

national**grid**ESO

EU NCER: System Test Plan (Including Distributed Re-Start)

Issue 2

March 2022



Contents

- Contents 1
- EU NCER: System Test Plan 2
- 1 Version Control..... 3
- 2 Introduction..... 4
- 3 REQUIREMENTS OF THE TEST PLAN 4
- 4 Application 5
- 5 IMPLEMENTATION OF THE TEST PLAN IN GB 5
- 5.1 Assessment and Compliance 5
- 6 Compliance Testing and Periodic Review of the System Defence Plan... 7
- 7 Compliance Testing and Periodic Review of the Restoration Plan..... 10
- 8 Implementation of the Restoration Plan in GB 11
- 9 Future Work..... 13



EU NCER: System Test Plan

1 Version Control

| Version | Date | Author | Rationale |
|---------|------------|--------|--|
| Issue 1 | Dec 2019 | NGESO | Each TSO shall have a Test Plan in Place |
| Issue 2 | March 2021 | NGESO | Further detail added to reflect changes since the first version of the document was published in December 2019 |

2 Introduction

The *European Network Code on Emergency & Restoration*¹ (**EU NCER**) came into force on 18 December 2017.

Under Article 43 of the EU NCER there is a requirement for each TSO (which in GB is NGESO) in consultation with Distribution System Operators, Significant Grid User's Defence Service Providers and Restoration Service Providers to prepare a Test Plan.

The purpose of this document is to define how the Test Plan is implemented in Great Britain (GB) and the relationship with other GB documents such as the System Defence Plan, the System Restoration Plan and the Grid Code.

This Test Plan is not intended to replace any provisions or testing requirements currently or proposed in the GB Codes.

3 REQUIREMENTS OF THE TEST PLAN

Article 43 of the EU NCER is reproduced below, which defines the General Principles of the Test Plan.

1. *Each TSO shall periodically assess the proper functioning of all equipment and capabilities considered in the system defence plan and the restoration plan. To this end, each TSO shall periodically verify the compliance of such equipment and capabilities, in accordance with paragraph 2 and with Article 41(2) of Regulation (EU) 2016/631, Article 35(2) of Regulation (EU) 2016/1388 and Article 69(1) and (2) of Regulation (EU) 2016/1447.*
2. *By 18 December 2019, each TSO shall define a test plan in consultation with the DSOs, the SGUs identified pursuant to Articles 11(4) and 23(4), the defence service providers and the restoration service providers. The test plan shall identify the equipment and capabilities relevant for the system defence plan and the restoration plan that have to be tested.*
3. *The test plan shall include the periodicity and conditions of the tests, following the minimum requirements outlined in Articles 44 to 47. The test plan shall follow the methodology laid down in Regulation (EU) 2016/631 Regulation (EU) 2016/1388 and Regulation (EU) 2016/1447 for the corresponding tested capability. For SGUs that are not subject to Regulation (EU) 2016/631, Regulation (EU) 2016/1388 and Regulation (EU) 2016/1447, the test plan shall follow the provisions of national law.*
4. *Each TSO, DSO, SGU, defence service provider and restoration service provider shall not endanger the operational security of the transmission system and of the interconnected transmission system during the test. The test shall be conducted in a way that minimises the impact on system users.*
5. *The test is deemed to be successful when it fulfils the conditions established by the relevant system operator pursuant to paragraph 3. As long as a test fails to fulfil these criteria, the TSO, DSO, SGU,*

¹*Network Code on Emergency and Restoration*

http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2017.312.01.0054.01.ENG&toc=OJ:L:2017:312:TOC

defence service provider and restoration service provider shall repeat the test.

4 Application

In GB, the parties within scope of the EU NCER are defined in Appendix A of the System Defence Plan and System Restoration Plan. In summary this extends to CUSC Parties and Non-CUSC Parties who have contract with NGESO to provide a Defence Service or a Restoration Service.

Although the UK has departed from the EU, the majority of the requirements in the EU NCER have been retained in GB law via Statutory Instrument (SI 533 2019). Therefore, unless provided for by exception in SI 533 2019, the requirements of the EU NCER will apply unchanged.

5 IMPLEMENTATION OF THE TEST PLAN IN GB

5.1 Assessment and Compliance

- 5.1.1 Article 43(1) states *“Each TSO shall periodically assess the proper functioning of all equipment and capabilities considered in the System Defence Plan and the Restoration Plan. To this end, each TSO shall periodically verify the compliance of such equipment and capabilities, in accordance with paragraph 2 and with Article 41(2) of Regulation (EU) 2016/631, Article 35(2) of Regulation (EU) 2016/1388 and Article 69(1) and (2) of Regulation (EU) 2016/1447”*
- 5.1.2 NGESO has prepared a System Defence and System Restoration Plan. These documents are available on the NGESO Website. In order to ensure the equipment owned or operated by GB Parties who fall within the scope of the EU NCER (as defined in the Appendix A of the System Defence Plan and System Restoration Plan) compliance testing, simulation and monitoring is undertaken as required in the Grid Code (for example through the Compliance Processes (CP's), European Compliance Processes (ECP's), Operating Code 5 (OC5) and Operating Code 12 (OC12).
- 5.1.3 In addition, through the European Compliance Processes (ECP's), compliance with Article 41(2) of Regulation (EU) 2016/631 (Requirements for Generators under ECP8.1), Article 35(2) of Regulation (EU) 2016/1388 (Demand Connection Code under DRSC.11.3.2.2) and Article 69(1) and (2) of Regulation (EU) 2016/1447 (HVDC Code under ECP1.1) is assured.
- 5.1.4 Article 43 (2) states *“By 18 December 2019 each TSO shall define a test plan in consultation with the DSOs, the SGUs identified pursuant to Articles 11(4) and 23(4), the defence service providers and the restoration service providers. The test plan shall identify the equipment and capabilities relevant for the system defence plan and the restoration plan that have to be tested.*
- 5.1.5 Table 1 below shows the applicable requirements of the EU NCER which are implemented in the Grid Code, all of which are necessary for compliance purposes.

Requirement

Grid Code Clause

| | |
|---|---|
| Connection Requirements | CC/ECC.6.3 and OC5 |
| Compliance Requirements against the Connection Conditions and European Connection Conditions | CC/ECP.A.3, CC/ECP.A.5, CC/ECC.A.6 and CC/ECC.A.7 |
| Power Generating Module Black Start Service repeatability, Anchor Plant and Restoration Service Provider Plant testing every three years as required under NCER Art 44(1) | OC5.7.1 / OC5.7.2 / OC5.7.4 |
| Type C and Type D Power Generating Module and Anchor Plant quick Resynchronisation tests required after two unsuccessful operations in real time as required under NCER Art 44(2) | ECC.6.3.5.6 / OC5.7.1.1(a)(iii) / OC5.7.1.1(b)(iv) / OC5.7.1.2 (e) / OC5.7.3 / OC5.7.4.5 |
| Demand Modification Tests required after two unsuccessful operations in real time or at least every year as required under NCER Art 45(1) | DRSC11.7.1 |
| Low frequency demand disconnection Test within a period defined at National Level as required under NCER Art 45(2) | DRSC11.7.2 – The test period is defined in GB as every three years. |
| HVDC Black Start Service, Anchor HVDC System and Anchor Dc Converter testing to be carried out every three years in accordance with NCER Art 46 | OC5.7.1 / OC5.7.2 / OC5.7.4 |
| Low frequency demand disconnection Relay testing to be tested within a period defined at National Level as required under NCER Art 47 | CC/ECC.A.5.4.2 and CC/ECC.A.5.4.3 – In GB a period of once every three years has been selected. |
| Testing of communication systems and backup power supplies for those communication systems in accordance with NCER Art 48 | CC/ECC.6.5.4.4 - Testing of inter TSO communications is covered in Section 6.0 below. |

Table 1

- 5.1.6 Article 43 (3) states “*The test plan shall include the periodicity and conditions of the tests, following the minimum requirements outlined in Articles 44 to 47. The test plan shall follow the methodology laid down in Regulation (EU) 2016/631 Regulation (EU) 2016/1388 and Regulation (EU) 2016/1447 for the corresponding tested capability. For SGUs that are not subject to Regulation (EU) 2016/631, Regulation (EU) 2016/1388 and Regulation (EU) 2016/1447, the test plan shall follow the provisions of national law*”.

- 5.1.7 The periodicity and conditions of the requirements and tests in relation to Articles 44 to 47 of the NCER are covered in the Grid Code as summarised in Table 1 above. For parties who fall under the requirements of the EU NCER as defined in Appendix A of the System Defence Plan and System Restoration Plan which are not covered by the requirements of RfG (Regulation (EU) 2016/631, DCC (Regulation (EU) 2016/1388) and HVDC Code (Regulation (EU) 2016/1447) these are covered through the existing requirements of the Grid Code through the Compliance Processes and Operating Code 5.
- 5.1.8 Article 43(4) states “*Each TSO, DSO, SGU, defence service provider and restoration service provider shall not endanger the operational security of the — transmission system and of the interconnected transmission system during the test. The test shall be conducted in a way that minimises the impact on system users*”.
- 5.1.9 As defined in Appendices A of the System Defence Plan and System Restoration Plan, the approach adopted by NGESO is that the EU NCER will only apply to CUSC parties and Non-CUSC parties who have a contract with NGESO to provide a Defence Service or a Restoration Service. A “Defence Service” and a “Restoration Service” is defined in the Glossary of the System Defence Plan and System Restoration Plan. OC5.5.3.3 states “The User is responsible for carrying out the test on their plant and retains the responsibility for the safety of personnel and their plant during the test”. As part of this Test Plan any tests undertaken by a User, Defence Service Provider or Restoration Service Provider should not put the operational security of the Transmission System at risk and any tests conducted should also minimise the impact on System Users as provided for under OC.5.5.3.3.
- 5.1.10 Article 43(5) states “*The test is deemed to be successful when it fulfils the conditions established by the relevant system operator pursuant to paragraph 3. As long as a test fails to fulfil these criteria, the TSO, DSO, SGU, defence service provider and restoration service provider shall repeat the test.*”
- 5.1.11 OC5.5.4 refers the individual performance requirements for each type of plant and tests against which the Grid Code requirements are assessed which include the requirements of RfG, DCC and HVDC Connection Network Codes. OC5.5.4 of the Grid Code states the pass and fail criteria against the tests to be conducted.
- 5.1.12 CC.7.10/ECC.7.10 detail the obligations on User’s in respect of Critical Tools and Facilities. In particular CC.7.10.3 and ECC.7.10.3 details the requirements for testing these Critical Tools and Facilities.

6 Compliance Testing and Periodic Review of the System Defence Plan

- 6.1.1 Article 50(1) of EU NCER states “*Each DSO concerned by the implementation of the low frequency demand disconnection on its installations shall update once a year the communication to the notifying system operator provided for in point (b) of Article 12(6). This communication shall include the frequency settings at which netted demand disconnection is initiated and the percentage of netted demand disconnected at every such setting*”.

- 6.1.2. Article 50(2) of the EU NCER states *“Each TSO shall monitor the proper implementation of the low frequency demand disconnection on the basis of the yearly written communication referred to in paragraph 1 and on the basis of implementation details of TSOs' installations where applicable.*
- 6.1.3 Both the requirements of Articles 50(1) and 50(2) of the EU NCER are fulfilled through the Grid Code Week 24 process as required under PC.A.1.2 and PC.A.4.6 of the Planning Code. The technical requirements for low frequency demand disconnection are detailed in CC.6.4.3, ECC.6.4.3, CC.A.5, ECC.A.5 and OC6.6.6.
- 6.1.4. Article 50(3) of the EU NCER states *“Each TSO shall review, at least every five years, its complete system defence plan to assess its effectiveness. The TSO shall in this review take into account at least:*
- (a) the development and evolution of its network since the last review or first design;*
 - (b) the capabilities of new equipment installed on the transmission and distribution systems since the last review or first design;*
 - (c) the SGUs commissioned since the last review or first design, their capabilities and relevant services offered;*
 - (d) the tests carried out and the analysis of system incidents pursuant to Article 56(5) of Regulation (EU) 2017/1485; and*
 - (e) the operational data collected during normal operation and after disturbance”.*
- 6.1.5 With the introduction of the EU NCER, it is proposed that NGESO in coordination with GB Stakeholders will review and update the System Defence Plan. The mechanism by which items (a) to (e) of Article 50(3) are undertaken are summarised in Table 2 below.

| EU Requirement | GB Implementation |
|--|---|
| <i>The development and evolution of its network since the last review or first design;</i> | Covered through the Grid Code Week 24 process under PC.A.1.2 and STC STCP 22-1, STCP 04-4 STCP 12-1, |
| <i>The capabilities of new equipment installed on the transmission and distribution systems since the last review or first design;</i> | For Transmission this is covered through the STC via STCP Procedures STCP 22-1, STCP 19-5, STCP 18-1, STCP 19-4, STCP 04-1, STCP 19-3, STCP 27-1 and STCP 19-3. In the case of Distribution Systems caught by the requirements of the Grid Code, these issues are captured under the Connection Conditions, European Connection Conditions, Compliance Processes, European Compliance Processes, Planning Code and Data Registration Code |
| <i>The SGUs commissioned since the last review or first design, their capabilities and relevant services offered;</i> | Captured through the Grid Code compliance process under the Compliance Processes and European Compliance Processes defined in the Grid Code. In this context first design |

| | |
|---|---|
| | means then the SGU was commissioned. |
| <i>The tests carried out and the analysis of system incidents pursuant to Article 56(5) of Regulation (EU) 2017/1485; and</i> | Captured through Grid Code OC5, OC7 and OC12. Through the System Operator Transmission Owner Code these requirements are captured through STCP-03-1, STCP 06-3, STCP 06-4, STCP 08-3, STCP 08-4, STCP 27-01 and STCP 19-3. In addition, the outcome of measures introduced following previous System events and Incidents to prevent re-occurrence are managed through external investigations (eg via EC3, internal investigations and internal procedures including training and authorisation. |
| <i>The operational data collected during normal operation and after disturbance”.</i> | Captured through Grid Code CC.6.5.6, ECC.6.5.6, CC6.6, ECC.6.6 with any re-testing being carried out in OC5. For Transmission Licensees, the requirements are carried through the System Operator Transmission Owner Code under STCP 03-1, STCP 08-3 and STCP 27-01. |

- 6.1.6 Article 50(4) of the EU NCER states “*Each TSO shall review the relevant measures of its system defence plan in accordance with paragraph 3 before any substantial change in the configuration of the grid*”. This requirement relates to the need to review the System Defence Plan prior to making any changes to the Transmission System (for example major reinforcement made to the Transmission System as a result of load or generation growth which would need to be factored into the System Defence Plan). Within GB this requirement is implicit in so far that there is a requirement to update and maintain the Grid Code (Grid Code GR2 and GR3.2 refers) to ensure the Grid Code facilitates achievement of the Grid Code Objectives). The STC is governed by a similar approach as defined in Section 6 of the STC. In addition, and through internal and external investigations, learning points arising from System events, the development of internal procedures, training and authorisation beyond those already in existence updates will be introduced to the System Defence Plan, System Restoration Plan and industry codes to improve the reliability and robustness of the System and ensure its timely re-establishment in the event of a disturbance.
- 6.1.7 Article 50(5) of the EU NCER states “*When the TSO identifies the need to adapt the system defence plan, it shall amend its system defence plan and implement these amendments in accordance with points (c) and (d) of Article 4(2) and Articles 11 and 12*”. In summary there will be a need to update the System Defence Plan as the System (including reinforcement) and the type of plant connected to it evolves. When the System Defence Plan is updated, this shall follow the same process as defined in EU NCER Article 4(2) and Articles 11 and 12 in the same way that the current System Defence Plan has been prepared.

7 Compliance Testing and Periodic Review of the Restoration Plan

7.1.1 Article 51(1) of EU NCER states “Each TSO shall review the measures of its restoration plan using computer simulation tests, using data from the DSOs identified pursuant to Article 23(4) and the restoration service providers, at least every five years. The TSO shall define these simulation tests in a dedicated testing procedure covering at least:

- (a) the energising restoration path from restoration service providers with black start or island operation capabilities. This would include Restoration Service Providers taking part in both Local Joint Restoration Plans and Distribution Restoration Zone Plans;
- (b) the supply of power generating modules main auxiliaries;
- (c) the demand reconnection process; and
- (d) the process for resynchronisation of networks in island operation.

7.1.2 In the event of a Black Start situation when the System has shutdown, NGESO has a well established process to restore the System relying on its pre-prepared plan and strategy. In order to enact this plan, the first requirement is to have in place Black Start Contracts with a number of strategically placed Black Start Service Providers and Distribution Restoration Contracts with Restoration Service Providers for the provision of establishing several Distribution Restoration Zones. Black Start Service Providers are those with plants who can supply power and energise part of the System without any external Power Supply within two hours of an instruction from NGESO. The requirements for Black Start Service Providers and their capabilities are defined in CC/ECC.6.3.5, OC9.4.5 and their Black Start Contracts. In the case of Distribution Restoration Zones, there is a requirement for Anchor Plant Owners whose plant can supply power without any external Power Supply within eight hours of an instruction from the Distribution Network Operator. These capabilities are defined in CC/ECC.6.3.5 and their Distribution Restoration Contracts. There is also a requirement to ensure the facilities provided by Black Start Service Providers and Restoration Service Providers are fit for purpose and capable of operation when required which is why procedures (under OC5.7 of the Grid Code) are in place for routine testing. As part of this requirement under EU NCER, there will be a requirement for computer simulations and these will be included and developed as part of the Assurance Framework (see section 8.1.2 below).

7.1.3 Once the Black Start Providers, or Distribution Network Operators have been instructed to establish a Distribution Restoration Zone as per OC9.4.7, their purpose is to energise parts of the System to form Power Islands with local demand being fed within these power islands. Once the Power Islands are established, the individual Power Islands are then connected to each other which then enables the System to be re-established. This process continues until the whole System is reconnected and all Demand re-established.

7.1.4 In respect of Users of the Transmission System (for example Generators, HVDC System Owners, Distribution Network Operators) and Restoration Service Providers who are Non-CUSC Parties and have a contract with NGESO to provide a Restoration Service, the requirements for System

Restoration during a Black Start situation are detailed in OC9 of the Grid Code. The requirements on Transmission Licensees are detailed in STCP 06-[1](#) and the obligations on User's connected to the Distribution Network are within DOC9.4 of the Distribution Code.

7.1.5 Articles 51(2)(3)(4) and (5) of the EU NCER state: -

Article 51(2) - In addition, where deemed necessary by the TSO for the effectiveness of the restoration plan, each TSO shall execute operational testing of parts of the restoration plan, in coordination with the DSOs identified pursuant to Article 23(4) and the restoration service providers. The TSO shall set out, in consultation with the DSOs and restoration service providers, those operational tests in a dedicated testing procedure.

Article 51(3) - Each TSO shall review its restoration plan to assess its effectiveness, at least every five years.

Article 51(4). Each TSO shall review the relevant measures of its restoration plan in accordance with paragraph 1 and review their effectiveness before any substantial change in the configuration of the grid.

Article 51(5). When the TSO identifies the need to adapt the restoration plan, it shall amend its restoration plan and implement these amendments in accordance with points (c) and (d) of Article 4(2) and Articles 23 and 24.

7.1.6 Each of the items raised in section 7.1.5 above are covered through the assurance framework and Implementation of the Restoration Plan as discussed in section 8 below.

8 Implementation of the Restoration Plan in GB

8.1.1 NGESO works with all stakeholders as Emergency response plans and procedures cannot be considered reliable until they have been exercised and proven to be workable. This is especially true for Black Start restoration, where it is not possible to exercise the process end-to-end in its entirety.

8.1.2 Exercising provides the following benefits:

- a. Builds capability and competence across the sector and ensures all stakeholders are aware of their roles and responsibilities;
- b. Identifies staff training needs and opportunities;
- c. Validates existing response plans and procedures and ensures these are supported through continuous development, review and improvement including computer modelling
- d. Provides assurance that the sector can effectively respond to a Black Start.

- 8.1.3 It is recognised that organisations carry out a range of exercising / testing activities for their own internal assurance. NGESO however needs to engage and work with External Stakeholders through an assurance framework to ensure that System restoration is achieved in the most efficient manner. A diagram showing this assurance framework is shown below.



Figure 1.0

- 8.1.4 In order to achieve this objective, NGESO has undertaken the following activities:
- Identified and mapped the high-level interactions that are likely to take place between organisations during a Black Start.
 - Reviewed current exercising practices across the sector through an industry-wide survey
 - Analysed survey response and assessed the gaps in current exercising practices;
 - Proposed a framework to align and standardise Black Start exercising and testing across the sector.
- 8.1.5 Individual organisations will be responsible for undertaking the Black Start exercising and tests at the frequencies necessary. Where the NGESO is not legally obliged to assess the outcome of the tests, organisations will be expected to assess themselves.
- 8.1.6 NGESO working with the Energy Emergency Executive Committee (E3C) proposes developing a risk matrix for each stakeholder, tailored according to the tests they are expected to undertake and weighted according to their importance to the Black Start restoration process which would be included as part of the wider Electricity System Restoration Standard (ESRS) work.
- 8.1.7 NGESO is responsible for collating and analysing returns from across the sector and providing an assurance assessment based on the

overarching GB risk. This will provide an indication of the level of confidence around the ability of stakeholders to respond to a Black Start event and restore electricity supply within tolerated timeframes.

- 8.1.8 This risk matrix is currently based on the frequency of exercising/testing undertaken across the industry over a year. But further work is required to incorporate other performance criteria e.g. successful execution of testing.

9 Future Work

- 9.1 It is recognised that as the System continues to evolve with new forms of connection technologies, there is a need to constantly review and update the System Defence Plan, System Restoration Plan and Test Plan. It is believed that this work is fully within the spirit and requirements of the EU NCER.

Faraday House, Warwick Technology Park,
Gallows Hill, Warwick, CV346DA
nationalgridNGESO.com