shall be demonstrated by examination of the generator MW for increased damping of any MW oscillation. Bandwidth limited (200mHz – 3Hz) random noise injection will also be required for spectrum analysis. Both step injection and random noise injection will be carried out with and without PSS to demonstrate the damping effect. The PSS gain should be continuously controllable (not discrete components) during testing.

The tests are listed below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test** | **Dispatch MW** | **Dispatch Mvar** | **Step Change** | **Configuration** |
| 1 | No Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -0.5% |  |
| 2 | No Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +0.5% |  |
| 3 | No Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -1% |  |
| 4 | No Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +1% |  |
| Hold Point – Consider results of previous tests prior to proceeding | | | | |
| 5 | No Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -2% |  |
| 6 | No Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +2% |  |
| Hold Point – Consider results of previous tests prior to proceeding | | | | |
| 7 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -0.5% | PSS OFF |
| 8 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -0.5% | PSS ON |
| 9 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +0.5% | PSS OFF |
| 10 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +0.5% | PSS ON |
| 11 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -1% | PSS OFF |
| 12 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -1% | PSS ON |
| 13 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +1% | PSS OFF |
| 14 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +1% | PSS ON |
| Hold Point – Consider results of previous tests prior to proceeding | | | | |
| 15 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -2% | PSS ON |
| 16 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +2% | PSS ON |
| Hold Point – Consider results of previous tests prior to proceeding | | | | |
| 17 | Minimum Load | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | Energise Transmission Plant | PSS ON |
| Hold Point – Consider results of previous tests prior to proceeding | | | | |
| 18 | 100% | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -0.5% | PSS ON |
| 19 | 100% | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +0.5% | PSS ON |
| 20 | 100% | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -1% | PSS ON |
| 21 | 100% | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +1% | PSS ON |
| Hold Point – Consider results of previous tests prior to proceeding | | | | |
| 22 | 100% | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | -2% | PSS ON |
| 23 | 100% | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | +2% | PSS ON |
| Hold Point – Consider results of previous tests prior to proceeding | | | | |
| 24 | 100% | Insert Leading/Lagging/ Unity Mvar as agreed with the TSO | Energise Transmission Plant at the discretion of CHCC and dependent on System conditions on the day of test. | PSS ON |

Depending on relative strength of the system it is expected the test will result in a 275kV system voltage step comparable to the injection step to the AVR i.e. up to 2%. Based on the generator and transformer parameters the step voltage change can be expected to create a step change in reactive dispatch of +/-60 Mvar. Transient overshoot in Mvar and voltage step may be higher.

As it is possible during PSS testing that an oscillation may occur that is not damped, the following steps will be taken.

If the oscillation has a **decreasing** amplitude

1. Do nothing if the oscillation is damped unless it takes longer than 10 seconds

If the oscillation has stable or **increasing** amplitude, then after 10 seconds:

1. If the PSS is ON then switch off the PSS. The test must be halted.
2. If the PSS is OFF, then switch on the PSS.
3. Increase reactive power (especially in case of under excited operation)
4. Alter Active Power at normal unloading rate.
5. If oscillation still cannot be **reduced/stopped** open GCB.

## Pass Criteria

The following is the pass criteria for the test. Any subsequent report for this test will be assessed against each of these criteria.

1. Excitation system functions correctly including small signal performance during open circuit response during step response.
2. PSS functions correctly. Comparisons are made on the performance with and without the PSS in service.
3. Correct operation of the PSS is demonstrated through the addition of a damping torque due to the presence of the PSS on power oscillations induced through both the step change in the AVR voltage set point and Transmission Plant switch in. This shall be assessed by analysis of plots of oscillations of MW output revealing increased damping with the PSS On.
   1. Instrumentation and Onsite Data Trending

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

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Signal Name** | **Sample Rate** | **Source** |
| 1 | Active Power at Generator Terminals (MW) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 2 | Reactive Power at Generator Terminals (Mvar) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 3 | Active Power at Transmission Plant Terminals (MW) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 4 | Reactive Power at Transmission Plant Terminals (Mvar) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 5 | Generator Terminal Voltage (kV) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 6 | Generator Frequency (Hz) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 7 | Excitation Current (A) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 8 | Excitation Volts (V) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 9 | PSS On/Off | Unit to specify | Unit to specify |
| 10 | UEL On | Unit to specify, | Unit to specify |
| 11 | OEL On | Unit to specify, | Unit to specify |
| 12 | Alarm/Event page | Screenshot alarms / events for duration of the test. | |
| 13 | 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 | |
| 14 | EDIL instructions | Screenshot as logged during the test. | |

