

# Generator Commissioning guide and relevant documentation

This guide is for Certified Commissioning officers and explains which ENA documentation is required to be completed for a successful commissioning of a Electrical Generation site.

## Why do we need to commission generation connections?

When an application to connect generation is received, design work is completed to ensure that the local network can accept the electricity generated, and continue to operate within the required legal limits. The first priority when operating an electrical distribution network is to ensure that it is operated in a safe manner. However, sometimes the generator or network may operate abnormally causing faults. When this happens we can't allow the generator to continue to backfeed a fault and/or create an island network which poses further risk. Therefore it is essential to ensure loss of mains protection, where the generator will automatically disconnect protecting staff and assets.

Project commissioning is the process of assuring all systems and components of the installation are designed, installed and tested to the appropriate engineering specification/recommendation.

### Looking for commissioning documents for secondary substations?

The following documents for commissioning and installing secondary substations can be found on our secure portal area by logging in at [www.ssen.co.uk/Forms/signIn/?ReturnUrl=CompetitionInConnectionsSecureDocuments](http://www.ssen.co.uk/Forms/signIn/?ReturnUrl=CompetitionInConnectionsSecureDocuments)

- PR-PS-063 Procedure for over voltage testing of high voltage apparatus up to and including 400kV
- TG-PS-896 Commissioning of Distribution Network Assets
- FO-PS-1013 Solar Farm 33kV Contestable Connection Witnessing Reminder – Construction Phase
- FO-PS-1014 Declaration of Commissioning and Test Results for the Installation of Metal Enclosed Switchgear at 22kV and 33kV
- TG-PS-883 The Design and Installation of New Secondary Substations for Adoption or Use by SSEPD Including Joint User Substation

## Which documents are required to be completed?

### Type tested system:

A type tested system is one that uses solely type test approved equipment. To classify as type test approved the equipment must have completed the tests detailed in Appendix 13.1 of G59/3 and have correspondent certificate to prove this and be listed on the Energy Network Association's Type test verification report register. An example of this would be a 200kW solar PV system using type-tested inverters <50kW.

Commissioning documents require Appendix 13.2 of G59/3 to be filled in which can be found below or on the ENA website:

[www.energynetworks.org/electricity/engineering/distributed-generation/engineering-recommendation-g59.html](http://www.energynetworks.org/electricity/engineering/distributed-generation/engineering-recommendation-g59.html)



## Non-type tested system:

A non type-tested system is one that uses non type-tested factory approved equipment (as defined in G59/3) which means a G59/3 relay must be used.

Some examples of this would be:

- A Hydro, Wind and Solar PV system using non type-tested inverters with a G59/3 protection relay
- A CHP System
- An Anaerobic Digester with a gas engine
- A diesel engine

It is worth noting that sometimes type-tested equipment can be used as part of a non type-tested system and therefore still requires a witness test as a G59/3 relay would be in use. Any additional equipment in the install (e.g. inverter) containing G59/3 protection should be set to mirror the settings applied in the G59/3 relay.

Commissioning documents required Appendix 13.2 & 13.3 of G59/3 can be found below or on the ENA website:

[www.energynetworks.org/electricity/engineering/distributed-generation/engineering-recommendation-g59.html](http://www.energynetworks.org/electricity/engineering/distributed-generation/engineering-recommendation-g59.html)

## Commissioning Guidance notes

### Appendix 13.2

This document is required to be completed for all installations. The first page is site information and installation details to be completed by the installer/generator. Required also are details of Generating units.

You can find a guide to MPAN creation for generation sites by going to

[www.ssen.co.uk/MPAN](http://www.ssen.co.uk/MPAN)

The second page will focus on the on site commissioning checks that will need to be undertaken. The commissioning checks encompass all types of generation and not all checks maybe applicable to your installation.

The third page is a declaration that needs to be completed by the installer or Generator depending on size of installation.





## Appendix 13.3

This document is for Non-type tested installations only.

The document below includes certain test and information requirements which are not included on the original ENA Appendix 13.3 test sheet but are required by G59/3. These include the additional:

- Information
  - Relay details
  - Test equipment
  - Calibration date and certificates
  - Time date of test
  - Site details
- Tests
  - Loss of mains test
  - Loss of control power
  - Contactor/circuit breaker timing test
  - Relay auto restore time

NOTE: Relevant pages to be completed dependant on site connection being LV or HV.



