ICS 2023 Annual Report

25 September 2024

From: Incident Classification Scale Subgroup

ICS 2023 Annual Report

Report rendered 25 September 2024

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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 2023 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 the 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 the 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 members Moldelectrica in Moldova and 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.

Data for two of the operational security indicators relevant for operational security (OS-G1 and OS-G2) have been collected by Working Group Annual Load-Frequency Control (ALFC) [4].

2 Incident Classification Scale

The criteria for incident classification are defined by using definitions from SOGL [1]. Each criterion describes an incident or an observable situation in the power system. 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 2023 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 2019–2023.

3.1 Number of classified events and incidents

This section presents the number of ICS incidents and ICS events 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 3768 ICS events in 2023, of which 3201 were of scale 0, 564 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 84%, 15.8% and 0.2%, respectively. There were 117 more ICS events than ICS incidents. The similar number of ICS events and ICS incidents indicates that most ICS incidents only violated one ICS criteria. 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 2023. 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 92% 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 2023 were events on transmission network elements (T0) with 2064 events, violations of standards on voltage (OV0 and OV1) with 437 events, and events leading to frequency degradation (F0) with 302 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 (Iceland) and CE (Ukraine and Moldova). Chapter 4 describes the reported scale 2 incidents in more detail.

There were no scale 3 events in the ENTSO-E area in 2023.

Table 3.1: Number of incidents and events per scale in 2023 and their percentage distribution.

	Number of incidents	Percentage of total	Number of events	Percentage of total
Scale 0	3083	84.7%	3201	85.0%
Scale 1	556	15.3%	564	15.0%
Scale 2	2	0.1%	3	0.1%
Scale 3	0	0.0%	0	0.0%
Grand total	3641	100.0%	3768	100.0%

Table 3.2: Number of incidents per scale and synchronous area in 2023.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand total
Baltic	33	1	-	-	34
Continental Europe	2591	548	1	-	3140
Great Britain	219	1	-	-	220
Ireland	18	-	-	-	18
Isolated systems	13	1	1	-	15
Nordic	209	5	-	-	214
Grand total	3083	556	2	-	3641

Table 3.3: Number of events per scale and synchronous area in 2023.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand total
Baltic	35	1	-	-	36
Continental Europe	2690	556	2	-	3248
Great Britain	231	1	-	-	232
Ireland	18	-	-	-	18
Isolated systems	13	1	1	-	15
Nordic	214	5	-	-	219
Grand total	3201	564	3	-	3768

Table 3.4: Percentage distribution of incidents per scale and synchronous area in 2023.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	97.1%	2.9%	-	-
Continental Europe	82.5%	17.5%	0.0%	-
Great Britain	99.5%	0.5%	-	-
Ireland	100.0%	-	-	-
Isolated systems	86.7%	6.7%	6.7%	-
Nordic	97.7%	2.3%	-	-
Grand total	84.7%	15.3%	0.1%	-

Table 3.5: Percentage distribution of events per scale and synchronous area in 2023.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	97.2%	2.8%	-	-
Continental Europe	82.8%	17.1%	0.1%	-
Great Britain	99.6%	0.4%	-	-
Ireland	100.0%	-	-	-
Isolated systems	86.7%	6.7%	6.7%	-
Nordic	97.7%	2.3%	-	-
Grand total	85.0%	15.0%	0.1%	-

Table 3.6: Number of incidents per scale for each TSO in the pan-European transmission grid in 2023.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	AST	6	-	-	-	6
	Elering	20	-	-	-	20
	Litgrid	7	1	-	-	8
	Total	33	1	-	-	34
Continental Europe	50Hertz	69	5	-	-	74
	Amprion	90	10	-	-	100
	APG	19	8	-	-	27
	CEPS	87	45	-	-	132
	CGES	19	3	-	-	22
	ELES	10	10	-	-	20
	Elia	11	1	-	-	12
	EMS	33	138	-	-	171
	Energinet (CE)	18	4	-	-	22
	ESO	111	-	-	-	111
	Freq (CE)	203	13	-	-	216
	HOPS	46	2	-	-	48
	IPTO	93	20	-	-	113
	MAVIR	330	132	-	-	462
	Moldelectrica	15	-	1	-	16
	NOS BiH	8	3	-	-	11
	OST	21	-	-	-	21
	PSE	87	1	-	-	88
	Red Eléctrica	254	13	-	-	267
	REN	27	2	-	-	29
	RTE	309	22	-	-	331
	SEPS	6	6	-	-	12
	Swissgrid	68	9	-	-	77
	TEIAS	20	1	-	-	21
	TenneT DE	60	11	-	-	71
	TenneT NL	74	10	-	-	84
	Terna	67	2	-	-	69
	Transelectrica	203	53	-	-	256
	TransnetBW	20	2	-	-	22
	Ukrenergo	213	22	1	-	236
	Total	2591	548	2	-	3141
Great Britain	National Grid ESO	219	1	-	-	220
	Total	219	1	-	-	220
Ireland and Northern Ireland	EirGrid	17	-	-	-	17
	SONI	1	-	-	-	1
	Total	18	-	-	-	18
Isolated system	Landsnet	13	1	1	-	15
	Total	13	1	1	-	15
Nordic	Energinet (Nordic)	5	1	-	-	6
	Fingrid	7	-	-	-	7
	Freq (Nordic)	88	-	-	-	88
	Statnett	32	4	-	-	36
	Svenska kraftnät	77	-	-	-	77
	Total	209	5	-	-	214
Grand total		3083	556	3	-	3642

Table 3.7: Number of events per scale for each TSO in the pan-European transmission grid in 2023.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	AST	6	-	-	-	6
	Elering	20	-	-	-	20
	Litgrid	9	1	-	-	10
	Total	35	1	-	-	36
Continental Europe	50Hertz	74	5	-	-	79
	Amprion	90	11	-	-	101
	APG	19	8	-	-	27
	CEPS	87	52	-	-	139
	CGES	19	3	-	-	22
	ELES	10	10	-	-	20
	Elia	11	1	-	-	12
	EMS	33	138	-	-	171
	Energinet (CE)	18	4	-	-	22
	ESO	142	-	-	-	142
	Freq (CE)	210	13	-	-	223
	HOPS	52	2	-	-	54
	IPTO	93	20	-	-	113
	MAVIR	330	132	-	-	462
	Moldelectrica	15	-	1	-	16
	NOS BiH	8	3	-	-	11
	OST	41	-	-	-	41
	PSE	87	1	-	-	88
	Red Eléctrica	267	13	-	-	280
	REN	27	2	-	-	29
	RTE	309	22	-	-	331
	SEPS	8	6	-	-	14
	Swissgrid	69	9	-	-	78
	TEIAS	33	1	-	-	34
	TenneT DE	60	11	-	-	71
	TenneT NL	74	10	-	-	84
	Terna	68	2	-	-	70
	Transelectrica	203	53	-	-	256
	TransnetBW	20	2	-	-	22
	Ukrenergo	213	22	1	-	236
	Total	2690	556	2	-	3248
Great Britain	National Grid ESO	231	1	-	-	232
	Total	231	1	-	-	232
Ireland and Northern Ireland	EirGrid	17	-	-	-	17
	SONI	1	-	-	-	1
	Total	18	-	-	-	18
Isolated system	Landsnet	13	1	1	-	15
	Total	13	1	1	-	15
Nordic	Energinet (Nordic)	5	1	-	-	6
	Fingrid	7	-	-	-	7
	Freq (Nordic)	88	-	-	-	88
	Statnett	36	4	-	-	40
	Svenska kraftnät	78	-	-	-	78
	Total	214	5	-	-	219
Grand total		3201	564	3	-	3768

Table 3.8: Incidents by dominating criteria for each synchronous area in 2023.

