Proposal Document

Design of the System Defence Plan for Northern Ireland

In accordance with the requirements of Articles 11 and 4.5 of the Commission Regulation (EU) 2017/2196 establishing a network code on electricity emergency and restoration

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SONI

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1. Background

COMMISSION REGULATION (EU) 2017/2196, establishing a Network Code on Electricity Emergency and Restoration (NCER) came into force on the 18th of December 2017. This network code details the requirements for each TSO to develop a System Defence Plan (SDP). This SDP should detail a TSO's business processes, procedures and measures in managing events on the power system. In SONI, the requirements of the SDP are captured in pre-existing business processes.

This SDP has been designed based on the requirements set out within Article 11 of the NCER. The measures and actions outlined in this document will be activated depending on the 'state' of the power system.

The requirements of the SDP are detailed in Article 11 – Article 22 of the NCER. The high level requirements of these articles include;

- Design of the SDP
- Implementation of the SDP
- Activation of the SDP
- Measures of the SDP

The Terms and Conditions for System Defence Providers, as defined in NCER, are conveyed through the Connection and Operating Conditions of the Grid Code and Condition 29 of the SONI Transmission License. In the recent past, there has been an extensive process of consultation on modifications to the Grid Code and the development of system services contracts. Where appropriate, system services contracts were procured through a tendering process. This is expected to continue for the foreseeable future.

The relevant legislative and Grid Code articles relating to the SDP are listed in the table below.

Table 1 – SDP Requirements

Article	Text	Currently Defined Within
Article 11 – Article 22	Detailed requirements of the SDP to include design, implementation, activation and measures	Condition 29 of the SONI Transmission License. Grid Code OC2, Operational Planning. Grid Code OC3, Operating Margin. Grid Code OC4, Demand Control. Grid Code CC5, Supply Standards. Grid Code SDC1, Unit Scheduling. Grid Code SDC2, Control Scheduling and Dispatch. Interconnector Operating Protocol.

The measures and remedial actions detailed in this document will be enacted depending on the status of the power system and or market conditions in Ireland.

2. Design of the System Defence Plan

The design of the SDP has been carried out in accordance with the requirements of Article 11 of the NCER. This article details the specific requirements of the SDP and what should be considered when drafting.

The following requirements shall be taken into account;

- Operational security limits set out in accordance with Article 25 of Regulation (EU) 2017/1485[1]
- Behaviour and capability of load and generation within the synchronous area
- Specific needs of the high priority significant grid users
- Characteristics of the transmission system and of the underlying DSO system

This document is drafted taking into account the existing policies and procedures currently in place. This document will include all existing agreements in place with relevant stakeholders where these exist.

2.1 Provisions of System Defence Plan

Article 11 of the NCER states that the SDP shall contain the following provisions;

- The conditions under which the SDP is activated
- The SDP instructions to be issued by the TSO
- The measures subject to real time consultation or coordination with the identified parties

2.2 Technical and Organisational Measures

Article 11 details the technical and organisational measures that should be considered in the drafting of the SDP. These include;

- Automatic under-frequency control scheme
- Automatic over-frequency control scheme
- Automatic scheme against voltage collapse
- Frequency Deviation Management Procedure

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R1485&from=EN

- Voltage Deviation Management Procedure
- Power Flow Management Procedure
- Assistance for Active Power Procedure
- Manual Demand Disconnection Procedure
- Inter-TSO assistance and coordination in emergency state

These measures should comply with the following principles;

- Their impact on the system shall be minimal
- They shall be economically efficient
- Only those measures that are necessary shall be activated
- They shall not lead to the TSO's transmission system or the interconnected system into an emergency or blackout state.

3. Activation of the System Defence Plan

3.1 Conditions for activation of System Defence Plan

SONI shall activate a measure of the SDP based on the following criteria;

1. The system is in an emergency state in accordance with the criteria set out in Article 18(3) of Regulation (EU) 2017/1485[2] and there are no remedial actions available to restore the system to the normal state.
2. Based on the operational security analysis, the operational security of the transmission system requires the activation of a measure of the SDP pursuant to Article 11(5) in addition to the available remedial actions.

SONI will issue instructions to the relevant stakeholders as required.

Any procedure or measure of the SDP will be activated in coordination with the DSO, SGU and Defence Service Providers. All instructions issued by SONI must be executed without undue delay.

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R1485&from=EN

4. Measures of the System Defence Plan

The measures of the SDP are detailed in Article 15 through to Article 21 of the NCER: SONI has a number of processes and procedures detailing the business' response to events that may cause a system emergency. Actions taken by the business will depend on the likely severity of the forecasted event.

Any measures to be implemented by the DSO will be communicated by SONI.

