Energinet
Tonne Kjærsvej 65
DK-7000 Fredericia

+45 70 10 22 44
info@energinet.dk
CVR no. 39 31 49 59

Date:
17 December 2019

Author:
CHD/MRR/JJB

MEMO

EXPLANATORY DOCUMENT FOR TEST PLAN, CF. NETWORK CODE EMERGENCY AND RESTORATION (NC ER) ARTICLES 43-51

REV.	DESCRIPTION	PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY
1	PUBLISHED EDITION	14-12-2019	15-10-2019	15-10-2019	16-12-2019
		JJB	MRR	CHD	JBO

Contents

1. Purpose and legal basis of the explanatory document

This explanatory document elaborates on the rules and explains the principles of the test plan covered by Commission Regulation (EU) 2017/2196 establishing a network code on electricity emergency and restoration (hereinafter NC ER).

The explanatory document is structured in such a way that all articles from NC ER relevant to the test plan are copied into this document. In extension of the individual articles, the requirements for specific tests are described in the points entitled *Test requirements.*

In case of any discrepancy between the test plan and this explanatory document, the test plan will be applicable.

1.1 Legal basis

NC ER stipulates that each Transmission System Operator (TSO) must submit a proposal for the definition of a test plan to the relevant regulatory authority for approval, cf. NC ER point (g) of Article 4(2).

The test plan must contain the items described in Articles 44-51. However, it is only the contents of Articles 44-47 that must be registered with and approved by the Danish Utility Regulator, cf. NC ER Article 43(3). The remaining articles relevant to the test plan (Articles 48-51) are also included in the test plan and in this document, but they do not have to be registered with and approved by the Danish Utility Regulator.

Energinet Elsystemansvar A/S is entitled to obtain documentation of tests performed pursuant to the test plan, cf. Articles 45-51, from all relevant market participants. For tests below for which no documentation requirements are specified, market participants are free to decide the method they use to submit documentation of completed tests. Documentation of the relevant tests should be submitted as specified in the test plan by the end of February.

It has not been possible to formulate a test plan for Articles 44(2) and 45(1) and (2) as there are currently no market participants providing these services. If this changes at a later time, the test plan will be updated to also describe tests for the articles mentioned above.

1.1.1 Legal assumptions

The test plan is universally applicable. However, account must be taken of the connection conditions under which a facility is connected, which describe the requirements imposed and the functions that may therefore need to be tested.

2. Compliance testing of capability of power-generating facility

2.1 Responsible market participants

- Suppliers with which the TSO has entered into a contract.

2.2 Affected market participants

- The supplier with which the TSO has entered into a contract
- Energinet Elsystemansvar A/S.

2.3 Article 44 – Compliance testing of capability of power-generating facility

1. *Each restoration service provider which is a power generating module delivering black start service shall execute a black start capability test, at least every three years, following the methodology laid down in Article 45(5) of Regulation (EU) 2016/631.*

2. *Each restoration service provider which is a power generating module delivering a quick re-synchronisation service shall execute tripping to houseload test after any changes of equipment having an impact on its houseload operation capability, or after two unsuccessful consecutive tripping in real operation, following the methodology laid down in Article 45(6) of Regulation (EU) 2016/631.*

2.3.1 Test requirements

1. Testing of facilities delivering a black start service must be executed after revisions or changes to the facility, but at least once a year. The test must be performed according to an approved test proposal.
    a. Seven tests per calendar year consisting of: black start of auxiliary supply to the black start unit and operation for one hour.
    Two of these tests are ordered unannounced by Energinet Elsystemansvar A/S.
    Five of these tests are planned by the restoration service provider.
    b. One test per calendar year consisting of: black start of the auxiliary supply of the black start unit followed by start-up of the black start unit itself.
    The test is carried out by de-energising the grid of the entire power plant/facility.

2. If requested by Energinet Elsystemansvar A/S, connection of a transmission line or black start of a large, isolated grid area will also take place. The test must be performed according to an approved test proposal.

3. There are currently no restoration service providers that provide quick re-synchronisation, and therefore there is no need for testing.

3. Compliance testing of demand facilities providing demand side response

3.1 Responsible market participants

- Not relevant.

3.2 Affected market participants

- Not relevant.

3.3 Article 45 – Compliance testing of demand facilities providing demand side response

1. *Each defence service provider delivering demand response shall execute a demand modification test, after two consecutive unsuccessful responses in real operation or at least every year, following the methodology laid down in Article 41(1) of Regulation (EU) 2016/1388.*

2. *Each defence service provider delivering demand response low frequency demand disconnection shall execute a low frequency demand disconnection test within a period to be defined at national level and following the methodology laid down in Article 37(4) of Regulation (EU) 2016/1388 for transmission connected demand facilities or according to a similar methodology defined by the relevant system operator for other demand facilities.*

3.3.1 Test requirements

1. It is not possible to define a test (see legal basis).

2. It is not possible to define a test (see legal basis).

4. Compliance testing of HVDC capabilities

4.1 Responsible market participants

- Owners of HVDC capacity.

