Demonstration of Start-Up Times

[Insert Unit Name]

Insert Unit

Version 0.1



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# 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 |  | EirGrid |

1. **Introduction**

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

Units wishing to demonstrate cold, warm, hot start up times will need to consider carefully within the commissioning programme how and when this is best demonstrated based on the applicable cooling boundaries. Testing of Minimum load can be carried out at the same time as this test. A separate test procedure shall be agreed for a Minimum Load test.

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.

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:

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

# Abbreviations

CHCC Castlereagh House Control Centre

Mvar Mega Volt Ampere – reactive

MW Mega Watt

TSO Transmission System Operator

EDIL Electronic Dispatch Instruction Logger

# Unit DATA

|  |  |
| --- | --- |
| Unit Test Coordinator | Unit to Specify Name, Company and contact details. |
| Unit name | Unit to Specify |
| Unit connection point | Unit to Specify |
| Unit connection voltage | Unit to Specify |
| Unit Fuel Type: Primary Fuel / Secondary Fuel. | Unit to Specify |
| Registered Capacity | Unit to Specify |
| Block Load | Unit to Specify |
| Minimum Load | Unit to Specify |
| Contracted MEC | Unit to Specify |
| Hot Cooling Boundary | Unit to Specify |
| Warm Cooling Boundary | Unit to Specify |
| End Point of Start Up Period | Unit to Specify |
| Synchronous Start up time Cold | Unit to Specify |
| Load Up Break Point Cold | Unit to Specify |
| Loading Rate Cold | Unit to Specify |
| Soak Time Cold | Unit to Specify |
| Soak Time Trigger Point Cold | Unit to Specify |
| Load Up Break Point Hot | Unit to Specify |
| Loading Rate Hot | Unit to Specify |
| Soak Time Hot | Unit to Specify |
| Soak Time Trigger Point Hot | Unit to Specify |
| Synchronous Start up time Hot | Unit to Specify |
| Load Up Break Point Warm | Unit to Specify |
| Loading Rate Warm | Unit to Specify |
| Soak Time Warm | Unit to Specify |
| Soak Time Trigger Point Warm | Unit to Specify |
| Synchronous Start up time Warm | Unit to Specify |

|  |  |  |  |
| --- | --- | --- | --- |
| **Description** | **Min Value** | **Max Value** | **Licence Limit** |
| CO2 | XX mg/m3 | xxx mg/m3 | As applicable |
| O2 | XX % | xxx % | As applicable |
| CO | xxx mg/m3 | xxx mg/m3 | As applicable |
| SO2 | xxx mg/m3 | xxx mg/m3 | xxxx mg/m3 |
| NOx | xxxx mg/m3 | xxxx mg/m3 | xxxx mg/m3 |

# SONI Grid Code references

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

CC.S1.1.3.7 **Start-Up** and Ramp Rates

1. A **Generating Unit** must be capable of **Start-Up**:-

(i) from cold within 14 hours;

(ii) from warm within 5 hours;

(iii) from hot within 3 hours.

The block **Load** on synchronising must be no greater than 40 **MW**.

(b) A **Generating Unit** which is in a hot condition must be capable of ramping up from part-load pursuant to a **Dispatch** instruction at a rate of at least 3% of MCR per minute.

(c) A **Generating Unit** must be capable of de-loading at a rate of at least 3% of MCR per minute.