Scale	ICS criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale0	Incidents on load (L0)	-	4	-	-	1	-	5
	Incidents leading to frequency degradation (F0)	-	203	3	-	-	88	294
	Incidents on network elements (T0)	24	1659	184	5	12	88	1972
	Incidents on power generating facilities (G0)	9	90	9	13	-	17	138
	Separation from the grid (RS0)	-	1	-	-	-	2	3
	Violation of standards on voltage (OV0)	-	436	-	-	-	-	436
	Reduction of reserve capacity (RRC0)	-	91	-	-	-	-	91
	Loss of tools, means and facilities (LT0)	-	107	23	-	-	14	144
	Total	33	2591	219	18	13	209	3083
Scale1	Incidents on load (L1)	-	20	-	-	-	-	20
	Incidents leading to frequency degradation (F1)	-	13	-	-	-	-	13
	Incidents on network elements (T1)	1	19	-	-	1	3	24
	Incidents on power generating facilities (G1)	-	2	1	-	-	-	3
	N-1 violation (ON1)	-	57	-	-	-	1	58
	Separation from the grid (RS1)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	359	-	-	-	-	359
	Reduction of reserve capacity (RRC1)	-	60	-	-	-	-	60
	Loss of tools, means and facilities (LT1)	-	18	-	-	-	1	19
	Total	1	548	1	-	1	5	556
Scale2	Incidents on load (L2)	-	1	-	-	-	-	1
	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	-	1	-	-	1	-	2
Scale3	Blackout (OB3)	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-
Grand Total		34	3140	220	18	15	214	3641

Table 3.9: Events by dominating criteria for each synchronous area in 2023.

Scale	ICS criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale0	Incidents on load (L0)	-	10	-	-	1	3	14
	Incidents leading to frequency degradation (F0)	-	210	4	-	-	88	302
	Incidents on network elements (T0)	26	1741	192	5	12	88	2064
	Incidents on power generating facilities (G0)	9	94	11	13	-	18	145
	Separation from the grid (RS0)	-	1	-	-	-	2	3
	Violation of standards on voltage (OV0)	-	436	-	-	-	1	437
	Reduction of reserve capacity (RRC0)	-	91	-	-	-	-	91
	Loss of tools, means and facilities (LT0)	-	107	24	-	-	14	145
	Total	35	2690	231	18	13	214	3201
Scale1	Incidents on load (L1)	-	27	-	-	-	-	27
	Incidents leading to frequency degradation (F1)	-	13	-	-	-	-	13
	Incidents on network elements (T1)	1	19	-	-	1	3	24
	Incidents on power generating facilities (G1)	-	2	1	-	-	-	3
	N-1 violation (ON1)	-	58	-	-	-	1	59
	Separation from the grid (RS1)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	359	-	-	-	-	359
	Reduction of reserve capacity (RRC1)	-	60	-	-	-	-	60
	Loss of tools, means and facilities (LT1)	-	18	-	-	-	1	19
	Total	1	556	1	-	1	5	564
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		36	3248	232	18	15	219	3768

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 2023.

The data concerning circuit length and energy consumption 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 2023 per consumption, the Baltic area has the highest value, at 1.3 ICS events per TWh of consumption, whereas the Ireland and Northern Ireland synchronous area has the lowest value at 0.4 events per TWh of consumption. For scale 1, the minimum value is 0 events per TWh in IE/NI, and the maximum value is 0.2 events per TWh in Continental Europe. 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 2023 is normalised by circuit length, 0.5 events per 100 km circuit length can be found for isolated systems. The Baltic and Nordic synchronous areas recorded respectively 0.2 and 0.4 events per 100 km circuit length, with the remaining synchronous areas showing 0.6 events per 100 km circuit length.

Incidents on transmission network elements caused a significant portion of the events in the transmission grid in 2023, 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 to the difference, and in IE/NI, where G0 events constitute the majority of reported ICS incidents.

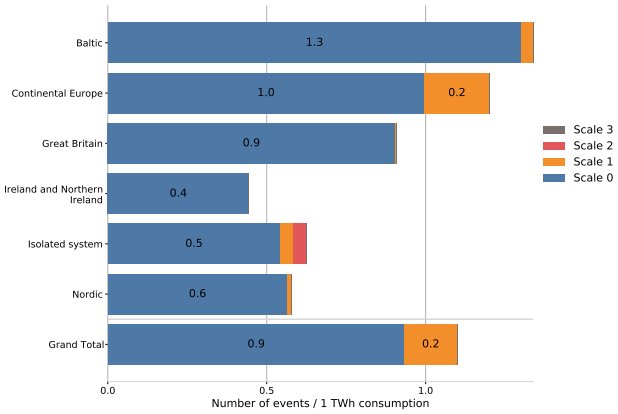

Figure 3.1: Number of events per 1 TWh of energy consumption in 2023.

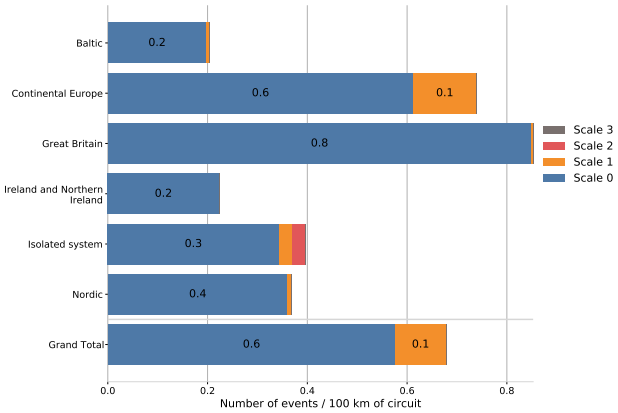

Figure 3.2: Number of events per 100 km of circuit length in 2023.

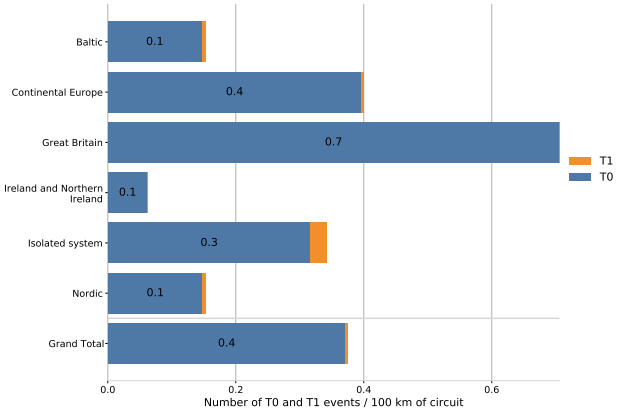

Figure 3.3: Number of events on transmission network elements (T0 and T1) per 100 km of circuit length in 2023.

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3.3 Evolution 2019–2023

This section presents classified events according to the ICS Methodology [2] as it developed between 2019–2023. 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 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 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 2019 and 2023. 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 is higher than in 2020 and before. The increase consists mainly of F1 events in 2021 and OV1 events since 2021. 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, returned to 2019 levels in 2022 and increased again significantly in 2023. The fluctuation is mainly visible in the varying number of registered F0 and T0 events.