4.2 Affected market participants

- Owners of HVDC capacity
- Energinet Elsystemansvar A/S.

4.3 Article 46 - Compliance testing of HVDC capabilities

1. Each restoration service provider which is an HVDC system delivering a black start service shall execute a black start capability test, at least every three years, following the methodology laid down in Article 70(11) of Regulation (EU) 2016/1447.

4.3.1 Test requirements

1. Testing of facilities delivering a black start service must be executed after revisions or changes to the facility, but at least once a year.
    a. Seven tests per calendar year consisting of: black start of auxiliary supply to the black start unit and operation for one hour.
    Two of these tests are ordered unannounced by Energinet Elsystemansvar A/S.
    Five of these tests are planned by the restoration service provider.
    b. One test per calendar year consisting of: black start of the auxiliary supply of the black start unit followed by start-up of the black start unit itself.
    The test is carried out by de-energising the grid of the entire power plant/facility.
    If requested by Energinet Elsystemansvar A/S, connection of a transmission line or black start of a large, isolated grid area will also take place. The test must be performed according to an approved test proposal.

5. Compliance testing of low frequency demand disconnection relays

5.1 Responsible market participants

- DSOs.

5.2 Affected market participants

- DSOs.

5.3 Article 47 - Compliance testing of low frequency demand disconnection relays

1. Each DSO and TSO shall execute testing on the low frequency demand disconnection relays implemented on its installations, within a period to be defined at national level and following the methodology laid down in Article 37(6) and Article 39(5) of Regulation (EU) 2016/1388.

5.3.1 Test requirements

1. DSOs must test their low frequency load-shedding relays within a period defined on the basis of their respective asset management systems, but at least every eight years.
    a. As a minimum, the test must comply with the following:
        i. Nominal voltage 0.15 Hz above set load-shedding value: no trip
        ii. Nominal voltage 55 Hz: no trip
        iii. Nominal voltage 48 Hz with blocking function on: trip
        iv. Low voltage, corresponding to set value for voltage blocking, 48 Hz: no trip
        v. Nominal voltage, set load-shedding value: trip, note relay time.

    There is no requirement for load-shedding at low voltage, and therefore there is no plan for testing this.

6. Testing of communication systems

6.1 Responsible market participants

- DSOs
- SGUs (restoration service providers)
- Energinet Elsystemansvar A/S.

6.2 Affected market participants

- DSOs
- SGUs (restoration service providers)
- Energinet Elsystemansvar A/S.

6.3 Article 48 - Testing of communication systems

1. *Each DSO and SGU identified pursuant to Article 23(4), each TSO and each restoration service provider shall test the communication systems defined in Article 41, at least every year.*

2. *Each DSO and SGU identified pursuant to Article 23(4), each TSO and each restoration service provider shall test the backup power supply of their communication systems at least every five years.*

3. *By 18 December 2024 each TSO, in consultation with other TSOs, shall define a test plan for testing the inter-TSO communication.*

6.3.1 Test requirements

1. Testing of communication systems must include IT systems and voice communication. The requirement for a successful test is met when contact is established with voice communication between Control Centre Electricity of Energinet Elsystemansvar A/S and the relevant DSO or SGU.
   This contact must include confirmation that communication over IT systems was received and understood.

2. Testing of the backup power supply of the communication systems must be carried out at least every five years. The test is considered successful when the backup power supply supplies the communication systems.

3. Test to be determined later (only relevant for TSO).

7. Testing of tools and facilities

7.1 Responsible market participants

- DSOs
- Energinet Elsystemansvar A/S.

7.2 Affected market participants

- DSOs
- Energinet Elsystemansvar A/S.

7.3 Article 49 - Testing of tools and facilities

1. *Each TSO shall test the capability of main and backup power sources to supply its main and backup control rooms, provided for in Article 42, at least every year.*

2. *Each TSO shall test the functionality of critical tools and facilities referred to in Article 24 of Regulation (EU) 2017/1485, at least every three years, covering both main and backup tools and facilities. Where these tools and facilities involve DSOs or SGUs, these parties shall participate in this test.*

3. *Each TSO shall test the capability of backup power sources to supply essential services of the substations identified as essential for the restoration plan procedures pursuant to Article 23(4), at least every five years. When these substations are in distribution systems, DSOs shall execute this test.*

4. *Each TSO shall test the transfer procedure for moving from the main control room to the backup control room, provided for in Article 42(4), at least every year.*

7.3.1 Test requirements

1. Energinet Elsystemansvar A/S must test the start-up function and the delivery of emergency supply to the primary control centre and the emergency control centre at least once a month.
   Energinet Elsystemansvar A/S must carry out an inspection of the emergency supply to the primary control centre and the emergency control centre at least once a year. The test must cover all elements of the structure of the emergency supply system, ensuring that:
   a. Installed equipment providing the supply can demonstrably supply the system for the period of time specified in the equipment specifications.
   b. Battery testing can be carried out in accordance with DEFU KR107 or similar. For generators, fuel cells, etc., start-up, operation, and capability to supply the necessary power must be demonstrated.