4.1 Automatic under-frequency control scheme

In accordance with the detailed requirements of the automatic under-frequency control scheme in Article 15 of the NCER:

1. There is a high level requirement in the network code for Automatic under-frequency demand disconnection. This requirement is detailed in the Northern Ireland Grid Code (OC4.4).
2. The NCER requires the TSO to identify any additional system protection schemes to arrest falling frequency. Where special conditions for connections arise where SONI have identified the requirement for automatic load shedding, this is detailed in the NI Grid Code under section CC6.9.
3. This measure requires the TSO to identify any additional system protection schemes to arrest falling frequency. This is the responsibility of the TSO and assessments are made based on the changing nature of the power system in line.

4.2 Automatic over-frequency control scheme

In accordance with the detailed requirements of the automatic over-frequency control scheme in Article 16 of the NCER:

1. The NI Grid Code details the technical requirements for generators connecting. CC5 and 'Connection Conditions Schedule 1' details the frequency limits that generators must comply with.
2. Agreements are in place that provides high frequency response services on the HVDC interconnector.

4.3 Automatic scheme against voltage collapse

In accordance with the detailed requirements of the automatic scheme against voltage collapse found in Article 17 of the NCER:

1. The NI Grid Code details the connection requirements for any new user to the transmission network. Specific requirements for managing voltage at the users installation are detailed in the 'Connection Conditions' (CC) part of the NI Grid Code.
2. As part of the DS3 system services project, SONI has identified the system services required to operate the power system with increasing levels of renewable/non-synchronous generation. Specific products have been procured and contracted to allow SONI the ability to manage system voltage. These are detailed in Appendix 7.1 below.
3. Studies are carried out in real time to ensure the limits detailed in the Operational Security Standards are met under normal operating conditions and in the event of a secured event on the transmission network.
4. Capacitor and Reactor banks are installed at various locations to provide SONI the flexibility of managing a changing voltage profile throughout the year.

4.4 Frequency Deviation Management Procedure

In accordance with the detailed requirements of the Frequency Deviation Management Procedure scheme found in Article 18 of the NCER:

1. The NI Grid Code details the 'Frequency Variations' of the NI System and details the frequency limits users connecting should consider when designing their plant/connections (CC5, Supply Standards).
2. The Operating Reserve requirements are detailed in the NI Grid Code under the 'Operating Code No. 3'
3. The 'Scheduling and Dispatch Code No.1' (SDC1) details the procedure used by the TSO to develop unit commitment schedules and the interactions with generators in fulfilling this role.
4. System Service contracts are in place with providers who have been identified as being able to provide operating reserve to manage system frequency/events in the following timescales;
    - Primary Operating Reserve (POR) (5-15 seconds)
    - Secondary Operating Reserve (SOR) (15-90 seconds)
    - Tertiary Operating Reserve 1 (TOR1) (90 seconds – 5 mins)
    - Tertiary Operating Reserve 2 (TOR2) (5 mins – 20 mins)
5. Replacement Reserve Synchronised (RRS) and Replacement Reserve Desynchronised (RRD) are two system service products that provide an option for managing frequency in a system event.

4.5 Voltage Deviation Management Procedure

In accordance with the detailed requirements of the Voltage Deviation Management Procedure found in Article 19 of the NCER:

1. SONI is required to operate the transmission system within the voltage limits detailed in the Operating Security Standards. This is achieved using synchronised generators operating within their reactive power capabilities and static sources of reactive power.
2. Ongoing studies of the network are carried out in real time assessing the impact on voltage depending on the changing schedule of generation. This also includes varying levels of non-synchronous generation such as wind energy and the impact this will have on voltage.
3. SDC2.4.2.4 details the requirements of the TSO issuing a dispatch instruction to a generator. This includes the requirements for the issuing of a reactive power set point to generators.
4. A business process is in place that details how voltage should be managed and the actions that should be taken to mitigate a variety of risks/scenarios
5. Capacitor and Reactor banks are installed at various locations to provide SONI the flexibility of managing a changing voltage profile.

4.6 Power Flow Management Procedure

In accordance with the detailed requirements of the Power Flow Management Procedure found in Article 20 of the NCER:

1. Power flows are managed by SONI within the technical limits of installed equipment on the power system.
2. SDC2, Scheduling and Dispatch Code No.1 details the requirements of generators in declaring to the TSO their availability to generate.
3. Operating Code No. 7 and No.11 details the requirements of generators when operating with a dispatch instruction from SONI.
4. Special protection schemes are identified and installed to mitigate damage to equipment from thermal overloads where required.
5. SONI publishes an 'Operational Constraints Update' detailing the rules in scheduling generation and managing power flows on the network. This document is kept up to date and any changes to these are communicated to the industry.