The number of scale 1 events in 2023 is on the same level as 2022 which is still less than the peak in 2021 (815 events) and higher than the level of 2019 and 2020 (363 and 328 events respectively). This shift was mainly driven by the increased number of OV1 events. The second driver in 2021 was F1 events, which increased by 95 events but decreased back to 7 registered F1 events in 2022 and 13 events in 2023.

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 fluctuated since 2020 and decreased significantly in 2023. For the other synchronous areas, the numbers are more or less stable.

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 2023 decreased compared to 2022 in all synchronous areas. 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.

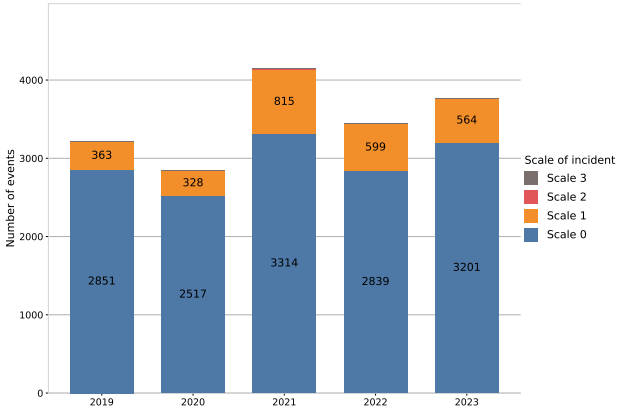

Figure 3.4: The annual number of events per scale from 2019–2023.

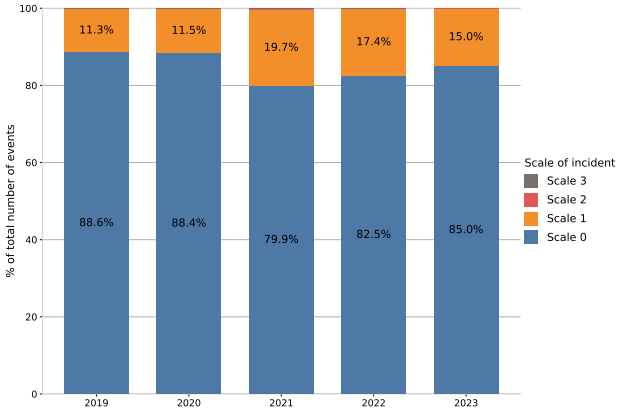

Figure 3.5: The annual percentage distribution of events per scale from 2019–2023.

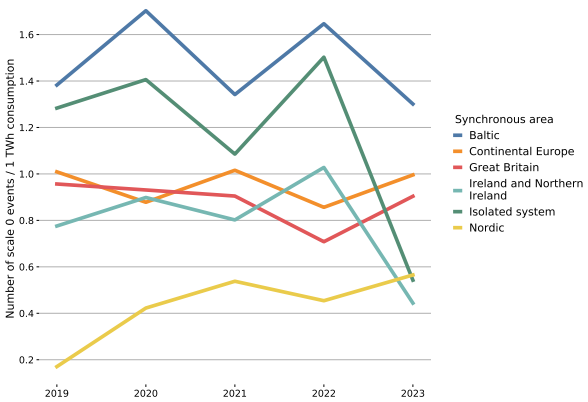

Figure 3.6: The annual number of scale 0 events per 1 TWh of energy consumption from 2019–2023.

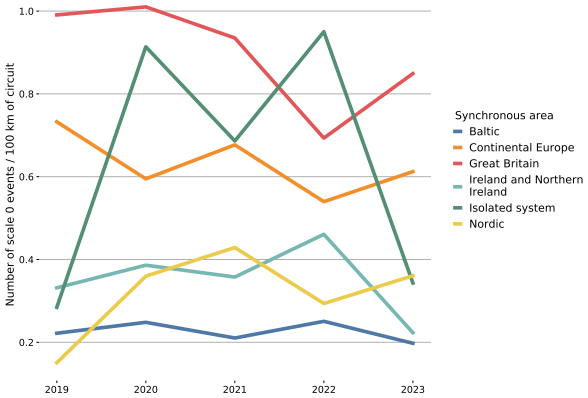

Figure 3.7: The annual number of scale 0 events per 100 km of circuit length from 2019–2023.

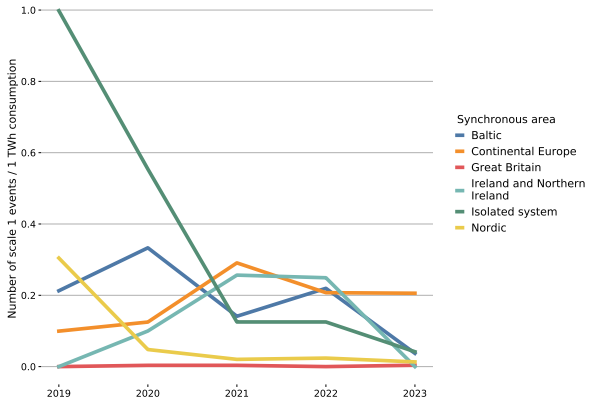

Figure 3.8: The annual number of scale 1 events per 1 TWh of energy consumption from 2019–2023.

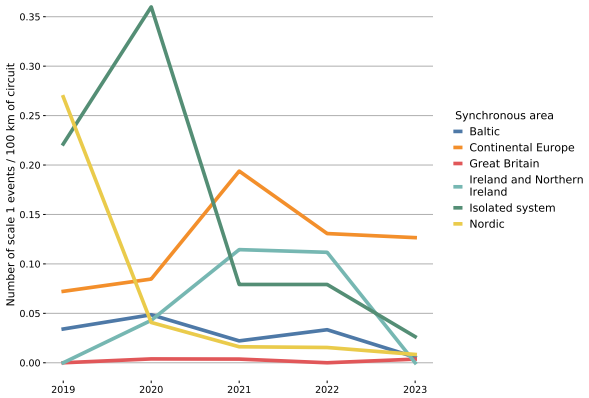

Figure 3.9: The annual number of scale 1 events per 100 km of circuit length from 2019–2023.

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Table 3.10: The annual number of incidents per dominating criteria from 2019–2023.

Scale	ICS criterion	2019	2020	2021	2022	2023
Scale0	Incidents on load (L0)	-	2	1	9	5
	Incidents leading to frequency degradation (F0)	841	356	811	275	294
	Incidents on network elements (T0)	1453	1314	1539	1446	1869
	Incidents on power generating facilities (G0)	119	144	186	155	138
	Separation from the grid (RS0)	-	-	-	-	3
	Violation of standards on voltage (OV0)	286	422	456	441	432
	Reduction of reserve capacity (RRC0)	1	-	26	185	91
	Loss of tools, means and facilities (LT0)	149	185	102	90	98
	Total	2849	2423	3121	2601	2930
Scale1	Incidents on load (L1)	4	7	1	3	20
	Incidents leading to frequency degradation (F1)	114	7	95	7	13
	Incidents on network elements (T1)	32	30	30	29	23
	Incidents on power generating facilities (G1)	-	-	5	-	3
	N-1 violation (ON1)	25	59	67	68	57
	Separation from the grid (RS1)	-	1	1	-	-
	Violation of standards on voltage (OV1)	9	116	500	382	268
	Reduction of reserve capacity (RRC1)	161	66	61	74	57
	Loss of tools, means and facilities (LT1)	18	30	32	21	19
	Total	363	316	792	584	460
Scale2	Incidents on load (L2)	-	1	2	2	1
	Incidents leading to frequency degradation (F2)	1	-	1	-	-
	Incidents on network elements (T2)	1	-	3	1	1
	Incidents on power generating facilities (G2)	-	-	1	-	-
	N violation (ON2)	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	-	-
	Total	3	1	11	3	2
Scale3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		3215	2740	3924	3188	3392

Table 3.11: The annual number of events per dominating criteria from 2019–2023.