Information to be enclosed	
Description	Confirmation
Final copy of circuit diagram	Yes / No*
<b>Generating Unit</b> Type Test Reference Number, or for <b>Generating Units</b> not yet listed on the ENA web site a completed <b>Generating Unit</b> Type Test Sheet	Yes / No*
Schedule of protection settings ( may be included in circuit diagram )	Yes / No*
Commissioning Checks	
Installation satisfies the requirements of BS7671 (IET Wiring Regulations).	Yes / No*
Suitable lockable points of isolation have been provided between the <b>Generating Units</b> and the rest of the installation.	Yes / No*
Labels have been installed at all points of isolation in accordance with EREC G59.	Yes / No*
Interlocking that prevents <b>Generating Units</b> being connected in parallel with the <b>DNO</b> system (without synchronising) is in place and operates correctly.	Yes / No*
The <b>Interface Protection</b> settings have been checked and comply with EREC G59/3	Yes / No*
<b>Generating Units</b> successfully synchronise with the <b>DNO</b> system without causing significant voltage disturbance.	Yes / No*
<b>Generating Units</b> successfully run in parallel with the <b>DNO</b> system without tripping and without causing significant voltage disturbances.	Yes / No*
<b>Generating Units</b> successfully disconnect without causing a significant voltage disturbance, when they are shut down.	Yes / No*
<b>Interface Protection</b> operates and disconnects the <b>Generating Units</b> quickly (within 1s) as required by section 12.3.1 (g)	Yes / No*
<b>Generating Unit(s)</b> remain disconnected for at least 20s after switch is reclosed.	Yes / No*
<b>Loss of tripping and auxiliary supplies</b> Where applicable, loss of supplies to tripping and protection relays results in either <b>Generating Unit</b> lockout or an alarm to a 24hr manned control centre.	Yes / No*
<b>Balance of Multiple Single Phase Generating Units</b> Confirm that design of the complete installation has been carried out to limit output power imbalance to below 16A/phase, as required by section 7.5 of EREC G59/3	Yes / No*

Additional Comments / Observations:

**Declaration – to be completed by Installer for Power Stations under 50kW or by the Generator for Power Stations above 50kW**

I declare that the **Generating Units** and the installation which together form a **Power Station** at the above address, comply with the requirements of EREC G59/3 and the commissioning checks have been successfully completed. \*The **Power Station** comprises only **Generating Units Type Tested** to EREC G59 or EREC G83/2 or later, or \*part or all of this **Power Station** contains **Generating Units** not **Type Tested** to EREC G59 or EREC G83 and the **Generating Plant** Installation and Commissioning tests form (Appendix 13.3) has been completed in addition to this form.

\* Delete the part which does not apply.

Signature:

Date:

### 13.3 Generating Plant Installation and Commissioning Tests

**Commissioning test requirements for non-Type Tested Generating Units in addition to those required in Appendix 13.2**

<b><u>Site Name:</u></b>
<b><u>Site Address:</u></b>
<b><u>SSEPD Job reference (e.g ABC123):</u></b>
<b><u>Relay Details</u></b>  <b>Manufacturer:</b>  <b>Type/model:</b>  <b>Serial Number:</b>  <b>Software Version:</b>
<b><u>Testing Equipment (Please list below test equipment used including make/model, calibration dates etc.)</u></b>

**Date:**

**Signed:**

**Job Ref:**

<b>Over and Under Voltage Protection Tests LV</b>							
<b>Stability Tests</b>							
Test Description	Setting	Time Delay	Test Condition ( 3-Phase Value )	Test Voltage all phases ph-n	Test Duration	Con- firm No Trip	Result
Inside Normal band	-----	-----	< OV Stage 1	258.2V	5.00s		Pass/Fail
<b>Stage 1 Over Voltage</b>	<b>262.2V</b>	<b>1.0s</b>	> OV Stage 1	269.7V	0.95s		Pass/Fail
<b>Stage 2 Over Voltage</b>	<b>273.7V</b>	<b>0.5s</b>	> OV Stage 2	277.7V	0.45s		Pass/Fail
Inside Normal band	-----	-----	> UV Stage 1	204.1V	5.00s		Pass/Fail
<b>Stage 1 Under Voltage</b>	<b>200.1V</b>	<b>2.5s</b>	< UV Stage 1	188V	2.45s		Pass/Fail
<b>Stage 2 Under Voltage</b>	<b>184.0V</b>	<b>0.5s</b>	< UV Stage 2	180V	0.45s		Pass/Fail
Overvoltage test - Voltage shall be stepped from 258V to the test voltage and held for the test duration and then stepped back to 258V. Undervoltage test – Voltage shall be stepped from 204.1V to the test voltage and held for the test duration and then stepped back to 204.1V							
<b>Additional Comments / Observations::</b>							

Date:

Signed:

Job Ref:



<b>Over and Under Voltage Protection Tests HV</b>											
<b>referenced to 110V ph-ph VT output</b>											
<b>Calibration and Accuracy Tests</b>											
Phase	Setting	Time Delay	<b>Pickup Voltage</b>				<b>Time Delay</b> measured value plus or minus 2V				
<b>Stage 1 Over Voltage</b>			Lower Limit	Mea- sured Value	Upper Limit	Result	Test Value	Lower Limit	Mea- sured Value	Upper Limit	Result
L1 - L2	<b>121V</b> 110V VT secondary	<b>1.0s</b>	119.35		122.65	Pass/Fail	Mea- sured value plus 2V	1.0s		1.1s	Pass/Fail
L2 - L3						Pass/Fail					Pass/Fail
L3 - L1						Pass/Fail					Pass/Fail
<b>Stage 2 Over Voltage</b>			Lower Limit	Mea- sured Value	Upper Limit	Result	Test Value	Lower Limit	Mea- sured Value	Upper Limit	Result
L1 - L2	<b>124.3V</b> 110V VT secondary	<b>0.5s</b>	122.65		125.95	Pass/Fail	Mea- sured value plus 2V	0.5s		0.6s	Pass/Fail
L2 - L3						Pass/Fail					Pass/Fail
L3 - L1						Pass/Fail					Pass/Fail
<b>Stage 1 Under Voltage</b>			Lower Limit	Mea- sured Value	Upper Limit	Result	Test Value	Lower Limit	Mea- sured Value	Upper Limit	Result
L1 - L2	<b>95.70V</b> 110V VT secondary	<b>2.5s</b>	94.05		97.35	Pass/Fail	Mea- sured value minus 2V	2.5s		2.6s	Pass/Fail
L2 - L3						Pass/Fail					Pass/Fail
L3 - L1						Pass/Fail					Pass/Fail
<b>Stage 2 Under Voltage</b>			Lower Limit	Mea- sured Value	Upper Limit	Result	Test Value	Lower Limit	Mea- sured Value	Upper Limit	Result
L1 - L2	<b>88.00V</b> 110V VT secondary	<b>0.5s</b>	86.35		89.65	Pass/Fail	Mea- sured value minus 2V	0.5s		0.6s	Pass/Fail
L2 - L3						Pass/Fail					Pass/Fail
L3 - L1						Pass/Fail					Pass/Fail

Date:

Signed:

Job Ref:

**Over and Under Voltage Protection Tests HV**

**referenced to 110V ph-ph VT output** (Secondary voltages are indicated for convenience, where different VT nominal outputs are present these values should be re-calculated using an appropriate ratio)

**Stability Tests**

Test Description	Setting	Time Delay	Test Condition ( 3-Phase Value )	Test Voltage All phases ph-ph	Test Duration	Con- firm No Trip	Result
Inside Normal band	-----	-----	< OV Stage 1	119V	5.00s		Pass/Fail
<b>Stage 1 Over Voltage</b>	<b>121V</b>	<b>1.0s</b>	> OV Stage 1	122.3V	0.95s		Pass/Fail
<b>Stage 2 Over Voltage</b>	<b>124.3V</b>	<b>0.5s</b>	> OV Stage 2	126.3V	0.45s		Pass/Fail
Inside Normal band	-----	-----	> UV Stage 1	97.7V	5.00s		Pass/Fail
<b>Stage 1 Under Voltage</b>	<b>95.7V</b>	<b>2.5s</b>	< UV Stage 1	90V	2.45s		Pass/Fail
<b>Stage 2 Under Voltage</b>	<b>88V</b>	<b>0.5s</b>	< UV Stage 2	86V	0.45s		Pass/Fail

Additional Comments / Observations:

**Date:**

**Signed:**

**Job Ref:**

<b>Over and Under Frequency Protection Tests</b>											
<b>Calibration and Accuracy Tests</b>											
Setting		Time Delay	Pickup Frequency			Time Delay					
Stage 1 Over Frequency		Lower Limit	Measured Value	Upper Limit	Result	Freq step	Lower Limit	Measured Value	Upper Limit	Result	
51.5Hz		90s	51.40		51.60	Pass/Fail	51.2-51.8Hz	90.0s		90.9s	Pass/Fail
Stage 2 Over Frequency		Lower Limit	Measured Value	Upper Limit	Result	Freq step	Lower Limit	Measured Value	Upper Limit	Result	
52Hz		0.5s	51.90		52.10	Pass/Fail	51.7-52.3Hz	0.50s		0.60s	Pass/Fail
Stage 1 Under Frequency		Lower Limit	Measured Value	Upper Limit	Result	Freq step	Lower Limit	Measured Value	Upper Limit	Result	
47.5Hz		20s	47.40		47.60	Pass/Fail	47.8-47.2Hz	20.0s		20.2s	Pass/Fail
Stage 2 Under Frequency		Lower Limit	Measured Value	Upper Limit	Result	Freq step	Lower Limit	Measured Value	Upper Limit	Result	
47Hz		0.5s	46.90		47.1	Pass/Fail	47.3-46.7Hz	0.50s		0.60s	Pass/Fail
<b>Stability Tests</b>											
Test Description		Setting	Time Delay	Test Condition		Test Frequency	Test Duration	Confirm No Trip		Result	
Inside Normal band		-----	-----	< OF Stage 1		51.3Hz	120s			Pass/Fail	
<b>Stage 1 Over Frequency</b>		51.5Hz	90s	> OF Stage 1		51.7Hz	89.0s			Pass/Fail	
<b>Stage 2 Over Frequency</b>		52Hz	0.5s	> OF Stage 2		52.2Hz	0.45s			Pass/Fail	
Inside Normal band		-----	-----	> UF Stage 1		47.7Hz	30s			Pass/Fail	
<b>Stage 1 Under Frequency</b>		47.5Hz	20s	< UF Stage 1		47.3Hz	19.5s			Pass/Fail	
<b>Stage 2 Under Frequency</b>		47Hz	0.5s	< UF Stage 2		46.8Hz	0.45s			Pass/Fail	
Overfrequency test - Frequency shall be stepped from 51.3Hz to the test frequency and held for the test duration and then stepped back to 51.3Hz.											
Underfrequency test - Frequency shall be stepped from 47.7Hz to the test frequency and held for the test duration and then stepped back to 47.7Hz											
Additional Comments / Observations:											