4.7 Assistance for Active Power Procedure

In accordance with the detailed requirements of the Assistance for Active Power procedure can be found in Article 21 of the NCER:

1. Commercial agreements are in place with neighbouring TSO's for assistance in an emergency situation. This emergency assistance is provided via the HVDC interconnector.
2. Where a forced outage of a generating unit has occurred and has the potential to put the system into an emergency state, the NI Grid Code allows the TSO to request alterations to existing agreed maintenance outages to alleviate system issues. This is covered under section OC2.6.4 (e) of the NI Grid Code.

4.8 Manual Demand Disconnection Procedure

In accordance with the detailed requirements of the Manual Demand Disconnection Procedure found in Article 22 of the NCER:

1. Article 22, clause 1 states that the TSO 'may establish an amount of netted demand to be manually disconnected'. This is be done in conjunction with the DSO where such an action is required.
2. Operating Code No.4 of the NI Grid Code, Demand Control, details the requirements of the TSO and DSO in identifying when and how customer demand should be disconnected.

5. Appendix

5.1 Contracted System Services

Service	Description
Synchronous Inertial Response SIR	Provision of Inertia from synchronous machines that can operate with low minimum generation point.
Fast Frequency Response FFR	MW delivered between 2 and 10 seconds in response to automated frequency trigger
Primary Operating Reserve POR	MW delivered between 5 and 15 seconds in response to automated frequency trigger
Secondary Operating Reserve SOR	MW delivered between 15 to 90 seconds in response to automated frequency trigger
Tertiary Operating Reserve 1 TOR1	MW delivered between 90 seconds to 5 minutes in response to automated frequency trigger
Tertiary Operating Reserve 2 TOR2	MW delivered between 5 minutes to 20 minutes in response to a control / dispatch instruction
Replacement Reserve – Synchronised RRS	MW delivered between 20 minutes to 1 hour in response to a control / dispatch instruction

Replacement Reserve – Desynchronised RRD	MW delivered between 20 minutes to 1 hour in response to a control / dispatch instruction from a zero megawatt starting position.
Ramping Margin 1 RM1	The increased MW output that can be delivered with a good degree of certainty for the given time horizon.
Ramping Margin 3 RM3	The increased MW output that can be delivered with a good degree of certainty for the given time horizon.
Ramping Margin 8 RM8	The increased MW output that can be delivered with a good degree of certainty for the given time horizon.
Fast Post Fault Active Power Recovery FPFAPR	Active power recovery within 250 ms of a voltage fault
Steady State Reactive Power SSRP	Reactive power response within 40ms of a voltage fault
Dynamic Reactive Response DRR	MVAr capability during large (>30%) voltage dips

5.2 Automatic low frequency demand disconnection

This table is included in the annex of the NCER and is required depending on the requirements of the TSO.

Automatic low frequency demand disconnection scheme characteristics:

Parameter	Values SA Continental Europe	Values SA Nordic	Values SA Great Britain	Values SA Ireland	Measuring Unit
Demand disconnection starting mandatory level: Frequency	49	48,7 – 48,8	48,8	48,85	Hz
Demand disconnection starting mandatory level: Demand to be disconnected	5	5	5	6	% of the Total Load at national level
Demand disconnection final mandatory level: Frequency	48	48	48	48,5	Hz
Demand disconnection final mandatory level: Cumulative Demand to be disconnected	45	30	50	60	% of the Total Load at national level
Implementation range	± 7	± 10	± 10	± 7	% of the Total Load at national level, for a given Frequency
Minimum number of steps to reach the final mandatory level	6	2	4	6	Number of steps
Maximum Demand disconnection for each step	10	15	10	12	% of the Total Load at national level, for a given step

5.3 Definitions

- ‘defence service provider’ means a legal entity with a legal or contractual obligation to provide a service contributing to one or several measures of the system defence plan;

- ‘restoration service provider’ means a legal entity with a legal or contractual obligation to provide a service contributing to one or several measures of the restoration plan;

- ‘high priority significant grid user’ means the significant grid user for which special conditions apply for disconnection and re-energisation;

- ‘restoration plan’ means all technical and organisational measures necessary for the restoration of the system back to normal state;

- ‘re-energisation’ means reconnecting generation and load to energise the parts of the system that have been disconnected;

- ‘top-down re-energisation strategy’ means a strategy that requires the assistance of other TSOs to re-energise parts of the system of a TSO;

- ‘bottom-up re-energisation strategy’ means a strategy where part of the system of a TSO can be re-energised without the assistance from other TSOs;

- ‘resynchronisation’ means synchronising and connecting again two synchronised regions at the resynchronisation point;

- ‘Resynchronisation point’ means the device used to connect two synchronised regions, usually a circuit breaker.