Scale	ICS criterion	2019	2020	2021	2022	2023
Scale0	Incidents on load (L0)	-	4	4	11	14
	Incidents leading to frequency degradation (F0)	841	360	819	280	302
	Incidents on network elements (T0)	1455	1362	1664	1596	2064
	Incidents on power generating facilities (G0)	119	146	197	179	145
	Separation from the grid (RS0)	-	2	2	3	3
	Violation of standards on voltage (OV0)	286	454	495	480	437
	Reduction of reserve capacity (RRC0)	1	-	26	185	91
	Loss of tools, means and facilities (LT0)	149	189	107	105	145
	Total	2851	2517	3314	2839	3201
Scale1	Incidents on load (L1)	4	9	2	5	27
	Incidents leading to frequency degradation (F1)	114	7	95	7	13
	Incidents on network elements (T1)	32	35	35	29	24
	Incidents on power generating facilities (G1)	-	1	6	-	3
	N-1 violation (ON1)	25	62	68	69	59
	Separation from the grid (RS1)	-	1	1	1	-
	Violation of standards on voltage (OV1)	9	117	513	392	359
	Reduction of reserve capacity (RRC1)	161	66	63	74	60
	Loss of tools, means and facilities (LT1)	18	30	32	22	19
	Total	363	328	815	599	564
Scale2	Incidents on load (L2)	-	1	2	2	2
	Incidents leading to frequency degradation (F2)	1	-	1	-	-
	Incidents on network elements (T2)	1	-	4	1	1
	Incidents on power generating facilities (G2)	-	-	1	-	-
	N violation (ON2)	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	-	-
	Total	3	1	17	3	3
Scale3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		3217	2846	4146	3441	3768

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 2023 is similar to 2022. The main difference is caused by Nordic Area where number of incidents increased for 63%. Nevertheless, even Nordic situation is normal and 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.

Table 3.12: The annual number of F-events from 2019–2023.

Synchronous area	2019	2020	2021	2022	2023
Baltic	1	-	-	-	-
CE	766	299	839	226	223
GB	79	2	3	7	4
IE-NI	4	-	-	-	-
Isolated system	-	-	-	-	-
Nordic	106	66	73	54	88
Grand total	956	367	915	287	315

Table 3.13: The annual number of F-events per cause from 2019–2023.

Cause of event	2019	2020	2021	2022	2023
Unexpected flows	2	-	-	-	-
Loss of generation	16	1	-	-	1
Environmental causes	1	-	-	-	-
Operation and maintenance	1	-	-	-	-
Tripped network element	15	-	-	-	-
Previous event	-	1	4	7	6
LGF deviations	7	2	-	-	-
Other	2	1	-	-	2
Unknown	912	362	911	280	306
Grand total	956	367	915	287	315

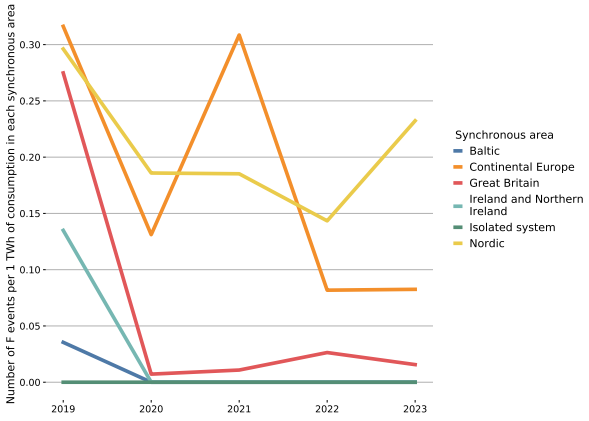

Figure 3.10: The annual number of F events per 1 TWh of consumption in each synchronous area from 2019–2023.

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 shows 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 in 2023 are caused mostly by technical equipment reasons, which have considerably increased when compared to data reported in previous years and they justify the rise of the grand total of reported T-events. Environmental and unknown causes are once again representing two of the main causes behind this kind of events.

The number of T events between 2019 and 2023 shows an increasing pattern which lies in the increase of incidents reported for CE. For this synchronous area, the trend of the annual number of T events per-100 km installed circuit length has considerably increased in 2023 compared to 2022. The reason is that almost 500 more events have been reported when compared to 2022 and the difference cannot be compensated by the increasing kms of installed circuit length, which is almost negligible when relating both parameters.

Table 3.14: The annual number of T-events from 2019–2023 per synchronous area.

Synchronous area	2019	2020	2021	2022	2023
Baltic	31	25	25	33	27
CE	1221	1078	1318	1288	1760
GB	155	169	218	157	192
IE-NI	9	8	11	18	5
Isolated system	12	41	27	32	14
Nordic	60	76	104	98	91
Grand total	1488	1397	1703	1626	2089

Table 3.15: The annual number of T-events per cause from 2019–2023.

Cause of event	2019	2020	2021	2022	2023
Nature (animals, vegetation)	74	1	-	-	-
Unexpected flows	4	-	-	-	-
Unavailability of reactive compensation	2	-	-	-	-
Loss of tools or facilities	34	-	-	-	-
Environmental causes	266	306	341	375	427
External influences	-	95	138	154	175
Operation and maintenance	36	90	165	92	119
Technical equipment	87	113	488	523	770
Tripped network element	605	53	2	1	17
Previous event	-	32	50	48	47
LGF deviations	1	-	-	-	4
Other	218	86	138	95	95
Unknown	161	621	381	338	435
Grand total	1488	1397	1703	1626	2089

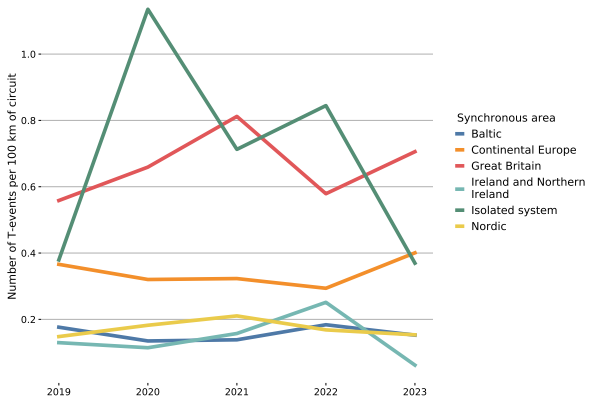

Figure 3.11: The annual number of T-events per 100 km installed circuit length in each synchronous area from 2019–2023.

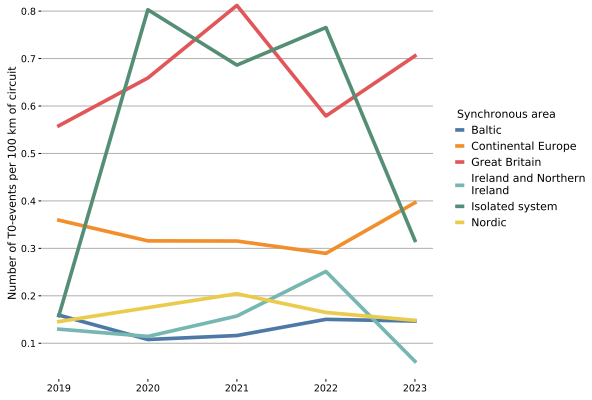

Figure 3.12: The annual number of T0-events per 100 km installed circuit length in each synchronous area from 2019–2023.

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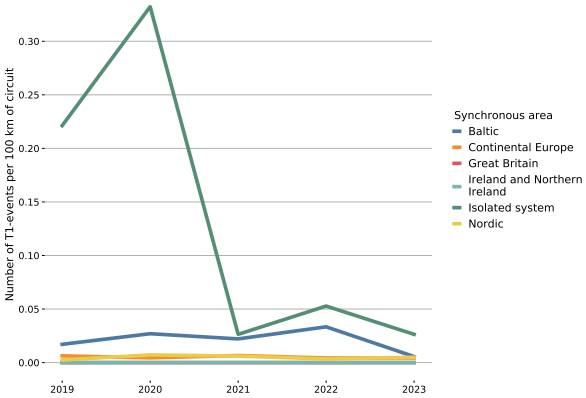

Figure 3.13: The annual number of T1-events per 100 km installed circuit length in each synchronous area from 2019–2023.

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 2023 when compared to 2022 and 2021, the year in which the number of G events was much higher than previous years. The trend is the same for all synchronous areas but for the Nordic SA and GB, in which the number of G events has slightly increased.

From Table 3.17, it can be seen that most G events are due to technical reasons. Even though the number of T events have considerably increased in 2023 in CE, the overall number of G events that are caused by tripped network elements has not increased that much.

Almost all G events were of Scale 0 in 2023 and only 3 G1 events were reported. Even though the amount of G events per TWh of consumption in the Baltics was the highest of all synchronous areas in 2021 and 2022, the lower number of G events reported in 2023 equalises it with the ration in Ireland and Northern Ireland (IE/NI) (its ratio of events per TWh of consumption has also decreased but less than that of the Baltics).

Table 3.16: The annual number of G-events from 2019–2023.

Synchronous area	2019	2020	2021	2022	2023
Baltic	11	27	16	18	9
CE	93	81	143	123	96
GB	-	12	14	9	12
IE-NI	10	19	14	15	13
Isolated system	4	3	2	-	-
Nordic	1	5	15	14	18
Grand total	119	147	204	179	148

Table 3.17: The annual number of G-events per cause from 2019–2023.

Cause of event	2019	2020	2021	2022	2023
Loss of generation	83	6	-	-	1
Environmental causes	-	-	-	-	3
Operation and maintenance	-	-	1	-	-
Technical equipment	2	94	125	121	96
Tripped network element	-	20	43	16	7
Previous event	-	1	9	4	4
LGF deviations	-	1	-	-	1
Other	3	2	3	9	20
Unknown	31	23	23	29	16
Grand total	119	147	204	179	148

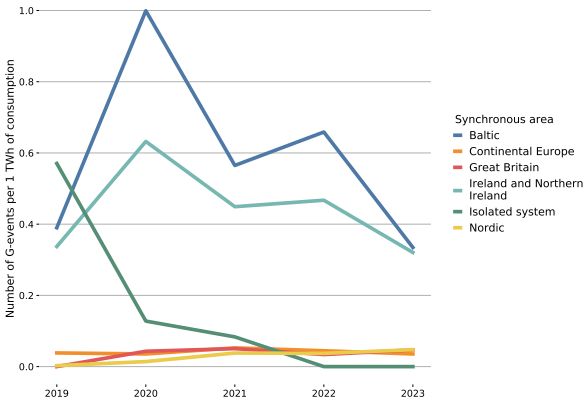

Figure 3.14: The annual number of G-events per 1 TWh of consumption for each synchronous area from 2019–2023.

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 2019 to 2023 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 with the exception of one event which occurred in the Nordics. The total number of OV events was 796 in 2023. While the number remains high ranking the category as the second most reported event after events on transmission system elements, it dropped by 9% compared to 2022 values and by 21% compared to 2021. Of the total of 796 OV events, 55% were classified as OV0 events with the remaining being OV1 events. This distribution remains the same as the previous year.

The TSOs CEPS, EMS, IPTO, MAVIR, Swissgrid and Transelectrica all reported more than 30 voltage violations in 2023 with the TSOs MAVIR, Transelectrica and EMS each reporting more than 100 voltage violations. Significant increases in the number of reported OV events in comparison to the previous year were seen by the TSOs CEPS, EMS, Red Eléctrica and TenneT NL while the TSOs Amprion, IPTO, MAVIR, RTE and Swissgrid all saw significant decreases in the number of reported OV events in comparison to 2022.

The main contributing factors of voltage violations in the European grid continue to be in the infeed of power from renewable energies, particularly at times of low demand. This, coupled with a gradual phasing out of conventional power generation facilities and the loss of flexible provision of reactive power and system inertia associated with it, can lead to increased volatility of voltage levels. Additionally, some TSOs have been experiencing an increase in reactive power feed in from the distribution system which can contribute to increased numbers of voltage violations.

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 2019–2023.

Synchronous area	2019	2020	2021	2022	2023
Baltic	-	1	-	-	-
CE	295	570	1008	872	795
GB	-	-	-	-	-
IE-NI	-	-	-	-	-
Isolated system	-	-	-	-	-
Nordic	-	-	-	-	1
Grand total	295	571	1008	872	796

Table 3.19: The annual number of OV-events per cause from 2019–2023.

Cause of event	2019	2020	2021	2022	2023
Unexpected flows	1	-	-	-	-
Loss of generation	-	-	-	3	-
Unavailability of reactive compensation	221	40	-	-	-
Operation and maintenance	-	2	-	-	-
Technical equipment	-	2	1	-	-
Tripped network element	-	1	-	-	-
Previous event	-	1	22	-	4
LGF deviations	-	-	1	7	9
Other	30	229	770	249	287
Unknown	43	296	214	613	496
Grand total	295	571	1008	872	796

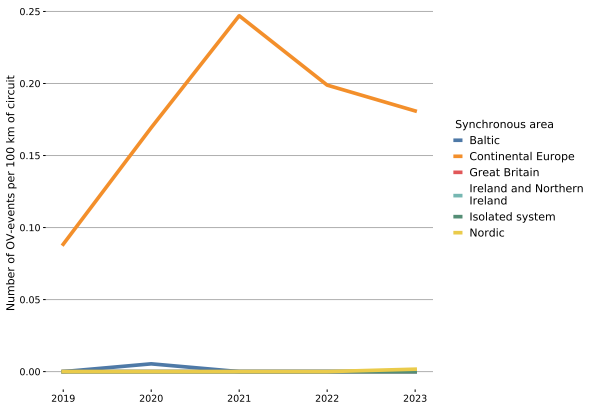

Figure 3.15: The annual number of OV-events per 100 km of installed circuit length in each synchronous area from 2019–2023.

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 2019 to 2023.

All RRC events were reported by seven TSOs located in the synchronous area CE. Of all reported RCC incidents, 85% were reported by MAVIR. Of the 151 events reported, 91 were scale 0 (RRC0), 60 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.

Table 3.20: The annual number of RRC-events from 2019–2023.

Synchronous area	2019	2020	2021	2022	2023
Baltic	-	-	-	-	-
CE	162	66	90	259	151
GB	-	-	-	-	-
IE-NI	-	-	-	-	-
Isolated system	-	-	-	-	-
Nordic	-	-	-	-	-
Grand total	162	66	90	259	151

Table 3.21: The annual number of RRC-events per cause from 2019–2023.

Cause of event	2019	2020	2021	2022	2023
Loss of generation	1	-	4	7	9
External influences	-	1	-	-	1
Technical equipment	-	-	-	-	1
Lack of reserves	158	64	-	-	-
Previous event	-	-	2	-	1
LGF deviations	2	-	62	242	131
Other	-	-	10	10	8
Unknown	1	1	12	-	-
Grand total	162	66	90	259	151

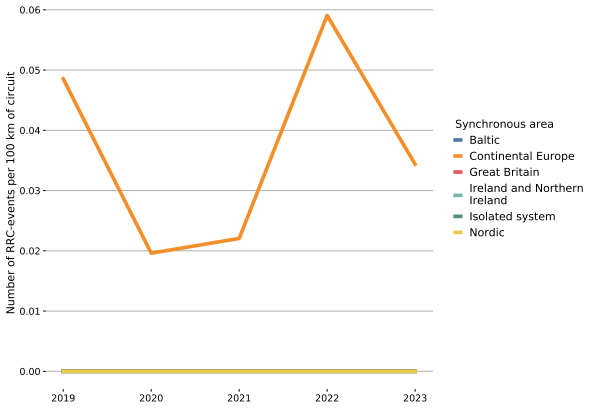

Figure 3.16: The annual number of RRC-events per 100 km of installed circuit length in each synchronous area from 2019–2023.

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 2022, the number of LT events has increased from 127 to a total of 164. As in 2022, TenneT Netherlands also reported the most LT0 incidents in 2023. This represents 31% of all LT0 incidents. No LT2 incidents occurred in 2023.

Most of the LT events had as cause other, unknown or by technical equipment, as seen in Table 3.23.

Table 3.22: The annual number of LT-events from 2019–2023.

Synchronous area	2019	2020	2021	2022	2023
Baltic	-	-	1	-	-
CE	124	125	98	105	125
GB	42	77	17	15	24
IE-NI	-	-	-	-	-
Isolated system	-	1	1	2	-
Nordic	1	16	23	5	15
Grand total	167	219	140	127	164

Table 3.23: The annual number of LT-events per cause from 2019–2023.

Cause of event	2019	2020	2021	2022	2023
Loss of tools or facilities	134	25	1	-	-
Environmental causes	-	1	-	-	-
Operation and maintenance	-	7	7	5	7
Technical equipment	-	93	49	35	33
Previous event	-	4	-	-	-
LGF deviations	-	1	-	-	-
Other	33	70	55	59	83
Unknown	-	18	28	28	41
Grand total	167	219	140	127	164

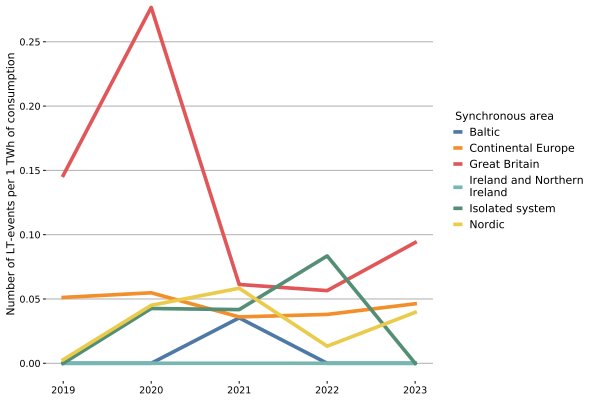

Figure 3.17: The annual number of LT-events per 1 TWh of consumption for each synchronous area from 2019–2023.

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 2023, ON violations were only reported in the synchronous area CE (58) and Nordic (1).

Like in previous years, most ON events were caused by unexpected discrepancies from load or generation forecasts. Improving load flow and generation forecasts could drastically reduce the number of ON events. While this improvement is of critical importance as each ON event degrades the TSO's operating state to alert or emergency, it is difficult to implement as renewable forecasting becomes more elusive due to extreme weather events as a result of climate change and the increase in RES in distributed energy resources.

In the synchronous area CE the TSOs RTE (15), Amprion (9), TenneT DE (9), APG (8) and ELES (8) have the most reported number of ON1 events. No ON2 incidents occurred in 2023.

Table 3.24: The annual number of ON-events from 2019–2023.

Synchronous area	2019	2020	2021	2022	2023
Baltic	-	1	-	-	-
CE	26	56	61	57	58
GB	-	-	-	-	-
IE-NI	-	3	8	8	-
Isolated system	-	-	-	-	-
Nordic	-	2	-	4	1
Grand total	26	62	69	69	59

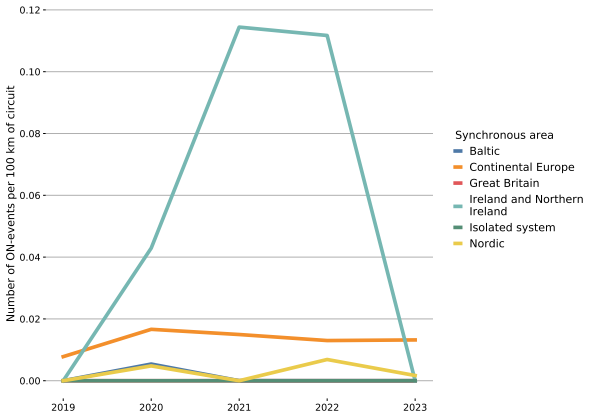

Figure 3.18: The annual number of ON-events per 100 km of installed circuit length in each synchronous area from 2019–2023.

Table 3.25: The annual number of ON-events per cause from 2019–2023.

Cause of event	2019	2020	2021	2022	2023
Unexpected flows	23	2	-	-	-
Loss of generation	-	-	-	-	2
Operation and maintenance	-	3	-	-	-
Technical equipment	-	-	1	-	-
Tripped network element	-	1	-	-	-
Previous event	-	6	9	10	1
LGF deviations	-	39	44	37	37
Other	3	9	10	21	9
Unknown	-	2	5	1	10
Grand total	26	62	69	69	59

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 Baltic, GB, Nordic or IE/NI in 2023. The only synchronous areas with scale 2 incidents in 2023 was the isolated system in Iceland with one scale 2 incident and CE with 1 (Moldelectrica and Ukrenergo each reported one incident, which were the same in the end). The scale 2 incident in Iceland was due to an overload when one 220kV line tripped because it sagged down to a tree and shorted.

The scale 2 incident Ukraine and Moldova occurred on 30 May 2023 12:28 CET due to a permanent earth fault located in the Belarusian part of the 330 kV line Chornobyl NPP – Slavutych . The permanent earth fault was a short-circuit, after which the relay protection schemes began to disconnect the 330 kV lines (cascade shutdown of several 330 kV). After the cascading event, the UA/MD power grid was divided into two parts: one where the Western UA remained connected to the synchronous area of CE, with an unintended power deviation of approximately 2240 MW (surplus), and a second with the rest of the UA/MD system, which experienced a significant power deficit and caused a decrease in frequency down to 48.2 Hz, which was limited by means of the Low Frequency Demand Disconnection (LFDD). The total amount of deenergized load by LFDD was 1962.8 MW in Ukraine 225 MW in Moldova. Frequency was restored to 50.0 Hz after approximately 25 seconds. The UA/MD power system was re-synchronized to CE At 13:05 CET by reclosing the 330 kV TL Dnistrovska HPP – Balti. The remaining transmission lines where subsequently reclosed and the re-synchronization was completed at 13:22 CET.

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 OS-F2 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 2023.

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 per year per TSO – SOGL Article 15(3)(a) [2].	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) [2].	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) [2].	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) [2].	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) [2].	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) [2].	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) [2].	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 SO GL Annex II per year per TSO – SOGL Article 15(3)(f) [2].	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 [2].
OS-F2	Number of voltage deviations exceeding the ranges from Tables 1 and 2 of SOGL [2] Annex II per year per TSO – SOGL Article 15(3)(f) [2].	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 [2].
OS-G1	Number of minutes outside the standard frequency range per year per synchronous area – SOGL Article 15(3)(g) [2].	Annual Load-Frequency Control Reporting [4] 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) [2].	Annual Load-Frequency Control reporting [4] 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) [2].	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) [2].	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	7	1	-	-	-	-	-	-	-	-	-	-	-	8
	Elering	20	9	-	-	-	-	-	-	-	-	-	-	-	29
	Litgrid	12	-	-	15	1	-	-	-	-	-	-	-	-	28
	Total	39	10	-	15	1	-	-	-	-	-	-	-	-	65
Continental Europe	50Hertz	72	3	-	29	1	-	-	-	-	-	-	-	-	105
	Amprion	89	10	-	1019	9	-	-	-	-	-	-	-	-	1127
	APG	19	23	-	1500	8	-	-	-	-	-	-	-	-	1550
	CEPS	59	3	310	243	2	-	-	10515	153	-	-	-	-	11285
	CGES	22	-	-	-	-	-	-	-	-	-	-	-	-	22
	ELES	6	-	-	2070	14	-	-	-	-	-	-	-	-	2090
	Elia	8	1	-	-	-	-	-	-	-	-	-	-	-	9
	EMS	36	170	100	1458	6	1473	4	92162	132	-	-	-	-	95541
	Energinet (CE)	26	-	-	-	-	-	-	-	-	-	-	-	-	26
	ESO	143	6	-	-	-	-	-	-	-	-	-	-	-	149
	Freq (CE)	-	-	-	-	-	-	-	-	-	15389.18	212.08	-	-	15601.27
	HOPS	52	16	-	460	2	-	-	-	-	-	-	-	-	530
	IPTO	80	-	104	-	-	-	-	4376	85	-	-	-	-	4645
	MAVIR	7	-	-	-	-	4320	129	33664	1198	-	-	-	-	39318
	Moldelectrica	18	4	259	3	1	-	-	-	-	-	-	-	-	285
	NOS BiH	16	-	-	-	-	-	-	-	-	-	-	-	-	16
	OST	42	-	-	-	-	-	-	-	-	-	-	-	-	42
	PSE	103	13	6	480	1	11836	12	-	-	-	-	-	-	12451
	Red Eléctrica	372	95	-	-	-	-	-	2792	63	-	-	-	-	3322
	REN	63	71	-	139	1	-	-	-	-	-	-	-	-	274
	RTE	325	23	229	52	1	161	2	452	14	-	-	-	-	1259
	SEPS	9	-	-	748	5	5068	5	-	-	-	-	-	-	5835
	Swissgrid	33	2	113	1399	6	-	-	2515	117	-	-	-	-	4185
	TEIAS	109	48	61514	-	-	-	-	23	1	-	-	-	-	61695
	TenneT DE	58	-	-	-	-	-	-	-	-	-	-	-	-	58
	TenneT NL	17	10	-	864	6	-	-	1160	12	-	-	-	-	2069
	Terna	82	-	-	-	-	39	1	90	2	-	-	-	-	214
	Transelectrica	116	34	-	-	-	-	-	10419	202	-	-	-	-	10771
	TransnetBW	22	12	-	291	3	-	-	-	-	-	-	-	-	328
	Ukrenergo	367	43	7956	-	-	3066	11	-	-	-	-	-	-	11443
	Total	2371	587	70591	10755	66	25963	164	158168	1979	15389.18	212.08	-	-	286245.30
Great Britain	National Grid ESO	192	67	-	-	-	-	-	9	1	710.60	60.48	-	-	1040.08
	Total	192	67	-	-	-	-	-	9	1	710.60	60.48	-	-	1040.08
Ireland and Northern Ireland	EirGrid	6	13	-	-	-	-	-	-	-	3.62	0.08	-	-	22.70
	SONI	1	-	-	-	-	-	-	-	-	-	-	-	-	1
	Total	7	13	-	-	-	-	-	-	-	3.62	0.08	-	-	23.70
Isolated system	Landsnet	35	13	572	6403	15	-	-	-	-	-	-	-	-	7038
	Total	35	13	572	6403	15	-	-	-	-	-	-	-	-	7038
Nordic	Energinet (Nordic)	5	-	-	-	-	-	-	-	-	-	-	-	-	5
	Fingrid	7	7	-	-	-	-	-	-	-	-	-	-	-	14
	Freq (Nordic)	-	-	-	-	-	-	-	-	-	9714	-	-	-	9714
	Statnett	50	8	151	179	3	-	-	10	-	-	-	-	-	401
	Svenska kraftnät	64	14	-	-	-	-	-	-	-	-	-	-	-	78
	Total	126	29	151	179	3	-	-	10	-	9714	-	-	-	10212
Grand Total		2770	719	71314	17352	85	25963	164	158187	1980	25817.40	272.65	-	-	304624.10

5.1.1 Evolution of operational security indicators relevant for operational security, 2019–2023

Figure 5.1–Figure 5.12 show the annual calculated values for the OS indicators OS-A to OS-H for 2019–2023. The OS indicator OS-I has been omitted from this section as no scale 3 events were recorded in the ENTSO-E area from 2019–2023.

The security indicator OS-A, that is, the number of tripped transmission network elements, has a stable trend in all synchronous areas. The indicator OS-B (number of tripped power generating facilities) continues to decrease slightly compared to 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, which tracks energy not supplied due to unscheduled disconnection of demand facilities, was record high in continental Europe due to the earthquake that struck southern and central Türkiye. The reason OS-C is high in the isolated systems is mainly due to extreme weather in Iceland, which is the same reason as in 2022. 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 (number of minutes in alert or emergency state) decreased in 2023 in all synchronous areas except the isolated systems. The high values in isolated systems is due to extreme weather in Iceland.

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 reported by a few TSOs in CE. All the indicators OS-E and OS-F indicators decreased compared to the levels reported in 2022. However, they did not decrease back to the levels measured in 2020. This indicates that the measures TSOs have taken to combat the increased number of voltage violations and reductions of reserves are working. Nevertheless, TSOs still need to take measures to track and mitigate voltage violations and incidents impacting reserves. This is especially important as the green energy transition will further increase the amount of renewable energy sources in the generation mix, which challenges grid operations due to lack of reactive power and system inertia.