Date:

Signed:

Job Ref:

Note that the table below applies to Power Stations less than 5 MW capacity.

The DNO will be able to provide, on request, corresponding figures for Power Stations of 5MW and above.

Loss-of-Mains (LOM) Protection Tests – RoCoF for Power Stations <5MW								
Calibration and Accuracy Tests								
Ramp in range 49.5-50.5Hz	Pickup (+ / -0.025Hzs <sup>-1</sup> )				Time Delay RoCoF = +0.05Hz/s above setting			
Setting = 0.125 / 0.20 Hzs <sup>-1</sup>	Lower Limit	Measured Value	Upper Limit	Re-sult	Test Condition	Mea-sured Value	Upper Limit	Result
Increasing Frequency	0.1 0.175		0.15 0.225	Pass/ Fail	0.175 Hzs <sup>-1</sup> 0.25 Hzs <sup>-1</sup>		<0.5s	Pass/Fail
Reducing Frequency	0.1 0.175		0.15 0.225	Pass/ Fail	0.175 Hzs <sup>-1</sup> 0.25 Hzs <sup>-1</sup>		<0.5s	Pass/Fail
Stability Tests								
Ramp in range 49.5-50.5Hz	Test Condition		Test frequency ramp		Test Duration	Confirm No Trip		Result
Inside Normal band	< RoCoF ( increasing f )		Higher of 0.075 Hzs <sup>-1</sup> or ROCOF - 0.05 Hzs <sup>-1</sup>		5.0s			Pass/Fail
Inside Normal band	< RoCoF ( reducing f )		= _____ 5.0s		5.0s			Pass/Fail
Additional Comments / Observations:								

Date:

Signed:

Job Ref:

Loss-of-Mains (LOM) Protection Tests - Vector Shift								
Calibration and Accuracy Tests								
Vector Shift	Pickup ( ± 1.5 degree )				Time Delay Vector shift = 3 deg above setting			
	Setting = 6 / 12 degrees	Lower Limit	Measured Value	Upper Limit	Result	Test Condition	Measured Value	Upper Limit
Vector Shift : Lagging Angle	4.5 10.5		7.5 13.5	Pass/Fail	9 deg 15 deg		<0.5s	Pass/Fail
Vector Shift : Leading Angle	4.5 10.5		7.5 13.5	Pass/Fail	9 deg 15 deg		<0.5s	Pass/Fail
Stability Tests								
Test Description	Test Condition	Test vector shift			Test Duration	Confirm No Trip		Result
Inside Normal band	< Vector Shift ( Lagging f )	Higher of 4 degrees or vector shift -2 degree = _____						Pass/Fail
Inside Normal band	< Vector Shift ( Leading f )					Pass/Fail		
Additional Comments / Observations:								

Date:

Signed:

Job Ref:

**Contactors / CB Timing Tests:**

**Additional Tests (To be carried out whilst in Parallel):**

Loss of Mains - PASS / FAIL

Loss of Control Power to Relay – PASS / FAIL

Relay Auto Restore time:

Auto Reclose functional test demonstrated (if applicable):

Time elapsed before generation:

**Declaration – to be completed by Generator or Generators Appointed Technical Representative.**

I declare that the **Generating Unit** and the installation comply with the requirements of EREC G59/3 and the additional commissioning checks noted above have been successfully completed in addition to those required for all **Generating Unit** installations (see Appendix 13.2)

Signature:

Date:

Position.

**Declaration – to be completed by DNO Witnessing Representative**

I confirm that I have witnessed the tests in this document on behalf of

\_\_\_\_\_ SEPD \_\_\_\_\_ and that the results are an accurate record of the tests

Signature:

Date:

Print:

Position: