ICS 2022 Annual Report

Publication Date: 29 September 2023

From: Incident Classification Scale Subgroup

European Network of
Transmission System Operators
for Electricity

entsoe

ICS 2022 Annual Report

Report rendered 29 September 2023

Table of Contents

List of Figures

List of Tables

Glossary

ALFC Annual Load-Frequency Control

CE Continental Europe

Contingency list "the list of contingencies to be simulated in order to test the compliance with the operational security limits" [1]

ENS Energy not supplied

ENTSO-E European Network of Transmission System Operators for Electricity

Energy not supplied "the estimated energy which would have been supplied to end-users if no interruption and no transmission restrictions had occurred"

Exceptional contingency "the simultaneous occurrence of multiple contingencies with a common cause" [1]

FCR Frequency Containment Reserves

FRR Frequency Restoration Reserves

GB Great Britain

ICS Incident Classification Scale

ICS event An ICS event indicates the occurrence of a single ICS criteria violation

ICS incident In the ICS Annual Report, the term incident is used to represent all related ICS events that have affected the normal operation of the electric power grid. Therefore, one ICS incident may have multiple ICS events.

IE/NI Ireland / Northern Ireland

LFC area Load-frequency control area

OPS Operational security indicator relevant to operational planning and scheduling

OS Operational security indicator relevant to operational security

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" [1]

PGF Power Generating Facility

RR Replacement Reserves

SA Synchronous area

SOGL System Operation Guideline, i.e., Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation [1]

TSO Transmission System Operator

1 Introduction

The 2022 Incident Classification Scale Annual Report has been prepared according to the Incident Classification Scale (ICS) Methodology developed by ENTSO-E according to Article 15(1) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SOGL) [1].

The latest ICS Methodology was approved on 4 December 2019 [2] and was used for the first time in the 2020 ICS Annual Report. The ICS Methodology has been updated several times since its creation in 2012 [3]. The latest changes made in 2018 and 2019 are presented in Section 2.1. The ICS aims to:

- Provide an overview of operational security indicators as specified in Article 15 of SOGL;
- Identify any improvements necessary to support sustainable and long-term operational security;
- Identify any appropriate improvements to the network operation tools required to maintain operational security and that are related to real-time operation and operational planning to support Transmission System Operators (TSOs) in their task identified in Article 55(e) of SOGL; and
- Provide explanations for the reasons for incidents at the operational security ranking scales 2 and 3 as per the ICS adopted by ENTSO for Electricity; those explanations are based on an investigation of the incidents by the TSO. The process of this investigation is set out in the ICS Methodology.

The Annual Report aggregates the data prepared by each TSO and provides a high-level summary of scale 0–3 ICS incidents, and a detailed review of scale 2 and scale 3 incidents.

The Annual Report of the ICS includes incident reports from all of ENTSO-E's full members, observer member TEIAS in Türkiye, and National Grid ESO in Great Britain (GB). Amprion provided information regarding incidents leading to frequency degradation in continental Europe (CE) for odd months, and Swissgrid provided information for even months. The frequency events in the Nordics were provided by Svenska Kraftnät.

2 Incident Classification Scale

The criteria for incident classification are defined by using definitions from SOGL [1] and IEC standards. Each criterion factually describes an incident or an observable situation.

Only significant incidents are recorded and classified according to a scale based on severity. Therefore, this report is not a compilation of all the incidents that occurred but rather those that meet the criteria of the ICS Methodology.

The ICS has four levels of increasing severity, ranging from noteworthy incidents up to significant or widespread incidents. System events not classified as incidents are recorded in a 'Below Scale' category. The severity levels are compliant with the system state definitions listed in the SOGL. The scales used in the Annual Report are:

- Below Scale[1], for anomalies and local events – the system remains in a normal state. Below scale events are only included in the calculation of operational security indicators;
- Scale 0, for noteworthy local incidents – the system remains in a normal state;
- Scale 1, for significant incidents with violation of operational security limits – the system is in an alert state;
- Scale 2, for extensive incidents involving a probability of a wide area incident – the system is in an emergency state; and
- Scale 3, for major incidents in the control area of a single TSO – the system is in a blackout state.

Table 2.1: The Incident Classification Scale used to categorise incidents in the pan-European power system.

Below scale Anomaly		Scale 0 Noteworthy		Scale 1 Significant incident		Scale 2 Extensive incident		Scale 3 Major incident	
Priority	Short definition (Criterion short code)	Priority	Short definition (Criterion short code)	Priority	Short definition (Criterion short code)	Priority	Short definition (Criterion short code)	Priority	Short definition (Criterion short code)
		#20	Incidents on load (L0)	#11	Incidents on load (L1)	#2	Incidents on load (L2)	#1	Blackout (OB3)
#28	Incidents leading to frequency degradation (FBS)	#21	Incidents leading to frequency degradation (F0)	#12	Incidents leading to frequency degradation (F1)	#3	Incidents leading to frequency degradation (F2)		
		#22	Incidents on network elements (T0)	#13	Incidents on network elements (T1)	#4	Incidents on network elements (T2)		
#29	Incidents on power generating facilities (GBS)	#23	Incidents on power generating facilities (G0)	#14	Incidents on power generating facilities (G1)	#5	Incidents on power generating facilities (G2)		
				#15	N-1 violation (ON1)	#6	N violation (ON2)		
		#24	Separation from the grid (RS0)	#16	Separation from the grid (RS1)	#7	Separation from the grid (RS2)		
#30	Violation of standards on voltage (OVBS)	#25	Violation of standards on voltage (OV0)	#17	Violation of standards on voltage (OV1)	#8	Violation of standards on voltage (OV2)		
		#26	Reduction of reserve capacity (RRC0)	#18	Reduction of reserve capacity (RRC1)	#9	Reduction of reserve capacity (RRC2)		
		#27	Loss of tools, means and facilities (LT0)	#19	Loss of tools, means and facilities (LT1)	#10	Loss of tools, means and facilities (LT2)		

[1] Remark: 'Below Scale' level has been added to report events that are needed to be calculated for the operational security indicators that are relevant to operational security but these events are not included in the ICS Scale 0, 1, 2 and 3. These events are considered anomalies. 'Below Scale' only exists for reporting of violations of standards of voltage, incidents on power generating facilities and incidents leading to frequency degradation. For all other criteria the ICS scales of 0, 1, 2 and 3 are sufficient to calculate the operational security indicators

2.1 Changes in the Incident Classification Scale Methodology

The current ICS Methodology has been updated several times since its introduction. The latest update in 2019 was to implement input received from ACER. This included an update of several thresholds and the addition of the new 'below scale' level. In addition, some adjustments were made to improve the quality of the ICS data. The first ICS Annual Report to use the 2019 update was the 2020 ICS Annual Report.

The updates made in 2019 are described below. The update has significantly changed the reported data. Therefore, the results gathered after each update cannot be directly compared to those from previous years.

As of 2018, annual workshops are being organised to ensure high-quality and consistent reporting for all TSOs.

ICS Methodology 2019 criteria updates

The main update in the 2019 ICS Methodology was the addition of the 'below scale' criteria for incidents on frequency degradation (FBS), incidents on power generating facilities (GBS) and violation of standards on voltage (OVBS). This addition decreases the reporting threshold for G and OV incidents sufficiently to enable the better calculation of the security indicators OS-B, OS-F1 and OS-F2. Furthermore, short frequency deviations that do not endanger the system operating condition are registered as below scale instead of scale 0. However, the below-scale events are only used when the operational security indicators are calculated.

In addition, definitions were clarified and the vocabulary was aligned to that used in ENTSO-E.

New ICS criteria

Incidents on load (L0) and separation from the grid (RS0) were added to the ICS criteria table. L0 incidents include disconnections of load of more than 100 MW and less than 1% of the load in a TSO's control area (between 1–5% in isolated systems). RS0 incidents include grid separations involving only one TSO when the asynchronous systems have a load of 1–5% of the total load prior to the incident.

Incidents leading to frequency degradation (F)

The duration thresholds for incidents leading to frequency degradation were changed. Scale 0 duration thresholds were increased by 2–4 minutes and scale 2 duration thresholds were added as they did not previously exist. A 'below scale' level was added to collect short frequency deviations between 0–5 minutes, which would have been scale 0 events previously. See the ICS Methodology for further details.

Incidents on transmission network elements (T)

Incidents on network elements (T) were extended to also include voltage levels below 220 kV when the network elements are relevant for maintaining operational security in the TSO's control area.

Violation on standards on voltage (OV)

All thresholds for violations on standards on voltage (OV) were revised. Prior to 2020, only voltage deviations longer than 30 minutes were registered. As of 2020, voltage deviations may already be registered after 5 minutes, or 30 seconds if they are major. Furthermore, the criteria of one or multiple substations being affected was removed. See the ICS Methodology for further details.

Reduction of reserve capacity (RRC)

The time threshold of 15 minutes was changed to the minimum scheduling resolution of the power generation facilities of each TSO as the scheduling resolution can vary by 5 to 30 minutes between TSO.

ICS Methodology 2019 security indicator updates

The operational security indicators OS-B, OS-F1, OS-F2 conditions were extended to cover 'below scale' incidents.

3 Pan-European Overview

This chapter provides a pan-European overview of the events and incidents in 2022 reported by the TSOs. The general overview per synchronous area and TSO is provided in Section 3.1. Section 3.2 analyses events per circuit length and consumption, and Section 3.3 illustrates the evolution of events between 2018–2022.

3.1 Number of classified events and incidents

This section presents the number of ICS events and ICS incidents that meet the ICS criteria. The numbers are shown per synchronous area and TSO and their distribution by scale or ICS criterion. The term ICS event differs from ICS incident as an incident may contain multiple events. The ICS criteria used in this report are presented in Table 2.1.

As shown in Table 3.1, TSOs reported 3441 ICS events in 2022, of which 2839 were of scale 0, 599 of scale 1 and 3 were scale 2. No scale 3 events were reported. The percentage distribution of scales 0, 1 and 2 ICS events were 82.5%, 17.4% and 0.1%, respectively. There were 113 more ICS events than ICS incidents. The similar number of ICS events and ICS incidents indicates that most ICS incidents only had one ICS event. In all synchronous areas, scale 0 events were most common. This indicates that the transmission grids remained in normal state even after the event.

Table 3.2 presents the total number of ICS incidents per synchronous area and scale in 2022. Table 3.3 presents the same information but for ICS events. Table 3.4 shows the percentage allocation of reported ICS incidents by scale and synchronous area. Table 3.5 presents the same information but for ICS events. Approximately 85% of all events, as well as incidents, occurred in CE. The high percentage is due to the large size of CE. However, it should be noted that in smaller synchronous areas, single incidents can have a disproportionate effect on the percentage distributions as the total number of incidents within them is small. To enable better comparisons, Section 3.2 presents these numbers normalised by consumption and circuit length in each region.

Table 3.6 shows the number of ICS incidents per TSO and scale and Table 3.7 shows the number of ICS events per TSO and ICS scale. The responsible TSO for events leading to frequency degradation is marked in most cases as 'Freq (CE)' in CE and 'Freq (Nordic)' in the Nordic synchronous area because it is rarely possible to determine which TSO is responsible for a particular frequency event. Usually, frequency events are caused by a combination of different reasons. The actual causes of many of the unknown F events are usually deterministic frequency deviations (DFDs) caused by changes in generation and balance diagrams at the beginning and end of each hour. Incidents classified as scale 0 and scale 1 are widely distributed across most TSOs. There were zero scale 2 events in all synchronous areas except for Iceland.

Table 3.8 and Table 3.9 show the number of ICS incidents and ICS events by ICS criteria and synchronous area, respectively. The most frequent events in 2022 were events on transmission network elements (T0) with 1596 events, violations of standards on voltage (OV0 and OV1) with 872 events, and events leading to frequency degradation (F0) with 280 events. Violations of standards on voltage and reductions of reserve capacity are only reported in continental Europe. Scale 2 events were only registered in isolated systems. There were no scale 3 events in the ENTSO-E area in 2022.

Table 3.1: Number of incidents and events per scale in 2022 and their percentage distribution.

	Number of incidents	Percentage of total	Number of events	Percentage of total
Scale 0	2732	82.1%	2839	82.5%
Scale 1	593	17.8%	599	17.4%
Scale 2	3	0.1%	3	0.1%
Scale 3	0	0.0%	0	0.0%
Grand total	3328	100.0%	3441	100.0%

Table 3.2: Number of incidents per scale and synchronous area in 2022.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand total
Baltic	45	6	-	-	51
Continental Europe	2276	569	-	-	2845
Great Britain	179	-	-	-	179
Ireland	33	8	-	-	41
Isolated systems	36	3	3	-	42
Nordic	163	7	-	-	170
Grand total	2732	593	3	-	3328

Table 3.3: Number of events per scale and synchronous area in 2022.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand total
Baltic	45	6	-	-	51
Continental Europe	2366	573	-	-	2939
Great Britain	188	-	-	-	188
Ireland	33	8	-	-	41
Isolated systems	36	3	3	-	42
Nordic	171	9	-	-	180
Grand total	2839	599	3	-	3441

Table 3.4: Percentage distribution of incidents per scale and synchronous area in 2022.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	88.2%	11.8%	-	-
Continental Europe	80.0%	20.0%	-	-
Great Britain	100.0%	-	-	-
Ireland	80.5%	19.5%	-	-
Isolated systems	85.7%	7.1%	7.1%	-
Nordic	95.9%	4.1%	-	-
Grand total	82.1%	17.8%	0.1%	-

Table 3.5: Percentage distribution of events per scale and synchronous area in 2022.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	88.2%	11.8%	-	-
Continental Europe	80.5%	19.5%	-	-
Great Britain	100.0%	-	-	-
Ireland	80.5%	19.5%	-	-
Isolated systems	85.7%	7.1%	7.1%	-
Nordic	95.0%	5.0%	-	-
Grand total	82.5%	17.4%	0.1%	-

Table 3.6: Number of incidents per scale for each TSO in the pan-European transmission grid in 2022.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	AST	6	-	-	-	6
	Elering	32	-	-	-	32
	Litgrid	7	6	-	-	13
	Total	45	6	-	-	51
Continental Europe	OST	18	-	-	-	18
	TenneT NL	63	9	-	-	72
	PSE	151	6	-	-	157
	REN	12	-	-	-	12
	Transelectrica	107	71	-	-	178
	SEPS	8	8	-	-	16
	TEIAS	26	-	-	-	26
	EMS	20	122	-	-	142
	Terna	56	1	-	-	57
	APG	13	5	-	-	18
	NOS BiH	26	-	-	-	26
	HOPS	36	1	-	-	37
	ELES	9	1	-	-	10
	Elia	7	-	-	-	7
	ESO	55	-	-	-	55
	Swissgrid	100	5	-	-	105
	CEPS	41	18	-	-	59
	TransnetBW	28	10	-	-	38
	TenneT DE	48	18	-	-	66
	Amprion	129	15	-	-	144
	50Hertz	39	12	-	-	51
	Energinet (CE)	16	3	-	-	19
	Red Eléctrica	209	-	-	-	209
	RTE	229	23	-	-	252
	IPTO	67	28	-	-	95
	MAVIR	526	207	-	-	733
	CGES	22	-	-	-	22
	Freq (CE)	215	6	-	-	221
	Total	2276	569	-	-	2845
Great Britain	National Grid ESO	179	-	-	-	179
	Total	179	-	-	-	179
Ireland and Northern Ireland	EirGrid	28	8	-	-	36
	SONI	5	-	-	-	5
	Total	33	8	-	-	41
Isolated system	Landsnet	36	3	3	-	42
	Total	36	3	3	-	42
Nordic	Fingrid	7	-	-	-	7
	Statnett	33	2	-	-	35
	Svenska kraftnät	65	1	-	-	66
	Energinet (Nordic)	5	3	-	-	8
	Freq (Nordic)	53	1	-	-	54
	Total	163	7	-	-	170
Grand total		2732	593	3	-	3328

Table 3.7: Number of events per scale for each TSO in the pan-European transmission grid in 2022.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	AST	6	-	-	-	6
	Elering	32	-	-	-	32
	Litgrid	7	6	-	-	13
	Total	45	6	-	-	51
Continental Europe	OST	32	-	-	-	32
	TenneT NL	63	9	-	-	72
	PSE	151	6	-	-	157
	REN	12	-	-	-	12
	Transelectrica	108	71	-	-	179
	SEPS	8	8	-	-	16
	TEIAS	27	-	-	-	27
	EMS	20	122	-	-	142
	Terna	57	1	-	-	58
	APG	13	5	-	-	18
	NOS BiH	26	-	-	-	26
	HOPS	39	1	-	-	40
	ELES	10	1	-	-	11
	Elia	7	-	-	-	7
	ESO	91	-	-	-	91
	Swissgrid	102	6	-	-	108
	CEPS	42	19	-	-	61
	TransnetBW	28	10	-	-	38
	TenneT DE	48	18	-	-	66
	Amprion	129	15	-	-	144
	50Hertz	46	14	-	-	60
	Energinet (CE)	16	3	-	-	19
	Red Eléctrica	223	-	-	-	223
	RTE	233	23	-	-	256
	IPTO	67	28	-	-	95
	MAVIR	526	207	-	-	733
	CGES	22	-	-	-	22
	Freq (CE)	220	6	-	-	226
	Total	2366	573	-	-	2939
Great Britain	National Grid ESO	188	-	-	-	188
	Total	188	-	-	-	188
Ireland and Northern Ireland	EirGrid	28	8	-	-	36
	SONI	5	-	-	-	5
	Total	33	8	-	-	41
Isolated system	Landsnet	36	3	3	-	42
	Total	36	3	3	-	42
Nordic	Fingrid	7	-	-	-	7
	Statnett	40	4	-	-	44
	Svenska kraftnät	66	1	-	-	67
	Energinet (Nordic)	5	3	-	-	8
	Freq (Nordic)	53	1	-	-	54
	Total	171	9	-	-	180
Grand total		2839	599	3	-	3441

Table 3.8: Incidents by dominating criteria for each synchronous area in 2022.

Scale	ICS criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale0	Incidents on load (L0)	-	2	-	-	6	1	9
	Incidents leading to frequency degradation (F0)	-	215	7	-	-	53	275
	Incidents on network elements (T0)	27	1191	148	18	29	92	1505
	Incidents on power generating facilities (G0)	18	120	9	15	-	12	174
	Separation from the grid (RS0)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	479	-	-	-	-	479
	Reduction of reserve capacity (RRC0)	-	185	-	-	-	-	185
	Loss of tools, means and facilities (LT0)	-	84	15	-	1	5	105
	Total	45	2276	179	33	36	163	2732
Scale1	Incidents on load (L1)	-	2	-	-	-	1	3
	Incidents leading to frequency degradation (F1)	-	6	-	-	-	1	7
	Incidents on network elements (T1)	6	19	-	-	2	2	29
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	57	-	8	-	3	68
	Separation from the grid (RS1)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	391	-	-	-	-	391
	Reduction of reserve capacity (RRC1)	-	74	-	-	-	-	74
	Loss of tools, means and facilities (LT1)	-	20	-	-	1	-	21
	Total	6	569	-	8	3	7	593
Scale2	Incidents on load (L2)	-	-	-	-	2	-	2
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	1	-	1
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-
	Total	-	-	-	-	3	-	3
Scale3	Blackout(OB3)	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-
Grand Total		51	2845	179	41	42	170	3328

Table 3.9: Events by dominating criteria for each synchronous area in 2022.

Scale	ICS criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale0	Incidents on load (L0)	-	4	-	-	6	1	11
	Incidents leading to frequency degradation (F0)	-	220	7	-	-	53	280
	Incidents on network elements (T0)	27	1269	157	18	29	96	1596
	Incidents on power generating facilities (G0)	18	123	9	15	-	14	179
	Separation from the grid (RS0)	-	1	-	-	-	2	3
	Violation of standards on voltage (OV0)	-	480	-	-	-	-	480
	Reduction of reserve capacity (RRC0)	-	185	-	-	-	-	185
	Loss of tools, means and facilities (LT0)	-	84	15	-	1	5	105
	Total	45	2366	188	33	36	171	2839
Scale1	Incidents on load (L1)	-	4	-	-	-	1	5
	Incidents leading to frequency degradation (F1)	-	6	-	-	-	1	7
	Incidents on network elements (T1)	6	19	-	-	2	2	29
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	57	-	8	-	4	69
	Separation from the grid (RS1)	-	-	-	-	-	1	1
	Violation of standards on voltage (OV1)	-	392	-	-	-	-	392
	Reduction of reserve capacity (RRC1)	-	74	-	-	-	-	74
	Loss of tools, means and facilities (LT1)	-	21	-	-	1	-	22
	Total	6	573	-	8	3	9	599
Scale2	Incidents on load (L2)	-	-	-	-	2	-	2
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	1	-	1
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-
	Total	-	-	-	-	3	-	3
Scale3	Blackout(OB3)	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-
Grand Total		51	2939	188	41	42	180	3441

3.2 Events per circuit length and energy consumption

The figures in this section present the number of ICS events in proportion to consumption or circuit length that occurred in the European synchronous areas in 2022.

The data concerning circuit length and energy consumption until 2018 are based on the ENTSO-E Power Statistics [4]. The consumption and circuit length data after 2018 have been gathered directly from the TSOs. Whenever a TSO has not reported the latest consumption and circuit length values, the value for the previous year has been used.

Figure 3.1 shows the number of events per TWh of energy consumption, and Figure 3.2 presents the number of events per 100 km of circuit length. Figure 3.3 presents the number of events on transmission network elements (T0 and T1) per 100 km of circuit length.

When normalising the number of scale 0 events in 2022 per consumption, the Baltic area has the highest value, at 1.6 ICS events per TWh of consumption, whereas the Nordic synchronous area has the lowest value, at 0.5 events per TWh of consumption. For scale 1, the minimum value is 0 events per TWh in GB, and the maximum value is 0.2 events per TWh in IE/NI. The number of scale 2 events per TWh of consumption was zero in all synchronous areas except isolated systems, where it was 0.1.

When the number of scale 0–3 events in 2022 is normalised by circuit length, 1.0 events per 100 km circuit length can be found for isolated systems. The Baltic and Nordic synchronous areas recorded 0.3 events per 100 km circuit length, with the remaining synchronous areas showing 0.5–0.7 events per 100 km circuit length.

Incidents on transmission network elements caused a significant portion of the events in the transmission grid in 2022, as seen in the similarities between Figure 3.2 and Figure 3.3. The largest deviation is found in CE, where OV1 events contributed significantly, and in IE/NI, where ON1 events increased the number of recorded scale 1 events per 100 km of circuit.

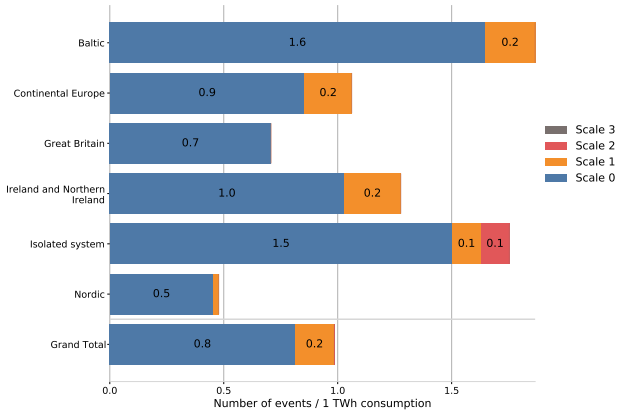

Figure 3.1: Number of events per 1 TWh of energy consumption in 2022.

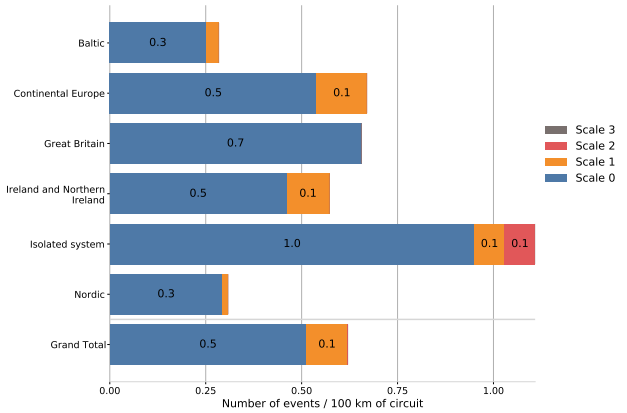

Figure 3.2: Number of events per 100 km of circuit length in 2022.

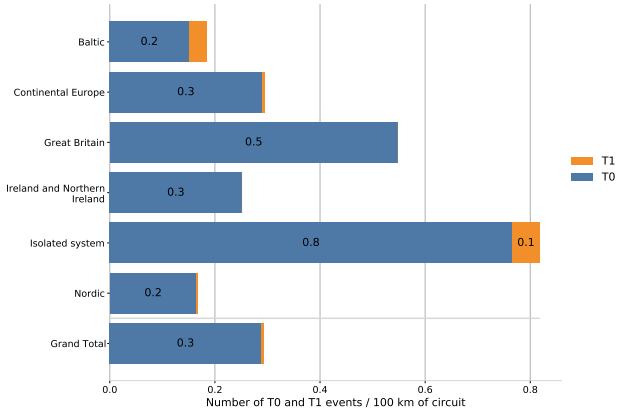

Figure 3.3: Number of events on transmission network elements (T0 and T1) per 100 km of circuit length in 2022.

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

3.3 Evolution 2018–2022

This section presents classified events according to the ICS Methodology [2] as it developed between 2018–2022. In addition, a detailed view of the ICS criteria F, T, G, OV, RRC, LT and ON is presented in Sections 3.3.1–3.3.7.

It should be noted that the data for 2018–2019 were reported according to the 2018 Methodology [5], and the data as of 2020 were reported according to the Methodology updated in 2019 [2]. Therefore, the results for individual years cannot directly be compared. Furthermore, one of the important updates in 2020 registered individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

It should further be noted that trends and impacts on the system must be interpreted according to specific considerations due to inherent differences in the manner in which networks have been designed and are operated across separate synchronous areas.

Figure 3.4 and Figure 3.5 present the annual number of ICS events between 2018 and 2022. Figure 3.4 presents the annual number of events grouped by scale, and Figure 3.5 shows the annual percentage allocation of the scale of the events.

Both graphs, which show annual values by scale, indicate that the number of scale 1 events has increased since 2020. The increase consists mainly of F1 events in 2021 and OV1 events in 2021 and 2022. A detailed view of these incident categories is presented in Section 3.3.1 and Section 3.3.4, respectively. The number of scale 0 events jumped in 2021 but returned to 2019 levels in 2022. The fluctuation is mainly visible in the varying number of registered F0 events.

The number of scale 1 events in 2022 decreased compared to 2021 (815 events) but was still higher than in 2020 (328 events). This shift was mainly driven by the increased number of OV1 events. The second driver in 2021 was F1 events, which increased by 88 events but decreased back to 9 registered F1 events in 2022.

Figure 3.6 and Figure 3.7 present the annual number of scale 0 events by consumption and circuit length ratios. In Baltics and isolated systems, the number of Scale 0 events per TWh of energy consumption has increased relatively continuously since 2018. For the other synchronous areas, the numbers are more or less stable. Changes have to be viewed regarding changes in the Methodology in 2020, which added the requirement to also report tripped network elements below 220kV that are relevant for operational security.

Figure 3.8 and Figure 3.9 present the ratios of the number of scale 1 events to consumption and the number of scale 1 events to length of circuit, respectively. The ratio of scale 1 events per 100 km circuit length in IE/NI and CE decreased in all synchronous areas except for the Baltic, which increased but only slightly. The number of Scale 1 events per consumption and circuit length for Isolated Systems decreased significantly compared to 2019 and 2020. A detailed view of the annual number of ICS incidents and events, grouped by ICS criterion, is shown in Table 3.10 and Table 3.11, respectively.

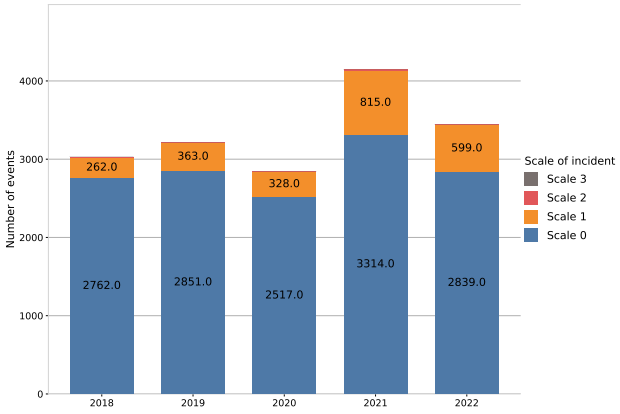

Figure 3.4: The annual number of events per scale from 2018–2022.

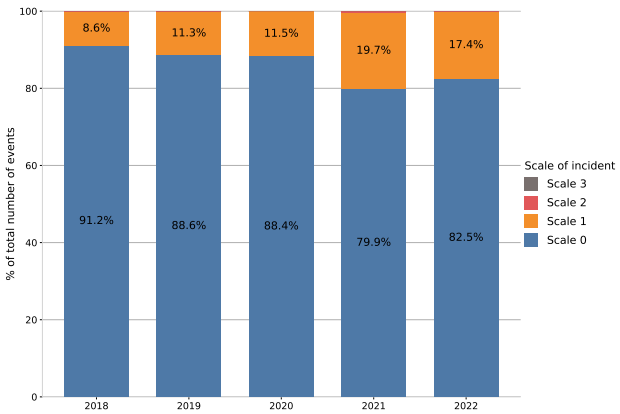

Figure 3.5: The annual percentage distribution of events per scale from 2018–2022.

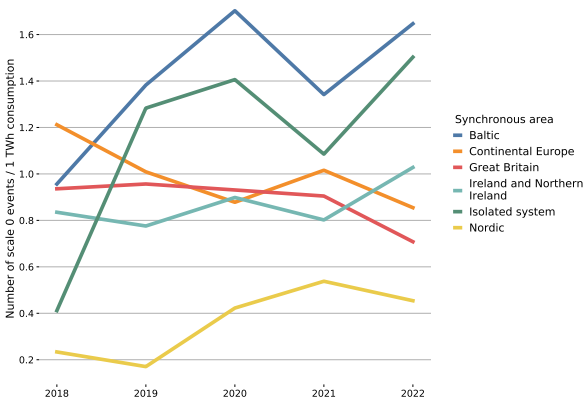

Figure 3.6: The annual number of scale 0 events per 1 TWh of energy consumption from 2018–2022.

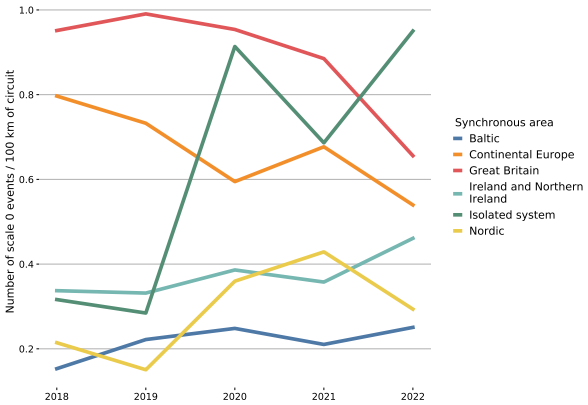

Figure 3.7: The annual number of scale 0 events per 100 km of circuit length from 2018–2022.

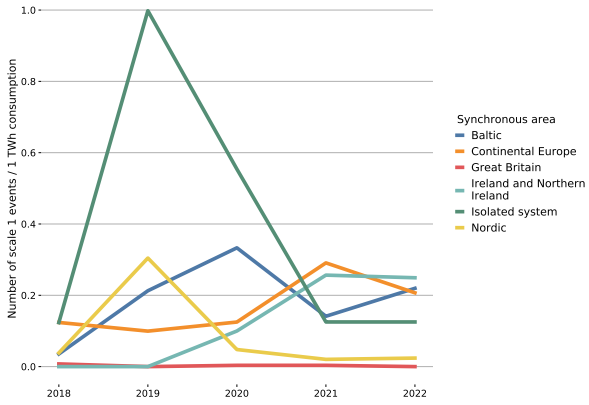

Figure 3.8: The annual number of scale 1 events per 1 TWh of energy consumption from 2018–2022.

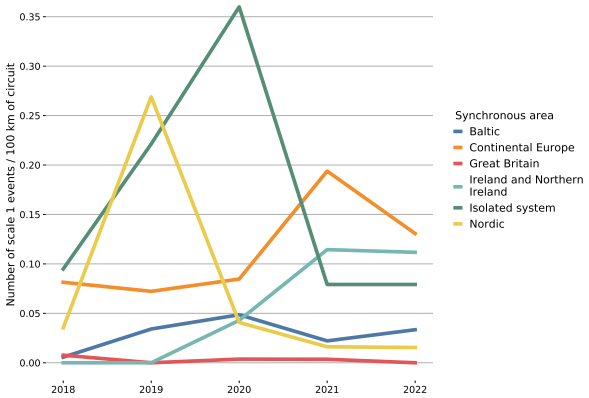

Figure 3.9: The annual number of scale 1 events per 100 km of circuit length from 2018–2022.

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

Table 3.10: The annual number of incidents per dominating criteria from 2018–2022.

Scale	ICS criterion	2018	2019	2020	2021	2022
Scale0	Incidents on load (L0)	-	-	2	1	9
	Incidents leading to frequency degradation (F0)	1021	841	356	811	275
	Incidents on network elements (T0)	1144	1453	1314	1539	1462
	Incidents on power generating facilities (G0)	126	119	144	186	155
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	341	286	422	456	444
	Reduction of reserve capacity (RRC0)	-	1	-	26	185
	Loss of tools, means and facilities (LT0)	130	149	185	102	93
	Total	2762	2849	2423	3121	2623
Scale1	Incidents on load (L1)	6	4	7	1	3
	Incidents leading to frequency degradation (F1)	10	114	7	95	7
	Incidents on network elements (T1)	15	32	30	30	29
	Incidents on power generating facilities (G1)	-	-	-	5	-
	N-1 violation (ON1)	35	25	59	67	68
	Separation from the grid (RS1)	-	-	1	1	-
	Violation of standards on voltage (OV1)	50	9	116	500	382
	Reduction of reserve capacity (RRC1)	118	161	66	61	74
	Loss of tools, means and facilities (LT1)	28	18	30	32	21
	Total	262	363	316	792	584
Scale2	Incidents on load (L2)	1	-	1	2	2
	Incidents leading to frequency degradation (F2)	1	1	-	1	-
	Incidents on network elements (T2)	-	1	-	3	1
	Incidents on power generating facilities (G2)	-	-	-	1	-
	N violation (ON2)	3	1	-	1	-
	Separation from the grid (RS2)	-	-	-	2	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	1	-	-	1	-
	Total	6	3	1	11	3
Scale3	Blackout(OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		3030	3215	2740	3924	3210

Table 3.11: The annual number of events per dominating criteria from 2018–2022.

Scale	ICS criterion	2018	2019	2020	2021	2022
Scale0	Incidents on load (L0)	-	-	4	4	11
	Incidents leading to frequency degradation (F0)	1021	841	360	819	280
	Incidents on network elements (T0)	1144	1455	1362	1664	1596
	Incidents on power generating facilities (G0)	126	119	146	197	179
	Separation from the grid (RS0)	-	-	2	2	3
	Violation of standards on voltage (OV0)	341	286	454	495	480
	Reduction of reserve capacity (RRC0)	-	1	-	26	185
	Loss of tools, means and facilities (LT0)	130	149	189	107	105
	Total	2762	2851	2517	3314	2839
Scale1	Incidents on load (L1)	6	4	9	2	5
	Incidents leading to frequency degradation (F1)	10	114	7	95	7
	Incidents on network elements (T1)	15	32	35	35	29
	Incidents on power generating facilities (G1)	-	-	1	6	-
	N-1 violation (ON1)	35	25	62	68	69
	Separation from the grid (RS1)	-	-	1	1	1
	Violation of standards on voltage (OV1)	50	9	117	513	392
	Reduction of reserve capacity (RRC1)	118	161	66	63	74
	Loss of tools, means and facilities (LT1)	28	18	30	32	22
	Total	262	363	328	815	599
Scale2	Incidents on load (L2)	1	-	1	2	2
	Incidents leading to frequency degradation (F2)	1	1	-	1	-
	Incidents on network elements (T2)	-	1	-	4	1
	Incidents on power generating facilities (G2)	-	-	-	1	-
	N violation (ON2)	3	1	-	1	-
	Separation from the grid (RS2)	-	-	-	6	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	1	-
	Loss of tools, means and facilities (LT2)	1	-	-	1	-
	Total	6	3	1	17	3
Scale3	Blackout(OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		3030	3217	2846	4146	3441

3.3.1 Detailed view of events leading to frequency degradation (F)

This section presents a detailed view of scale 0–2 events leading to frequency degradation; that is, F0, F1 and F2 events. 'Unknown' is used for events caused by many minor reasons where it was not possible to define the most important or initial source of incident.

Table 3.12 presents the annual number of events leading to frequency degradation for each synchronous area, and Table 3.13 shows the same distributed by cause for all synchronous areas combined. Figure 3.10 presents the annual number of F events normalised by the consumption in each synchronous area.

Before 2020, the scale 0 time threshold to report a frequency event was the 'alert state trigger time', which was 0. This was increased in 2020 to 2–7 minutes (depending on the synchronous area magnitude of the frequency deviation) to avoid reporting occurrences which do not affect system security.

Another important update in use as of 2020 was to also register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The ICS Methodology updates are summarised in Section 2.1.

The number of incidents leading to frequency degradations (F) in 2022 is much lower than 2021 but within the range from previous years. Usually, frequency events are caused by a combination of different factors. The actual causes of many of the unknown F events are mainly deterministic frequency deviations (DFDs) caused by changes in generation and balance diagrams at the beginning and end of each hour. In 2022, frequency degradation caused by known incident did not occur.

Table 3.12: The annual number of F-events from 2018–2022.

Synchronous area	2018	2019	2020	2021	2022
Baltic	-	1	-	-	-
CE	963	766	299	839	226
GB	58	79	2	3	7
IE-NI	9	4	-	-	-
Isolated system	-	-	-	-	-
Nordic	2	106	66	73	54
Grand total	1032	956	367	915	287

Table 3.13: The annual number of F-events per cause from 2018–2022.

Cause of event	2018	2019	2020	2021	2022
Unexpected flows	-	2	-	-	-
Loss of generation	10	16	1	-	-
Environmental causes	-	1	-	-	-
Operation and maintenance	-	1	-	-	-
Tripped network element	12	15	-	-	-
Previous event	-	-	1	4	7
LGF deviations	-	7	2	-	-
Other	-	2	1	-	-
Unknown	1010	912	362	911	280
Grand total	1032	956	367	915	287

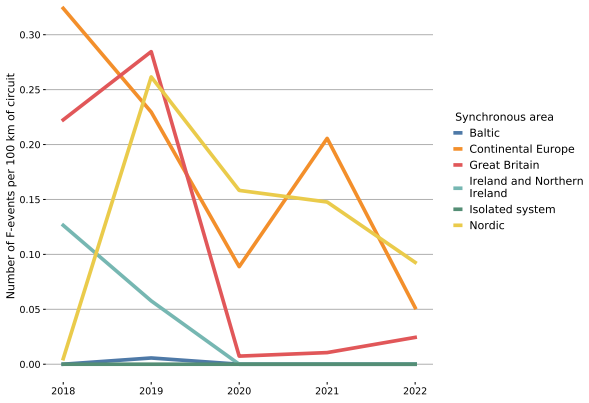

Figure 3.10: The annual number of F-events per 100 km of installed circuit length in each synchronous area from 2018–2022.

3.3.2 Detailed view of events on transmission system elements (T)

This section presents a detailed view of scale 0–2 events on transmission system elements; that is, T0, T1 and T2 events.

Table 3.14 presents the annual number of events on transmission network elements for each synchronous area, and Table 3.15 show the same distributed per cause for all synchronous areas combined. Figure 3.11 presents the annual number of T events normalised by the installed circuit length in each synchronous area. Figure 3.12 presents the number of T0 events normalised by the installed circuit length in each synchronous area, and Figure 3.13 the same but for T1 events.

As seen in Table 3.15, T events are caused mostly by technical reasons and environmental causes, although the number of T events with an unknown cause is significant. External influences also represent an important share of the overall T events in 2022, as does the cause 'other', which includes detailed causes such as operation and maintenance and failure of infrastructure.

The increase in T events in 2018 is due to a change in the ICS Methodology [2], which added the 220–330kV voltage range to the report.

Before 2018, only 380–420 kV or 220 kV cross-border was included. Furthermore, the 2019 ICS Methodology update used as of 2020 included parts of the 100–150 kV network relevant for the TSOs' operational security. Another important update in use as of 2020 was to also register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

The number of T events between 2018 and 2022 show no indication of a decreasing or increasing pattern, and future reports should investigate this trend further. Only for CE does the trend of the annual number of T events per 100 km installed circuit length seems to be decreasing from 2019 onward, although the difference is not significant.

Table 3.14: The annual number of T-events from 2018–2022 per synchronous area.

Synchronous area	2018	2019	2020	2021	2022
Baltic	25	31	25	25	33
CE	872	1221	1078	1318	1288
GB	156	155	169	218	157
IE-NI	9	9	8	11	18
Isolated system	13	12	41	27	32
Nordic	84	60	76	104	98
Grand total	1159	1488	1397	1703	1626

Table 3.15: The annual number of T-events per cause from 2018–2022.

Cause of event	2018	2019	2020	2021	2022
Nature (animals, vegetation)	55	74	1	-	-
Unexpected flows	3	4	-	-	-
Lack of remedial actions	1	-	-	-	-
Unavailability of reactive compensation	6	2	-	-	-
Loss of tools or facilities	34	34	-	-	-
Environmental causes	231	266	306	341	375
External influences	-	-	95	138	154
Operation and maintenance	20	36	90	165	92
Technical equipment	66	87	113	488	523
Tripped network element	523	605	53	2	1
Previous event	-	-	32	50	48
LGF deviations	-	1	-	-	-
Other	145	218	86	138	95
Unknown	75	161	621	381	338
Grand total	1159	1488	1397	1703	1626

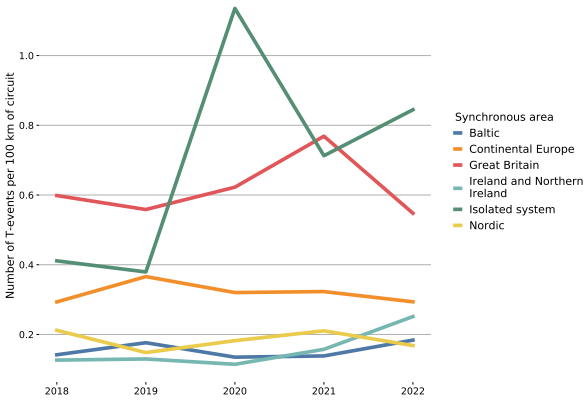

Figure 3.11: The annual number of T-events per 100 km installed circuit length in each synchronous area from 2018–2022.

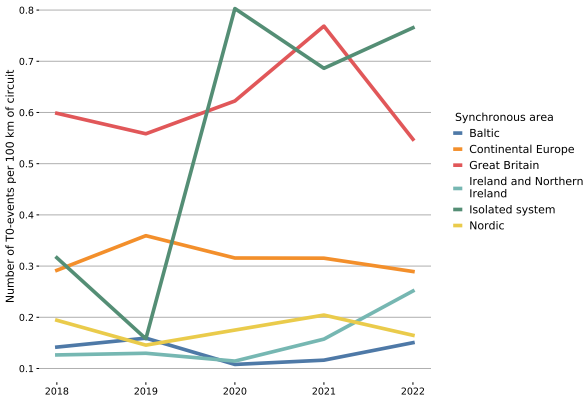

Figure 3.12: The annual number of T0-events per 100 km installed circuit length in each synchronous area from 2018–2022.

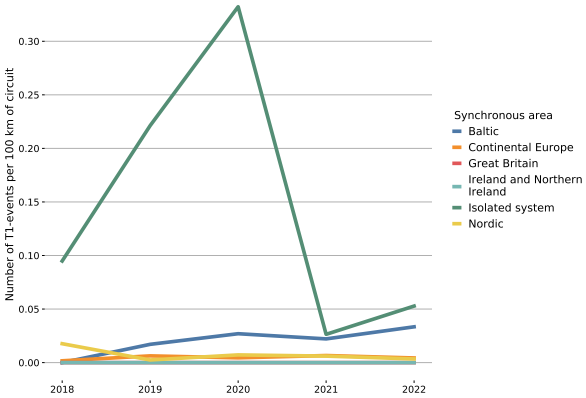

Figure 3.13: The annual number of T1-events per 100 km installed circuit length in each synchronous area from 2018–2022.

3.3.3 Detailed view of events on power generating facilities (G)

This section presents a detailed view of events on power generating facilities; that is, G0, G1 and G2 events.

Table 3.16 presents the annual number of events on power generating facilities for each synchronous area, and Table 3.17 shows the same distributed per cause for all synchronous areas combined. Figure 3.14 presents the annual number of G events normalised by the consumption in each synchronous area.

As seen from Table 3.16, the annual number of G events has decreased in 2022 when compared to 2021, the year in which the number of G events was much higher than previous years. For the remaining synchronous areas, the trend does not seem to have changed in 2022.

From Table 3.17, it can be seen that most G events are due to technical reasons. The remaining G events are mainly due to tripped network elements or unknown reasons.

All G events were of Scale 0 (cf. Section 3.1). While the Baltics reported fewer events in 2022 and 2021 than in 2020, the amount of G events per TWh of consumption is still the highest of all synchronous areas. The number of G events per TWh of consumption ratio decreased in all synchronous areas except Baltic and Ireland, although for CE and GB, the change of the trend is not high.

Table 3.16: The annual number of G-events from 2018–2022.

Synchronous area	2018	2019	2020	2021	2022
Baltic	2	11	27	16	18
CE	113	93	81	143	123
GB	3	-	12	14	9
IE-NI	7	10	19	14	15
Isolated system	-	4	3	2	-
Nordic	1	1	5	15	14
Grand total	126	119	147	204	179

Table 3.17: The annual number of G-events per cause from 2018–2022.

Cause of event	2018	2019	2020	2021	2022
Loss of generation	102	83	6	-	-
Operation and maintenance	1	-	-	1	-
Technical equipment	4	2	94	125	121
Tripped network element	-	-	20	43	16
Previous event	-	-	1	9	4
LGF deviations	-	-	1	-	-
Other	8	3	2	3	9
Unknown	11	31	23	23	29
Grand total	126	119	147	204	179

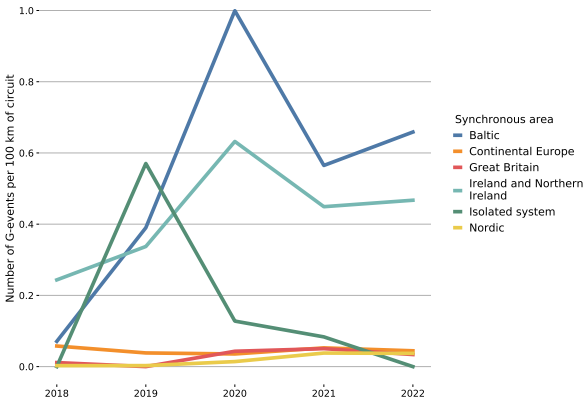

Figure 3.14: The annual number of G-events per 1 TWh of consumption for each synchronous area from 2018–2022.

3.3.4 Detailed view of violations of standards on voltage (OV)

This section presents a detailed view of events on violations of standards on voltage; that is, OV0, OV1 and OV2 events.

Table 3.18 presents the annual number of OV events from 2018 to 2022 for each synchronous area. Table 3.19 show the same events distributed by cause for all synchronous areas combined. Figure 3.15 presents the annual number of OV events normalised by the installed circuit length in each synchronous area.

As can be seen in Table 3.18, OV events continue to occur almost exclusively in the CE synchronous area. The total number of OV events in 2022, while remaining very high and displaying an increase of 53% compared to 2020, dropped by almost 14% compared to 2021 values. Of the total of 872 OV events, 55% were classified as OV0 events with the remaining 45% being OV1 events.

The TSOs RTE, Swissgrid, SEPS and Terna all reported more than 30 voltage violations in 2021 and saw a large reduction of the number of violations reported in 2022 with SEPS and Terna each reporting 0 voltage violations in 2022. Three TSOs identified lower loads in 2021 as being the main contributing factor for increased voltage levels. In general, the increased numbers of voltage violations is due to the increased amount of renewable energy sources in the power system, which has led to fewer conventional power plants available to regulate reactive power in the grid. MAVIR, which reported the largest majority of OV events, accounting for 55% of all reported OV events, conducted an analysis of the high number of OV events, which concluded that the high numbers were a result of low relative power consumption, related to a sharp increase in the infeed from PV. These high voltage levels are due to be managed by MAVIR in the future by optimising the use of already existing assets.

Table 3.19 shows that OV events due to unavailable reactive compensation have not been registered since 2020. The causes of OV events continue to be mainly 'other' or 'unknown'.

Table 3.18: The annual number of OV-events from 2018–2022.

Synchronous area	2018	2019	2020	2021	2022
Baltic	-	-	1	-	-
CE	386	295	570	1008	872
GB	-	-	-	-	-
IE-NI	-	-	-	-	-
Isolated system	-	-	-	-	-
Nordic	5	-	-	-	-
Grand total	391	295	571	1008	872

Table 3.19: The annual number of OV-events per cause from 2018–2022.

Cause of event	2018	2019	2020	2021	2022
Unexpected flows	4	1	-	-	-
Loss of generation	-	-	-	-	3
Unavailability of reactive compensation	167	221	40	-	-
Environmental causes	1	-	-	-	-
Operation and maintenance	-	-	2	-	-
Technical equipment	-	-	2	1	-
Tripped network element	-	-	1	-	-
Previous event	-	-	1	22	-
LGF deviations	-	-	-	1	7
Other	132	30	229	770	249
Unknown	87	43	296	214	613
Grand total	391	295	571	1008	872

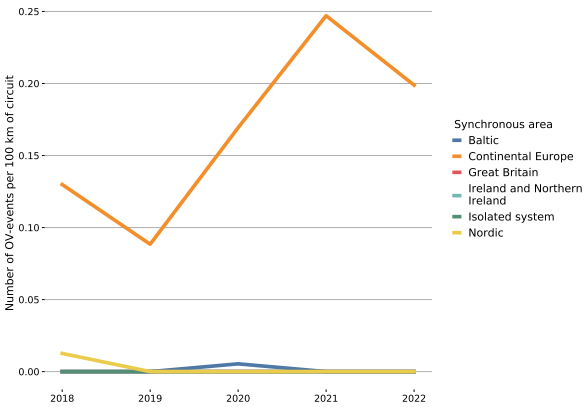

Figure 3.15: The annual number of OV-events per 100 km of installed circuit length in each synchronous area from 2018–2022.

3.3.5 Detailed view of events involving a reduction of reserve capacity (RRC)

This section presents a detailed view of scale 0–2 events involving a reduction of reserve capacity; that is, RRC0, RRC1 and RRC2 events.

Table 3.20 presents the annual number of RRC events for each synchronous area, and Table 3.21 show the same distributed per cause for all synchronous areas combined. Figure 3.16 presents the annual number of RRC events per 100 km of installed length in each synchronous area from 2018 to 2022.

All RRC events were reported by 6 TSOs located in the synchronous area CE. Of all reported RCC incidents, nearly 92% were reported by MAVIR. Of the 259 events reported, 185 were scale 0 (RRC0), 74 scale 1 (RRC1) and no scale 2 events (RRC2). Most of the RRC events were caused by unexpected discrepancies from load or generation forecasts, as seen in Table 3.21.

It should be noted that the recorded values for 2017–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Table 3.20: The annual number of RRC-events from 2018–2022.

Synchronous area	2018	2019	2020	2021	2022
Baltic	-	-	-	-	-
CE	118	162	66	90	259
GB	-	-	-	-	-
IE-NI	-	-	-	-	-
Isolated system	-	-	-	-	-
Nordic	-	-	-	-	-
Grand total	118	162	66	90	259

Table 3.21: The annual number of RRC-events per cause from 2018–2022.

Cause of event	2018	2019	2020	2021	2022
Loss of generation	1	1	-	4	7
External influences	-	-	1	-	-
Lack of reserves	117	158	64	-	-
Previous event	-	-	-	2	-
LGF deviations	-	2	-	62	242
Other	-	-	-	10	10
Unknown	-	1	1	12	-
Grand total	118	162	66	90	259

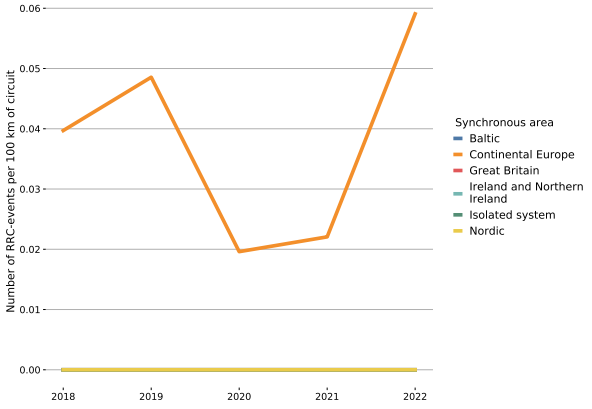

Figure 3.16: The annual number of RRC-events per 100 km of installed circuit length in each synchronous area from 2018–2022.

3.3.6 Detailed view of events involving loss of tools, means or facilities (LT)

This section presents a detailed view of events involving loss of tools or facilities, that is, LT0, LT1 and LT2 events.

Table 3.22 presents the annual number of LT events for each synchronous area, and Table 3.23 shows the same distributed by cause for all synchronous areas combined. Figure 3.17 presents the annual number of LT events per TWh of consumption for each synchronous area.

Compared to 2021, the number of LT events has decreased slightly from 140 to a total of 127. Most LT0 incidents were reported by TenneT NL. This represents 25% of all LT0 incidents. No LT2 incidents occurred in 2022.

LT events continued to be due to technical equipment and other causes, as seen in Table 3.23.

Table 3.22: The annual number of LT-events from 2018–2022.

Synchronous area	2018	2019	2020	2021	2022
Baltic	1	-	-	1	-
CE	124	124	125	98	105
GB	31	42	77	17	15
IE-NI	-	-	-	-	-
Isolated system	1	-	1	1	2
Nordic	2	1	16	23	5
Grand total	159	167	219	140	127

Table 3.23: The annual number of LT-events per cause from 2018–2022.

Cause of event	2018	2019	2020	2021	2022
Loss of tools or facilities	147	134	25	1	-
Environmental causes	-	-	1	-	-
Operation and maintenance	1	-	7	7	5
Technical equipment	-	-	93	49	35
Previous event	-	-	4	-	-
LGF deviations	-	-	1	-	-
Other	7	33	70	55	59
Unknown	4	-	18	28	28
Grand total	159	167	219	140	127

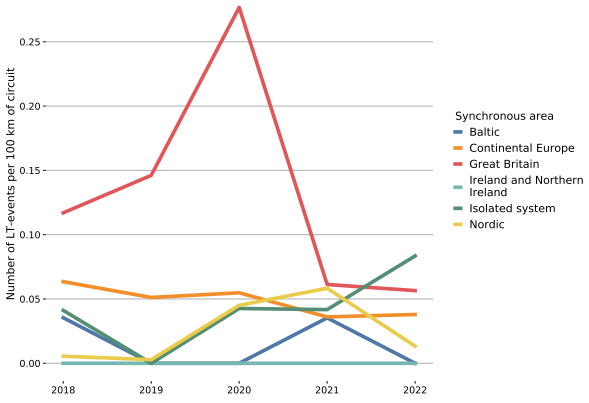

Figure 3.17: The annual number of LT-events per 1 TWh of consumption for each synchronous area from 2018–2022.

3.3.7 Detailed view of N- and N-1 violations (ON)

This section presents a detailed view of events involving N and N-1 violations, that is, ON0, ON1 and ON2 events.

Table 3.24 presents the annual number of ON1 and ON2 violation events for each synchronous area. Table 3.25 shows the same distributed by cause for all synchronous areas combined. Figure 3.18 presents the annual number of ON events per 100 km of circuit length in each synchronous area.

In 2022, ON violations were only reported in the synchronous area CE, IE/NI and Nordic.

Most ON events during 2018 and 2019 were caused by unexpected flows, whereas from 2020 to 2022 they were mostly due to unexpected discrepancies from load or generation forecasts. These causes are very similar in nature, and improving load flow and generation forecasts could drastically reduce the number of ON events. This improvement is of critical importance as each ON event degrades the TSO's operating state to alert or emergency.

In the synchronous area CE, RTE and Amprion has the most reported ON1 events. No ON2 incidents occurred in 2022.

It should be noted that the recorded values for 2018–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Table 3.24: The annual number of ON-events from 2018–2022.

Synchronous area	2018	2019	2020	2021	2022
Baltic	-	-	1	-	-
CE	34	26	56	61	57
GB	2	-	-	-	-
IE-NI	-	-	3	8	8
Isolated system	-	-	-	-	-
Nordic	2	-	2	-	4
Grand total	38	26	62	69	69

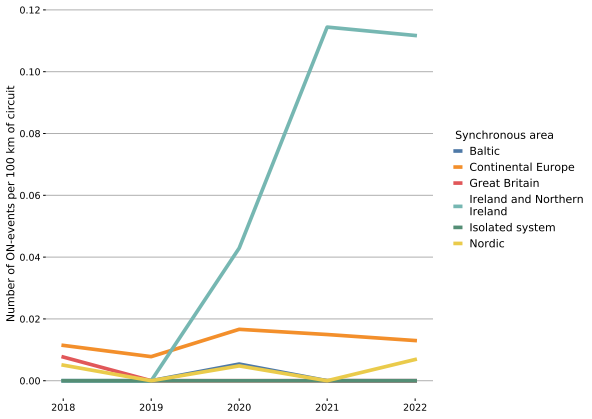

Figure 3.18: The annual number of ON-events per 100 km of installed circuit length in each synchronous area from 2018–2022.

Table 3.25: The annual number of ON-events per cause from 2018–2022.

Cause of event	2018	2019	2020	2021	2022
Unexpected flows	26	23	2	-	-
Environmental causes	2	-	-	-	-
Operation and maintenance	1	-	3	-	-
Technical equipment	1	-	-	1	-
Tripped network element	3	-	1	-	-
Previous event	-	-	6	9	10
LGF deviations	2	-	39	44	37
Other	3	3	9	10	21
Unknown	-	-	2	5	1
Grand total	38	26	62	69	69

4 Detailed view of scale 2 and scale 3 incidents

No scale 2 or scale 3 ICS incidents were reported in the synchronous areas of CE, GB, Nordic, IE/NI or Baltic in 2022. The only synchronous area with scale 2 incidents in 2022 was the isolated system in Iceland with three scale 2 incidents. These three scale 2 incidents were caused by extreme weather with high wind speeds and icing.

5 Operational Security Indicators

This chapter presents the operational security indicators relevant to operational security (OS) and planning and scheduling (OPS), as required by the SOGL Articles 15(3) and 15(4) [1].

5.1 Operational security indicators relevant to operational security

This section presents the operational security indicators relevant to operational security (OS). For convenience, each security indicator, along with its abbreviation, description and calculation method, is presented in Table 5.1.

Most security indicators are calculated with scale 0–3 ICS incidents. However, the OS-indicators OS-B, OS-F1 and OSF2 also use the reported 'Below Scale' ICS events. OS-F1 and OS-F2 use OVBS reported by TSOs, and OS-B uses GBS events processed from the ENTSO-E Transparency Platform. The used data sources from the Transparency Platform were 'Unavailability of Production and Generation Units 15.1' and 'Actual Generation Output per Generation Unit 16.1'.

Table 5.2 shows the calculated values for each security indicator for the year 2022.

Table 5.1: The operational security indicators relevant to operational security

Abbr.	Description of the operational security indicator	Calculation method
OS-A	Number of tripped transmission system elements year per TSO – SOGL Article 15(3)(a) [1].	Add up the number of transmission system elements tripped reported for all the incidents on scale 0, 1, 2 and 3.
OS-B	Number of tripped power generation facilities per year per TSO – SOGL Article 15(3)(b) [1].	Add up the number of power generation facilities tripped reported for all the events/incidents on 'Below Scale' and Scale 0, 1, 2 and 3. The number of tripped generation facilities collected for the 'Below Scale' category will be taken from the transparency platform.
OS-C	Energy not supplied due to unscheduled disconnection of demand facilities per year per TSO – SOGL Article 15 (3)(c) [1].	Add up the energy not supplied reported for all incidents on scale 0, 1, 2 and 3 due to unscheduled disconnection of demand facilities.
OS-D1	Time duration of being in alert and emergency states per year per TSO – SOGL Article 15(3)(d) [1].	Add up the time being in alert and emergency states reported for all incidents on scale 0, 1, 2 and 3.
OS-D2	Number of instances of being in alert and emergency states per year per TSO – SOGL Article 15(3)(d) [1].	Add up the number of incidents on scale 0, 1, 2 and 3 in case alert or emergency state was reported.
OS-E1	Time duration within which there was a lack of reserve identified per year per TSO – SOGL Article 15(3)(e) [1].	Add up the duration of incidents reported under the criteria RRC0, RRC1 and RRC2; and the duration of all other incidents on scale 0, 1, 2 and 3 in case the reduction of reserve capacity is reported.
OS-E2	Number of events within which there was a lack of reserve identified per year per TSO – SOGL Article 15(3)(e) [1].	Add up the number of incidents reported under the criteria RRC0, RRC1 and RRC2; and the number of all other incidents on scale 0, 1, 2 and 3 in case the reduction of reserve capacity is reported.
OS-F1	Time duration of voltage deviations exceeding the ranges from Tables 1 and 2 of SOGL Annex II per year per TSO – SO GL Article 15(3)(f) [1].	Add up the duration of events/incidents reported under the criteria OV 'Below Scale' and Scale OV1 and OV2; and add up the duration of all other incidents on the 'Below Scale', Scale 0, 1, 2 and 3 in case voltage deviations are reported which exceed the ranges from SOGL Annex II [1].
OS-F2	Number of voltage deviations exceeding the ranges from Tables 1 and 2 of SOGL [1] Annex II per year per TSO – SOGL Article 15(3)(f) [1].	Add up the number of events/incidents reported under the criteria OV 'Below Scale' and Scale OV0, OV1 and OV2; and add up the number of events/incidents of all other incidents on the 'Below Scale', Scale 0, 1, 2 and 3 in case voltage deviations are reported which exceed the ranges from SOGL Annex II [1].
OS-G1	Number of minutes outside the standard frequency range per year per synchronous area – SOGL Article 15 (3)(g) [1].	Annual Load-Frequency Control Reporting will provide data for number of minutes outside the standard frequency range.
OS-G2	Number of minutes outside the 50 % of maximum steady-state frequency range per year per synchronous area – SOGL Article 15(3)(g) [1].	Annual Load-Frequency Control reporting will provide data for number of minutes outside the 50 % of maximum steady state frequency deviation.
OS-H	Number of system-split separations or local blackout states per year – SOGL article 15(3)(h) [1].	Add up the number number of incidents reported under the criteria RS1 and RS2.
OS-I	Number of blackouts involving two or more TSOs per year – SOGL Article 15(3)(i) [1].	Add up the number of incidents reported under the criteria OB3, in case two or more TSOs are involved.

Table 5.2: Operational security indicators relevant to operational security per synchronous area (PGF = Power Generating Facility).

Synchronous Area	TSO	OS-A	OS-B	OS-C	OS-D1	OS-D2	OS-E1	OS-E2	OS-F1	OS-F2	OS-G1	OS-G2	OS-H	OS-I	Total
Baltic	AST	5	1	-	-	-	-	-	-	-	-	-	-	-	6
	Elering	32	18	-	-	-	-	-	-	-	-	-	-	-	50
	Litgrid	19	-	-	90	6	-	-	-	-	-	-	-	-	115
	Total	56	19	-	90	6	-	-	-	-	-	-	-	-	171
Continental Europe	50Hertz	49	19	-	1724	9	-	-	-	-	-	-	-	-	1801
	Amprion	96	29	-	981	12	-	-	2923	6	-	-	-	-	4047
	APG	18	12	-	531	5	-	-	-	-	-	-	-	-	566
	CEPS	50	21	149	135	2	-	-	659	39	-	-	-	-	1055
	CGES	22	-	-	-	-	-	-	-	-	-	-	-	-	22
	ELES	9	2	-	534	4	-	-	-	-	-	-	-	-	549
	Elia	9	14	-	-	-	-	-	-	-	-	-	-	-	23
	EMS	18	45	-	127	2	188	2	64195	123	-	-	-	-	64700
	Energinet (CE)	11	-	-	-	-	-	-	-	-	-	-	-	-	11
	ESO	91	4	6	-	-	-	-	-	-	-	-	-	-	101
	Freq (CE)	-	-	-	-	-	-	-	-	-	10935.23	124.70	-	-	11059.93
	HOPS	39	11	-	101	1	-	-	-	-	-	-	-	-	152
	IPTO	54	59	-	-	-	-	-	6899	83	-	-	-	-	7095
	MAVIR	12	7	-	-	-	7242	238	54241	1575	-	-	-	-	63315
	NOS BiH	59	-	-	-	-	-	-	-	-	-	-	-	-	59
	OST	32	-	-	-	-	-	-	-	-	-	-	-	-	32
	PSE	167	36	112	1327	7	7418	17	-	-	-	-	-	-	9084
	Red Eléctrica	341	128	-	-	-	-	-	76	1	-	-	-	-	546
	REN	22	6	-	6	1	-	-	-	-	-	-	-	-	35
	RTE	240	72	994	968	5	312	4	2147	26	-	-	-	-	4768
	SEPS	8	2	4	5312	8	28371	8	-	-	-	-	-	-	33713
	Swissgrid	47	7	-	790	8	-	-	2973	122	-	-	-	-	3947
	TEIAS	32	13	53	-	-	-	-	-	-	-	-	-	-	98
	TenneT DE	63	28	-	-	-	-	-	-	-	-	-	-	-	91
	TenneT NL	31	36	880	-	-	-	-	20	1	-	-	-	-	968
	Terna	79	18	-	-	-	220	1	42	2	-	-	-	-	362
	Transelectrica	60	30	-	-	-	-	-	14019	148	-	-	-	-	14257
	TransnetBW	10	22	-	935	8	-	-	-	-	-	-	-	-	975
	Total	1669	621	2198	13471	72	43751	270	148194	2126	10935.23	124.70	-	-	223431.90
Great Britain	National Grid ESO	188	86	-	-	-	-	-	-	-	754.93	83.68	-	-	1112.62
	Total	188	86	-	-	-	-	-	-	-	754.93	83.68	-	-	1112.62
Ireland and Northern Ireland	EirGrid	16	12	-	-	-	-	-	-	-	7.22	-	-	-	35.22
	SONI	2	3	-	-	-	-	-	-	-	-	-	-	-	5
	Total	18	15	-	-	-	-	-	-	-	7.22	-	-	-	40.22
Isolated system	Landsnet	97	23	1023	1175	5	-	-	-	-	-	-	-	-	2323
	Total	97	23	1023	1175	5	-	-	-	-	-	-	-	-	2323
Nordic	Energinet (Nordic)	5	8	-	-	-	-	-	-	-	-	-	-	-	13
	Fingrid	3	9	-	-	-	-	-	-	-	-	-	-	-	12
	Freq (Nordic)	-	-	-	1	1	-	-	-	-	9376	-	-	-	9378
	Statnett	54	35	225	6	2	-	-	-	-	-	-	-	-	322
	Svenska kraftnät	65	40	-	124	1	-	-	-	-	-	-	-	-	230
	Total	127	92	225	131	4	-	-	-	-	9376	-	-	-	9955
Grand Total		2155	856	3446	14867	87	43751	270	148194	2126	21073.38	208.38	-	-	237033.80

5.1.1 Evolution of operational security indicators relevant for operational security, 2018–2022

Figure 5.1–Figure 5.12 show the annual calculated values for the OS indicators OS-A to OS-H for 2018–2022. The OS indicator OS-I has been omitted from this section as no scale 3 events were recorded in the ENTSO-E area from 2018–2022.

Some of the increases visible in 2020 are due to the updates in the 2019 ICS Methodology. The 2018 and 2019 updates are summarised in Section 2.1. However, not all changes are due to the Methodology updates. The indicator OS-B decreased further in 2022 because the GBS events retrieved from the ENTSO-E Transparency Platform [6] were processed and validated at a higher rate than previously. The indicator OS-C increased significantly for the isolated systems mainly due to two scale 2 incidents in Iceland due to extreme weather. It should be noted that both OS-B and OS-C fluctuate depending on the occurrence of noteworthy incidents.

The indicators OS-D1 and OS-D2 decreased compared to 2020 and 2021, which means that there were fewer events that triggered alert or emergency states than before.

The security indicators OS-E1 and OS-E2, which measure the availability of reserve capacity, and OS-F1 and OS-F2, which measure the duration and number of OV events, are mostly seen by a few TSOs in CE. Both indicators OS-E2 and OS-F2 increased further compared to 2020 and 2021. The reason behind the increase in OS-F2 is due to the increased number of voltage violations attributed to an overall decrease in load and the increased amount of renewable energy sources in the grid and, therefore, fewer running conventional power plants capable of regulating reactive power.

The reported OS-G1 minutes in 2022 decreased compared to 2021. The decrease was moderate in CE and the Nordics and significant in IE/NI. More details can be seen in the Annual Load-Frequency Control (ALFC) Report of 2022. OS-G2 minutes were only registered in CE and GB, with 125 minutes registered in CE and 84 minutes in GB, respectively.

OS-H, which calculates the number of grid separation incidents (RS1 and RS2), is rarely recorded in the pan-European power systems. OS-H was registered once in 2020 (RS1) and three times in 2021 (two RS2 events in CE and one RS1 event in Nordics).

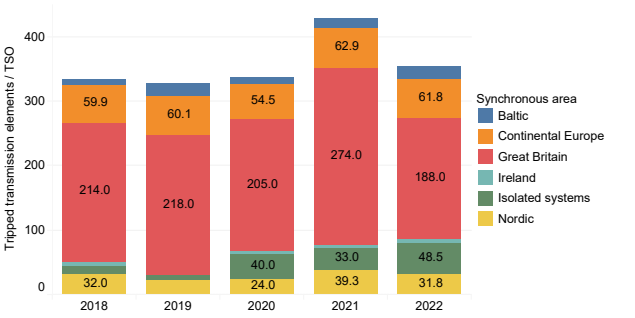

Figure 5.1: Operational security indicator OS-A from 2018–2022. It is calculated by adding up the number of tripped transmission system elements reported for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

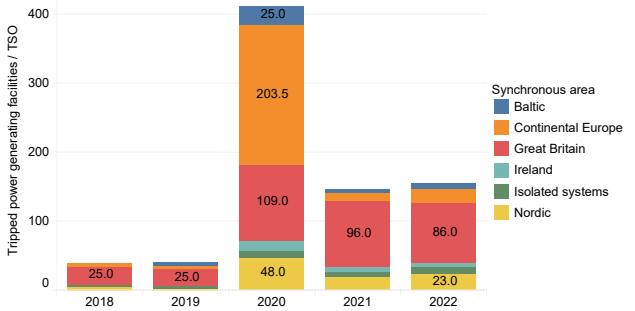

Figure 5.2: Operational security indicator OS-B from 2018–2022. It is calculated by adding up the number of tripped power generation facilities reported for scale 0–3 and below scale incidents and dividing by the number of TSOs in the synchronous area.

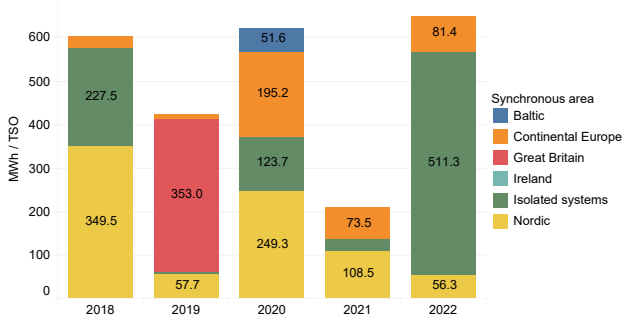

Figure 5.3: Operational security indicator OS-C from 2018–2022. It is calculated by adding up the reported energy not supplied due to unscheduled disconnection of demand facilities for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

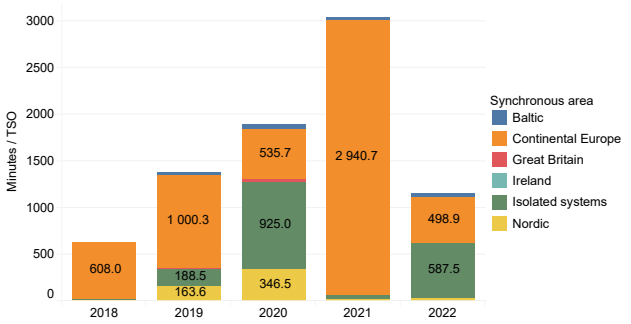

Figure 5.4: Operational security indicator OS-D1 from 2018–2022. It is calculated by adding up the number of minutes in alert and emergency states of all reported scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

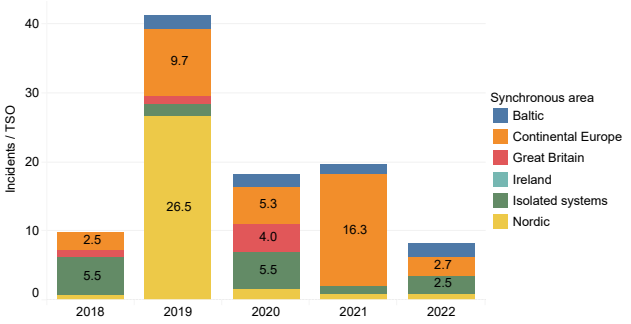

Figure 5.5: Operational security indicator OS-D2 from 2018–2022. It is calculated by counting the number of scale 0–3 incidents in which an alert or emergency state was reported, and dividing by the number of TSOs in the synchronous area.