2. Testing of critical tools and facilities includes testing of communication between Energinet Elsystemansvar A/S and the SCADA systems of the DSOs at least every three years. Testing takes place to confirm that commands from Energinet Elsystemansvar A/S in the Nettelegrafen and Produktionstelegrafen systems reach the control rooms of the DSOs. The test is considered successful when all commands have been exchanged, and confirmation of the commands received has been received in Control Centre Electricity of Energinet Elsystemansvar A/S.

3. The capacity of backup power sources must be tested at least every five years and must demonstrate the ability to supply critical substation services in the substations identified on the list of critical substations for 24 hours. The test must cover all elements of the structure of the backup supply system, ensuring that:
    a. Installed equipment providing the supply can demonstrably supply the system for the period of time specified in the equipment specifications. Battery testing can be carried out in accordance with DEFU KR107 or similar. For generators, fuel cells, etc., start-up, operation, and capability to supply the necessary power must be demonstrated.
    b. Alternative measures, such as emergency preparedness plans and mobile generators, are credibly shown to be able to cover demand not met by installed equipment. Tests of generators, fuel cells, etc. are considered successful when start-up, operation, and the capability to supply the necessary power have been demonstrated.

4. Energinet Elsystemansvar A/S must test the transfer procedure to the emergency control centre at least once a year. The tests should vary in form to cover the following aspects
    a. Procedure test
    b. Function test in emergency control centre
    c. Operation from emergency control centre
    d. Training exercises
    e. Incidents.

8. Compliance testing and periodic review of the system defence plan

8.1 Responsible market participants

- DSOs.

8.2 Affected market participants

- DSOs
- Energinet Elsystemansvar A/S.

8.3 Article 50 - Compliance testing and periodic review of the system defence plan

1. *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.*

8.3.1 Test requirements

1. Each load-shedding region must submit annually, by the end of February at the latest, a confirmation of the location of the frequency relays, their settings, and a general overview of the size of the load-shedding steps in the previous year. This confirmation must be sent to the emergency preparedness coordinator of Energinet Elsystemansvar A/S: BeredskabsKoordinator@energinet.dk.
    a. The size of the load-shedding steps must generally be reported per load-shedding region. However, it is possible to submit a joint report from several load-shedding regions if a DSO is part of several load-shedding regions and the area consumption cannot therefore be retrieved directly from DataHub. The quality of the information must at least meet the following standards:
        i. Hourly values: average values on an hourly basis over a whole year.
        ii. Area consumption: total pure consumption according to the ENTSO-E approved formula
        $$Area\ consumption = Production_{Net} + Transit - Energy\ storage$$
        The consumption stated as area consumption in DataHub can be used.
        iii. Consumption after load-shedding, for each step in MW. The consumption must be the actual amount of power disconnected at the point of disconnection.
        Conversion of ampere measurements to MW may be used.
        iv. At least 95% of the data must be valid.
        v. The file format can be either CSV or another type of spreadsheet. The layout must match the one indicated in the table below.

Hours	Area consumption [MW]	Step 1		Step 2		Step 3		Step 4		Step 5		Step 6	
		[MW]	[%]	[MW]	[%]	[MW]	[%]	[MW]	[%]	[MW]	[%]	[MW]	[%]
1													
2													
3													
4													
…													
8760													

9. Commencement

The test plan enters into force from the date on which the Danish Utility Regulator approves the test plan (expected no later than six months after 18 December 2019).

Appendix A: Checklist to confirm completed tests

DSOs can use the template below as a checklist when submitting confirmation of completed tests according to the test plan. Note that not all tests are annual and that each test described in the test plan has different requirements for how often the respective test must be performed.

[DSO name]	Test performed (YES/NO)	Documentation attached (YES/NO)	Comment
NC ER Article 47 (testing of relays)			
NC ER Article 48(1)			Energinet Elsystemansvar is currently responsible for documenting the test.
NC ER Article 48(2)			
NC ER Article 49(2)			Energinet Elsystemansvar is currently responsible for documenting the test.
NC ER Article 49(3)			
NC ER Article 50(1) (annual calculation of load-shedding)			