

# Nordic System Operation Agreement (SOA) – Annex Emergency & Restoration (ER)

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# 1 Introduction

## 1.1 Interaction with other agreements

This Annex is part of the System Operation Agreement. This Annex makes references to the requirements set up in:

- |                                                                                                                                                                                                                                                       |         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| ■ Commission Regulation (EU) 2017/2196 of 24 November 2017 establishing a network code on electricity emergency and restoration (hereafter referred to as “NCER”);                                                                                    | NCER    |
| ■ Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (hereinafter referred to as “SOGL”);                                                                                    | SOGL    |
| ■ Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (hereafter referred to as “NC RfG”);                                                                             | NC RfG  |
| ■ Commission Regulation (EU) 2016/1388 of 17 August 2016 establishing a network code on demand connection (hereafter referred to as “NC DCC”);                                                                                                        | NC DCC  |
| ■ Commission Regulation (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules (hereafter referred to as “NC HVDC”). | NC HVDC |

The implementation and coordination are expected to follow the ENTSO-E supporting documents unless it is otherwise specified in this Annex.

The scope of this Annex is limited to the three system states Emergency State, Blackout State and Restoration State in accordance with the definitions set forth in article 3 of SOGL.

## 1.2 Background

The main principles of NCER are to define requirements for a system defence plan and restoration plan including consistency assessment, ensuring continuity of energy transactions during emergency, blackout and restoration state, suspension and restoration of market activities, regional coordination, critical tools and facilities and compliance testing.

## 1.3 This Annex

In this Annex the Nordic TSOs agree upon the requirements and principles for the procedures and actions to be carried out in emergency, blackout and restorations states.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| This Annex shall be considered in addition to the principles, requirements and conditions included in NCER.                                                                                                                                                                                                                                                                                                                                              | NCER      |
| The Annex is also in addition to the terms and conditions that have been approved by the NRAs in accordance with article 4(2) of NCER. This Annex includes references to these terms and conditions. Where NRAs approved an implementation date in future, this Annex describes the existing situation.                                                                                                                                                  | NCER 4(2) |
| All TSOs anticipate regular updates in order to keep the agreements and terms and conditions in this Annex up-to-date. Consequently, this Annex includes mainly the agreements between the Nordic TSOs related to the existing situation. Changes shall be first approved by all Nordic TSOs, before the change will be implemented in the SOA at the latest when the change enters into force. The SOA maintenance group will follow the change agreed. |           |

## 1.4 Geographic area

The geographical area to which this Annex applies is the Nordic synchronous area.

## 1.5 Structure of this Annex

This Annex has the following structure:

- Chapter 2: TSO obligation to help adjacent TSOs
- Chapter 3: Proposals subject to NRA approval
- Chapter 4: Regional coordination
- Chapter 5: System Defence Plan
- Chapter 6: Restoration Plan
- Chapter 7: Suspension and restoration of market activities
- Chapter 8: Information exchange
- Chapter 9: Communication, tools and facilities

## 1.6 Definitions

For the purpose of this Annex, the terms used shall have the meaning of the definitions included in article 2 of RfG, in article 2 of DCC, in article 2 of HVDC, in article 3 of NC ER, in article 3 of SO GL and the other items of legislation referenced therein.

## 2 TSO obligation to help adjacent TSOs

Each TSO shall maintain proper risk level of its control area. In case of deficit areas, the TSO must pay specific attention to security of supply in its LFC areas. In case of surplus areas, the TSO has the possibility to deliver support to others within available grid capacity. All TSOs recognize that the prioritization of security of supply is:

1. Control Area (national)  
Rational for this: system security is a national responsibility, from an operational perspective since each TSO has control.
2. Nordic Synchronous Area Nordic LFC Block  
Rational for this: The dimensioning of frequency containment reserve (hereinafter referred to as "FCR") is determined on synchronous area level and reserves are shared between the countries. The synchronous system shares the same frequency unless islanding. The dimensioning of frequency restoration reserve (hereinafter referred to as "FRR") is determined on LFC Block level.
3. Nordic Capacity Calculation Region Nordic (hereinafter referred to as "Nordic CCR")  
Rational for this: The system security is coordinated in a first step in planning phase in Nordic CCR.
4. Other capacity calculation regions.

NCER 14  
NCER 21

## 3 Proposals subject to NRA approval

All TSOs agree that the following proposals in accordance with article 4(2) of NCER shall be prepared and submitted to the national regulatory authority (hereinafter referred to as "NRA") by each TSO individually. Relevant information of the methodologies and proposals shall be shared and coordinated between the TSOs:

- the terms and conditions to act as defence service providers on a contractual basis according article 4(2)(a) of NCER;
- the terms and conditions to act as restoration service providers on a contractual basis according article 4(2)(b) of NCER;
- the list of SGUs responsible for implementing on their installations the measures that result from mandatory requirements set out in Regulations (EU) 2016/631, (EU) 2016/1388 and (EU) 2016/1447 and/or from national legislation and the list of the measures to be implemented by these SGUs identified by the TSO according article 4(2)(c) of NCER;
- the list of high priority significant grid users or the principles applied to define those and the terms and conditions for disconnecting and re-energising the high priority grid users, unless defined by the national legislation according article 4(2)(d) of NCER;

NCER 4(2)

- the rules for suspension and restoration of market activities according article 4(2)(e) of NCER;
- specific rules for imbalance settlement and settlement of balancing energy in case of suspension of market activities according article 4(2)(f) of NCER;
- the test plan according article 4(2)(g) of NCER.

Each TSO shall seek an approval according to NCER by the NRAs for the relevant proposals and afterwards publish and apply the proposals.

## 4 Regional coordination

The consistency check of relevant parts of the system defence plan and restoration plan shall be performed according to the requirements set forth in NCER under the umbrella of "Cooperation Agreement regarding Regional Security Coordination in the Nordic region, Nordic RSC" (Nordic RSC Agreement).

NCER 6(3)

Unless otherwise agreed by the TSOs, no specific threshold shall be specified for the Nordic capacity calculation region. The objective of the threshold is to avoid actions that further worsen the situation for the power system. Communication shall be based on the procedures for normal state and alert state. In the Nordic capacity calculation region, system security is managed through close cooperation and communication between TSOs. What and how to communicate is event-based.

NCER 6(5)

## 5 System Defence Plan

Each TSO shall develop a system defence plan.

NCER 11

For emergency system state TSOs shall agree on bilateral/multilateral procedures including adequate information exchanges to be applied to all neighbouring TSOs.

### 5.1 Low frequency demand disconnection (LFDD)

#### 5.1.1 Design of LFDD

In case of a major frequency drop, automatic functions for load shedding functionality shall be implemented to prevent a further frequency drop and the collapse of the system according to specification in article 19 in the NC DCC and in article 15 in the NC ER.

NC DCC 19

Each TSO shall develop the LFDD activation plan within the framework specified in article 19 of the NC DCC and in article 15 in the NCER.

NCER 15(5)

The parameters of the LFDD activation plan must be set in accordance with the following criteria:

- Five steps, respectively at: 48.8 Hz, 48.6 Hz, 48.4 Hz, 48.2 Hz and 48.0 Hz
- The first four steps must be, as a minimum: 5%
- The fifth step must be, more than: 0%

All TSOs shall jointly assess the LFDD activation plan every 3 years.

### 5.1.2 Implementation of LFDD

Each TSO shall implement and coordinate its LFDD activation plan in its control area with the TSOs in the synchronous area in accordance with national legislation.

The implementation shall be coordinated between the Nordic TSOs.

### 5.1.3 Technical requirements for implementation of LFDD function

Each TSO shall consider LFDD implementation set forth in the technical requirements according to article 19 of NC DCC.

## 5.2 Over-frequency control

### 5.2.1 Design of over-frequency control

In case of a major frequency increase, automatic functions for decrease of total active power injection shall be implemented to prevent further frequency increase. Each TSO shall implement its over-frequency plan in accordance with the requirements in article 13(1) of NC RfG and in article 16 of NCER.

NC RfG 13(1)  
NCER 16

All TSOs shall jointly design an over-frequency control plan at Nordic synchronous area level with the objective to decrease active power in real-time as a part of the System Defence Plan.

All TSOs shall jointly assess the over-frequency control plan at least every five years.

### 5.2.2 Implementation of over-frequency control plan

Each TSO shall implement and coordinate its over-frequency control plan in its control area with the TSOs in the synchronous area in accordance with national legislation.

