# Operating Security Standards

Version 2, March 2026

| Revision History | | |
|---|---|---|
| **Version** | **Date** | **Description** |
| 1 | March 2016 | Original Document |
| 2 | March 2026 | Major Update, revision to structure |

# Contents

# 1. Introduction

## Objective & Scope

1.1 This document sets out the Operating Security Standards that the transmission licensee (SONI ltd) shall use in the operation of the Northern Ireland transmission system under normal system conditions.

1.2 Pursuant to Condition 21 of the Transmission Licence[1] in Northern Ireland the key Operating Security Standard that must be met at all times is the (N-1) security criteria. Accordingly, SONI must be able to maintain the transmission system within the operational security limits even after a single contingency incident.

1.3 The additional operational security limits for voltage, current, frequency and dynamic stability define the further Operating Security Standards.

1.4 However, in certain circumstances of system emergency conditions or limited grid availability as outlined in Condition 21 of the Transmission Licence, it may be necessary to operate the transmission system outside of these Operational Security Standards or even to restore the grid after a blackout (PSRP)[2].

1.5 SONI ltd along with EirGrid plc (the Transmission System Operator for Ireland), cooperate to ensure the all-island transmission system is operated in a secure and reliable manner. SONI shall as far as possible ensure that the operation of the EirGrid transmission system is not adversely affected by any matter within its control.

## Supporting Documents

1.6 The Transmission System Security and Planning Standards[3] (TSSPS) outlines the main standard that *transmission licensee* shall use in the planning of the Northern Ireland Transmission System. The TSSPS is referenced in this document and should be read to understand generation and demand connection criteria applied in Northern Ireland.

1.7 Additional criteria, for example covering more detailed and other aspects of quality of supply, are contained in the Grid Code[4] and the ESQCR[5] which should be read in conjunction with this document.

---

[1] LICENCE TO PARTICIPATE IN THE TRANSMISSION OF ELECTRICITY granted to SONI ltd.
[2] The Northern Ireland Power System Restoration Plan provides a plan of action to be implemented after a total power system blackout has occurred. This PSRP is supplementary to the OC7 of the SONI Grid Code.
[3] Northern Ireland Transmission System Security and Planning Standards 2015
[4] SONI Grid Code from April 2024
[5] The Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012

1.8 The Synchronous Area Operational Agreement (SAOA[6]) for IE/NI Synchronous Area between EirGrid plc and SONI ltd specifies the frequency limits that must be observed during system operation.

1.9 The guideline on electricity Transmission System Operation (SOGL) established by Commission Regulation (EU) 2017/1485 and the Methodology for coordinating operational security analysis (CSAM) by ACER defining the European standard.

# 2. (N-1) Security Criteria

### Normal Operational Criteria

2.1 The transmission system shall be operated under prevailing system conditions so that for the secured event of a single contingency incident (fault outage) on the transmission system as defined in Section 2.2 there shall not be any of the following[7]:

- a *loss of supply capacity* except as specified in Section 2.8
- *unacceptable frequency conditions as specified in Section 3*
- *unacceptable overloading* of any *primary transmission equipment*; as specified in Section 4
- *unacceptable voltage conditions* or *insufficient voltage performance margins* as specified in Section 5; or
- *system instability* as specified in Section 6

### Categorisation of contingencies

2.2 All contingencies within the transmission system should be categorized as either:

- Ordinary contingencies;
- Exceptional contingencies with permanent occurrence increasing factor applied;
- Exceptional contingencies with temporary occurrence increasing factor applied
- Out-of-range contingencies.

2.3 Permanent occurrence increasing factors may be applied based on (but not limited to) location or historical network design considerations. Temporary occurrence increasing factors may be applied based on (but not limited to) weather considerations, temporary prevailing operational conditions etc.

2.4 Based on the CSAM categorization SONI has to define it´s individual permanent and temporary contingency lists for the security analysis.

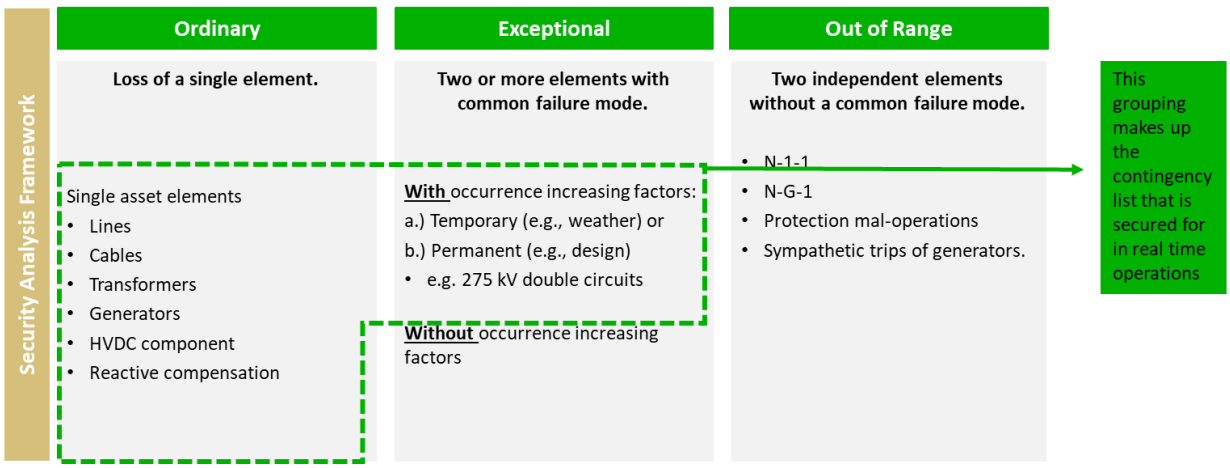
[6] Operational Agreements for Ireland and Northern Ireland Synchronous Area provided by EirGrid plc and SONI ltd.
[7] as defined in TSPSS chapter 4.6

Table 2.1 Example of contingency types[8]

| Ordinary contingency | Exceptional contingency | Out-of-range contingency |
|---|---|---|
| Loss of a single<br>• Circuit<br>• Transformer (includes distribution system transformer)<br>• Phase-shifting transformer<br>• Reactive compensation device<br>• Component of a HVDC system such as a line or a cable or a single HVDC converter unit<br>• Power generation set(s), connected to the transmission system through a single transformer<br>• Demand facility | Loss of network elements having common fault mode<br>• Loss of circuits supported on the same tower or loss of underground cables built in same trench<br>• Loss of grid users having common process mode, for example two gas turbines supplying a single steam set<br>• Loss of multiple generation units or demand facilities disconnected due to a voltage drop on the network or system frequency deviation | Loss of two or more independent transmission elements |

2.5 The contingency list of secured events should be made up of only of Ordinary and Exceptional contingencies. The probability of Out-of-range contingencies is so low that they are not protected against.

Figure 2.1: Composition of the contingency list




## Maximum permitted loss of supply capacity

2.6 For a secured event on the transmission system on connections to more than one demand group the permitted loss of supply capacity for that secured event is the maximum of the permitted loss of supply capacities set out below:

[8] CSAM categorization Title3-chapter1-Article 7

2.6.1 For Group Demand exceeding 300 MW there must be no loss of supply for a single contingency. During maintenance outage followed by a forced outage it must be possible to supply all the maintenance period demand (i.e. typically two thirds). If demand exceeds the normal maintenance period it would be restored following restoration of the planned outage.

2.6.2 For group demands between 60 MW and 300 MW, for a single contingency, it is unacceptable to lose greater than 20 MW. The remaining demand must be restored within 3 hours. For a maintenance followed by a trip it must resupply the smaller of the Group Demand less 100 MW or one third Group Demand within 3 hours, with the remainder after restoration of prearranged outage.

2.6.3 For group demands between 24 MW and 60 MW, for a single contingency, it is aimed to resupply the group demand less 20 MW. The remaining demand must be restored within 3 hours. For a maintenance followed by a trip the demand would be restored after restoration of prearranged outage.

## Conditional further operational criteria

2.7 During periods of *major system risk*, SONI may implement measures to mitigate the consequences of this risk in accordance to Licence Condition 21 2(a). Such measures may include but not limited to:

- providing additional reserve as specified in Section 7
- running machines out of merit order.

2.8 *Major system risks* are defined as those adverse conditions that significantly increase the likelihood of faults. These conditions can result from: extreme weather forecast, acting on information of potential premeditated nefarious actions or reasons related to the status of the power system (degraded configuration) and its operation (planned testing that can introduce enhanced levels of risk) etc.

2.9 Due to their nature, it is not possible to be prescriptive about adverse conditions. Ultimately, SONI will make a considered judgment on the level and implications of the risks, either in real time or when possible, at day ahead stage. For situations in which the integrity of the assets may be affected by the decision, agreement from the Transmission Asset Owner will be required.

## Post-fault Restoration of System Security

2.10 Following the occurrence of a *secured event* on the *transmission system*, measures shall be taken to re-secure the system to the above operational criteria as soon as reasonably practicable. To this end, it is permissible to put operational measures in place pre-fault to facilitate the speedy restoration of system security.

### Authorised Variations from the Normal Operational Criteria

2.11 Provided it is in accordance with the appropriate requirements of the demand connection criteria in Section 3 of the TSSPS, there may be associated loss of supply capacity due to a secured event, for example by virtue of the design of the generation connections and/or the designed switching arrangements at the substations concerned.

2.12 Exceptions to the criteria in paragraphs 2.1, 2.7 and 2.10 may be required where variations to the connection designs as per paragraphs 3.12 to 3.15 of the TSSPS have been agreed.

2.15 The principles of these operational criteria shall be applied at all times except in special circumstances where SONI, following consultation with the appropriate Network Operator or Generator, may need to give instructions to the contrary to preserve overall system integrity.

# 3. Network Frequency Limits

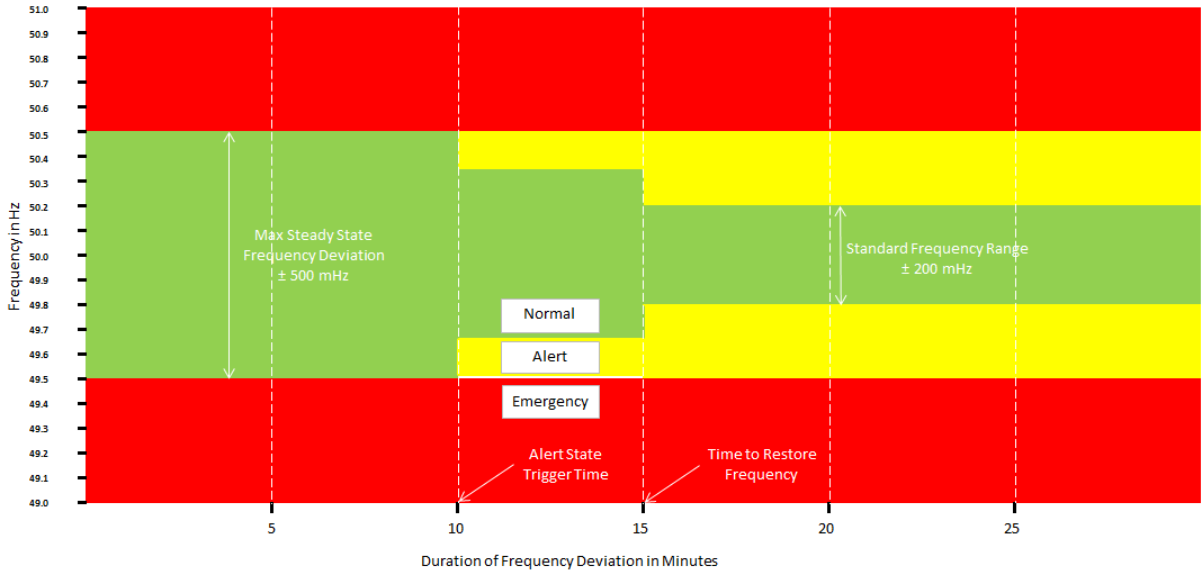
3.1 The transmission system shall operate at nominal frequency of 50 Hz and within the parameters outlined in the SAOA as in Table 3.1 below.

Table 3.1 System frequency parameters[9]

| Parameter | Normal / Steady State | Time limits |
|---|---|---|
| Nominal frequency | 50 Hz | |
| Standard frequency range | 49.8 - 50.2 Hz | |
| Maximum instantaneous frequency deviation | 1 Hz | |
| Maximum steady state frequency deviation | 500 mHz | |
| Frequency recovery range | 49.5 - 50.5 Hz | Time to recover frequency<br>1 Minute |
| Frequency restoration range | 49.8 - 50.2 Hz | Time to restore frequency<br>15 Minutes |
| Alert state trigger time | | 10 Minutes |
| Maximum number of minutes outside standard frequency range | 15000 per year | |
| Maximum rate of change of frequency (RoCoF)[10] | 1.0 Hz per second | |

[9] From SAOA Article 5
[10] added as frequency variations criteria to the SAOA table in line with SONI Grid Code CC5.3

Figure 3.1 System Alert States based on frequency deviations[11]




# 4. Network Current Limits

4.1 Current limits are specified for each *primary transmission equipment* and SONI shall operate the network in compliance with those limits in normal state and after a contingency incident.

### Operating current Limits

4.2 All equipment on the transmission system shall be operated within rated capacity, including transitory admissible overload limits, as specified by the Northern Ireland Electricity Networks (NIE Networks), so that all kind of relevant threshold limits for the elements of a circuit are not exceeded.

### Short Circuit Limits

4.3 The transmission system shall be operated such that the actual short circuit levels do not exceed the short circuit rating of equipment on the system. This is ensured by routine reconfiguration of the network when the short circuit level is insufficient for the protection to operate correctly.

[11] From SAOA Article 17

# 5. Network Voltage Limits

5.1 A voltage condition is unacceptable in operational timescales if, after either

- a *secured event*, or
- operational switching,

and the affected site remains directly connected to the *transmission system* in the *steady state* after the relevant event above, either of the following conditions applies:

5.1.1 the *voltage step change* at an interface between the *transmission system* and a customer exceeds that specified in Table 5.1

Table 5.1 The voltage step change limits in operational timescales

| ***Transmission System secured events* or switching event** | **Voltage fall** | **Voltage rise** |
|---|---|---|
| Following loss of single circuit | -6% | +6% |
| Following loss of *double circuit overhead line* | -10% | +6% |
| All operational switching[12] | -3% | +3% |

5.1.2 or there is any inability following such an event to achieve a steady state voltage as specified in Table 5.2 at transmission system substations using manual and/or automatic facilities available, including the switching in or out of relevant equipment.

Table 5.2 The steady state voltage limits in operational timescales

| **Nominal Voltage** | **Minimum Limit** | **Maximum Limit** |
|---|---|---|
| 275 kV | 247.5 kV (90%) | 302.5 kV (110%) |
| 110 kV | 99 kV (90%) | 121 kV (110%) |
| <110 kV | 96% - ***Note*** | 106 % |

**Note:**
It shall be possible to operate the lower voltage *busbar* of a BSP at 100% of nominal voltage after tap changing.

5.1.3 Where possible, the steady state pre-fault voltage on the transmission system will be no lower than 95% of nominal. The target operational voltages at GSPs should be as agreed with relevant Network Operators.

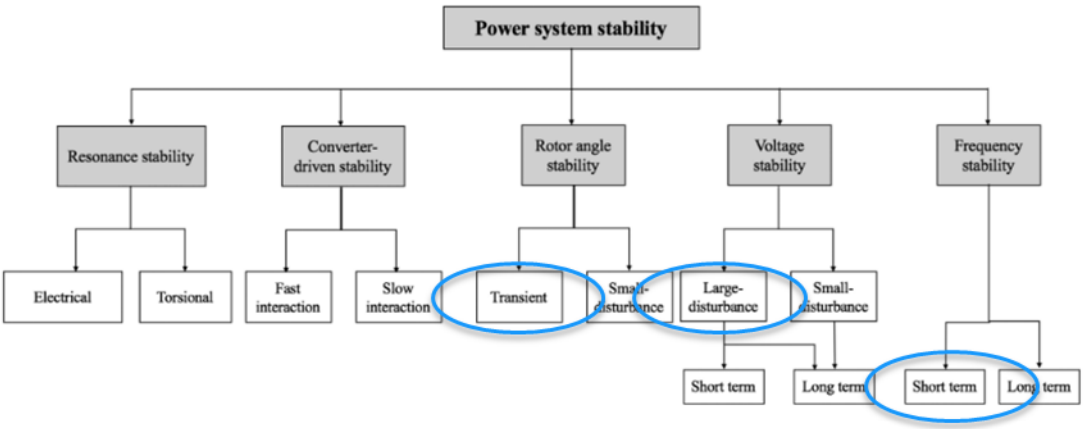
[12] Engineering Recommendation P28 Issue 2 – Chapter 5.4

# 6. Network Stability Limits

6.1 The power system shall be planned and operated such that under normal steady state operating conditions and after a contingency from the SONI contingency list there shall be no power system instability.

6.2 The power system stability shall be maintained for at least the following stability categories (in line with IEEE stability definitions from 2021):

Figure 6.1 IEEE stability definitions




With:

- **Rotor angle stability:** There shall be no cases of pole slipping or poor damping.
- **Voltage stability:** There shall be no cases of voltage collapse or exceedance of voltage limits without options available to the operator to timely return to operation within limits.
- **Frequency stability:** There shall be no cases that result in unwanted automatic disconnection of generation or load.
- **Resonance stability:** There shall be no cases of unacceptable electromechanical or electrical resonance conditions triggering widespread indiscriminate disconnection of plant and devices or inflicting damage on electrical components of synchronous machines.
- **Converter-driven stability:** There shall be no cases of plant and devices disconnecting on protection related functions in response to unstable response and behaviour from devices that interface the transmission system through converters.

The latter two are technical design principles, whereas the first three categories need to be monitored and secured by System Operations as marked in Figure 6.1.

# 7. Additional Reserves

7.1 Under normal operating conditions for the (N-1) Security Criteria sufficient generating capacity and demand reduction schemes shall be available to meet[13]:

- the forecast demand; and
- such level of reserve capability as the Licensee determines to be necessary

7.2 Reserve capability means the Licensee's reasonable expectation of the ability (in MW) of a generation set, a demand reduction scheme, a Northern Ireland Interconnector or the North/South Circuits to increase the net generation/demand balance on the total system.

### Generation Capacity

7.3 Reserve shall be maintained in line with the SAOA Article 2 and as published on the SONI web site from time to time.

### Demand Reduction Schemes

7.4 SONI shall implement such measures of Demand Control as it deems appropriate in accordance with the OC4 of the SONI Grid Code.

7.5 If Automatic Load Shedding is required it shall be reported on the basis of the criterion for reporting incidents as specified in Regulation 33 and Schedule 4 of the Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012.

An incident shall be reported if there has been:

7.5.1 Any single interruption of supply to one or more consumers of 20 MW or more for a period of one minute or longer; or

7.5.2 Any single interruption of supply to one or more consumers of 5 MW or more for a period of one hour or longer; or

7.5.3 Any single interruption of supply to 5,000 or more consumers for a period of one hour or longer.

[13] As defined in condition 21 chapter 2(a) of the Licence

# 8. Terms and Definitions

8.1 Defined terms in this standard unless otherwise specified are consistent with the Transmission System Security and Planning Standards (TSSPS) or the SONI Grid Code.

| | |
|---|---|
| *Active Power or MW* | As per SONI Grid Code. |
| *Authority* | As per the TSSPS. |
| *Bulk Supply Point (BSP)* | As per the TSSPS. |
| *Busbar* | As per the TSSPS. |
| *Demand* | As per SONI Grid Code. |
| *Demand group* | As per TSSPS. |
| *Distribution System* | As per the TSSPS. |
| *Double Circuit Overhead Line* | As per the TSSPS. |
| *Fault outage* | An outage of one or more items of primary transmission apparatus and/or generation plant initiated by automatic action unplanned at that time, which may or may not involve the passage of fault current. |
| *Generating Unit* | As per SONI Grid Code. |
| *Generator* | As per the TSSPS. |
| *Grid Supply Point (GSP)* | As per the TSSPS. |
| *Group Demand* | As per the TSSPS. |
| *Insufficient Voltage* | As per the TSSPS. |
| *Loss of Power Infeed* | As per the TSSPS. |
| *Loss of Supply Capacity* | As per the TSSPS. |

| | |
|---|---|
| *Major System Risk* | A period of *major system risk* is one in which *secured events* are judged to be significantly more likely than under the circumstances addressed by the normal criteria of this Standard, or they are judged to have a significantly greater impact than normal, or events not normally secured against are judged to be significantly more likely than normal such that measures should be taken to mitigate their impact. |
| *Network Operator* | As per the TSSPS. |
| *Operational Intertripping.* | As per the TSSPS. |
| *Planned Outage* | As per the TSSPS. |
| *Power Station* | As per SONI Grid Code. |
| *Prevailing System Conditions* | These are conditions on the Northern Ireland *transmission system* prevailing at any given time and will therefore normally include *planned outages* and unplanned outages. |
| *Primary Transmission Equipment* | As per the TSSPS. |
| *Reactive Power or Mvar* | As per SONI Grid Code. |
| *Secured event* | A contingency which would be considered for the purposes of assessing system security and which must not result in the remaining Northern Ireland *transmission system* being in breach of the security criteria. *Secured events* are individually specified throughout the text of this Standard. It is recognised that more onerous unsecured events may occur and additional operational measures may be utilised to maintain overall Northern Ireland *transmission system* integrity. |
| *Steady State* | As per the TSSPS. |
| *System Instability* | i) poor damping - where electromechanical oscillations of *generating units* are such that the resultant peak deviations in machine rotor angle and/or speed at the end of a 20 second period remain in excess of 15% of the peak deviations at the outset (i.e. the time constant |

| | |
|---|---|
| *System Instability (continued)* | of the slowest mode of oscillation exceeds 12 seconds); or<br>ii) pole slipping - where one or more transmission connected synchronous *generating units* lose synchronism with the remainder of the system to which it is connected<br><br>For the purpose of assessing the existence of *system instability*, a *fault outage* is taken to include a solid three phase to earth fault (or faults) anywhere on the Northern Ireland *transmission system* with an appropriate clearance time.<br><br>The appropriate clearance time is identified as follows:<br><br>i) On the 275kV system clearance times consistent with the fault location together with the worst single failure in the main protection system should be used;<br><br>ii) elsewhere, clearance times should be consistent with the fault location and appropriate to the actual protection, signaling equipment, trip and interposing relays, and circuit breakers involved in clearing the fault.<br>. |
| *Transient Time Phase* | As per the TSSPS. |
| *Transmission Circuit* | As per the TSSPS. |
| *Transmission Licensee* | As per the TSSPS. |
| *Transmission System* | As per the TSSPS. |
| *Unacceptable Frequency Conditions* | i) the *steady state* frequency falls outside the statutory limits of 49.8Hz to 50.2 Hz;<br>ii) a transient frequency during a transmission system disturbance falling outside the limits of 48 Hz to 52 Hz;<br>iii) a transient frequency during an exceptional transmission system disturbance falling outside the limits of 47 Hz to 52 Hz;<br>iv) any transient frequency deviation which does not recover to within 49.8 Hz to 50.2 Hz within 60 seconds. |

| | |
|---|---|
| *Unacceptable Overloading* | The overloading of any *primary transmission equipment* beyond its specified time-related capability. Due allowance shall be made for specific conditions (e.g. ambient/seasonal temperature), pre-fault loading, agreed time-dependent loading cycles of equipment and any additional relevant procedures. |
| *Unacceptable Voltage Conditions* | Voltage levels outside the limits specified in Section 3. |
| *Unacceptable Sub-Synchronous Oscillations* | Unacceptable Sub-Synchronous Oscillations are Sub-Synchronous Oscillations with the relevant modes of oscillation having negative or insufficient net damping. |
| *Voltage collapse* | Where progressive, fast or slow voltage decrease or increase develops such that it can lead to either tripping of *generating units* and/or loss of demand |
| *Voltage Step Change* | The difference in voltage between that immediately before a *secured event* or operational switching and that at the end of the *transient time phase* after the event. |