**Glossary:**

|  |  |
| --- | --- |
| **Start-Up** | The action of bringing a **Generating Unit** from **Shutdown** to the speed required by the **Generating Unit** to enable it to be **Synchronised** to a **System**. |
| **Block Load Cold** | **Block Load** during a **Cold Start**. |
| **Block Load Hot** | **Block Load** during a **Hot Start**. |
| **Block Load Warm** | **Block Load** during a **Warm Start**. |
| **Cold Start** | Any **Synchronisation** of a **Generating Unit** that has previously not been **Synchronised** for a period of time longer than its submitted **Warm Cooling Boundary**. |
| **Hot Start** | Any **Synchronisation** of a **Generating Unit** that has previously not been **Synchronised** for a period of time shorter than or equal to its submitted **Hot Cooling Boundary**. |
| **Hot Cooling Boundary** | The period of time, following **De-Synchronisation** of a **Generating Unit** afterwhich the **Warmth State** transfers from being hot to being warm. |
| **End Point of Start Up Period** | The time after which the rate of change of the **Generating Unit Output** is not dependent upon the initial **Warmth** of the **Generating Unit**. |
| **Load Up Break Point Cold** | The break point which defines the shared MW boundary between the two **Loading Rates Cold**. The first **Loading Rate Cold** applies from **Block** **Load** to the first **Load Up Break Point Cold**, the second **Loading Rate Cold** applies from the first **Load Up Break Point Cold** to the second **Load** **Up Break Point Cold**, the third **Loading Rate** **Cold** applies from the second **Load Up Break** **Point Cold** to the end point of the **Start-Up** period, which should be set equal to the **Minimum** **Generation**. |
| **Load Up Break Point Hot** | The break point which defines the shared MW boundary between the **Loading Rates Hot**. The first **Loading Rate Hot** applies from **Block Load** to the first **Load Up Break Point Hot**, the second **Loading Rate Hot** applies from the first **Load Up Break Point Hot** to the second **Load Up Break** **Point Hot,** the third **Loading Rate Hot** applies from the second **Load Up Break Point Hot** to the end point of the **Start-Up** period, which should be set equal to the **Minimum Generation**. |
| **Load Up Break Point Warm** | The break point which defines the shared MW boundary between the **Loading Rates Warm**. The first **Loading** rate applies from **Block Load** to the first **Load Up Break Point Warm**, the second **Loading Rate Hot** applies from the first **Load Up** **Break Point Warm** to the second **Load Up** **Break Point Warm**, the third **Loading Rate** **Warm** applies from the second **Load Up Break** **Point Warm** to the end point of the **Start-Up** period, which should be set equal to the **Minimum Generation**. |
| **Loading Rate Cold** | The rate at which a **Generating Unit** increases **Output** from **Block Load** to **Minimum** **Generation** when it is instructed to **Cold Start**. There may be circumstances where more than one parameter applies and this is indicated by adding a number at the end of the parameter. |
| **Loading Rate Hot** | The rate at which a **Generating Unit** increases **Output** from **Block Load** to **Minimum** **Generation** when it is instructed to **Hot Start**. There may be circumstances where more than one parameter applies and this is indicated by adding a number at the end of the parameter. |
| **Loading Rate Warm** | The rate at which a **Generating Unit** increases **Output** from **Block Load** to **Minimum** **Generation** when it is instructed to **Warm Start**. There may be circumstances where more than one parameter applies and this is indicated by adding a number at the end of the parameter. |
| **Soak Time Cold** | The duration of time for which the **Generating Unit** must remain at the **Soak Time Trigger Point Cold** during a **Cold Start**. There may becircumstances where more than one parameterapplies and this is indicated by adding a number atthe end of the parameter. |
| **Soak Time Hot** | The duration of time for which the **Generating Unit** must remain at the **Soak Time Trigger Point Hot** during a **Hot Start**. There may becircumstances where more than one parameterapplies and this is indicated by adding a number atthe end of the parameter. |
| **Soak Time Trigger Point Cold** | A constant **MW** level at which a **Generating Unit** must remain while loading up between **Block Load** and **Minimum Generation** after a **Cold Start**. There may be circumstances where morethan one parameter applies and this is indicated byadding a number at the end of the parameter.  |
| **Soak Time Trigger Point Hot** | A constant **MW** level at which a **Generating Unit** must remain while loading up between **Block Load** and **Minimum Generation** after a **Hot Start**. There may be circumstances where morethan one parameter applies and this is indicated byadding a number at the end of the parameter. |
| **Soak Time Trigger Point Warm** | A constant **MW** level at which a **Generating Unit** must remain while loading up between **Block Load** and **Minimum Generation** after a **Warm Start**. There may be circumstances where morethan one parameter applies and this is indicated byadding a number at the end of the parameter. |
| **Soak Time Warm** | The duration of time for which the **Generating Unit** must remain at that **Soak Time Trigger Point Warm** during a **Warm Start**. There may becircumstances where more than one parameterapplies and this is indicated by adding a number at the end of the parameter. |
| **Synchronous Start-Up Time Cold** | The time taken to bring a **Generating Unit** to a **Synchronised** state from a **Cold** (**De-Synchronised**) state. |
| **Synchronous Start-Up Time Hot** | The time taken to bring a **Generating Unit** to a **Synchronised** state from a **Hot** (**De-** **Synchronised**) state. |
| **Synchronous Start-Up Time Warm** | The time taken to bring a **Generating Unit** to a **Synchronised** state from a **Warm** (**De- Synchronised**) state. |
| **Synchronised** | The condition where an incoming **Generating Unit** or **System** is connected to another **System** sothat the **Frequencies** and phase relationships of that **Generating Unit** or **System**, as the case maybe, and the **System** to which it is connected areidentical and all like terms shall be construedaccordingly. |
| **Warm Start** | Any **Synchronisation** of a **Generating Unit** that has previously not been **Synchronised** for a period of time equal to or longer than its submitted **Hot** **Cooling Boundary** and shorter than or equal to its submitted **Warm Cooling Boundary**. |
| **Warmth State** | Either cold, warm or hot, as defined under the timeframes since last **De-Synchronisations** for **Cold Start**, **Warm Start** or **Hot Start** respectively. |

# site Safety requirements

The following is required for the 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
 | 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

This purpose of this test is to demonstrate the time to synchronise and to achieve minimum load on cold, warm and hot starts and following turbine and boiler trips.

## Pass Criteria

1. The time for the Unit to synchronise from a hot load is not greater than 3 hours.
2. The time for the Unit to synchronise from a warm load is not greater than 8 hours.
3. The time for the Unit to synchronise from a cold load is not greater than 12 hours.
4. Block Load shall be no greater than 40MW.

## 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 Connection Point (MW)  | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 2 | Reactive Power at Connection Point (Mvar) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 3 | Active Power at Generator (MW) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 4 | Reactive Power at Generator (Mvar) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 6 | Generator Voltage (kV) | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 7 | Ambient Conditions:1. Temperature (ºC)
2. Pressure (mbar)
3. Humidity (%)
 | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 8 | Emissions Measurements:1. NOX (mg/Nm3)
2. SO2 (mg/Nm3)
3. CO2 (%)
4. O2 (mg/m3)
5. CO (mg/m3)
 | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 9 | Other signals as required by the unit or by Generator\_Testing@soni.ltd.uk. | Unit to specify, 100ms or as agreed with TSO | Unit to specify |
| 10 | Alarm/Event page | Screenshot of alarms/events for duration of the test. |
| 11 | Generator Overview Screen | Screenshot at appropriate milestones during the test |
| 12 | EDIL instructions  | Screenshot as logged during the test. |

##

## Initial Conditions and Calculations

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. | Yes/No |
| 2 | Unit Fuel Type: Primary Fuel / Secondary Fuel | Yes/No |
| 3 | Verify all normal start up support auxiliary systems are aligned and in service. | Yes/No |
| 4 | For Cold starts, the Unit is not synchronised and is deemed cold as demonstrated from the last de synchronisation instruction is in excess of **XX hours.** (Warm cooling boundary).  | Yes/No |
| 5 | For Warm starts, the Unit is not yet synchronised and is deemed warm as demonstrated from the last de synchronisation instructions plant is **XX hours**. (Time between Hot and warm cooling boundaries). | Yes/No |
| 6 | For Hot starts, the Unit is not yet synchronised and is deemed hot as demonstrated from the last de synchronisation instructions plant is **XX hours**. (Time less than the Hot cooling boundary). | Yes/No |
| 7 | Required signals, as described in section 8.3 are available | Yes/No |

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

#

# Test Steps

## Cold Start

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comment** |
| 1 | Unit operator notes the last de synchronisation instruction for the Unit as per EDIL and confirms Warmth state is Cold as per initial condition 4.  |  | Date and time of last De synchronisation instruction \_\_:\_\_:\_\_, \_\_:\_\_ |
| 2 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 3 | Unit operator contacts CHCC and requests permission to begin test and a Synchronisation instruction and dispatch instruction to Minimum Load via EDIL. |  |  |
| 4 | Unit operator receives switching instruction from CHCC to synchronise |  |  |
| 5 | Unit operator receives EDIL instruction and Synchronises the Unit and notes the following:  |  | Time of Synchronisation: \_\_:\_\_.Synchronous Start up time: \_\_\_minutes.Block Load: \_\_\_\_MW. |
| 6 | Unit operator dispatches the Unit to Minimum Load at a rate of **XX** MW per minute.  |  | Loading rate cold: \_\_\_\_MW per minute. Load Up Break Point Cold: \_\_\_MW for soak time of \_\_\_\_minutes.  |
| 7 | The Unit Operator monitors that the unit remains at Minimum Load for a minimum of **[insert no of hours as agreed with TSO]** hours. |  |  |
| 8 | Unit operator ends data recording for all trends |  |  |