## Initial Conditions

Should “No” be answered to any of the following, contact 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 [neartime@soni.ltd.uk](mailto:neartime@soni.ltd.uk). | Yes/No |
| 2 | EDIL will be used for dispatch instructions to the Unit Control Room from CHCC during the test. | Yes/No |
| 3 | Excitation System in AVR Mode | Yes/No |
| 4 | Frequency Response Mode On | Yes/No |
| 5 | Power System Stabiliser Off | Yes/No |
| 6 | Required signals, as described in section 7.3 are available. | Yes/No |

|  |  |  |
| --- | --- | --- |
| **No.** | **Calculation** | **Calculated on day of test** |
| 1 | MW availability on day of test. | \_\_\_MW |
| 2 | Corrected Registered Capacity. | \_\_\_MW |
| 3 | Corrected Minimum load. | \_\_\_MW |

# Test Steps

## Step Response Tests at No Load (Open Circuit Response)

### Load Set point = No Load, Generator Voltage Reference Step Change = 0.5%

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and informs that the Unit is operating at No load and rated terminal voltage and speed. |  |  |
| 3 | Unit operator confirms status of PSS |  | PSS OFF / ON |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **0.5%** and records the following:   1. Generator Terminal Voltage. 2. Exciation Voltage 3. Excitation Current 4. Step injection |  |  |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **0.5%** and records the following:   1. Generator Terminal Voltage. 2. Exciation Voltage 3. Excitation Current 4. Step injection |  |  |
| 6 | Stop Recording the data as listed in section 7.3 |  |  |
| 7 | Review Results and confirm with CHCC before proceeding |  |  |

### Load Set point = No Load, Generator Voltage Reference Step Change = 1%

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and informs that the Unit is operating at No load and rated terminal voltage and speed. |  |  |
| 3 | Unit operator confirms status of PSS |  | PSS OFF / ON |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **1%** and records the following:   1. Generator Terminal Voltage. 2. Exciation Voltage 3. Excitation Current 4. Step injection |  |  |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **1%** and records the following:   1. Generator Terminal Voltage. 2. Exciation Voltage 3. Excitation Current 4. Step injection |  |  |
| 6 | Stop Recording the data as listed in section 7.3 |  |  |
| 7 | Review Results and confirm with CHCC before proceeding |  |  |

### 

### Load Set point = No Load, Generator Voltage Reference Step Change = 2%

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and informs that the Unit is operating at No load and rated terminal voltage and speed. |  |  |
| 3 | Unit operator confirms status of PSS |  | PSS OFF / ON |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **2%** and records the following:   1. Generator Terminal Voltage. 2. Exciation Voltage 3. Excitation Current 4. Step injection |  |  |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **2%** and records the following:   1. Generator Terminal Voltage. 2. Exciation Voltage 3. Excitation Current 4. Step injection |  |  |
| 6 | Stop Recording the data as listed in section 7.3 |  |  |
| 7 | Review Results and confirm with CHCC before proceeding |  |  |

## Step Response Tests at Minimum Load

### Load Set point = Minimum Load, Generator Voltage Reference Step Change = 0.5%

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and requests permission to begin test and a dispatch instruction to [insert minimum load] **MW** via EDIL. Await dispatch of the unit to **XX MW** by CHCC. |  | MW Output: \_\_\_\_\_MW.  Corrected Minimum Load: \_\_\_MW. |
| 3 | Unit operator confirms that the PSS is **OFF**. |  | PSS OFF / ON |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **0.5%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **0.5%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 6 | Unit operator confirms that the PSS is **ON**. |  | PSS OFF / ON |
| 7 | Unit operator injects an **increase** to the the generator voltage set point of **0.5%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 8 | Unit operator injects a **decrease** to the the generator voltage set point of **0.5%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 9 | Stop Recording the data as listed in section 7.3 |  |  |
| 10 | Review Results and confirm with CHCC before proceeding |  |  |

### Load Set point = Minimum Load, Generator Voltage References Step Change = 1%

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and requests permission to begin test and a dispatch instruction to [insert minimum load] **MW** via EDIL. Await dispatch of the unit to **XX MW** by CHCC. |  | MW Output: \_\_\_\_\_MW.  Corrected Minimum Load: \_\_\_MW. |
| 3 | Unit operator confirms that the PSS is **OFF**. |  | PSS OFF / ON |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **1%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **1%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 6 | Unit operator confirms that the PSS is **ON**. |  | PSS OFF / ON |
| 7 | Unit operator injects an **increase** to the the generator voltage set point of **1%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 8 | Unit operator injects a **decrease** to the the generator voltage set point of **1%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 9 | Stop Recording the data as listed in section 7.3 |  |  |
| 10 | Review Results and confirm with CHCC before proceeding |  |  |

### Load Set point = Minimum Load, Generator Voltage References Step Change = 2%

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and requests permission to begin test and a dispatch instruction to [insert minimum load] **MW** via EDIL. Await dispatch of the unit to **XX MW** by CHCC. |  | MW Output: \_\_\_\_\_MW.  Corrected Minimum Load: \_\_\_MW. |
| 3 | Unit operator confirms that the PSS is **OFF**. |  | PSS OFF / ON |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **2%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **1%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 6 | Unit operator confirms that the PSS is **ON**. |  | PSS OFF / ON |
| 7 | Unit operator injects an **increase** to the the generator voltage set point of **2%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 8 | Unit operator injects a **decrease** to the the generator voltage set point of **2%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations 4. Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_. 3. Dampening time \_\_\_\_\_. |
| 9 | Stop Recording the data as listed in section 7.3 |  |  |
| 10 | Review Results and confirm with CHCC before proceeding |  |  |

### Load Set point = Minimum Load, Transmission Plant Energisation

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and requests permission to begin test and a dispatch instruction to [insert minimum load] **MW** via EDIL. Await dispatch of the unit to **XX MW** by CHCC. |  | MW Output: \_\_\_\_\_MW.  Corrected Minimum Load: \_\_\_MW. |
| 3 | Unit operator confirms that the PSS is **ON.** |  | PSS OFF / ON |
| 4 | Switch in Transmission Plant |  |  |
| 5 | Record any station alarms and system events such as frequency dips or dispatch instructions |  |  |
| 6 | Stop Recording the data as listed in section 7.3 |  |  |
| 7 | Review Results and confirm with CHCC before proceeding |  |  |

## 

## Step Response Tests at 100% of Registered Capacity

### Step Change 0.5% in Generator Voltage Reference, Load Set point = 100% RC

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and requests permission to begin test and a dispatch instruction to 100% Registered Capacity via EDIL. Await dispatch of the unit to **XX MW** by CHCC. |  | MW output: \_\_\_\_\_\_\_MW. |
| 3 | Unit operator confirms that the PSS is **ON** |  | PSS Off / On |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **0.5%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations   Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_.   Dampening time \_\_\_\_\_. |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **0.5%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations   Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_.   Dampening time \_\_\_\_\_. |
| 6 | Stop Recording the data as listed in section7.3 |  |  |
| 7 | Review Results and confirm with CHCC before proceeding |  |  |

### 

### Step Change 1% in Generator Voltage Reference, Load Set point = 100% RC

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and requests permission to begin test and a dispatch instruction to 100% Registered Capacity via EDIL. Await dispatch of the unit to **XX MW** by CHCC. |  | MW output: \_\_\_\_\_\_\_MW. |
| 3 | Unit operator confirms that the PSS is **ON** |  | PSS Off / On |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **1.0%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations   Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_.   Dampening time \_\_\_\_\_. |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **1.0%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations   Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_.   Dampening time \_\_\_\_\_. |
| 6 | Stop Recording the data as listed in section 7.3 |  |  |
| 7 | Review Results and confirm with CHCC before proceeding |  |  |

### 

### Step Change 2% in Generator Voltage Reference, Load Set point = 100% RC

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and requests permission to begin test and a dispatch instruction to 100% Registered Capacity via EDIL. Await dispatch of the unit to **XX MW** by CHCC. |  | MW output: \_\_\_\_\_\_\_MW. |
| 3 | Unit operator confirms that the PSS is **ON** |  | PSS Off / On |
| 4 | Unit operator injects an **increase** to the the generator voltage set point of **2%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations   Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_.   Dampening time \_\_\_\_\_. |
| 5 | Unit operator injects a **decrease** to the the generator voltage set point of **2%** and records the following:   1. MW oscillation in MW output until MW output has settled to pre-step value 2. Peak to Peak MW Oscillation 3. Number of Oscillations   Dampening time |  | 1. Peak to Peak MW Oscillation –: \_\_\_\_\_MW. 2. Number of Oscillations \_\_\_\_\_.   Dampening time \_\_\_\_\_. |
| 6 | Stop Recording the data as listed in section 7.3 |  |  |
| 7 | Review Results and confirm with CHCC before proceeding |  |  |

### 

### Transmission Plant Energisation, Load Set point = 100% RC

This test will be carried out at the discretion of CHCC and will be subject to system conditions on the test day.

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comments** |
| 1 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 2 | Unit operator contacts CHCC and requests permission to begin test and a dispatch instruction to 100% Registered Capacityvia EDIL. Await dispatch of the unit to **XX MW** by CHCC. |  | MW Output: \_\_\_\_\_MW.  Corrected Minimum Load: \_\_\_MW. |
| 3 | Unit operator confirms that the PSS is **ON.** |  | PSS OFF / ON |
| 4 | Unit request CHCC to Switch in Transmission Plant to induce step change in system voltage. |  | Time Transmission Plant is switched:\_\_\_\_\_ |
| 5 | Record any station alarms and system events such as frequency dips or dispatch instructions |  |  |
| 6 | Stop Recording the data as listed in section 7.3 |  |  |
| 7 | Review Results and confirm with CHCC before proceeding |  |  |

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

1. https://www.soni.ltd.uk/how-the-grid-works/grid-codes/ [↑](#footnote-ref-1)
2. For example a simulation model of the Generator performance characteristics under the test procedure [↑](#footnote-ref-2)