Operating Security Standards

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Revision History		
Revision	**Date**	**Description**
1	2011	Original document
2	2021	Major update, revision to structure
3	2025	Minor update, revision to format

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1 Introduction

The Operating Security Standards (OSS) are the standards and limits within which the transmission system of Ireland shall be operated. EirGrid, the Transmission System Operator (TSO), shall aim to operate the transmission system in accordance with the criteria stated in this OSS, for normal operational periods (the steady state) and for post-contingency periods.

In certain circumstances, it may be necessary to operate the transmission system outside of these criteria for limited time periods. Examples where this could happen include (but are not limited to) the avoidance of high-risk operating conditions for the transmission system, safety of transmission assets, personnel and the public or as provided for in the EirGrid Grid Code, System Defence Plan (SDP) or in the Power System Restoration Plan (PRSP).

2 Scope

The OSS applies to the transmission system of Ireland.

EirGrid shall operate the transmission system in conjunction with SONI, ESB Networks TAO (the transmission asset owner of Ireland) and ESB Networks DSO (the distribution system operator of Ireland), to meet the criteria set out in this OSS.

3 Regulatory Framework

The creation, approval and publication of the OSS is a requirement under Condition 16 of the TSO License for Ireland[1]. The OSS sits within a broader regulatory framework and is produced in order to comply with the following documents:

3.1 System Operation Guideline (SOGL)

The European Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SOGL) sets the criteria for the:

- Current Limits (described in Section 5 of this OSS);
- Frequency Limits (described in Section 6 of this OSS); and
- Voltage Limits (described in Section 7 of this OSS).

The SOGL also sets the criteria for the Synchronous Area Operational Agreement (SAOA) developed by EirGrid and SONI.

3.2 Coordinated Security Assessment Methodology (CSAM)

The Coordinated Security Assessment Methodology (CSAM) sets the criteria for the:

- Security Criteria (described in Section 4 of this OSS).

3.3 Other Standards and Documentation

The information from the following EirGrid documents feed into the criteria set out in this OSS:

- EirGrid Grid Code; and
- EirGrid Transmission System Security and Planning Standards (TSSPS).

[1] https://www.semcommittee.com/files/semcommittee/media-files/AIP-SEM-07-253%20Transmission%20System%20Operator%20Licence%20Granted%20to%20Eirgrid.pdf

4 Security Framework

The transmission system shall be operated within the following security framework:

4.1 Security Criteria

The transmission network must remain N-1 secure for all contingencies in the contingency list. Secure in this context means within the limits as defined in subsequent sections for:

- Current Limits (described in Section 5 of this OSS);
- Frequency Limits (described in Section 6 of this OSS);
- Voltage Limits (described in Section 7 of this OSS); and
- Dynamic Stability (described in Section 8 of this OSS).

4.2 Contingency Definition and List

The contingency list categorisation for security analysis is defined by the SOGL and CSAM. Security analysis using the security criteria defined in Section 4.1 should be performed on the transmission network for the contingencies defined in Table 1, specifically for:

- Ordinary contingencies;
- Exceptional contingencies with permanent occurrence increasing factor applied; and
- Exceptional contingencies with temporary occurrence increasing factor applied.

Permanent occurrence increasing factors may be applied to exceptional contingencies based on (but not limited to) location or network design considerations.

Temporary occurrence increasing factors may be applied to exceptional contingencies based on weather or temporary operational considerations.

Exceptional contingencies that do not have occurrence increasing factors and out-of-range contingencies are not secured for ordinarily but may be secured for on an ad-hoc basis as part of a risk assessment framework with the TAO and/or DSO.

Table 1 Contingency Definitions

Ordinary contingency	Exceptional contingency	Out-of-range contingency
Loss of a single: • circuit, • transformer, • phase-shifting transformer, • reactive compensation device, • component of a HVDC system such as a line or a cable or a single HVDC converter unit, • power generation unit, • demand facility.	• Loss of network elements having common fault mode, for example busbar, HVDC grounding system, circuit breaker, measurement transformer, • Loss of circuits supported on the same tower or loss of underground cables built in same trench, • Loss of grid users having common process mode, for example two gas turbines supplying a single steam set, • Loss of multiple generation units or demand facilities disconnected due to a network or system disturbance.	• Loss of two or more independent transmission network elements without a common failure mode.

4.3 Post-contingency Actions

The TSO must have a plan to return the system to its normal state as soon as possible, following the occurrence of a contingency. In case of utilisation of available Transitory Admissible Overload Limits (TAOL), EirGrid shall prepare in advance remedial actions to be applied and executed within the timeframe allowed for these transitory admissible overloads.

4.4 Dual-fed Transmission Stations with Demand and Generation

The transmission network in Ireland has many transmission stations connected to the wider network via two circuits. Planned outages of one of the two circuits expose demand or generation at the station to N-1 risk of disconnection. The pre- and post-mitigation measures for these outages may be managed using a separate risk-based framework between EirGrid, ESB Networks TAO and ESB Networks DSO.

4.5 Specific Arrangements for Out-of-Range Contingencies

The probability of a power generation unit tripping is relatively high. As a result, in operational planning timeframes, where planned outages have long return to service times, the loss of a power generation unit and another ordinary contingency are sometimes secured against. This is typically only done in certain parts of the network (mainly the greater Dublin area) where these N-G-1 contingencies can be problematic to solve in real-time operation. Ordinarily, these are out-of-range contingencies and are not secured for. A separate risk-based framework may be used to decide if these contingencies should be secured against.

5 Current Limits

This section explains how equipment shall be operated in normal state and after a contingency event.

5.1 Current Limits

Each element on the transmission system shall be operated within its rated current limit in terms of thermal rating, including Transitory Admissible Overload Limits (TAOL).

5.2 Short Circuit Current Limits

Each element on the transmission system shall be operated within its rated short circuit current limit.

EirGrid shall:

- determine the short circuit current at which the rated capability of equipment is exceeded; and
- ensure protection relays operate for minimum short circuit current level conditions.

EirGrid shall apply operational or other measures to prevent the maximum short circuit current limits being exceeded. A deviation from these limits is allowed only during switching sequences.

6 Frequency Limits

The transmission system frequency shall operate within the parameters outlined in the SAOA replicated in Table 2 below. Frequency shall remain within these parameters for the Reference Incidents.

Table 2 System frequency parameters

Parameter	Value
Nominal frequency	50 Hz
Standard frequency range	49.8 - 50.2 Hz
Maximum instantaneous frequency deviation	1 Hz[2]
Maximum steady state frequency deviation	0.5 Hz
Time to recover frequency	1 Minute
Frequency recovery range	49.5 - 50.5 Hz
Time to restore frequency	15 Minutes
Frequency restoration range	49.8 - 50.2 Hz
Alert trigger time	10 Minutes
Maximum number of minutes outside standard frequency range	15,000 per year
Maximum rate of change of frequency (RoCoF)[3]	1.0 Hz per second

[2] with reference to 50 Hz

[3] calculated over a rolling 500 millisecond period as per EirGrid Grid Code

7 Voltage Limits

The transmission system shall operate within the voltage ranges as per Table 3.

Table 3 Voltage ranges

Nominal voltage	Normal state range	Post-contingency range
400 kV	370 – 410 kV	360 – 420 kV
220 kV	210 – 240 kV	200 – 245 kV
110 kV	105 – 120 kV	99 – 123 kV
275 kV	260 – 300 kV	250 – 303 kV

The maximum voltage step change for operational switching and ordinary contingencies shall not exceed 10%.

8 Dynamic Stability

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

8.1 Dynamic Stability Security Criteria

The security criteria for each stability category are given in Table 4:

Table 4 Stability categories

Stability Category	Security Criteria and Limits
Rotor angle stability	No pole slipping of synchronous generators or synchronous condensers
Voltage stability	Voltage within limits defined in Section 7
Frequency stability	Frequency within limits defined in Section 6 and peak-to-peak oscillations of 100 mHz and damping ratio no less than 0.05.

Rotor angle, voltage and frequency stability should be studied in real time using a dynamic security assessment simulator for the normal state and N-1. For steady-state and N-1 scenarios that violate the dynamic security standards, mitigation actions should be deployed to alleviate the risk.

To ensure power system stability is maintained, the simulation analysis performed must consider the Ordinary contingencies and relevant Exceptional contingencies in Table 1 and worst-case credible scenarios for the type of plant or devices under study.

9 Acronyms and Definitions

9.1 Acronyms

HVDC	High Voltage Direct Current
Hz	Hertz
IE	Ireland
kV	kilo Volt
NI	Northern Ireland
OSS	Operating Security Standards
PRSP	Power System Restoration Plan
RoCoF	Rate of Change of Frequency
SAOA	Synchronous Area Operational Agreement (SAOA) for Synchronous Area IE/NI
SDP	System Defence Plan
SONI	System Operator Northern Ireland
TAO	Transmission Asset Owner
TAOL	Transitory Asset Overloading Limit

9.2 Definitions

Alert trigger time	The time before alert state becomes active.
Common fault mode	Single fault that will lead to loss of more than one network element.
Common process mode	Total or partial loss of one grid user will lead to the total or partial loss of others.
Contingency	The identified and possible or already occurred outage of an element of the transmission system, including not only the transmission system elements, but also significant grid users and distribution network elements if relevant for the transmission system operational security.
Contingency list	The list of contingencies to be simulated in order to test the compliance with the operational security limits.
CSAM	Methodology for coordinating operational security analysis.
Dynamic stability	The ability of an electric power system, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance, with most system variables bounded so that practically the entire system remains intact.
EirGrid	The independent statutory electricity transmission system operator in Ireland.
Exceptional contingency	The loss of more than one network element due to common cause.
Frequency recovery range	The system frequency range to which the system frequency is expected to return in the IE/NI synchronous areas, after the occurrence of an imbalance equal to or smaller than the reference incident, within the time to recover frequency.
Frequency restoration range	The system frequency range to which the system frequency is expected to return in the IE/NI synchronous areas, after the occurrence of an imbalance equal to or smaller than the reference incident within the time to restore frequency.
Frequency stability	The ability of a power system to maintain frequency within specified ranges and return to those ranges after being subjected to a disturbance.
Maximum instantaneous frequency deviation	The maximum expected absolute value of an instantaneous frequency deviation after the occurrence of an imbalance equal to or smaller than the reference incident, beyond which emergency measures are activated.
Nominal frequency	Frequency value used as a target to operate the system at.
Normal state	A situation in which the system is within operational security limits in the N-situation or after the occurrence of any contingency from the contingency list, considering the effect of the available remedial actions.

N-situation	The situation where all planned outages are implemented, and no contingency has occurred.
Operational security	The transmission system's capability to retain a normal state or to return to a normal state as soon as possible, and which is characterised by operational security limits.
Ordinary contingency	The occurrence of a contingency which leads to single network element outage.
Out-of-range contingency	The simultaneous occurrence of multiple contingencies without a common cause, or a loss of power generating modules with a total loss of generation capacity exceeding the reference incident.
Permanent occurrence increasing factor	A factor that explains a permanent increase of the probability of occurrence of an exceptional contingency.
Planned outage	Scheduled outage of equipment for example maintenance.
SAOA	Synchronous Area Operational Agreement (SAOA) for Synchronous Area IE/NI.
Reference Incident	The maximum positive or negative power deviation occurring instantaneously between generation and demand in a synchronous area
SOGL	Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation.
Standard frequency range	A defined symmetrical interval around the nominal frequency within which the system frequency of a synchronous area is supposed to be operated.
Steady state	State after occurrence of an imbalance, once the system frequency has been stabilised.
Steady state frequency deviation	The absolute value of frequency deviation after occurrence of an imbalance, once the system frequency has been stabilised.
Temporary occurrence increasing factor	A factor that explains a temporary increase of the probability of occurrence of an exceptional contingency.
Time to recover frequency	For the synchronous areas IE/NI, the maximum expected time after the occurrence of an imbalance smaller than or equal to the reference incident in which the system frequency returns to the maximum steady state frequency deviation.
Time to restore frequency	The maximum expected time after the occurrence of an instantaneous power imbalance smaller than or equal to the reference incident in which the system frequency returns to the frequency restoration range for synchronous areas with only one LFC area and in the case of synchronous areas with more than one LFC area, the maximum expected time after the occurrence of an instantaneous power imbalance of an LFC area within which the imbalance is compensated.
Transient stability	The ability of the power system to remain in synchronism in normal state and regain synchronism after being subjected to a disturbance.

Transitory admissible overload	The temporary overloads of transmission system elements which are allowed for a limited period, and which do not cause physical damage to the transmission system elements as long as the defined duration and thresholds are respected.
Transmission asset	Fixed and movable items used in the generation and/or consumption of and/or supply and/or transmission of electricity.
Transmission system	The system consisting of (wholly or mainly) high voltage electric lines and cables operated by the TSO for the purposes of transmission of electricity from one power station to a sub-station or to another power station or between sub-stations or to or from any external interconnection including any plant and apparatus and meters owned or operated by the TSO or TAO in connection with the transmission of electricity.
Transmission System Operator (TSO)	The licensed entity that is responsible for transmitting electricity from generators to regional or distribution operators.
Voltage stability	The ability of a power system to maintain steady voltages at all buses in the system after being subjected to a disturbance.