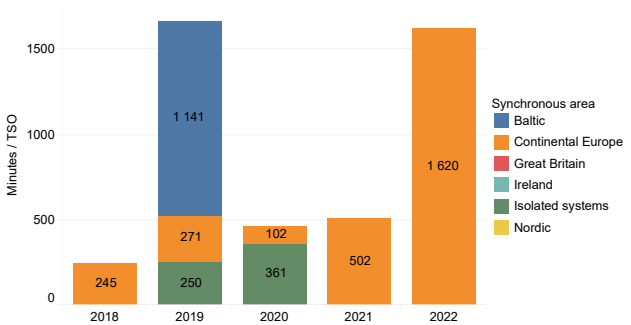

Figure 5.6: Operational security indicator OS-E1 from 2018–2022. It is calculated by adding up the duration of RRC0, RRC1 and RRC2 incidents and the duration of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area.

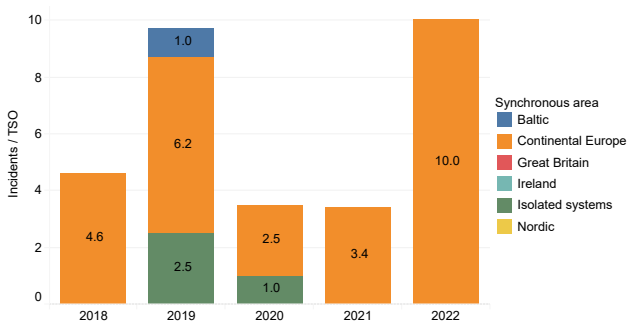

Figure 5.7: Operational security indicator OS-E2 from 2018–2022. It is calculated by counting the number RRC0, RRC1 and RRC2 incidents and the number of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area.

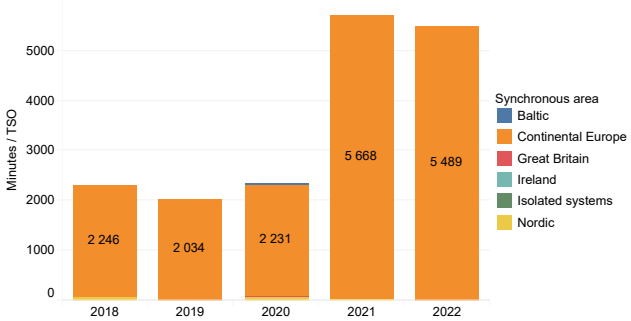

Figure 5.8: Operational security indicator OS-F1 from 2018–2022. It is calculated by adding up the duration of OVBS, OV0, OV1 and OV2 incidents and the duration of all other incidents on below scale and scale 0–3 where voltage deviations exceed the ranges from SOGL Annex II [1] are reported, and dividing by the number of TSOs in the synchronous area.

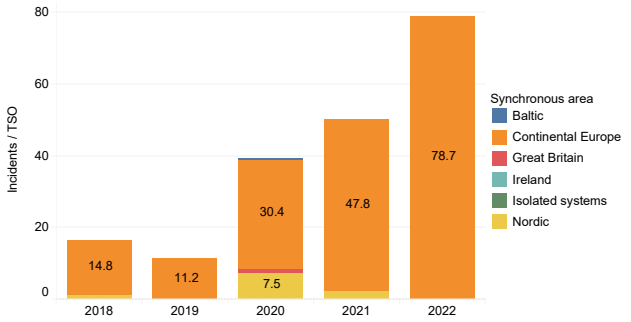

Figure 5.9: Operational security indicator OS-F2 from 2018–2022. It is calculated by counting the number of violation of standards of voltage incidents (OVBS, OV0, OV1 and OV2) and the number of all other below scale and scale 0–3 incidents in which the voltage standards are violated, and dividing by the number of TSOs in the synchronous area.

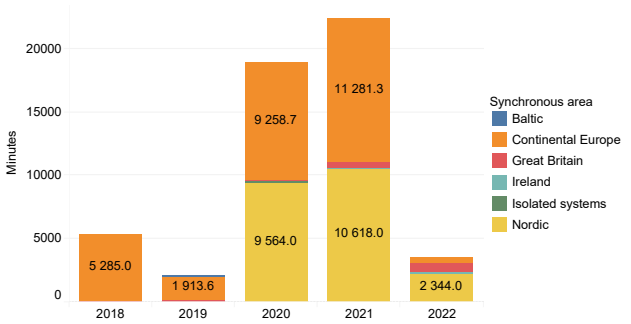

Figure 5.10: Operational security indicator OS-G1 from 2018–2022. It is calculated by adding up the number of minutes outside the standard frequency range for all scale 0–3 incidents.

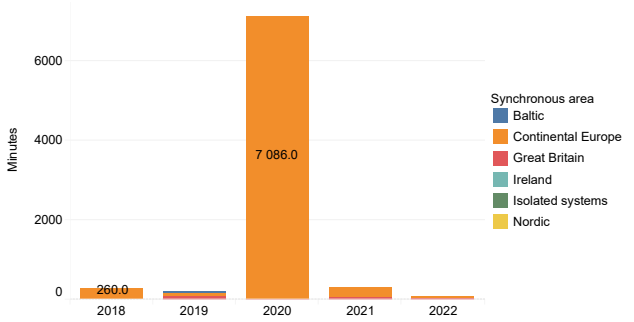

Figure 5.11: Operational security indicator OS-G2 from 2018–2022. It is calculated by adding up the number of minutes outside the 50 % of maximum steady-state frequency deviation for all scale 0–3 incidents.

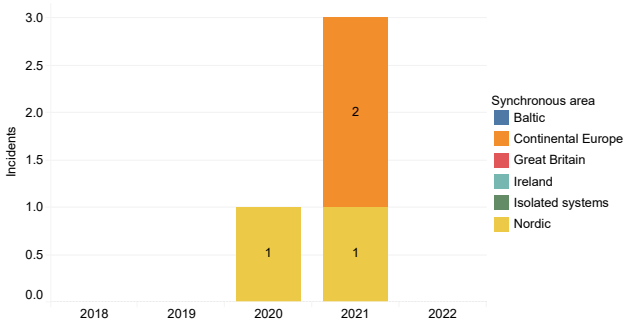

Figure 5.12: Operational security indicator OS-H from 2018–2022. It is calculated by counting the number of grid separation incidents (RS1 and RS2). As can be seen, RS1- and RS2-incidents are rare and has only been registered in 2016 and 2020.

5.2 Operational security indicators relevant to operational planning and scheduling

This chapter presents the operational security indicators relevant to operational security (OS) and planning and scheduling (OPS), as required by the SOGL Articles 15(3) and 15(4) [1].

Table 5.3: The operational security indicators relevant to operational planning and scheduling

Abbr.	Description of the operational security indicator	Calculation method
OPS-A	Number of events where an incident contained in the contingency list led to a degradation of the system operation state – SOGL Article 15(4)(a) [1].	Add up the number of incidents on scale 0, 1, 2 and 3 in case degradation of system operation state is reported and in case the cause of the incident is a contingency from contingency list.
OPS-B	Number of the events counted by indicator OPS-A (events in which an incident contained in the contingency list led to a degradation of the system operation state), in which a degradation of system operation conditions occurred as a result of unexpected discrepancies from load or generation forecasts – SOGL Article 15(4)(b) [1].	Add up the number of incidents counted by indicator OPS-A in case unexpected discrepancies from load and generation forecasts were reported as the cause of the incident.
OPS-C	Number of events in which there was a degradation in system operation conditions due to an exceptional contingency – SOGL Article 15(4)(c) [1].	Add up the number of incidents on scale 0, 1, 2 and 3 in case degradation of system operation state is reported and in case the cause of the incident is an exceptional contingency.
OPS-D	Number of the events counted by indicator OPS-C (events in which there was a degradation in system operation conditions due to an exceptional contingency), in which a degradation of system operation conditions occurred as a result of unexpected discrepancies from load or generation forecasts – SOGL Article 15(4)(d) [1].	Add up the number of incidents counted by indicator OPS-C in case unexpected discrepancies from load and generation forecasts were reported as the cause of the incident.
OPS-E	Number of events leading to a degradation in system operation conditions due to lack of active power reserves – SO GL Article 15(4)(e) [1].	Add up the number of incidents on scale 0, 1, 2 and 3 in case lack of active power reserves was reported as the cause of the incident.

Table 5.4: Operational security indicators relevant to operational planning and scheduling for each synchronous area.

Synchronous Area	TSO	OPS-A	OPS-B	OPS-C	OPS-D	OPS-E	Total
Baltic	AST	-	-	-	-	-	-
	Elering	-	-	-	-	-	-
	Litgrid	6	-	-	-	-	6
	Total	6	-	-	-	-	6
Continental Europe	50Hertz	8	-	-	-	-	8
	Amprion	12	12	-	-	-	24
	APG	4	3	-	-	-	7
	CEPS	15	-	-	-	-	15
	CGES	-	-	-	-	-	-
	ELES	1	-	-	-	-	1
	Elia	-	-	-	-	-	-
	EMS	1	-	-	-	-	1
	Energinet (CE)	-	-	-	-	-	-
	ESO	-	-	-	-	-	-
	Freq (CE)	-	-	-	-	-	-
	HOPS	-	-	-	-	-	-
	IPTO	28	-	-	-	-	28
	MAVIR	-	-	-	-	-	-
	NOS BiH	-	-	-	-	-	-
	OST	-	-	-	-	-	-
	PSE	6	1	-	-	-	7
	Red Eléctrica	-	-	-	-	-	-
	REN	-	-	-	-	-	-
	RTE	15	13	1	1	-	30
	SEPS	8	-	-	-	-	8
	Swissgrid	1	-	-	-	-	1
	TEIAS	-	-	-	-	-	-
	TenneT DE	18	-	-	-	-	18
	TenneT NL	9	7	-	-	-	16
	Terna	-	-	-	-	-	-
	Transelectrica	-	-	-	-	-	-
	TransnetBW	3	3	-	-	-	6
	Total	129	39	1	1	-	170
Great Britain	National Grid ESO	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Ireland and Northern Ireland	EirGrid	-	-	-	-	-	-
	SONI	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Isolated system	Landsnet	7	-	4	-	-	11
	Total	7	-	4	-	-	11
Nordic	Energinet (Nordic)	3	-	-	-	-	3
	Fingrid	-	-	-	-	-	-
	Freq (Nordic)	-	-	-	-	-	-
	Statnett	2	-	-	-	-	2
	Svenska kraftnät	1	-	-	-	-	1
	Total	6	-	-	-	-	6
Grand Total		148	39	5	1	-	193

5.2.1 Evolution of operational security indicators relevant for operational planning and scheduling, 2018–2022

This section presents the operational security indicators relevant to operational planning and scheduling (OPS) for 2018–2022. Figure 5.13 through Figure 5.17 show the annual calculated values for the OPS indicators OPS-A, OPS-B, OPS-C, OPS-D and OPS-E, respectively.

The indicators OPS-A, -B and -C decreased compared to 2020 and 2021. The value of OPS-B in CE is approximately a third of the value of OPS-A. This indicates that a third of incidents that were caused by contingencies in the contingency list (OPS-A) could be prevented by improving the accuracy of load and generation forecasts in CE.

The other indicator remained the same. OPS-B in CE is approximately 30% as large as OPS-A. This indicates that a third of incidents that were caused by contingencies in the contingency list (OPS-A) could be prevented by improving the accuracy of load and generation forecasts in CE.

The indicator OPS-E remained zero in 2022 because no events, not even RRC events, were caused by reduced reserve capacity.

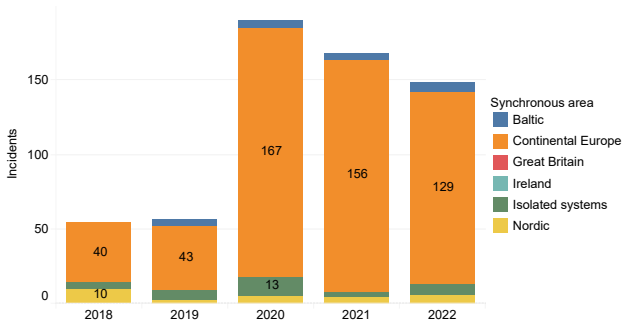

Figure 5.13: Operational security indicator OPS-A annually from 2018–2022. It is calculated by counting the number of scale 0–3 incidents where a contingency from the contingency list degraded the system operation state. Most of the OPS-A incidents are due to ordinary-contingency, and only a few are due to exceptional-contingency or out-of-range-contingency.

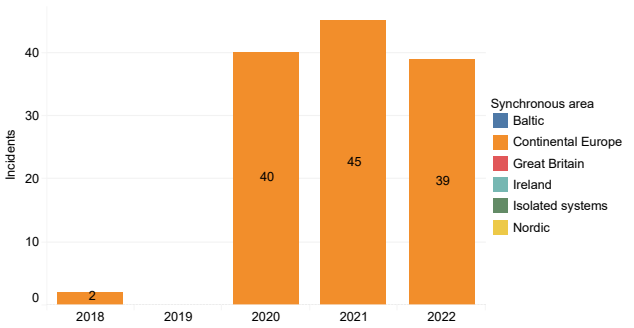

Figure 5.14: Operational security indicator OPS-B annually from 2018–2022. It is calculated by counting the number of OPS-A indicators where the cause was unexpected discrepancies from load and generation forecasts.

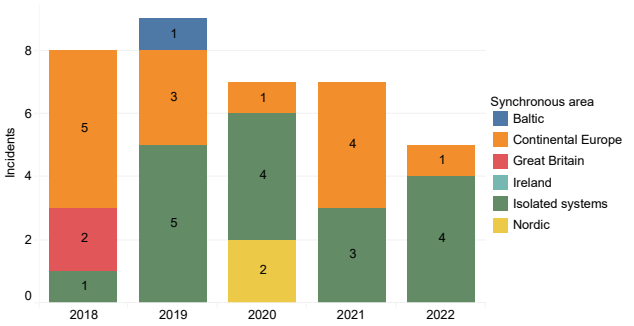

Figure 5.15: Operational security indicator OPS-C annually from 2018–2022. It is calculated by counting the number of scale 0–3 incidents where an exceptional contingency degraded the system operation state.

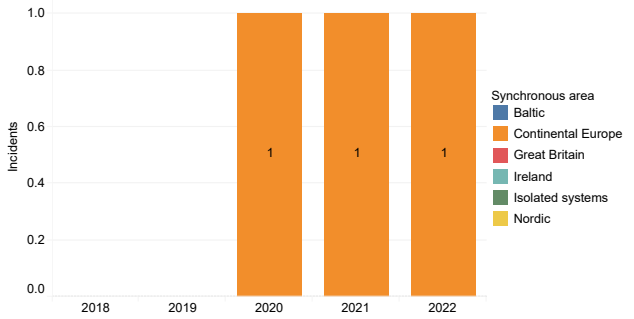

Figure 5.16: Operational security indicator OPS-D annually from 2018–2022. It is calculated by counting the number of OPS-C indicators caused by unexpected discrepancies from load and generation forecasts.

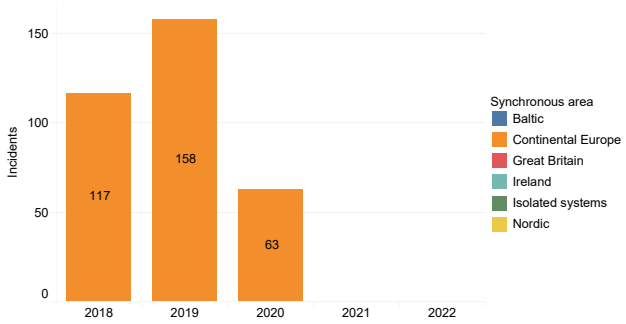

Figure 5.17: Operational security indicator OPS-E annually from 2018–2022. It is calculated by counting the number of scale 0–3 incidents caused by lack of active power reserves.

6 Events in Continental Europe

6.1 Overview of 2022

This section presents an overview of scale 0–3 ICS events in CE in 2022. The scale 0-3 ICS events are organised by ICS criterion and further grouped by month and duration in Table 6.1 and Table 6.2, respectively.

As Table 6.1 shows, a total of 2939 ICS events meeting the ICS criteria were reported by TSOs in CE in 2022. Together, these events formed 2845 ICS incidents, meaning that most events only involved one ICS criteria violation. Approximately 80.5% of all scale 0–3 events were scale 0 events and 19.5% of all scale 0–3 events were scale 1 events. Neither scale 2 nor 3 events were reported.

Events on transmission network elements (T0) accounted for 43% of all events and violations on standards of voltage (OV0+OV1) for 30% of all events. Combined, these three ICS categories accounted for 73% of all events. The number of T0 events was higher during the winter and summer and lower during spring and autumn. The number of OV0 and OV1 events was higher during spring and autumn, and ON1 events were mostly reported during spring.

As shown in Table 6.2, approximately 56% of all scale 0 events and 14% of all scale 1 were resolved within less than an hour. All frequency deviations in scale 0 (F0), reduction of reserve capacity in scale 0 (RRC0) and almost all violations of standards on voltage (OV0) events were cleared in less than an hour. However, almost 50% of G events were resolved in less than 10 hours. The duration of T and G events depended mainly on the underlying cause of the trip. 92% of LT events were resolved within less than five hours.

For many TSOs, 30 minutes is the minimum scheduling resolution of power generation. As such, in the 2018 ICS Methodology, RRC incidents that last for more than 30 minutes are automatically classified as scale 1 events. Therefore, RRC0 events are not reported by these TSOs. The other TSOs have a minimum scheduling time of 5–15 minutes and are not affected by this.

Table 6.1: Number of events by dominant criteria distributed per month in 2022 in Continental Europe.

		2022												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	1	-	-	1	-	-	-	1	1	4
	Incidents leading to frequency degradation (F0)	61	26	29	31	1	15	10	13	-	16	1	17	220
	Incidents on network elements (T0)	93	123	89	99	126	148	149	125	103	64	66	84	1269
	Incidents on power generating facilities (G0)	12	7	15	8	7	10	12	9	11	14	9	9	123
	Separation from the grid (RS0)	-	-	-	-	-	-	1	-	-	-	-	-	1
	Violation of standards on voltage (OV0)	24	26	23	43	52	41	28	29	52	60	56	46	480
	Reduction of reserve capacity (RRC0)	7	7	12	18	12	21	24	22	19	25	3	15	185
	Loss of tools, means and facilities (LT0)	7	5	8	3	12	4	6	5	8	8	12	6	84
	Total	204	194	176	203	210	239	231	203	193	187	148	178	2366
Scale1	Incidents on load (L1)	-	-	-	-	-	1	-	-	1	-	-	2	4
	Incidents leading to frequency degradation (F1)	1	1	1	2	-	-	-	-	-	1	-	-	6
	Incidents on network elements (T1)	3	-	-	-	1	5	1	5	-	2	-	2	19
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	4	3	5	12	10	10	1	3	2	4	1	2	57
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	11	19	14	20	65	33	12	41	54	63	31	29	392
	Reduction of reserve capacity (RRC1)	5	-	6	10	4	4	7	10	11	8	1	8	74
	Loss of tools, means and facilities (LT1)	1	1	1	5	-	2	4	2	1	1	1	2	21
	Total	25	24	27	49	80	55	25	61	69	79	34	45	573
Scale2	Incidents on load (L2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		229	218	203	252	290	294	256	264	262	266	182	223	2939

Table 6.2: Cumulative number of events by dominant criteria and duration in 2022 in Continental Europe.

	2022						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	2	4	4	4	4	4
	Incidents leading to frequency degradation (F0)	220	220	220	220	220	220
	Incidents on network elements (T0)	391	545	802	942	1059	1269
	Incidents on power generating facilities (G0)	25	32	41	61	76	123
	Separation from the grid (RS0)	-	-	1	1	1	1
	Violation of standards on voltage (OV0)	475	480	480	480	480	480
	Reduction of reserve capacity (RRC0)	185	185	185	185	185	185
	Loss of tools, means and facilities (LT0)	33	59	77	82	84	84
	Total	1331	1525	1810	1975	2109	2366
Scale1	Incidents on load (L1)	4	4	4	4	4	4
	Incidents leading to frequency degradation (F1)	6	6	6	6	6	6
	Incidents on network elements (T1)	6	9	13	13	17	19
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	21	39	54	57	57	57
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	5	113	253	360	381	392
	Reduction of reserve capacity (RRC1)	35	58	66	69	69	74
	Loss of tools, means and facilities (LT1)	4	11	15	19	21	21
	Total	81	240	411	528	555	573
Scale2	Incidents on load (L2)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		1412	1765	2221	2503	2664	2939

6.2 Evolution 2018–2022

This section presents the annual number of ICS events in CE from 2018 to 2022, distributed by scale and ICS criterion.

As shown in Table 6.3, scale 0 events in 2022 decreased by 397 (-14%) compared to 2021 and increased by 363 (+18%) compared to 2020. In the year 2018, the ICS Methodology change was introduced for the 2018 Annual Report. One of the important updates for the years 2020–2022 was to register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

The number of scale 1 events decreased by 219 (-28 %) over 2021 and increased by 287 (+101%) over 2020. The largest changes in the number of scale 1 events are seen in violations of standards on voltage (OV1) and incident leading to frequency degradation (F1). OV1 events decreased from 513 events in 2021 to 392 events in 2022, while F1 events decreased from 92 events in 2021 to 6 events in 2022. All other scale 1 categories show similar numbers to previous years.

No scale 2 events were reported in CE in 2022. The number of scale 2 events decreased from 16 events in 2021 to 0 events in 2022 and from 0 events in 2020 to 16 events in 2021. The largest changes in the number of scale 2 events are seen in separation from the grid (RS2) and incidents on network elements (T2). RS2 events decreased from 6 events in 2021 to 0 events in 2022, and T2 events decreased from 4 events in 2021 to 0 events in 2022. All other scale 2 categories show similar numbers or increased slightly comparing to previous years.

No scale 3 events were reported in CE in 2022.

Table 6.3: The annual number of events by dominating criterion from 2018–2022.

Scale	ICS criterion	2018	2019	2020	2021	2022
Scale0	Incidents on load (L0)	-	-	4	2	4
	Incidents leading to frequency degradation (F0)	953	759	296	746	220
	Incidents on network elements (T0)	867	1199	1063	1287	1269
	Incidents on power generating facilities (G0)	113	93	81	138	123
	Separation from the grid (RS0)	-	-	2	-	1
	Violation of standards on voltage (OV0)	336	286	454	495	480
	Reduction of reserve capacity (RRC0)	-	1	-	26	185
	Loss of tools, means and facilities (LT0)	99	106	102	68	84
	Total	2368	2444	2002	2762	2366
Scale1	Incidents on load (L1)	3	-	6	2	4
	Incidents leading to frequency degradation (F1)	10	7	3	92	6
	Incidents on network elements (T1)	5	21	15	27	19
	Incidents on power generating facilities (G1)	-	-	-	4	-
	N-1 violation (ON1)	31	25	56	60	57
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	50	9	116	513	392
	Reduction of reserve capacity (RRC1)	118	161	66	63	74
	Loss of tools, means and facilities (LT1)	25	18	23	30	21
	Total	242	241	285	791	573
Scale2	Incidents on load (L2)	-	-	-	2	-
	Incidents leading to frequency degradation (F2)	-	-	-	1	-
	Incidents on network elements (T2)	-	1	-	4	-
	Incidents on power generating facilities (G2)	-	-	-	1	-
	N violation (ON2)	3	1	-	1	-
	Separation from the grid (RS2)	-	-	-	6	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	1	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	3	2	-	16	-
Scale3	Blackout(OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		2613	2687	2287	3569	2939

6.3 Analysis of significant changes in trends

In 2022, 2937 events were reported in CE; a decrease of 18% compared to 2021 but an increase of 28% compared to 2020. This decrease appears to be significant, and is mainly due to the decrease in the number of reported F0 and F1 events.

The number of F0 events decreased by over 71% relative to 2021 and the number of F1 events decreased by over 93% relative to 2021. However, there was an increase of RRC0 events by over 600% relative to 2021. The increase of RRC0 events was due to the increase of RRC0 events in MAVIR. The change in the number after the year 2019 of reported OV and RRC events is due to the recent ICS Methodology change in 2020.

Voltage violations are described in more detail in Section 3.3.4. In general, the increased numbers of voltage violations is due to the increased amount of renewable energy sources in the power system, which has led to fewer conventional power plants being available to regulate reactive power in the grid.

The trend of scale 1 events shifting to scale 0 events observed in 2018 continued in 2019 to 2022. This shift is due to clarifications and better alignment of the ICS Methodology with the SOGL. The recent ICS Methodology updates are summarised in Section 2.1.

No scale 2 and 3 events were reported in CE.

7 Events in Nordic

7.1 Overview of 2022

This section presents an overview of ICS events in the Nordic synchronous area in 2022. The events are presented by ICS criterion and grouped by month and duration in Table 7.1 and Table 7.2, respectively. In 2022, 180 scale 0–3 ICS events were reported in the Nordic synchronous area, of which 171 were scale 0 events and 9 scale 1 events.

As shown in Table 7.1, T0 and F0 were the most common type with 96 events and 53 events in 2022, respectively.

These T0 events on network elements were mainly due to tripped HVDC links and HVAC elements because of faults in operation and maintenance or technical equipment. T0 and F0 events occurred more in winter period compared to other months. In addition, several T0 events occurred in August.

As shown in Table 7.2, 44% of the events were resolved in less than an hour, and 81% of all events were resolved in less than 24 hours. All events leading to frequency degradation (F0 and F1) were resolved within an hour. Other events took longer to resolve. Some (T0) and (G0) events took more than 24 h.

Table 7.1: Number of events by dominant criteria distributed per month in 2022 in Nordic.

		2022												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	1	-	-	-	-	-	-	-	-	-	-	1
	Incidents leading to frequency degradation (F0)	10	10	1	5	2	2	5	2	1	1	4	10	53
	Incidents on network elements (T0)	17	12	6	6	7	3	7	16	3	3	7	9	96
	Incidents on power generating facilities (G0)	2	1	1	1	-	3	1	-	2	-	-	3	14
	Separation from the grid (RS0)	1	-	-	-	-	-	-	1	-	-	-	-	2
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	-	-	-	1	3	-	-	5
	Total	31	24	8	12	9	8	13	19	7	7	11	22	171
Scale1	Incidents on load (L1)	-	-	-	1	-	-	-	-	-	-	-	-	1
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	1	1
	Incidents on network elements (T1)	1	-	-	-	-	-	-	-	1	-	-	-	2
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	1	-	-	-	-	-	-	3	-	-	-	-	4
	Separation from the grid (RS1)	1	-	-	-	-	-	-	-	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	3	-	-	1	-	-	-	3	1	-	-	1	9
Scale2	Incidents on load (L2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		34	24	8	13	9	8	13	22	8	7	11	23	180

Table 7.2: Cumulative number of events by dominant criteria and duration in 2022 in Nordic.

	2022						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	1
	Incidents leading to frequency degradation (F0)	53	53	53	53	53	53
	Incidents on network elements (T0)	22	30	52	61	73	96
	Incidents on power generating facilities (G0)	1	2	3	3	4	14
	Separation from the grid (RS0)	-	1	2	2	2	2
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	1	4	5	5	5
	Total	76	87	114	124	137	171
Scale1	Incidents on load (L1)	-	1	1	1	1	1
	Incidents leading to frequency degradation (F1)	1	1	1	1	1	1
	Incidents on network elements (T1)	-	-	1	1	2	2
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	2	3	3	3	4	4
	Separation from the grid (RS1)	-	-	-	-	1	1
	Violation of standards on voltage (OV1)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-
	Total	3	5	6	6	9	9
Scale2	Incidents on load (L2)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		79	92	120	130	146	180

7.2 Evolution 2018–2022

This section presents the annual number of ICS events in the Nordic synchronous area from 2018–2022, distributed by scale and ICS criterion. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

As mentioned in Chapter 1, the ICS Methodology has been changed several times, preventing a direct comparison of annual reporting results. Nevertheless, it is useful to examine recent incident reporting to identify potential trends. The update of the ICS Methodology has refined the definitions and thresholds to align with SOGL to improve the overall data quality, make results comparable between synchronous areas and TSOs, and ease the analysis and identification of improvements to system operations. A further important update as of 2020 was to also register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The Methodology updates are summarised in Section 2.1.

As seen in Table 7.3, the total number of events ranged from 99 to 220 during 2018-2022. The number of scale 0 events in 2022 compared to 2021 decreased by 19%. The largest decrease was in F0 and LT0. The number of scale 1 events was almost the same; 8 in 2021 and 9 in 2022.

Table 7.3: The annual number of events by dominating criterion from 2018–2022.

Scale	ICS criterion	2018	2019	2020	2021	2022
Scale0	Incidents on load (L0)	-	-	-	2	1
	Incidents leading to frequency degradation (F0)	2	-	62	70	53
	Incidents on network elements (T0)	77	59	73	101	96
	Incidents on power generating facilities (G0)	1	1	5	15	14
	Separation from the grid (RS0)	-	-	-	2	2
	Violation of standards on voltage (OV0)	5	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	1	10	22	5
	Total	85	61	150	212	171
Scale1	Incidents on load (L1)	3	2	1	-	1
	Incidents leading to frequency degradation (F1)	-	106	4	3	1
	Incidents on network elements (T1)	7	1	3	3	2
	Incidents on power generating facilities (G1)	-	-	-	-	-
	N-1 violation (ON1)	2	-	2	-	4
	Separation from the grid (RS1)	-	-	1	1	1
	Violation of standards on voltage (OV1)	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	2	-	6	1	-
	Total	14	109	17	8	9
Scale2	Incidents on load (L2)	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		99	170	167	220	180

7.3 Analysis of significant changes in trends

The total number of events has changed during the last three years as follows: 167 (2020), 220 (2021) and 180 (2022). There is no clear trend in the total number of events or in the numbers of any specific ICS criteria.

8 Events in Great Britain

8.1 Overview of 2022

This section presents an overview of ICS events in GB in 2022. The events are presented by ICS criterion and further grouped by month and duration in Table 8.1 and Table 8.2, respectively.

The National Grid Electricity System Operator (NGESO) of GB reported 188 ICS events (179 ICS incidents) in 2022, of which all were scale 0.

There were eight ICS incidents in which multiple ICS events were registered.

- In one incident, three events were on the transmission network element (T0)
- In seven incidents, two events were on the transmission network element (T0)

Of the 188 scale 0 ICS events, 157 events were related to transmission network elements (T0); 15 events were due to loss of tools, means or facilities (LT0); 9 events were on power generating facilities (G0); and 7 events were frequency degradations (F0). All transmission events were secured by applying curative remedial actions within appropriate timescales. Disturbances on transmission network elements (T0), loss of tools, means and facilities (LT0) and power generating facilities (G0) accounted for a significant portion of the reported ICS events, as shown in Table 8.1 and Table 8.2. Most of the events on transmission system elements (T0) were caused by primary system faults that resulted in the automatic operation of circuit breakers, following the detection of primary system fault current. The system remained secure following all events.

As shown in Table 8.1, the reported ICS events were spread out over the year, with peaks in some months but no specific trend.

As shown in Table 8.2, 18% of the reported ICS events were resolved within one hour and 47% of the reported events lasted longer than 24 hours. Thorough site investigations were initiated, and mitigating actions were deployed in most instances to ensure that the network elements were reconditioned and maintained before re-energisation, resulting in longer restoration times.

Approximately 46% (72) of the 157 events on transmission network elements (T0) and 100% (15) of the 15 events involving loss of tools, means and facilities (LT0) were resolved within 24 hours.

Table 8.1: Number of events by dominant criteria distributed per month in 2022 in Great Britain.

		2022												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	1	-	-	3	1	1	-	-	-	1	-	-	7
	Incidents on network elements (T0)	19	17	13	11	9	9	10	17	13	11	10	18	157
	Incidents on power generating facilities (G0)	-	-	-	2	-	-	2	2	1	-	1	1	9
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	2	3	-	-	1	-	1	1	3	1	-	3	15
	Total	22	20	13	16	11	10	13	20	17	13	11	22	188
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale2	Incidents on load (L2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		22	20	13	16	11	10	13	20	17	13	11	22	188

Table 8.2: Cumulative number of events by dominant criteria and duration in 2022 in Great Britain.

	2022						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	7	7	7	7	7	7
	Incidents on network elements (T0)	14	26	41	54	72	157
	Incidents on power generating facilities (G0)	-	-	5	6	6	9
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	12	15	15	15	15	15
	Total	33	48	68	82	100	188
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Scale2	Incidents on load (L2)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		33	48	68	82	100	188

8.2 Evolution 2018–2022

This section presents the annual number of ICS events in GB from 2018–2022, distributed by scale and ICS criterion. It should be noted that the recorded values for 2018–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

NGESO from GB recorded 188 scale 0–3 ICS events (179 ICS incidents) comparison with 252 ICS events (247 ICS incidents) in 2021, 260 incidents in 2020, 276 in 2019 and 250 in 2018. In 2022, there were 188 scale 0 ICS events, and no scale 1–3 events.

Table 8.3 shows that the yearly numbers of ICS events from 2018 to 2021 are fairly similar.

The large number of scale 0 incidents emerging in 2018–2022 are attributed to the change in the ICS Methodology. The ICS Methodology updates are summarised in Section 2.1.

In 2022, GB recorded no scale 1 ICS events compared to one in 2021, one in 2020, zero in 2019 and 2 in 2018. The first scale 2 incident in GB, recorded in 2019, was an incident leading to frequency degradation (F2). Details of the scale 2 incident can be found in the 2019 ICS Annual Report.

Table 8.3: The annual number of events by dominating criterion from 2018–2022.

Scale	ICS criterion	2018	2019	2020	2021	2022
Scale0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	58	78	2	3	7
	Incidents on network elements (T0)	156	155	169	218	157
	Incidents on power generating facilities (G0)	3	-	12	14	9
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	31	42	76	16	15
	Total	248	275	259	251	188
Scale1	Incidents on load (L1)	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-
	N-1 violation (ON1)	2	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	1	1	-
	Total	2	-	1	1	-
Scale2	Incidents on load (L2)	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	1	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	-	1	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		250	276	260	252	188

8.3 Analysis of significant changes in trends

In 2022, 188 scale 0–3 ICS events (179 ICS incidents) were reported in Great Britain's synchronous area, a decrease compared to previous years. The dominant ICS criteria in 2022 were incidents on transmission system elements (T0) and loss of tools and facilities (LT0).

The number of scale 0 incidents in 2022 decreased to 188 compared to 251 in 2021, and no scale 1 incident was reported compared to one in 2021, one in 2020, zero in 2019 and two in 2018.

There were no scale 2 events in 2022, unlike in 2019, when the first scale 2 incident in GB was recorded. The dominating ICS criterion of the scale 2 incident in 2019 was incidents leading to frequency degradation (F2).

The increased reporting of ICS incidents is primarily attributed to the ICS Methodology update in 2018 [5]. This evolving trend requires a follow-up when the ICS Methodology has stabilised.

9 Events in Baltic

9.1 Overview of 2022

This section presents an overview of ICS events in the Baltic area in 2022. The events are presented by ICS criterion and further grouped by month and duration in Table 9.1 and Table 9.2, respectively. In 2022, 51 ICS events were reported in the Baltic area. Of these, 45 were scale 0, 6 were scale 1. No scale 2 and 3 incidents were reported in 2022.

Incidents on transmission network elements (T0) and incidents on power generating facilities (G0) were the most frequent types of incidents, as shown in Table 9.1. Furthermore, the number of incidents recorded in 2022 has a uniform distribution during the year with a slight concentration of incidents in April. In 2022, there were 27 incidents on transmission network elements (T0) compared with 20 in 2020 and 21 in 2021. The increase in T0 incidents are due to repeating issues at one overhead line. The distribution of incidents by duration shown in Table 9.2 indicates that 9 of the 51 events in 2022 were resolved in less than an hour, and 13 events took more than 24 hours to resolve. Approximately 75% of all events were resolved within 24 hours.

Table 9.1: Number of events by dominant criteria distributed per month in 2022 in Baltic.

		2022												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	1	3	1	5	4	2	3	3	-	1	2	2	27
	Incidents on power generating facilities (G0)	1	2	-	2	1	3	1	3	2	1	1	1	18
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	2	5	1	7	5	5	4	6	2	2	3	3	45
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	1	1	-	2	1	1	-	-	-	-	-	-	6
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	1	1	-	2	1	1	-	-	-	-	-	-	6
Scale2	Incidents on load (L2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		3	6	1	9	6	6	4	6	2	2	3	3	51

Table 9.2: Cumulative number of events by dominant criteria and duration in 2022 in Baltic.

	2022						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-
	Incidents on network elements (T0)	7	8	13	18	21	27
	Incidents on power generating facilities (G0)	-	2	6	9	11	18
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-
	Total	7	10	19	27	32	45
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	2	3	5	5	6	6
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-
	Total	2	3	5	5	6	6
Scale2	Incidents on load (L2)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		9	13	24	32	38	51

9.2 Evolution 2018–2022

This section presents the annual number of ICS events in the Baltic area power system from 2018 to 2022, distributed by scale and ICS criterion. The ICS criteria used in this report are presented in Table 2.1. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

The number of reported events shows a slight annual increase, as seen in Table 9.3. The most common type of event is incidents on network elements (T0). Fifteen of the 16 G0 events in 2021 and 16 of the 18 G0 events in 2022 occurred in Elering's power grid. These events should be followed up on in the future.

Table 9.3: The annual number of events by dominating criterion from 2018–2022.

Scale	ICS criterion	2018	2019	2020	2021	2022
Scale0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	25	28	20	21	27
	Incidents on power generating facilities (G0)	2	11	26	16	18
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	1	-
	Total	27	39	46	38	45
Scale1	Incidents on load (L1)	-	2	1	-	-
	Incidents leading to frequency degradation (F1)	-	1	-	-	-
	Incidents on network elements (T1)	-	3	5	4	6
	Incidents on power generating facilities (G1)	-	-	1	-	-
	N-1 violation (ON1)	-	-	1	-	-
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	1	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	1	-	-	-	-
	Total	1	6	9	4	6
Scale2	Incidents on load (L2)	-	-	1	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	-	-	1	-	-
Scale3	Blackout(OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		28	45	56	42	51

9.3 Analysis of significant changes in trends

In 2022, a total of 51 scale 0–3 events were reported in the Baltic area. They were mostly caused by T0 incidents and G0 incidents. The number of T0 events increased and the number of G0 remain the same. Both T0 and G0 high levels are connected to repeating events.

The number of reported scale 1 events was higher in 2022 compared to 2021. They were caused only by events on transmission network elements (T1). In previous years small differences in other criteria have been more connected to the small size of the Baltic area and the probability of uncommon events.

10 Events in Ireland and Northern Ireland

10.1 Overview of 2022

This section presents an overview of ICS events in Ireland in 2022. The events are presented by ICS criterion and further grouped by month and duration in Table 10.1 and Table 10.2, respectively.

In 2022, 41 ICS events were reported in Ireland, of which 33 were of scale 0 and 8 of scale 1. No scale 2 or scale 3 incidents were reported. Of all ICS events in Ireland, 44% were incidents on transmission network elements (T0), 36% were incidents on power generating facilities (G0), and the remaining 20% were N-1 violations (ON1), as seen in Table 10.1. Tripped network elements caused all G0 events and 'technical equipment' was the cause of most of the T0 events. The events showed uniform monthly distribution during the year.

56% (23) of the 41 ICS events were cleared in under 24 hours, as seen in Table 10.2.

Table 10.1: Number of events by dominant criteria distributed per month in 2022 in Ireland and Northern Ireland.

		2022												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	2	-	1	5	4	-	1	1	-	-	2	2	18
	Incidents on power generating facilities (G0)	-	2	2	1	-	1	-	2	2	-	4	1	15
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	2	2	3	6	4	1	1	3	2	-	6	3	33
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	2	1	-	2	3	-	-	-	-	8
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	2	1	-	2	3	-	-	-	-	8
Scale2	Incidents on load (L2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		2	2	3	8	5	1	3	6	2	-	6	3	41

Table 10.2: Cumulative number of events by dominant criteria and duration in 2022 in Ireland and Northern Ireland.

	2022						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-
	Incidents on network elements (T0)	1	3	4	4	6	18
	Incidents on power generating facilities (G0)	-	2	4	5	9	15
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-
	Total	1	5	8	9	15	33
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	-	1	4	6	8	8
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-
	Total	-	1	4	6	8	8
Scale2	Incidents on load (L2)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		1	6	12	15	23	41

10.2 Evolution 2018–2022

This section presents the annual number of ICS events in Ireland from 2018 to 2022, distributed by scale and ICS criteria. It should be noted that the recorded values for 2018–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

The number of scale 0 ICS events reported in 2022 is similar to the five previous years, as seen in Table 10.3. Eight scale 1 ICS events were reported in 2022, 8 in 2021, 3 in 2020 and none in 2019. A stable trend of reported scale 0 events can be seen over the years; however, the number of ON1 events for 2022 and 2021 (N-1 violations) is almost triple that compared to 2020 (3 vs 8).

No scale 2 or scale 3 incidents were reported in Ireland in 2022. The previous scale 2 incident was in 2018, and it was caused by a frequency deviation, mainly due to a loss of generation.

Table 10.3: The annual number of events by dominating criterion from 2018–2022.

Scale	ICS criterion	2018	2019	2020	2021	2022
Scale0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	8	4	-	-	-
	Incidents on network elements (T0)	9	9	8	11	18
	Incidents on power generating facilities (G0)	7	10	19	14	15
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-
	Total	24	23	27	25	33
Scale1	Incidents on load (L1)	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-
	N-1 violation (ON1)	-	-	3	8	8
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-
	Total	-	-	3	8	8
Scale2	Incidents on load (L2)	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	1	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	1	-	-	-	-
Scale3	Blackout(OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		25	23	30	33	41

10.3 Analysis of significant changes in trends

In 2022, a total of 41 ICS events were reported in IE/NI, the highest ever reported.

The dominant criteria in 2022 were events on network elements (T0) and events involving power generating facilities (G0). The remaining eight were N-1 violations (ON1).

The continuing trend of G0 and T0 events can still be seen in IE/NI. However, in 2022 and 2021 there were many scale 1 N-1 violations (ON1). The number of scale 1 incidents was zero in 2018 and 2019, when the ICS Methodology was updated. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

No scale 2 or scale 3 events were reported in 2022, which means that the reported ICS events were low impact and did not affect normal operating conditions.

11 Events in Isolated system

11.1 Overview of 2022

This section presents an overview of ICS events in isolated systems in 2022. The events are presented by ICS criterion and further grouped by month and duration in Table 11.1 and Table 11.2, respectively.

In 2022, a total of 42 ICS events were reported for the isolated systems of Iceland and Cyprus. All the events occurred in Iceland. Three of the events were scale 2 events (two L2 events and one T2), whereas the other events were of scale 0 and 1. All scale 2 incidents were due to extreme weather with high wind speeds and icing.

Most of the reported scale 0 ICS events were events on transmission network elements (T0), as shown in Table 11.1. T0 events were primarily due to environmental causes. Two scale 1 events on network elements (T1) and one loss of tools, means and facilities (LT1) were also reported. Only six incidents took longer than 24 hours to resolve as seen in Table 11.2.

Table 11.1: Number of events by dominant criteria distributed per month in 2022 in Isolated system.

		2022												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	4	-	-	-	-	-	-	1	1	-	-	6
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	5	13	3	-	-	-	1	-	3	2	-	2	29
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	-	-	-	-	-	-	-	1
	Total	6	17	3	-	-	-	1	-	4	3	-	2	36
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	2	-	-	-	-	-	-	-	-	-	-	2
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	1	-	-	-	-	-	-	-	-	-	-	-	1
	Total	1	2	-	-	-	-	-	-	-	-	-	-	3
Scale2	Incidents on load (L2)	-	2	-	-	-	-	-	-	-	-	-	-	2
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	1	-	-	-	-	-	-	-	-	-	1
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	2	1	-	-	-	-	-	-	-	-	-	3
Scale3	Blackout(OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		7	21	4	-	-	-	1	-	4	3	-	2	42

Table 11.2: Cumulative number of events by dominant criteria and duration in 2022 in Isolated system.

	2022						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	2	3	3	6
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-
	Incidents on network elements (T0)	7	9	15	20	24	29
	Incidents on power generating facilities (G0)	-	-	-	-	-	-
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	1	1	1	1
	Total	7	9	18	24	28	36
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	1	1	1	2	2	2
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	1	1	1
	Total	1	1	1	3	3	3
Scale2	Incidents on load (L2)	-	-	1	1	2	2
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	1	1	1	1
	Incidents on power generating facilities (G2)	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-
	Total	-	-	2	2	3	3
Scale3	Blackout(OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		8	10	21	29	34	42

11.2 Evolution 2018–2022

This section presents the annual number of incidents in the isolated systems from to 2018 to 2022, distributed by scale and ICS criterion. It should be noted that the recorded values for 2018–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

The increase of T0 events in 2020 is a result of the recent ICS Methodology update, which included tripped 100–150 kV network elements which impact operational security. All other ICS criteria remained approximately on the same levels, with the only difference being the occurrence of six incidents on load (L0). L0 events were not reported during 2018–2022.

Three scale 2 events were reported in 2022, which is the highest number in isolated systems in a year during 2018–2022. No scale 3 events were reported from 2018 to 2022.

All ICS events during 2018–2022 in the isolated systems were reported by Landsnet in Iceland.

Table 11.3: The annual number of events by dominating criterion from 2018–2022.

Scale	ICS criterion	2018	2019	2020	2021	2022
Scale0	Incidents on load (L0)	-	-	-	-	6
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	10	5	29	26	29
	Incidents on power generating facilities (G0)	-	4	3	-	-
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	1	-	1
	Total	10	9	33	26	36
Scale1	Incidents on load (L1)	-	-	1	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	3	7	12	1	2
	Incidents on power generating facilities (G1)	-	-	-	2	-
	N-1 violation (ON1)	-	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	1
	Total	3	7	13	3	3
Scale2	Incidents on load (L2)	1	-	-	-	2
	Incidents leading to frequency degradation (F2)	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	1
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	1	-	-	1	-
	Total	2	-	-	1	3
Scale3	Blackout(OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		15	16	46	30	42

11.3 Analysis of significant changes in trends

In 2022, a total of 42 ICS events were reported in isolated systems by Landsnet in Iceland. All incidents were mainly events on transmission network elements (T). However, there is no clear visible trend over the last few years. In addition, the data must be interpreted cautiously as the overall number of events is low, and the isolated systems are only represented by two TSOs, Landsnet in Iceland and TSO-Cyprus in Cyprus, which have very different operating environments.

The number of scale 0, scale 1 and scale 2 events is not sufficiently significant to make a relevant comparison with previous years.

The recent ICS Methodology update for 2020, that included tripped 100–150 kV network elements which impact operational security, is the reason for the increased number of reported events after 2019. All of the events in the isolated systems occurred in Landsnet's transmission network, and the only finding that can be made is that overall, the number of scale 2 events is sporadic, with 2022 experiencing more scale 2 incidents than the other years.

12 Overview of events per TSO

This chapter presents detailed information about each TSO that reported data according to the ICS Methodology.

In total, 39 TSOs contributed data to the ICS report.

The TSO in each synchronous area are listed below. Creos and TSO Cyprus experienced no ICS events during 2018–2022 and are therefore omitted from the sections in this chapter.

TSOs were asked to comment on trends and out of average values. Received comments are presented in this report.

Baltic:

- AST
- Elering
- Litgrid

Continental Europe:

- 50Hertz
- APG
- Amprion
- CEPS
- CGES
- CREOS
- ELES
- EMS
- ESO
- Elia
- Energinet (CE)
- HOPS
- IPTO
- MAVIR
- NOS BiH
- OST
- PSE
- Red Eléctrica
- REN
- RTE
- SEPS
- Swissgrid
- TEIAS
- TenneT DE
- TenneT NL
- Terna
- Transelectrica
- TransnetBW

Isolated systems:

- Landsnet
- TSO Cyprus

Ireland/Northern Ireland:

- EirGrid
- SONI

Great Britain:

- National Grid ESO

Nordic:

- Energinet (Nordic)
- Fingrid
- Statnett
- Svenska kraftnät

12.1 Overview of events per TSOs in Continental Europe

12.1.1 Events reported by 50Hertz

This section presents events for 50Hertz, one of the TSOs in Germany. Table 12.1 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.2 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.1 presents the number of events grouped by duration in 2022.

Table 12.1: Monthly distribution of events by dominating criterion in 2022 for 50Hertz.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	6	4	2	2	2	7	6	2	1	2	-	2	36
	Incidents on power generating facilities (G0)	-	-	1	-	-	-	-	-	3	2	-	-	6
	Loss of tools, means and facilities (LT0)	-	-	-	-	1	-	1	1	-	1	-	-	4
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	2	2
	N-1 violation (ON1)	2	-	-	3	3	-	-	-	-	-	-	-	8
	Loss of tools, means and facilities (LT1)	-	-	-	1	-	-	2	1	-	-	-	-	4
Grand total		8	4	3	6	6	7	9	4	4	5	-	4	60

Table 12.2: The annual number of events by dominating criterion from 2018–2022 for 50Hertz.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on load (L0)	-	-	-	1	-
	Incidents on network elements (T0)	30	24	29	40	36
	Incidents on power generating facilities (G0)	-	2	9	8	6
	Loss of tools, means and facilities (LT0)	-	6	2	1	4
Scale 1	Incidents on load (L1)	-	-	-	-	2
	N-1 violation (ON1)	5	3	-	9	8
	Loss of tools, means and facilities (LT1)	-	3	9	8	4
Grand total		35	38	49	67	60

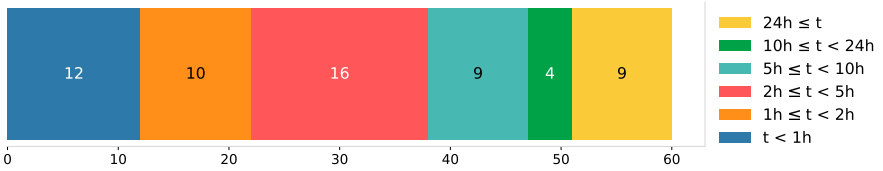

Figure 12.1: Number of events grouped by duration in 2022 for 50Hertz.

12.1.2 Events reported by Amprion

This section presents events for Amprion GmbH, one of the TSOs in Germany. Table 12.3 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.4 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.2 presents the number of events grouped by duration in 2022.

Table 12.3: Monthly distribution of events by dominating criterion in 2022 for Amprion.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	3	11	10	10	14	12	9	5	6	4	5	5	94
	Incidents on power generating facilities (G0)	2	-	4	1	-	2	3	-	-	5	1	-	18
	Violation of standards on voltage (OV0)	-	-	-	-	1	-	-	1	-	1	-	-	3
	Loss of tools, means and facilities (LT0)	-	1	3	-	3	-	2	1	-	1	3	-	14
Scale 1	N-1 violation (ON1)	-	3	-	4	-	1	-	2	1	1	-	-	12
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	3	-	-	-	3
Grand total		5	15	17	15	18	15	14	9	10	12	9	5	144

Table 12.4: The annual number of events by dominating criterion from 2018–2022 for Amprion.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	47	31	35	79	94
	Incidents on power generating facilities (G0)	13	7	9	19	18
	Violation of standards on voltage (OV0)	-	-	-	-	3
	Loss of tools, means and facilities (LT0)	-	6	3	4	14
Scale 1	Incidents on network elements (T1)	1	-	-	-	-
	N-1 violation (ON1)	7	3	4	3	12
	Violation of standards on voltage (OV1)	-	-	-	-	3
	Reduction of reserve capacity (RRC1)	-	1	-	-	-
	Loss of tools, means and facilities (LT1)	6	-	-	-	-
Grand total		74	48	51	105	144

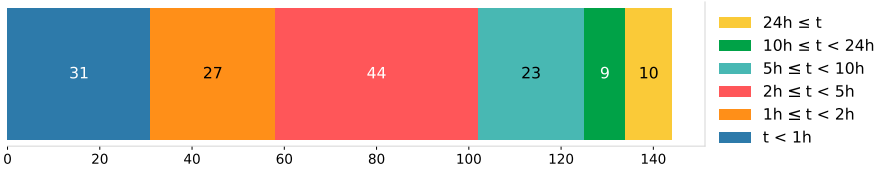

Figure 12.2: Number of events grouped by duration in 2022 for Amprion.

12.1.3 Events reported by APG

This section presents events for Austrian Power Grid AG (APG), the TSO in Austria. Table 12.5 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.6 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.3 presents the number of events grouped by duration in 2022.

Table 12.5: Monthly distribution of events by dominating criterion in 2022 for APG.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	1	-	1	-	2	2	1	3	2	-	-	13
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	N-1 violation (ON1)	-	-	1	1	-	-	-	-	-	-	1	-	3
	Loss of tools, means and facilities (LT1)	-	-	1	-	-	-	-	-	-	-	-	-	1
Grand total		1	1	2	2	-	3	2	1	3	2	1	-	18

Table 12.6: The annual number of events by dominating criterion from 2018–2022 for APG.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	10	24	24	17	13
	Loss of tools, means and facilities (LT0)	-	-	1	1	-
Scale 1	Incidents on network elements (T1)	-	-	-	-	1
	N-1 violation (ON1)	-	1	3	4	3
	Loss of tools, means and facilities (LT1)	-	2	2	-	1
Grand total		10	27	30	22	18

Figure 12.3: Number of events grouped by duration in 2022 for APG.

12.1.4 Events reported by CEPS

This section presents events for CEPS, the TSO in the Czech Republic. Table 12.7 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.8 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.4 presents the number of events grouped by duration in 2022.

Table 12.7: Monthly distribution of events by dominating criterion in 2022 for CEPS.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	1	1	1	5	2	4	1	3	2	5	5	30
	Incidents on power generating facilities (G0)	1	-	-	-	-	1	-	-	-	-	-	-	2
	Separation from the grid (RS0)	-	-	-	-	-	-	1	-	-	-	-	-	1
	Violation of standards on voltage (OV0)	-	-	-	-	3	1	-	-	-	1	-	3	8
	Loss of tools, means and facilities (LT0)	-	-	-	-	1	-	-	-	-	-	-	-	1
Scale 1	Incidents on load (L1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Incidents on network elements (T1)	-	-	-	-	-	4	1	-	-	1	-	2	8
	N-1 violation (ON1)	-	-	-	-	-	-	-	-	-	-	-	1	1
	Violation of standards on voltage (OV1)	-	-	-	-	2	-	-	-	1	2	-	1	6
	Loss of tools, means and facilities (LT1)	-	-	-	1	-	-	-	1	-	-	1	-	3
Grand total		1	1	1	2	11	9	6	2	4	6	6	12	61

Table 12.8: The annual number of events by dominating criterion from 2018–2022 for CEPS.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on load (L0)	-	-	1	-	-
	Incidents on network elements (T0)	2	11	18	29	30
	Incidents on power generating facilities (G0)	2	6	3	6	2
	Separation from the grid (RS0)	-	-	2	-	1
	Violation of standards on voltage (OV0)	31	19	-	3	8
	Loss of tools, means and facilities (LT0)	-	5	1	1	1
Scale 1	Incidents on load (L1)	-	-	-	1	1
	Incidents on network elements (T1)	-	2	4	-	8
	N-1 violation (ON1)	6	-	2	-	1
	Violation of standards on voltage (OV1)	7	3	5	3	6
	Loss of tools, means and facilities (LT1)	1	1	2	1	3
Grand total		49	47	38	44	61

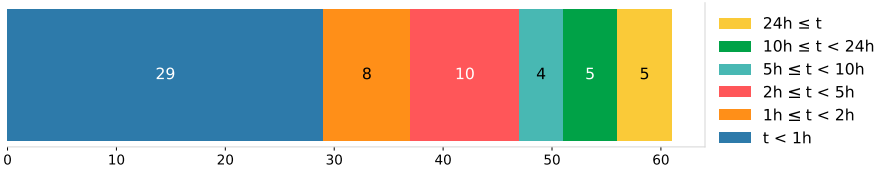

Figure 12.4: Number of events grouped by duration in 2022 for CEPS.

12.1.5 Events reported by CGES

This section presents events for CGES, the TSO in Montenegro. Table 12.9 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.10 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.5 presents the number of events grouped by duration in 2022.

Table 12.9: Monthly distribution of events by dominating criterion in 2022 for CGES.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	1	-	-	4	5	1	5	2	1	1	1	22
Grand total		1	1	-	-	4	5	1	5	2	1	1	1	22

Table 12.10: The annual number of events by dominating criterion from 2018–2022 for CGES.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	84	71	-	-	22
Grand total		84	71	-	-	22

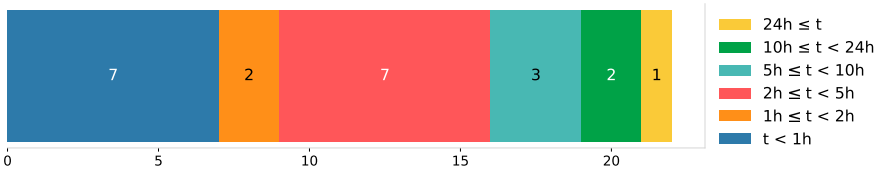

Figure 12.5: Number of events grouped by duration in 2022 for CGES.

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

12.1.6 Events reported by ELES

This section presents events for ELES, the TSO in Slovenia. 1 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.12 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.6 presents the number of events grouped by duration in 2022.

Table 12.11: Monthly distribution of events by dominating criterion in 2022 for ELES.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	-	-	1	-	2	1	1	-	-	2	7
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	-	-	-	1	-	1	-	3
Scale 1	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		1	-	-	-	1	1	2	1	2	-	1	2	11

Table 12.12: The annual number of events by dominating criterion from 2018–2022 for ELES.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	4	4	-	5	7
	Loss of tools, means and facilities (LT0)	-	-	-	-	3
Scale 1	Incidents on network elements (T1)	-	-	2	-	-
	N-1 violation (ON1)	-	-	2	1	1
	Violation of standards on voltage (OV1)	-	1	5	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	1	-
Scale 2	N violation (ON2)	-	1	-	-	-
Grand total		4	6	9	7	11

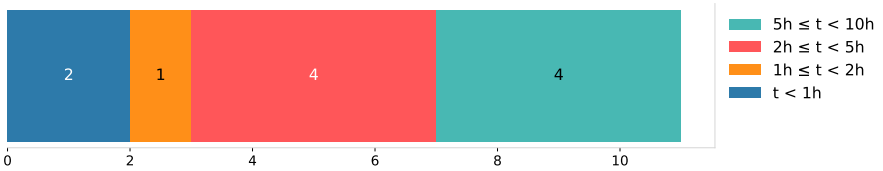

Figure 12.6: Number of events grouped by duration in 2022 for ELES.

12.1.7 Events reported by Elia

This section presents events for Elia, the TSO in Belgium. Table 12.13 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.14 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.7 presents the number of events grouped by duration in 2022.

Table 12.13: Monthly distribution of events by dominating criterion in 2022 for Elia.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	1	-	-	1	2	1	-	-	-	1	-	6
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	1	-	-	-	-	1
Grand total		-	1	-	-	1	2	1	1	-	-	1	-	7

Table 12.14: The annual number of events by dominating criterion from 2018–2022 for Elia.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on load (L0)	-	-	2	-	-
	Incidents on network elements (T0)	5	6	12	9	6
	Incidents on power generating facilities (G0)	1	2	-	1	1
	Violation of standards on voltage (OV0)	1	1	-	1	-
	Loss of tools, means and facilities (LT0)	-	4	3	-	-
Scale 1	Incidents on network elements (T1)	-	-	-	3	-
	N-1 violation (ON1)	1	8	4	2	-
	Violation of standards on voltage (OV1)	-	-	3	-	-
	Reduction of reserve capacity (RRC1)	-	1	-	-	-
	Loss of tools, means and facilities (LT1)	4	-	-	4	-
Grand total		12	22	24	20	7

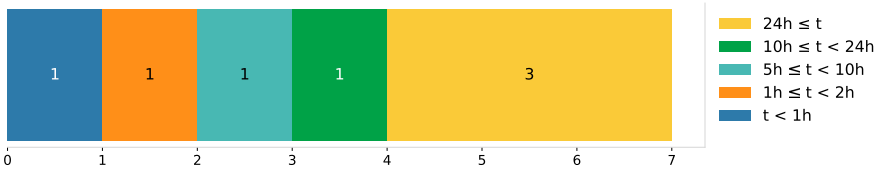

Figure 12.7: Number of events grouped by duration in 2022 for Elia.

12.1.8 Events reported by EMS

This section presents events for EMS JSC, the TSO of Serbia. Table 12.15 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.16 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.8 presents the number of events grouped by duration in 2022.

Table 12.15: Monthly distribution of events by dominating criterion in 2022 for EMS.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	1	3	1	1	5	3	-	2	-	-	16
	Violation of standards on voltage (OV0)	-	-	1	-	-	3	-	-	-	-	-	-	4
Scale 1	Incidents on network elements (T1)	-	-	-	-	1	-	-	-	-	-	-	-	1
	Violation of standards on voltage (OV1)	6	5	5	6	21	11	5	15	23	22	-	-	119
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	2	-	-	-	2
Grand total		6	5	7	9	23	15	10	18	25	24	-	-	142

Table 12.16: The annual number of events by dominating criterion from 2018–2022 for EMS.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	4	8	24	31	16
	Incidents on power generating facilities (G0)	28	-	-	2	-
	Violation of standards on voltage (OV0)	-	-	-	4	4
	Loss of tools, means and facilities (LT0)	-	1	-	-	-
Scale 1	Incidents on load (L1)	-	-	1	-	-
	Incidents on network elements (T1)	-	3	3	4	1
	Violation of standards on voltage (OV1)	-	-	-	109	119
	Reduction of reserve capacity (RRC1)	-	-	-	4	2
	Loss of tools, means and facilities (LT1)	-	-	1	2	-
Scale 2	Separation from the grid (RS2)	-	-	-	1	-
Grand total		32	12	29	157	142

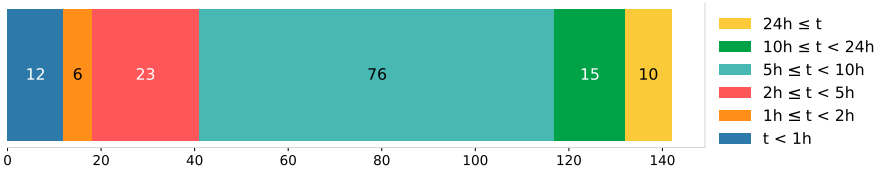

Figure 12.8: Number of events grouped by duration in 2022 for EMS.

12.1.9 Events reported by Energinet (CE)

This section presents events for Energinet (CE), the TSO in Denmark. Table 12.17 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.18 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.9 presents the number of events grouped by duration in 2022.

Table 12.17: Monthly distribution of events by dominating criterion in 2022 for Energinet (CE).

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	3	1	1	1	1	1	2	1	-	-	2	2	15
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	-	1	-	1
Scale 1	Loss of tools, means and facilities (LT1)	1	-	-	-	-	-	-	-	1	1	-	-	3
Grand total		4	1	1	1	1	1	2	1	1	1	3	2	19

Table 12.18: The annual number of events by dominating criterion from 2018–2022 for Energinet (CE).

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	6	15	15	35	15
	Violation of standards on voltage (OV0)	-	-	-	1	-
	Loss of tools, means and facilities (LT0)	-	4	3	2	1
Scale 1	Reduction of reserve capacity (RRC1)	-	-	1	-	-
	Loss of tools, means and facilities (LT1)	-	1	-	-	3
Grand total		6	20	19	38	19

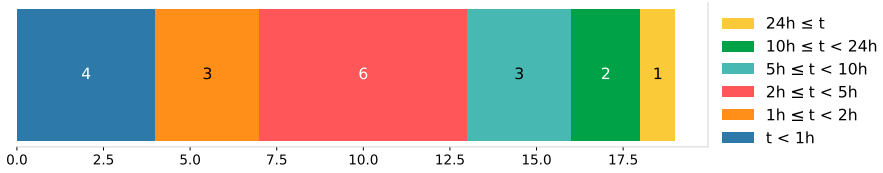

Figure 12.9: Number of events grouped by duration in 2022 for Energinet (CE).

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

12.1.10 Events reported by ESO

This section presents events for ESO EAD, the TSO in Bulgaria. Table 12.19 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.20 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.10 presents the number of events grouped by duration in 2022.

Table 12.19: Monthly distribution of events by dominating criterion in 2022 for ESO.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	8	2	10	8	11	20	6	4	14	2	3	3	91
Grand total		8	2	10	8	11	20	6	4	14	2	3	3	91

Table 12.20: The annual number of events by dominating criterion from 2018–2022 for ESO.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	29	38	40	38	91
	Incidents on power generating facilities (G0)	-	2	-	-	-
Grand total		29	40	40	38	91

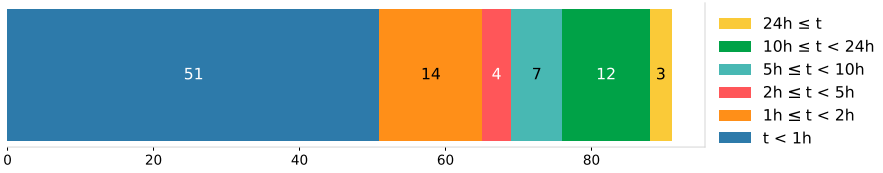

Figure 12.10: Number of events grouped by duration in 2022 for ESO.

12.1.11 Events reported by Freq (CE)

This section presents frequency events in continental Europe. Table 12.21 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.22 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.11 presents the number of events grouped by duration in 2022.

Table 12.21: Monthly distribution of events by dominating criterion in 2022 for Freq (CE).

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents leading to frequency degradation (F0)	61	26	29	31	1	15	10	13	-	16	1	17	220
Scale 1	Incidents leading to frequency degradation (F1)	1	1	1	2	-	-	-	-	-	1	-	-	6
Grand total		62	27	30	33	1	15	10	13	-	17	1	17	226

Table 12.22: The annual number of events by dominating criterion from 2018–2022 for Freq (CE).

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents leading to frequency degradation (F0)	953	758	296	746	220
Scale 1	Incidents leading to frequency degradation (F1)	10	5	3	92	6
Grand total		963	763	299	838	226

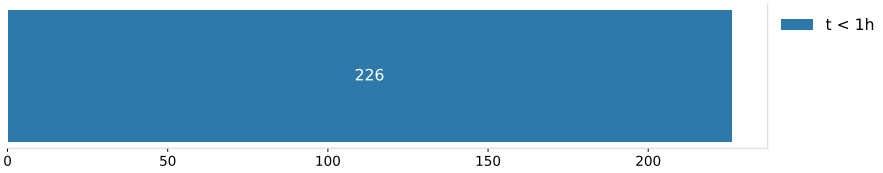

Figure 12.11: Number of events grouped by duration in 2022 for Freq (CE).

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

12.1.12 Events reported by HOPS

This section presents events for HOPS, the TSO in Croatia. Table 12.23 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.24 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.12 presents the number of events grouped by duration in 2022.

Table 12.23: Monthly distribution of events by dominating criterion in 2022 for HOPS.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	1	7	3	1	-	7	8	4	1	5	1	39
Scale 1	Loss of tools, means and facilities (LT1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		1	1	7	3	1	1	7	8	4	1	5	1	40

Table 12.24: The annual number of events by dominating criterion from 2018–2022 for HOPS.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	6	31	31	49	39
	Loss of tools, means and facilities (LT0)	-	-	1	11	-
Scale 1	Incidents on network elements (T1)	-	-	-	2	-
	Reduction of reserve capacity (RRC1)	-	-	-	12	-
	Loss of tools, means and facilities (LT1)	-	-	-	2	1
Scale 2	Incidents on network elements (T2)	-	-	-	1	-
	Separation from the grid (RS2)	-	-	-	2	-
Grand total		6	31	32	79	40

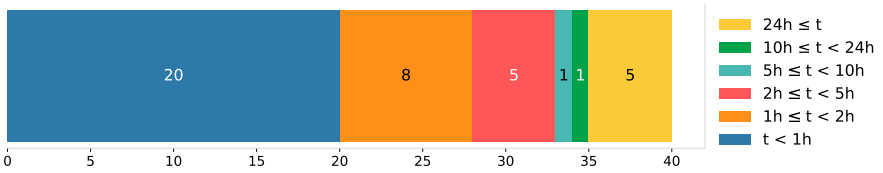

Figure 12.12: Number of events grouped by duration in 2022 for HOPS.

12.1.13 Events reported by IPTO

This section presents events for IPTO, the TSO in Greece. Table 12.25 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.26 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.13 presents the number of events grouped by duration in 2022.

Table 12.25: Monthly distribution of events by dominating criterion in 2022 for IPTO.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	3	3	-	6	7	1	1	2	4	2	2	4	35
	Violation of standards on voltage (OV0)	2	1	1	3	2	3	1	1	2	3	2	1	22
	Loss of tools, means and facilities (LT0)	1	1	1	-	1	2	-	-	-	1	1	2	10
Scale 1	Violation of standards on voltage (OV1)	1	1	-	5	5	4	-	-	3	6	2	1	28
Grand total		7	6	2	14	15	10	2	3	9	12	7	8	95

Table 12.26: The annual number of events by dominating criterion from 2018–2022 for IPTO.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	22	17	23	35	35
	Incidents on power generating facilities (G0)	-	-	-	1	-
	Violation of standards on voltage (OV0)	2	2	14	14	22
	Loss of tools, means and facilities (LT0)	-	-	-	10	10
Scale 1	Incidents on load (L1)	1	-	-	-	-
	Incidents on network elements (T1)	-	3	1	-	-
	Violation of standards on voltage (OV1)	1	1	26	34	28
Grand total		26	23	64	94	95

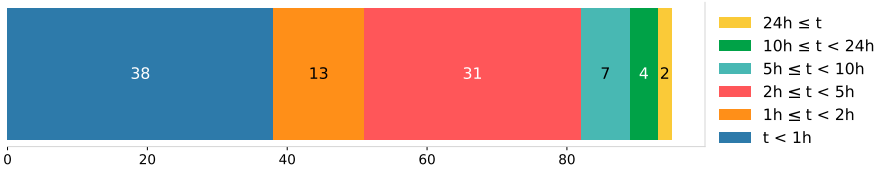

Figure 12.13: Number of events grouped by duration in 2022 for IPTO.

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

12.1.14 Events reported by MAVIR

This section presents events for MAVIR ZRt, the TSO in Hungary. Table 12.27 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.28 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.14 presents the number of events grouped by duration in 2022.

MAVIR, which reported the largest majority of OV events, accounting for 55% of all reported OV events, conducted an analysis of the high number of OV events, which concluded that the high numbers were a result of low relative power consumption, related to a sharp increase in the infeed from PV. These high voltage levels are due to be managed by MAVIR in the future by optimising the use of already existing assets.

Table 12.27: Monthly distribution of events by dominating criterion in 2022 for MAVIR.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	-	-	1	3	1	1	1	1	3	1	12
	Violation of standards on voltage (OV0)	19	23	16	24	35	22	18	16	45	37	43	31	329
	Reduction of reserve capacity (RRC0)	7	7	12	18	12	21	24	22	19	25	3	15	185
Scale 1	Violation of standards on voltage (OV1)	4	12	4	7	25	14	5	18	23	15	18	9	154
	Reduction of reserve capacity (RRC1)	3	-	6	9	1	3	7	5	4	7	1	7	53
Grand total		33	42	38	58	74	63	55	62	92	85	68	63	733

Table 12.28: The annual number of events by dominating criterion from 2018–2022 for MAVIR.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	72	52	6	-	12
	Violation of standards on voltage (OV0)	77	43	292	249	329
	Reduction of reserve capacity (RRC0)	-	1	-	25	185
Scale 1	Incidents on network elements (T1)	-	-	-	15	-
	N-1 violation (ON1)	1	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	287	154
	Reduction of reserve capacity (RRC1)	112	155	63	35	53
	Loss of tools, means and facilities (LT1)	-	1	-	-	-
Grand total		262	252	361	611	733

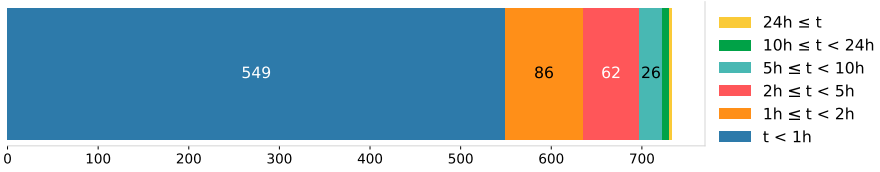

Figure 12.14: Number of events grouped by duration in 2022 for MAVIR.

12.1.15 Events reported by NOS BiH

This section presents events for NOS BiH, the TSO in Bosnia and Herzegovina. Table 12.29 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.30 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.15 presents the number of events grouped by duration in 2022.

Table 12.29: Monthly distribution of events by dominating criterion in 2022 for NOS BiH.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	1	3	-	7	1	1	6	2	1	1	2	26
Grand total		1	1	3	-	7	1	1	6	2	1	1	2	26

Table 12.30: The annual number of events by dominating criterion from 2018–2022 for NOS BiH.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	80	20	27	28	26
	Incidents on power generating facilities (G0)	-	-	-	1	-
Scale 1	Incidents on network elements (T1)	-	-	-	2	-
Scale 2	Incidents leading to frequency degradation (F2)	-	-	-	1	-
Grand total		80	20	27	32	26

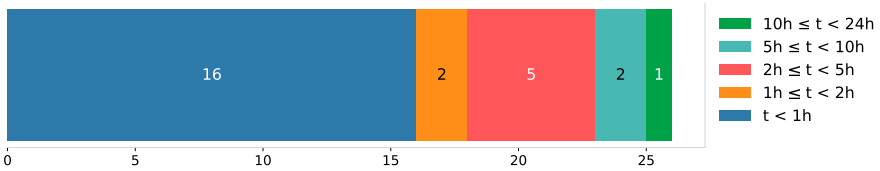

Figure 12.15: Number of events grouped by duration in 2022 for NOS BiH.

12.1.16 Events reported by OST

This section presents events for OST, the TSO in Albania. Table 12.31 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.32 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.16 presents the number of events grouped by duration in 2022.

Table 12.31: Monthly distribution of events by dominating criterion in 2022 for OST.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	2	2	1	8	2	-	-	10	1	-	3	3	32
Grand total		2	2	1	8	2	-	-	10	1	-	3	3	32

Table 12.32: The annual number of events by dominating criterion from 2018–2022 for OST.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	-	-	-	61	32
Grand total		-	-	-	61	32

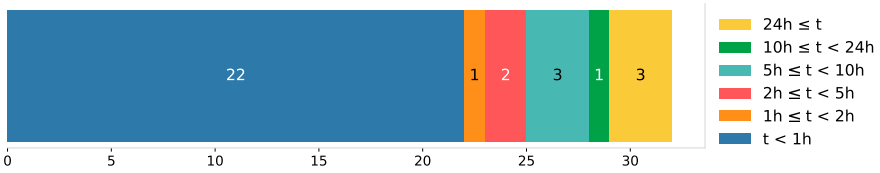

Figure 12.16: Number of events grouped by duration in 2022 for OST.

12.1.17 Events reported by PSE

This section presents events for PSE, the TSO in Poland. Table 12.34 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.35 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.17 presents the number of events grouped by duration in 2022.

Table 12.33: Monthly distribution of events by dominating criterion in 2022 for PSE.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	16	32	11	5	11	13	14	11	12	4	2	7	138
	Incidents on power generating facilities (G0)	1	-	-	-	3	1	2	3	-	2	-	-	12
	Loss of tools, means and facilities (LT0)	-	1	-	-	-	-	-	-	-	-	-	-	1
Scale 1	Reduction of reserve capacity (RRC1)	-	-	-	-	3	-	-	1	1	1	-	-	6
Grand total		17	33	11	5	17	14	16	15	13	7	2	7	157

Table 12.34: The annual number of events by dominating criterion from 2018–2022 for PSE.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	86	89	76	100	138
	Incidents on power generating facilities (G0)	14	10	13	14	12
	Loss of tools, means and facilities (LT0)	-	1	2	-	1
Scale 1	N-1 violation (ON1)	-	-	1	-	-
	Reduction of reserve capacity (RRC1)	-	1	-	1	6
	Loss of tools, means and facilities (LT1)	-	-	-	2	-
Scale 2	Incidents on power generating facilities (G2)	-	-	-	1	-
	Reduction of reserve capacity (RRC2)	-	-	-	1	-
Grand total		100	101	92	119	157

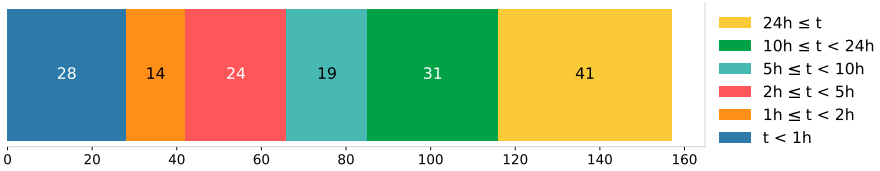

Figure 12.17: Number of events grouped by duration in 2022 for PSE.

12.1.18 Events reported by Red Eléctrica

This section presents events for Red Eléctrica, the TSO in Spain. Table 12.35 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.36 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.18 presents the number of events grouped by duration in 2022.

The ICS Methodology update in 2018 caused the number of events that Red Eléctrica reported in 2019 to increase significantly compared to previous years. As the same criteria were used for 2020, 2021 and 2022, the difference between the number of events reported for these years is fairly insignificant. All the events reported by RE in 2022 were scale 0 incidents, and the majority were related to incidents on network elements which represent almost 96% of the total. Five incidents were related to loss of tools, means and facilities and three, on power generating facilities. Only one incident of violation of standards on voltage was reported in 2022.

June, July, August and December were the months in which more incidents were reported by RE in 2022 (between 24 and 25), mainly because of equipment failures and fires. The rest of the year, the monthly number of events registered by the Spanish TSO was kept between 8 and 21.

Regarding the incidents that lasted longer than 24 hours, the main cause was fire; three out of ten were reported for that reason. Two of the three incidents on power generating facilities had a duration of more than 24 hours.

Table 12.35: Monthly distribution of events by dominating criterion in 2022 for Red Eléctrica.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	13	8	12	19	14	24	22	25	14	21	19	23	214
	Incidents on power generating facilities (G0)	-	-	1	-	-	-	-	-	1	-	-	1	3
	Violation of standards on voltage (OV0)	-	-	-	-	1	-	-	-	-	-	-	-	1
	Loss of tools, means and facilities (LT0)	1	-	-	-	1	-	2	-	1	-	-	-	5
Grand total		14	8	13	19	16	24	24	25	16	21	19	24	223

Table 12.36: The annual number of events by dominating criterion from 2018–2022 for Red Eléctrica.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	90	235	258	274	214
	Incidents on power generating facilities (G0)	-	-	-	-	3
	Violation of standards on voltage (OV0)	-	-	-	-	1
	Loss of tools, means and facilities (LT0)	1	2	5	-	5
Scale 1	Incidents on load (L1)	1	-	1	-	-
	Incidents on power generating facilities (G1)	-	-	-	1	-
	Loss of tools, means and facilities (LT1)	1	-	-	-	-
Scale 2	Incidents on load (L2)	-	-	-	1	-
	Incidents on network elements (T2)	-	-	-	1	-
	Separation from the grid (RS2)	-	-	-	1	-
Grand total		93	237	264	278	223

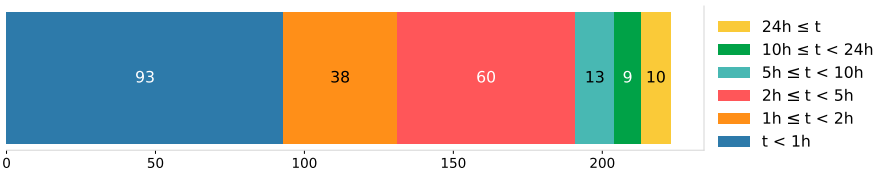

Figure 12.18: Number of events grouped by duration in 2022 for Red Eléctrica.

12.1.19 Events reported by REN

This section presents events for REN, the TSO in Portugal. Table 12.37 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.38 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.19 presents the number of events grouped by duration in 2022.

Table 12.37: Monthly distribution of events by dominating criterion in 2022 for REN.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	1	2	-	1	3	-	2	-	-	-	9
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	-	-	-	1	1
	Loss of tools, means and facilities (LT0)	-	-	-	-	1	-	-	-	1	-	-	-	2
Grand total		-	-	1	2	1	1	3	-	3	-	-	1	12

Table 12.38: The annual number of events by dominating criterion from 2018–2022 for REN.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	15	10	11	17	9
	Incidents on power generating facilities (G0)	1	-	-	1	1
	Loss of tools, means and facilities (LT0)	1	1	2	-	2
Scale 2	Incidents on load (L2)	-	-	-	1	-
	Separation from the grid (RS2)	-	-	-	1	-
Grand total		17	11	13	20	12

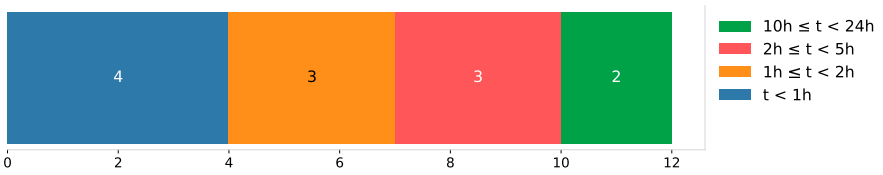

Figure 12.19: Number of events grouped by duration in 2022 for REN.

12.1.20 Events reported by RTE

This section presents events for RTE, the TSO in France. Table 12.39 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.40 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.20 presents the number of events grouped by duration in 2022.

A roadmap of deployment of means of voltage control is to be launched on the RTE side in the coming years.

Table 12.39: Monthly distribution of events by dominating criterion in 2022 for RTE.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-	1	-	-	-	1	1	3
	Incidents on network elements (T0)	15	27	12	18	18	15	21	15	18	9	7	15	190
	Incidents on power generating facilities (G0)	4	3	4	3	2	1	2	2	2	2	1	1	27
	Violation of standards on voltage (OV0)	-	-	-	-	5	2	4	2	-	-	-	-	13
Scale 1	N-1 violation (ON1)	1	-	-	-	5	5	-	1	-	-	-	-	12
	Violation of standards on voltage (OV1)	-	-	1	-	-	1	-	2	-	1	-	-	5
	Reduction of reserve capacity (RRC1)	2	-	-	1	-	-	-	-	-	-	-	1	4
	Loss of tools, means and facilities (LT1)	-	-	-	1	-	-	-	-	-	-	-	1	2
Grand total		22	30	17	23	30	24	28	22	20	12	9	19	256

Table 12.40: The annual number of events by dominating criterion from 2018–2022 for RTE.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on load (L0)	-	-	1	1	3
	Incidents on network elements (T0)	75	270	154	159	190
	Incidents on power generating facilities (G0)	30	19	29	30	27
	Violation of standards on voltage (OV0)	68	10	15	39	13
	Loss of tools, means and facilities (LT0)	14	29	4	1	-
Scale 1	Incidents on network elements (T1)	4	3	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	2	-
	N-1 violation (ON1)	4	-	30	31	12
	Violation of standards on voltage (OV1)	38	2	18	18	5
	Reduction of reserve capacity (RRC1)	5	1	2	2	4
	Loss of tools, means and facilities (LT1)	8	7	1	1	2
Scale 2	Incidents on network elements (T2)	-	-	-	1	-
Grand total		246	341	254	285	256

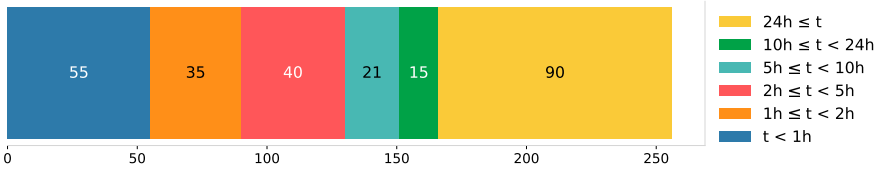

Figure 12.20: Number of events grouped by duration in 2022 for RTE.

12.1.21 Events reported by SEPS

This section presents events for SEPS, the TSO in Slovakia. Table 12.41 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.42 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.21 presents the number of events grouped by duration in 2022.

Table 12.41: Monthly distribution of events by dominating criterion in 2022 for SEPS.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	1	-	-	2	2	1	1	-	-	-	-	8
Scale 1	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	4	4	-	-	-	8
Grand total		1	1	-	-	2	2	1	5	4	-	-	-	16

Table 12.42: The annual number of events by dominating criterion from 2018–2022 for SEPS.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	6	2	4	8	8
	Violation of standards on voltage (OV0)	-	15	49	23	-
Scale 1	Incidents on network elements (T1)	-	-	3	-	-
	N-1 violation (ON1)	-	-	1	-	-
	Violation of standards on voltage (OV1)	-	2	11	12	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	8
	Loss of tools, means and facilities (LT1)	-	-	1	-	-
Grand total		6	19	69	43	16

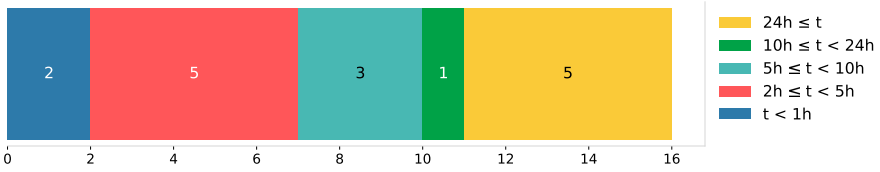

Figure 12.21: Number of events grouped by duration in 2022 for SEPS.

12.1.22 Events reported by Swissgrid

This section presents events for Swissgrid, the TSO in Switzerland. Table 12.43 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.44 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.22 presents the number of events grouped by duration in 2022.

Table 12.43: Monthly distribution of events by dominating criterion in 2022 for Swissgrid.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	3	1	4	2	4	2	13	2	-	-	2	1	34
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	1	-	1	-	-	-	2
	Violation of standards on voltage (OV0)	3	2	4	14	1	7	5	9	5	1	-	2	53
	Loss of tools, means and facilities (LT0)	2	1	2	2	-	1	-	1	3	-	-	1	13
Scale 1	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	-	-	2	-	-	-	2	1	-	-	-	5
Grand total		8	4	10	20	5	11	19	14	10	1	2	4	108

Table 12.44: The annual number of events by dominating criterion from 2018–2022 for Swissgrid.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents leading to frequency degradation (F0)	-	1	-	-	-
	Incidents on network elements (T0)	12	31	37	33	34
	Incidents on power generating facilities (G0)	1	6	2	2	2
	Violation of standards on voltage (OV0)	-	-	72	78	53
	Loss of tools, means and facilities (LT0)	5	16	21	13	13
Scale 1	Incidents on load (L1)	1	-	1	-	-
	Incidents leading to frequency degradation (F1)	-	2	-	-	-
	Incidents on network elements (T1)	-	4	2	-	-
	N-1 violation (ON1)	1	2	1	-	1
	Violation of standards on voltage (OV1)	-	-	27	12	5
	Reduction of reserve capacity (RRC1)	-	2	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	2	3	-
Scale 2	Incidents on network elements (T2)	-	1	-	-	-
	N violation (ON2)	3	-	-	-	-
Grand total		23	65	165	141	108

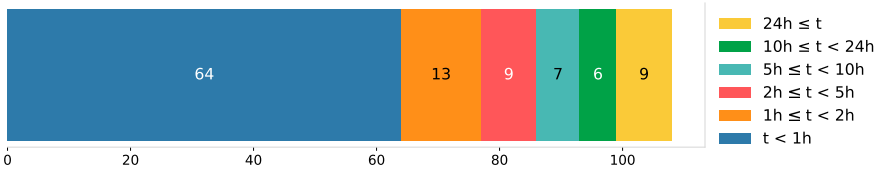

Figure 12.22: Number of events grouped by duration in 2022 for Swissgrid.

12.1.23 Events reported by TEIAS

This section presents events for TEIAS, the TSO in Turkey. Table 12.45 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.46 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.23 presents the number of events grouped by duration in 2022.

Table 12.45: Monthly distribution of events by dominating criterion in 2022 for TEIAS.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	1	-	-	-	-	-	-	-	-	1
	Incidents on network elements (T0)	4	1	-	3	1	3	3	-	1	1	1	-	18
	Incidents on power generating facilities (G0)	-	1	1	-	-	-	-	2	1	-	3	-	8
Grand total		4	2	1	4	1	3	3	2	2	1	4	-	27

Table 12.46: The annual number of events by dominating criterion from 2018–2022 for TEIAS.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on load (L0)	-	-	-	-	1
	Incidents on network elements (T0)	-	-	-	18	18
	Incidents on power generating facilities (G0)	-	-	-	23	8
Grand total		-	-	-	41	27

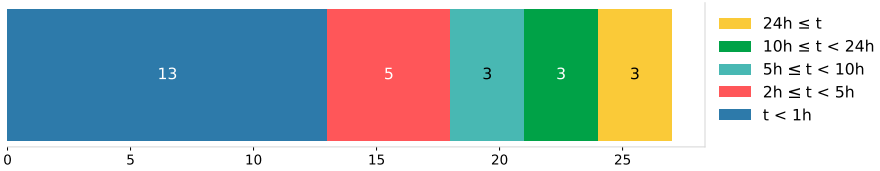

Figure 12.23: Number of events grouped by duration in 2022 for TEIAS.

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

12.1.24 Events reported by TenneT DE

This section presents events for TenneT TSO GmbH, one of the TSOs in Germany. Table 12.47 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.48 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.24 presents the number of events grouped by duration in 2022.

The changes in yearly numbers are nearly stable for consistent ICS Methodologies. The number of T0 events decreased slightly in 2022, while the number of T1 events increased. ON1 events also increased; however, the overall number of ICS events decreased. The variance during the year 2022 is insignificant, as it has been the past few years. Although the overall grid security is maintained, it is expected that the number of events might increase due to grid expansion and more frequent severe weather conditions.

Table 12.47: Monthly distribution of events by dominating criterion in 2022 for TenneT DE.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	6	7	1	4	8	2	4	3	4	3	-	1	43
	Incidents on power generating facilities (G0)	1	-	-	-	-	-	-	-	1	-	-	-	2
	Loss of tools, means and facilities (LT0)	-	-	1	-	1	-	-	-	-	-	-	1	3
Scale 1	Incidents on network elements (T1)	3	-	-	-	-	-	-	5	-	1	-	-	9
	N-1 violation (ON1)	1	-	2	2	1	-	-	-	-	3	-	-	9
Grand total		11	7	4	6	10	2	4	8	5	7	-	2	66

Table 12.48: The annual number of events by dominating criterion from 2018–2022 for TenneT DE.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	13	14	13	64	43
	Incidents on power generating facilities (G0)	19	12	6	-	2
	Loss of tools, means and facilities (LT0)	68	23	49	3	3
Scale 1	Incidents on network elements (T1)	-	1	-	1	9
	N-1 violation (ON1)	3	6	1	3	9
	Loss of tools, means and facilities (LT1)	3	1	1	2	-
Grand total		106	57	70	73	66

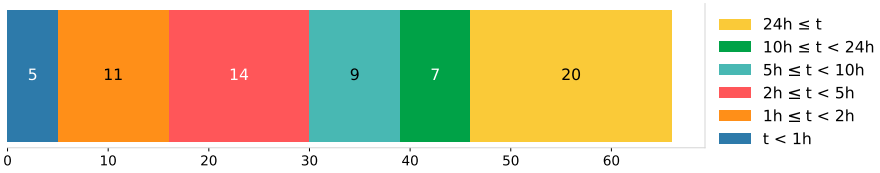

Figure 12.24: Number of events grouped by duration in 2022 for TenneT DE.

12.1.25 Events reported by TenneT NL

This section presents events for TenneT TSO B.V., the TSO in the Netherlands. Table 12.49 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.50 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.25 presents the number of events grouped by duration in 2022.

Table 12.49: Monthly distribution of events by dominating criterion in 2022 for TenneT NL.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	5	2	1	3	1	-	1	-	-	-	2	15
	Incidents on power generating facilities (G0)	1	2	3	4	2	5	2	-	1	-	-	2	22
	Loss of tools, means and facilities (LT0)	2	1	1	-	3	1	1	2	2	5	6	2	26
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	-	1	-	-	-	1
	N-1 violation (ON1)	-	-	-	1	1	2	1	-	1	-	-	1	7
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	1	-	1
Grand total		3	8	6	6	9	9	4	3	5	5	7	7	72

Table 12.50: The annual number of events by dominating criterion from 2018–2022 for TenneT NL.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	24	53	54	16	15
	Incidents on power generating facilities (G0)	-	-	1	11	22
	Violation of standards on voltage (OV0)	-	-	1	-	-
	Loss of tools, means and facilities (LT0)	10	5	5	21	26
Scale 1	Incidents on load (L1)	-	-	-	-	1
	Incidents on power generating facilities (G1)	-	-	-	1	-
	N-1 violation (ON1)	1	2	6	4	7
	Violation of standards on voltage (OV1)	4	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	2	-	-
Grand total		39	60	69	53	72

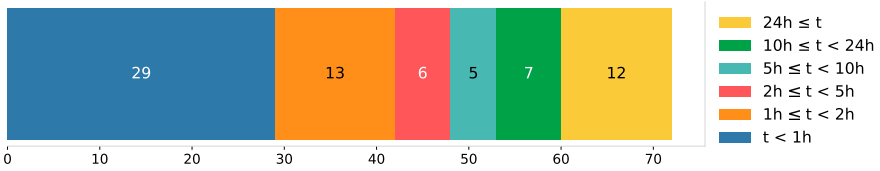

Figure 12.25: Number of events grouped by duration in 2022 for TenneT NL.

12.1.26 Events reported by Terna

This section presents events for TERNA, the TSO in Italy. Table 12.51 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.52 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.26 presents the number of events grouped by duration in 2022.

Table 12.51: Monthly distribution of events by dominating criterion in 2022 for Terna.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	3	9	4	1	5	8	6	5	6	4	2	4	57
Scale 1	Reduction of reserve capacity (RRC1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		3	9	4	1	5	9	6	5	6	4	2	4	58

Table 12.52: The annual number of events by dominating criterion from 2018–2022 for Terna.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	63	83	66	75	57
	Violation of standards on voltage (OV0)	-	-	-	12	-
	Reduction of reserve capacity (RRC0)	-	-	-	1	-
	Loss of tools, means and facilities (LT0)	-	3	-	-	-
Scale 1	Reduction of reserve capacity (RRC1)	-	-	-	9	1
Grand total		63	86	66	97	58

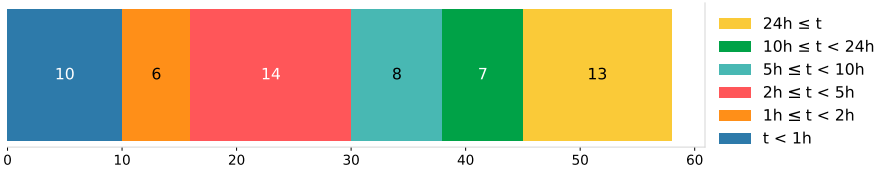

Figure 12.26: Number of events grouped by duration in 2022 for Terna.

12.1.27 Events reported by Transelectrica

This section presents events for Transelectrica, the TSO in Romania. Table 12.53 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.54 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.27 presents the number of events grouped by duration in 2022.

Table 12.53: Monthly distribution of events by dominating criterion in 2022 for Transelectrica.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	3	3	6	1	2	20	13	4	3	2	2	-	59
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	-	1	-	-	1
	Violation of standards on voltage (OV0)	-	-	1	2	4	3	-	-	-	17	11	9	47
	Loss of tools, means and facilities (LT0)	-	-	-	1	-	-	-	-	-	-	-	-	1
Scale 1	Violation of standards on voltage (OV1)	-	1	4	-	12	3	2	4	-	17	10	18	71
Grand total		3	4	11	4	18	26	15	8	3	37	23	27	179

Table 12.54: The annual number of events by dominating criterion from 2018–2022 for Transelectrica.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	64	44	77	56	59
	Incidents on power generating facilities (G0)	4	-	1	3	1
	Violation of standards on voltage (OV0)	157	196	11	71	47
	Loss of tools, means and facilities (LT0)	-	-	-	-	1
Scale 1	Incidents on load (L1)	-	-	3	1	-
	Violation of standards on voltage (OV1)	-	-	21	38	71
	Reduction of reserve capacity (RRC1)	1	-	-	-	-
Scale 2	Incidents on network elements (T2)	-	-	-	1	-
	N violation (ON2)	-	-	-	1	-
	Separation from the grid (RS2)	-	-	-	1	-
Grand total		226	240	113	172	179

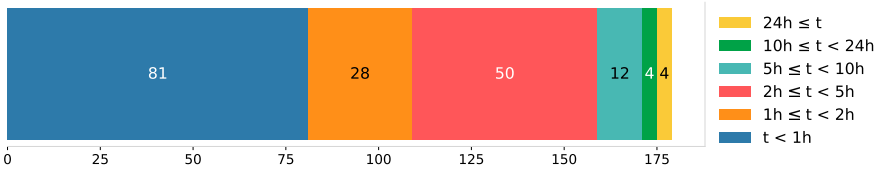

Figure 12.27: Number of events grouped by duration in 2022 for Transelectrica.

12.1.28 Events reported by TransnetBW

This section presents events for TransnetBW GmbH, one of the TSOs in Germany. Table 12.55 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.56 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.28 presents the number of events grouped by duration in 2022.

Table 12.55: Monthly distribution of events by dominating criterion in 2022 for TransnetBW.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	-	-	-	-	1	8	1	-	-	-	10
	Incidents on power generating facilities (G0)	2	1	1	-	-	-	2	1	1	2	4	4	18
Scale 1	N-1 violation (ON1)	-	-	2	1	-	-	-	-	-	-	-	-	3
	Loss of tools, means and facilities (LT1)	-	1	-	2	-	1	2	-	-	-	-	1	7
Grand total		2	2	3	3	-	1	5	9	2	2	4	5	38

Table 12.56: The annual number of events by dominating criterion from 2018–2022 for TransnetBW.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	14	16	29	11	10
	Incidents on power generating facilities (G0)	-	27	8	16	18
Scale 1	N-1 violation (ON1)	2	-	1	3	3
	Loss of tools, means and facilities (LT1)	2	2	2	4	7
Grand total		18	45	40	34	38

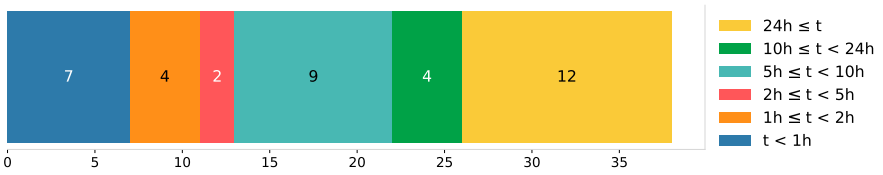

Figure 12.28: Number of events grouped by duration in 2022 for TransnetBW.

12.2 Overview of events per TSOs in Nordic

12.2.1 Events reported by Energinet (Nordic)

This section presents events for Energinet (Nordic), the TSO in Denmark. Table 12.57 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.58 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.29 presents the number of events grouped by duration in 2022.

Table 12.57: Monthly distribution of events by dominating criterion in 2022 for Energinet (Nordic).

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	-	-	-	-	-	1	2	1	-	-	-	5
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	3	-	-	-	-	3
Grand total		1	-	-	-	-	-	1	5	1	-	-	-	8

Table 12.58: The annual number of events by dominating criterion from 2018–2022 for Energinet (Nordic).

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	2	5	15	13	5
Scale 1	Incidents on network elements (T1)	1	1	-	-	-
	N-1 violation (ON1)	-	-	-	-	3
	Separation from the grid (RS1)	-	-	1	-	-
	Loss of tools, means and facilities (LT1)	2	-	2	-	-
Grand total		5	6	18	13	8

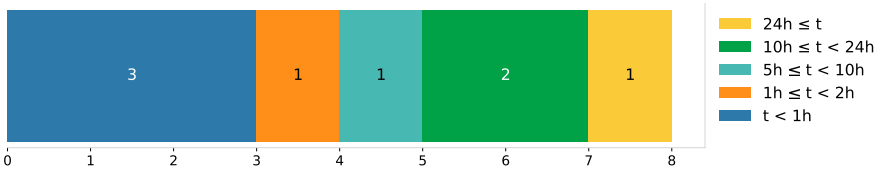

Figure 12.29: Number of events grouped by duration in 2022 for Energinet (Nordic).

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

12.2.2 Events reported by Fingrid

This section presents events for Fingrid Oyj, the TSO in Finland. Table 12.59 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.60 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.30 presents the number of events grouped by duration in 2022.

Table 12.59: Monthly distribution of events by dominating criterion in 2022 for Fingrid.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	-	1	-	-	1	1	-	-	-	-	3
	Incidents on power generating facilities (G0)	-	-	-	-	-	1	-	-	1	-	-	-	2
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	1	1	-	-	2
Grand total		-	-	-	1	-	1	1	1	2	1	-	-	7

Table 12.60: The annual number of events by dominating criterion from 2018–2022 for Fingrid.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	4	6	4	13	3
	Incidents on power generating facilities (G0)	1	-	1	-	2
	Violation of standards on voltage (OV0)	5	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	1	-	1	2
Scale 1	Incidents on network elements (T1)	3	-	-	-	-
Grand total		13	7	5	14	7

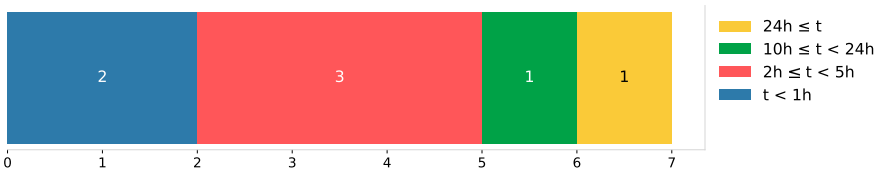

Figure 12.30: Number of events grouped by duration in 2022 for Fingrid.

12.2.3 Events reported by Freq (Nordic)

This section presents frequency events in the Nordics. Table 12.61 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.62 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.31 presents the number of events grouped by duration in 2022.

Table 12.61: Monthly distribution of events by dominating criterion in 2022 for Freq (Nordic).

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents leading to frequency degradation (F0)	10	10	1	5	2	2	5	2	1	1	4	10	53
Scale 1	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	1	1
Grand total		10	10	1	5	2	2	5	2	1	1	4	11	54

Table 12.62: The annual number of events by dominating criterion from 2018–2022 for Freq (Nordic).

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents leading to frequency degradation (F0)	-	-	62	70	53
Scale 1	Incidents leading to frequency degradation (F1)	-	106	4	3	1
Grand total		-	106	66	73	54

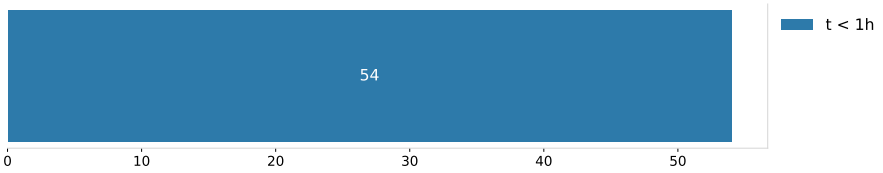

Figure 12.31: Number of events grouped by duration in 2022 for Freq (Nordic).

12.2.4 Events reported by Statnett

This section presents events for Statnett, the TSO in Norway. Table 12.63 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.64 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.32 presents the number of events grouped by duration in 2022.

Table 12.63: Monthly distribution of events by dominating criterion in 2022 for Statnett.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	1	-	-	-	-	-	-	-	-	-	-	1
	Incidents on network elements (T0)	10	6	1	2	-	-	-	5	-	-	6	4	34
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	1	-	-	2	3
	Separation from the grid (RS0)	1	-	-	-	-	-	-	1	-	-	-	-	2
Scale 1	Incidents on load (L1)	-	-	-	1	-	-	-	-	-	-	-	-	1
	Incidents on network elements (T1)	1	-	-	-	-	-	-	-	-	-	-	-	1
	N-1 violation (ON1)	1	-	-	-	-	-	-	-	-	-	-	-	1
	Separation from the grid (RS1)	1	-	-	-	-	-	-	-	-	-	-	-	1
Grand total		14	7	1	3	-	-	-	6	1	-	6	6	44

Table 12.64: The annual number of events by dominating criterion from 2018–2022 for Statnett.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on load (L0)	-	-	-	2	1
	Incidents on network elements (T0)	23	12	14	19	34
	Incidents on power generating facilities (G0)	-	1	2	2	3
	Separation from the grid (RS0)	-	-	-	2	2
	Loss of tools, means and facilities (LT0)	-	-	1	-	-
Scale 1	Incidents on load (L1)	3	2	1	-	1
	Incidents on network elements (T1)	2	-	2	2	1
	N-1 violation (ON1)	2	-	2	-	1
	Separation from the grid (RS1)	-	-	-	1	1
Grand total		30	15	22	28	44

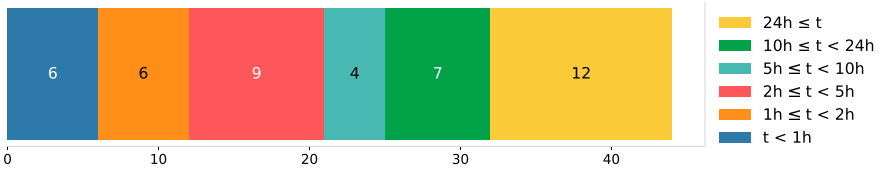

Figure 12.32: Number of events grouped by duration in 2022 for Statnett.

12.2.5 Events reported by Svenska kraftnät

This section presents events for Svenska Kraftät, the TSO in Sweden. Table 12.65 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.66 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.33 presents the number of events grouped by duration in 2022.

Table 12.65: Monthly distribution of events by dominating criterion in 2022 for Svenska kraftnät.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	6	6	5	3	7	3	5	8	2	3	1	5	54
	Incidents on power generating facilities (G0)	2	1	1	1	-	2	1	-	-	-	-	1	9
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	-	-	-	-	2	-	-	3
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand total		9	7	6	4	7	5	6	8	3	5	1	6	67

Table 12.66: The annual number of events by dominating criterion from 2018–2022 for Svenska kraftnät.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents leading to frequency degradation (F0)	2	-	-	-	-
	Incidents on network elements (T0)	48	36	40	56	54
	Incidents on power generating facilities (G0)	-	-	2	13	9
	Loss of tools, means and facilities (LT0)	-	-	9	21	3
Scale 1	Incidents on network elements (T1)	1	-	1	1	1
	Loss of tools, means and facilities (LT1)	-	-	4	1	-
Grand total		51	36	56	92	67

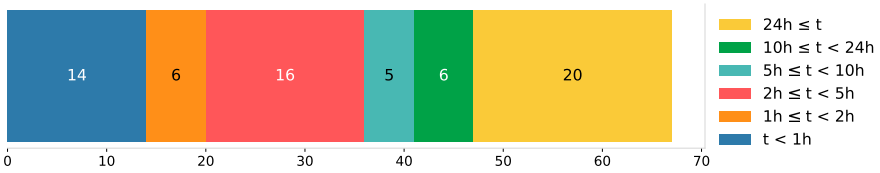

Figure 12.33: Number of events grouped by duration in 2022 for Svenska kraftnät.

ENTSO-E | Rue de Spa, 8 | 1000 Brussels | info@entsoe.eu | www.entsoe.eu | @entso_e

12.3 Overview of events per TSOs in Great Britain

12.3.1 Events reported by National Grid ESO

This section presents events for National Grid ESO, the TSO in Great Britain. Table 12.67 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.68 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.34 presents the number of events grouped by duration in 2022.

Table 12.67: Monthly distribution of events by dominating criterion in 2022 for National Grid ESO.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents leading to frequency degradation (F0)	1	-	-	3	1	1	-	-	-	1	-	-	7
	Incidents on network elements (T0)	19	17	13	11	9	9	10	17	13	11	10	18	157
	Incidents on power generating facilities (G0)	-	-	-	2	-	-	2	2	1	-	1	1	9
	Loss of tools, means and facilities (LT0)	2	3	-	-	1	-	1	1	3	1	-	3	15
Grand total		22	20	13	16	11	10	13	20	17	13	11	22	188

Table 12.68: The annual number of events by dominating criterion from 2018–2022 for National Grid ESO.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents leading to frequency degradation (F0)	58	78	2	3	7
	Incidents on network elements (T0)	156	155	169	218	157
	Incidents on power generating facilities (G0)	3	-	12	14	9
	Loss of tools, means and facilities (LT0)	31	42	76	16	15
Scale 1	N-1 violation (ON1)	2	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	1	1	-
Scale 2	Incidents leading to frequency degradation (F2)	-	1	-	-	-
Grand total		250	276	260	252	188

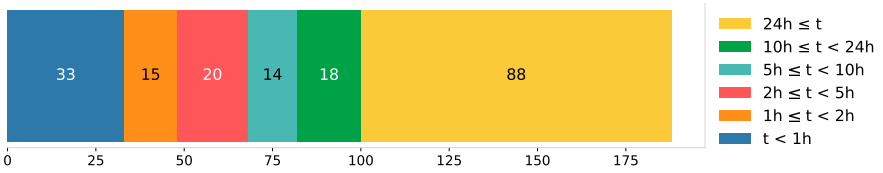

Figure 12.34: Number of events grouped by duration in 2022 for National Grid ESO.

12.4 Overview of events per TSOs in Baltic

12.4.1 Events reported by AST

This section presents events for AS Augstsprieguma tikls (AST), the TSO in Latvia. Table 12.69 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.70 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.35 presents the number of events grouped by duration in 2022.

Table 12.69: Monthly distribution of events by dominating criterion in 2022 for AST.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	-	1	2	-	1	-	-	1	-	-	5
	Incidents on power generating facilities (G0)	-	1	-	-	-	-	-	-	-	-	-	-	1
Grand total		-	1	-	1	2	-	1	-	-	1	-	-	6

Table 12.70: The annual number of events by dominating criterion from 2018–2022 for AST.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	7	6	4	6	5
	Incidents on power generating facilities (G0)	-	1	-	1	1
Scale 1	Incidents leading to frequency degradation (F1)	-	1	-	-	-
	Incidents on network elements (T1)	-	-	1	-	-
	Incidents on power generating facilities (G1)	-	-	1	-	-
	N-1 violation (ON1)	-	-	1	-	-
	Violation of standards on voltage (OV1)	-	-	1	-	-
	Loss of tools, means and facilities (LT1)	1	-	-	-	-
Scale 2	Incidents on load (L2)	-	-	1	-	-
Grand total		8	8	9	7	6

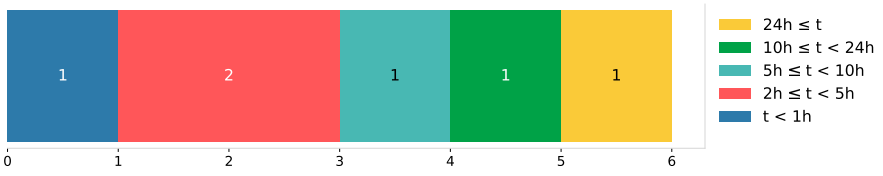

Figure 12.35: Number of events grouped by duration in 2022 for AST.

12.4.2 Events reported by Elering

This section presents events for Elering, the TSO in Estonia. Table 12.71 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.72 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.36 presents the number of events grouped by duration in 2022.

Table 12.71: Monthly distribution of events by dominating criterion in 2022 for Elering.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	3	-	3	2	1	1	3	-	-	1	2	16
	Incidents on power generating facilities (G0)	1	1	-	2	1	3	1	3	2	-	1	1	16
Grand total		1	4	-	5	3	4	2	6	2	-	2	3	32

Table 12.72: The annual number of events by dominating criterion from 2018–2022 for Elering.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	6	14	7	8	16
	Incidents on power generating facilities (G0)	1	10	23	15	16
Grand total		7	24	30	23	32

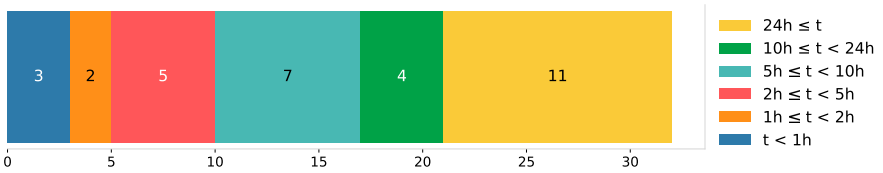

Figure 12.36: Number of events grouped by duration in 2022 for Elering.

12.4.3 Events reported by Litgrid

This section presents events for Litgrid AB, the TSO in Lithuania. Table 12.73 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.74 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.37 presents the number of events grouped by duration in 2022.

Table 12.73: Monthly distribution of events by dominating criterion in 2022 for Litgrid.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	-	1	1	-	1	1	-	-	-	1	-	6
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	-	1	-	-	1
Scale 1	Incidents on network elements (T1)	1	1	-	2	1	1	-	-	-	-	-	-	6
Grand total		2	1	1	3	1	2	1	-	-	1	1	-	13

Table 12.74: The annual number of events by dominating criterion from 2018–2022 for Litgrid.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on network elements (T0)	12	8	9	7	6
	Incidents on power generating facilities (G0)	1	-	3	-	1
	Loss of tools, means and facilities (LT0)	-	-	-	1	-
Scale 1	Incidents on load (L1)	-	2	1	-	-
	Incidents on network elements (T1)	-	3	4	4	6
Grand total		13	13	17	12	13

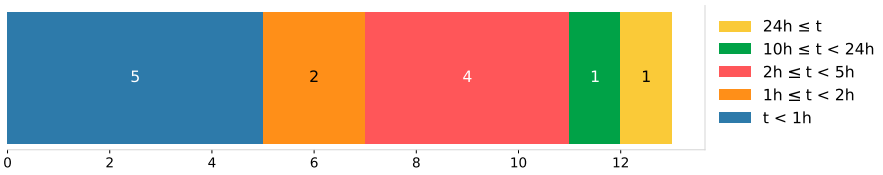

Figure 12.37: Number of events grouped by duration in 2022 for Litgrid.

12.5 Overview of events per TSOs in Ireland and Northern Ireland

12.5.1 Events reported by EirGrid

This section presents events for EirGrid, the TSO in Ireland. Table 12.75 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.76 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.38 presents the number of events grouped by duration in 2022.

Table 12.75: Monthly distribution of events by dominating criterion in 2022 for EirGrid.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	2	-	1	5	3	-	1	1	-	-	1	2	16
	Incidents on power generating facilities (G0)	-	2	1	1	-	-	-	2	2	-	3	1	12
Scale 1	N-1 violation (ON1)	-	-	-	2	1	-	2	3	-	-	-	-	8
Grand total		2	2	2	8	4	-	3	6	2	-	4	3	36

Table 12.76: The annual number of events by dominating criterion from 2018–2022 for EirGrid.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents leading to frequency degradation (F0)	7	4	-	-	-
	Incidents on network elements (T0)	8	9	6	8	16
	Incidents on power generating facilities (G0)	7	8	19	14	12
Scale 1	N-1 violation (ON1)	-	-	3	7	8
Scale 2	Incidents leading to frequency degradation (F2)	1	-	-	-	-
Grand total		23	21	28	29	36

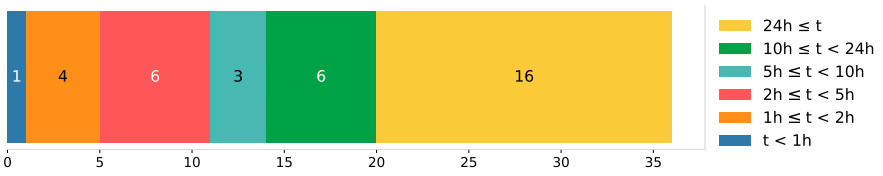

Figure 12.38: Number of events grouped by duration in 2022 for EirGrid.

12.5.2 Events reported by SONI

This section presents events for SONI, the TSO in Northern Ireland. Table 12.77 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.78 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.39 presents the number of events grouped by duration in 2022.

Table 12.77: Monthly distribution of events by dominating criterion in 2022 for SONI.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	-	-	1	-	-	-	-	-	1	-	2
	Incidents on power generating facilities (G0)	-	-	1	-	-	1	-	-	-	-	1	-	3
Grand total		-	-	1	-	1	1	-	-	-	-	2	-	5

Table 12.78: The annual number of events by dominating criterion from 2018–2022 for SONI.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents leading to frequency degradation (F0)	1	-	-	-	-
	Incidents on network elements (T0)	1	-	2	3	2
	Incidents on power generating facilities (G0)	-	2	-	-	3
Scale 1	N-1 violation (ON1)	-	-	-	1	-
Grand total		2	2	2	4	5

Figure 12.39: Number of events grouped by duration in 2022 for SONI.

12.6 Overview of events per TSOs in Isolated system

12.6.1 Events reported by Landsnet

This section presents events for Landsnet, the TSO in Iceland. Table 12.80 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.81 presents the annual number of ICS events by ICS criterion from 2018–2022. Figure 12.40 presents the number of events grouped by duration in 2022.

Table 12.79: Monthly distribution of events by dominating criterion in 2022 for Landsnet.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	4	-	-	-	-	-	-	1	1	-	-	6
	Incidents on network elements (T0)	5	13	3	-	-	-	1	-	3	2	-	2	29
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	-	-	-	-	-	-	-	1
Scale 1	Incidents on network elements (T1)	-	2	-	-	-	-	-	-	-	-	-	-	2
	Loss of tools, means and facilities (LT1)	1	-	-	-	-	-	-	-	-	-	-	-	1
Scale 2	Incidents on load (L2)	-	2	-	-	-	-	-	-	-	-	-	-	2
	Incidents on network elements (T2)	-	-	1	-	-	-	-	-	-	-	-	-	1
Grand total		7	21	4	-	-	-	1	-	4	3	-	2	42

Table 12.80: The annual number of events by dominating criterion from 2018–2022 for Landsnet.

Scale	Main event ICS criterion	2018	2019	2020	2021	2022
Scale 0	Incidents on load (L0)	-	-	-	-	6
	Incidents on network elements (T0)	10	5	29	26	29
	Incidents on power generating facilities (G0)	-	4	3	-	-
	Loss of tools, means and facilities (LT0)	-	-	1	-	1
Scale 1	Incidents on load (L1)	-	-	1	-	-
	Incidents on network elements (T1)	3	7	12	1	2
	Incidents on power generating facilities (G1)	-	-	-	2	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	1
Scale 2	Incidents on load (L2)	1	-	-	-	2
	Incidents on network elements (T2)	-	-	-	-	1
	Loss of tools, means and facilities (LT2)	1	-	-	1	-
Grand total		15	16	46	30	42

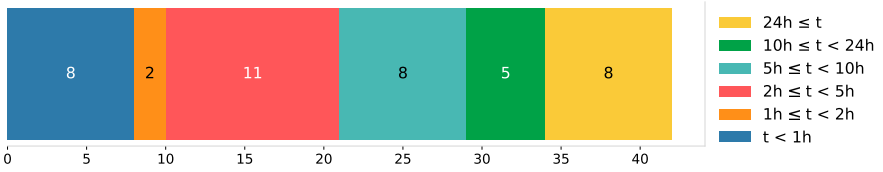

Figure 12.40: Number of events grouped by duration in 2022 for Landsnet.

13 Conclusion

The ENTSO-E ICS Methodology has been revised multiple times since its initial publication in 2014. The 2022 ICS Annual Report follows the most recent version, the 2019 ICS Methodology [2]. The 2022 Annual Report provides a clear overview of the incidents that occurred within the control area of each TSO. The Annual Report of the ICS includes incident reports from all of ENTSO-E's full members, observer member TEIAS in Türkiye, and National Grid ESO in Great Britain.

The included ENTSO-E Members reported a total of 3441 ICS events in 2022, of which 2839 were scale 0, 599 were scale 1 and 3 were scale 2. No scale 3 incidents were reported. There were 113 more events than incidents. The similar number of ICS events and ICS incidents indicates that most ICS incidents only had one ICS event. The term ICS event differs from ICS incident as an incident may contain multiple events.

Approximately 85% of all ICS events took place in CE, which is expected as 28 of the 39 TSOs are located there. The region dominated the number of incidents at all scales. All three reported scale 2 incidents occurred in Iceland and were due to extreme weather with high wind speeds and icing. The number of reported ICS events in 2022 decreased compared to 2021, but was still higher than the number reported in 2020. The most common registered ICS criteria are events on network elements (T), violations of standards on voltage (OV) and frequency degradation (F). An increase of RRC0 events could also be observed in CE, most of which were caused by unexpected discrepancies from load or generation forecast.

As required by the SOGL [1], the ICS Subgroup should provide recommendations to improve operational security in the European power grids. The ICS Subgroup has identified a high number of ICS events due to violations of standards on voltage (OV0 and OV1) and trips of network elements (T0). All voltage violations were registered in CE, and T events were mainly registered in CE but also occurred in other synchronous areas.

The ICS Subgroup has reviewed the reported voltage violations and concluded that the voltage violations are generally due to the increased amount of renewable energy sources in the power system, which has led to fewer conventional power plants being available to regulate reactive power in the grid. Affected TSOs have already noticed the trend and begun to take actions to prevent these in the future. For example, MAVIR will optimise the use of already existing assets to decrease the number of future voltage violations.

Finally, approximately 30% of the incidents due to contingencies from the contingency list are due to unexpected discrepancies from load and generation forecasts, as seen from the OPS indicators in Section 5.2. This indicates that the number of incidents due to contingencies in the contingency list could be decreased significantly by improving the accuracy of load and generation forecasts in CE.

References

[1] European Commission, "COMMISSION REGULATION (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation," July 2017.

[2] Incident Classification Scale Subgroup, "Incident Classification Scale Methodology 2019." https://eepublicdownloads.entsoe.eu/clean-documents/SOCClassification_Scale/200629_Incident_Classification_Scale_Methodology_revised_and_in_use_as_of_2020.pdf, December 2019.

[3] AD HOC Team Incidents Classification Scale Under System Operation Comittee, "Incident Classification Scale Guideline 2012." https://eepublicdownloads.entsoe.eu/clean-documents/pre2015/Key_Documents/120323-ICS_Methodology_final.pdf, March 2012.

[4] ENTSO-E, "ENTSO-E Power Statistics." https://www.entsoe.eu/data/power-stats/, August 2023.

[5] Subgroup Incident Classification Scale, "Incident Classification Scale Methodology 2018." https://eepublicdownloads.entsoe.eu/clean-documents/SOCClassification_Scale/ICS_Methodology_2018-2019__Incident_Classification_Scale.pdf, April 2018.

[6] ENTSO-E, "ENTSO-E Transparency Platform." https://transparency.entsoe.eu/, May 2022.

Contact

ENTSO-E AISBL
Rue de Spa 8
B-1000 Bruxelles
Tel +32 2 741 09 50
Fax +32 2 741 09 51
Email: info@entsoe.eu
www.entsoe.eu