## 5.3 Frequency deviation management

All TSOs shall establish and coordinate measures to manage the frequency deviations outside the frequency limits defined for emergency and system

NCER 18



restoration state by activation of manual or automatic measures defined in its system defence plan in accordance with article 18 of NCER.

The measures shall be coordinated between the Nordic TSOs and shall consider previously agreed coordinated actions in normal and alert state aiming at recovering the frequency.

## 5.4 Voltage deviation management

### 5.4.1 Design of voltage collapse management

Each TSO, in coordination with all the Nordic TSOs, shall develop and implement a plan for voltage deviation management to prevent voltage collapse in its control area. The plan may contain both manual and automatic (system protection schemes) measures.

NCER 19

Each TSO shall assess the plan for voltage deviation management at least every three years.

### 5.4.2 Implementation of voltage deviation management

Each TSO shall implement the voltage deviation management in its control area in accordance with national legislation.

### 5.4.3 Technical requirements for voltage deviation management

Each TSO shall consider LFDD implementation set forth in the technical requirements according to article 19 of NC DCC.

## 5.5 Power flow management

### 5.5.1 Design of power flow management

Each TSO shall, in coordination with as a minimum the TSOs of the Nordic synchronous area, develop and implement a plan for power flow management to manage power flow outside the operational security limits. The plan may contain both manual and automatic (protection schemes and if applicable emergency power control devices) measures.

NCER 20

The affected TSOs shall assess the plan for power flow management at least every three years.

### 5.5.2 Implementation of power flow management

Each TSO shall implement the agreed power flow management in its control area.

### 5.5.3 Technical requirements for power flow management

Each TSO shall consider in power flow management the requirements according article 20 of NC DCC, Chapter 4 of SOGL and article 20 of NCER.

## 5.6 Assistance for active power procedure

Each TSO may request assistance (requesting TSO) for active power from its neighbouring TSOs (assisting TSOs) in case of absence of control area adequacy. The assisting TSOs, which transmission system is in normal or alert state, shall provide active power to the requesting TSO if system security is not jeopardized in its own control area as a result of the assistance.

NCER 21

## 5.7 Manual demand disconnection

### 5.7.1 Design of manual demand disconnection

Each TSO shall develop and implement a plan for manual demand disconnection to prevent the propagation or worsening of an emergency state (power shortage procedures).

NCER 22

Each TSO shall, if necessary, coordinate its manual demand disconnection plan with concerned TSOs.

Each TSO shall assess the agreed plan for manual demand disconnection at least every three years.

## 6 Restoration Plan

Each TSO shall develop a restoration plan.

NCER 23

For restoration and blackout system state TSOs shall agree on bilateral/multilateral procedures including adequate information exchanges to be applied with all neighbouring TSOs.

## 6.1 Black start capability

### 6.1.1 Testing of the black start capability

|                                                                                                                                                                                                                       |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Each TSO, except Statnett <sup>1</sup> , shall organize the testing of the black start capability of HVDC systems and cross-border relevant power generation modules in accordance with article 44(1) and 46 of NCER. | NCER 44/46 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|

## 6.2 Re-energisation procedure from blackout state

### 6.2.1 Re-energisation procedure

|                                                                                                                    |         |
|--------------------------------------------------------------------------------------------------------------------|---------|
| Each TSO shall design a re-energisation procedure considering measures for top-down and bottom-up re-energisation. | NCER 26 |
|--------------------------------------------------------------------------------------------------------------------|---------|

When designing the re-energisation procedure all TSOs shall coordinate at least the measures for top-down re-energisation.

### 6.2.2 Activation of re-energisation procedure

|                                                                             |         |
|-----------------------------------------------------------------------------|---------|
| Each TSO shall activate the re-energisation procedure after blackout state. | NCER 27 |
|-----------------------------------------------------------------------------|---------|

Each TSO shall inform its neighbouring TSOs on its capability to support a top-down re-energisation strategy during restoration state.

Each TSO shall be entitled to request (requesting TSO) assistance for activation of a top-down re-energisation measure from its neighbouring TSOs (assisting TSO) that are in normal or alert state.