## Hot Start

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comment** |
| 1 | Unit operator notes the last de synchronisation instruction for the Unit as per EDIL and confirms Warmth state is Hot as per initial condition 5.  |  | Date and time of last de synchronisation instruction \_\_:\_\_:\_\_, \_\_:\_\_ |
| 2 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 3 | Unit operator contacts CHCC and requests permission to begin test and a Synchronisation instruction and dispatch instruction to Minimum Load via EDIL. |  |  |
| 4 | Unit operator receives switching instruction from CHCC to synchronise |  |  |
| 5 | Unit operator receives EDIL instruction and Synchronises the Unit and notes the following:  |  | Time of Synchronisation: \_\_:\_\_.Synchronous Start up time: \_\_\_minutes.Block Load: \_\_\_\_MW. |
| 6 | Unit operator dispatches the Unit to Minimum Load at a rate of **XX** MW per minute. |  | Loading rate Hot: \_\_\_\_MW per minute. Load Up Break Point Hot: \_\_\_MW for soak time of \_\_\_\_minutes.  |
| 7 | After reaching minimum load and following a period of **XX minutes** where the unit has stabilised, the Unit operator records the Minimum load value. |  | Minimum Load \_\_\_\_\_MW.Corrected Minimum Load: \_\_\_\_MW. |
| 8 | The Unit Operator monitors that the unit remains at Minimum Load for a minimum of **[insert no of hours as agreed with TSO]** hours. |  |  |
| 9 | Unit operator follows CHCC instruction for **30 minutes** following time period at Minimum Load (Instruction may be Shutdown, Ramp up or maintain output). |  | Instruction from CHCC\_\_\_\_\_\_\_\_\_\_\_ |
| 10 | Unit operator ends data recording for all trends |  |  |

## Warm Start

|  |  |  |  |
| --- | --- | --- | --- |
| **Step No.** | **Action** | **Time** | **Comment** |
| 1 | Unit operator notes the last de synchronisation instruction for the Unit as per EDIL and confirms Warmth state is Warm as per initial condition 4.  |  | Date and time of last De synchronisation instruction \_\_:\_\_:\_\_, \_\_:\_\_ |
| 2 | Unit operator begins data recording for all trends noted in Section 7.3. |  |  |
| 3 | Unit operator contacts CHCC and requests permission to begin test and a Synchronisation instruction and dispatch instruction to Minimum Load via EDIL. |  |  |
| 4 | Unit operator receives switching instruction from CHCC to synchronise |  |  |
| 5 | Unit operator receives EDIL instruction and Synchronises the Unit and notes the following:  |  | Time of Synchronisation: \_\_:\_\_.Synchronous Start up time: \_\_\_minutes.Block Load: \_\_\_\_MW. |
| 6 | Unit operator dispatches the Unit to Minimum Load at a rate of **XX** MW per minute. |  | Loading rate Warm: \_\_\_\_MW per minute. Load Up Break Point Warm: \_\_\_MW for soak time of \_\_\_\_minutes.  |
| 7 | After reaching minimum load and following a period of **XX minutes** where the unit has stabilised, the Unit operator records the Minimum load value. |  | Minimum Load \_\_\_\_\_MW.Corrected Minimum Load: \_\_\_\_MW. |
| 8 | The Unit Operator monitors that the unit remains at Minimum Load for a minimum of **[insert no of hours as agreed with TSO]** hours. |  |  |
| 9 | Unit operator follows CHCC instruction for **30 minutes** following time period at Minimum Load (Instruction may be Shutdown, Ramp up or maintain output). |  | Instruction from CHCC\_\_\_\_\_\_\_\_\_\_\_ |
| 10 | Unit operator ends data recording for all trends |  |  |

|  |
| --- |
| **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/conventional-generator-co/index.xml [↑](#footnote-ref-1)
2. For example simulation of the Generator performance characteristics under the test procedure [↑](#footnote-ref-2)