## 6.3 Frequency management

### 6.3.1 Frequency management procedure

|                                                                                         |         |
|-----------------------------------------------------------------------------------------|---------|
| TSOs agree to apply the frequency management procedure according to article 28 of NCER. | NCER 28 |
|-----------------------------------------------------------------------------------------|---------|

### 6.3.2 Appointment of a frequency leader

|                                                                                                                                                                                                                                                                                                                                        |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| The frequency leader shall announce its appointment and resignation to all TSOs via ENTSO-E Awareness System (EAS). The frequency leader is determined based on the highest K-factor monitored in the NOIS System. Either Statnett or Svk have the role of the frequency leader for Nordic synchronous area during system restoration. | NCER 29 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|

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<sup>1</sup> Unless otherwise agreed by the TSOs, Statnett shall be relieved from the obligation to organize tests since the legislation for black start is different in Norway.

|                                                                                             |         |
|---------------------------------------------------------------------------------------------|---------|
| 6.3.3 Frequency management after frequency deviation                                        |         |
| A frequency leader is appointed, and the appointment shall cover Emergency and Restoration. | NCER 30 |

|                                                                                             |         |
|---------------------------------------------------------------------------------------------|---------|
| 6.3.4 Frequency management after synchronous area split                                     |         |
| A frequency leader is appointed, and the appointment shall cover Emergency and Restoration. | NCER 31 |

## 6.4 Resynchronisation

|                                                                                                                             |         |
|-----------------------------------------------------------------------------------------------------------------------------|---------|
| 6.4.1 Appointment of a resynchronisation leader                                                                             |         |
| The resynchronisation leader shall announce its appointment and resignation to all TSOs via ENTSO-E Awareness System (EAS). | NCER 33 |

|                                                                                                                                                                                                     |                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| 6.4.2 Resynchronisation strategy                                                                                                                                                                    |                    |
| The resynchronisation leader of the concerned areas in collaboration with the frequency leader/s shall apply the required actions according to the agreed resynchronisation procedure/instructions. | NCER 32<br>NCER 34 |

## 6.5 Reconnection of load at DSO level

In case a reconnection of load at DSO level has cross-border impact, the concerned TSO shall coordinate the reconnection of load with the affected neighbouring TSO.

## 7 Suspension and restoration of market activities

The TSOs agree to apply the rules for the suspension and restoration of market activities, which are/were approved by the NRAs (national level).

## 8 Information exchange

|                                                                                                                                                                                                                                                                                                                                                                                                                      |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| During the emergency, blackout or restoration states each TSO shall provide in due time and for the purposes of system defence plan and system restoration plan procedures at least the following information to its neighbouring TSOs:                                                                                                                                                                              | NCER 40(2) |
| <ul style="list-style-type: none"> <li>■ the extent and borders of the synchronised region or synchronised regions to which its control area belongs;</li> <li>■ the restrictions to operate the synchronised region;</li> <li>■ the maximum duration and amount of active and reactive power that can be supplied via interconnectors and</li> <li>■ any other technical or organisational restrictions.</li> </ul> |            |

During the emergency, blackout or restoration states each TSO shall provide in due time and for the purposes of system defence plan and system restoration

plan procedures at least the following information to the frequency leader of its synchronised region:

- the restrictions to maintain island operation;
- the available additional load and generation and
- the availability of operational active power reserves.

NCER 40(3)

All TSOs in emergency, blackout or restoration state shall exchange at least the following information:

- the circumstances that led to the current system state of its transmission system and
- the potential problems providing active power assistance to requesting TSOs.

NCER 40(5)

Each TSO shall inform each affected TSO about its test plan.

## 9 Communication, tools and facilities

### 9.1 Communication systems

Each TSO shall establish, in consultation with its neighbouring TSOs and the other TSOs of its synchronous area, the technical requirements to be fulfilled by their voice communication systems as well as by the TSO's own voice communication system to allow their interoperability and to guarantee that the TSO's incoming call can be identified by the other TSOs and answered immediately.

NCER 41(3)

### 9.2 Tools and facilities

Each TSO shall define critical tools and facilities.

Each TSO shall test critical tools and facilities referred to in article 24 of SO GL used for system defence plan and restoration plan at least every three years covering both main and backup tools and facilities.

NCER 42  
SOGL 24