The reported OS-G1 minutes in 2023 reached an all-time high in 2023 and exceeded the frequency quality target parameter of 15000 minutes in CE defined by the SOGL [1]. More details can be seen in the Annual Load-Frequency Control (ALFC) Report of 2023.

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).

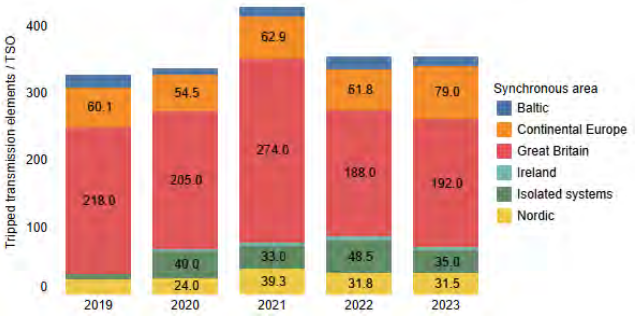

Figure 5.1: Operational security indicator OS-A from 2019–2023. It is calculated by adding up the number of tripped transmission system elements reported for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

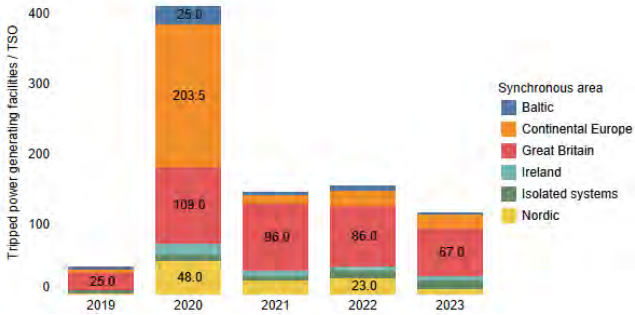

Figure 5.2: Operational security indicator OS-B from 2019–2023. It is calculated by adding up the number of tripped power generation facilities reported for scale 0–3 and below scale incidents and dividing by the number of TSOs in the synchronous area.

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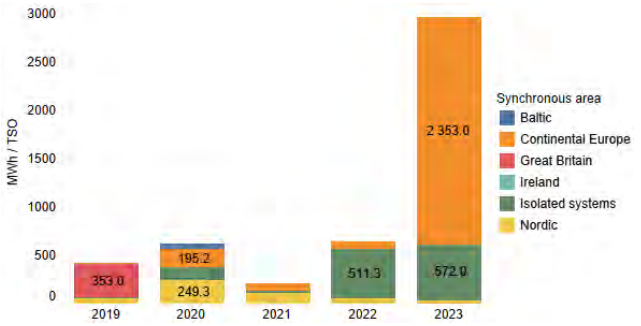

Figure 5.3: Operational security indicator OS-C from 2019–2023. It is calculated by adding up the reported energy not supplied due to unscheduled disconnection of demand facilities for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

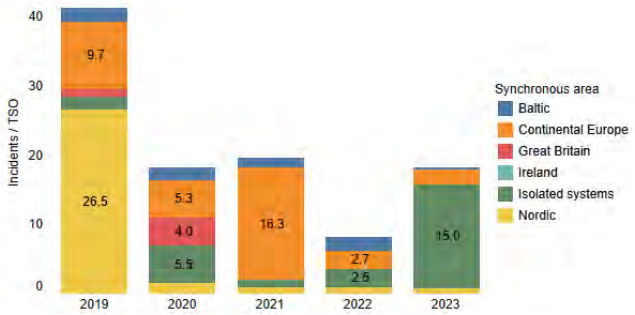

Figure 5.5: Operational security indicator OS-D2 from 2019–2023. It is calculated by counting the number of scale 0–3 incidents in which an alert or emergency state was reported, and dividing by the number of TSOs in the synchronous area.

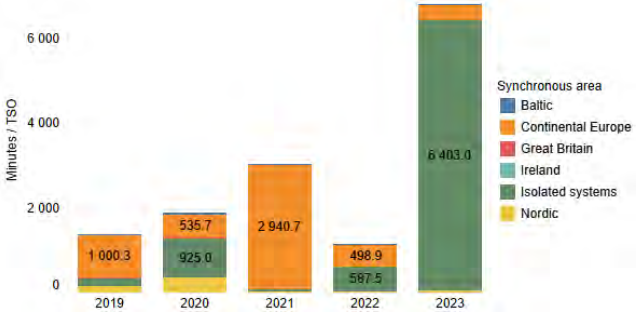

Figure 5.4: Operational security indicator OS-D1 from 2019–2023. It is calculated by adding up the number of minutes in alert and emergency states of all reported scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

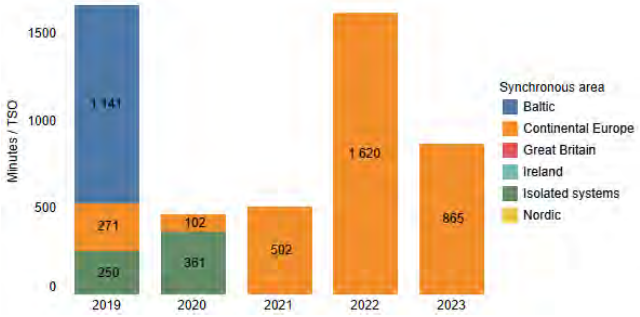

Figure 5.6: Operational security indicator OS-E1 from 2019–2023. It is calculated by adding up the duration of RRC0-, RRC1- and RRC2-incidents and the duration of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area.

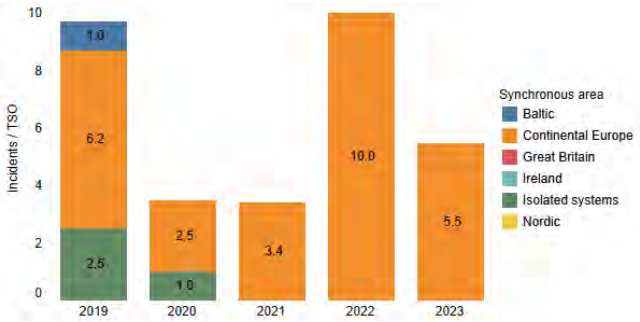

Figure 5.7: Operational security indicator OS-E2 from 2019–2023. It is calculated by counting the number RRC0-, RRC1- and RRC2-incidents and the number of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area.

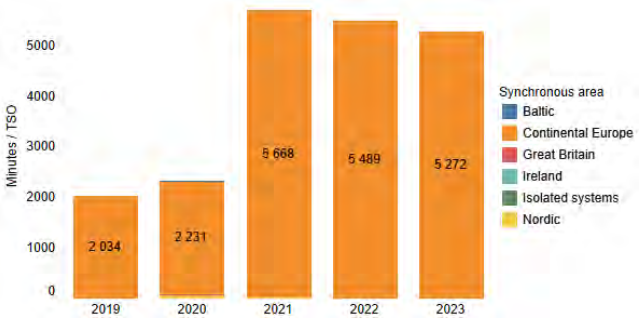

Figure 5.8: Operational security indicator OS-F1 from 2019–2023. It is calculated by adding up the duration of OVBS-, OV0-, OV1- and OV2-incidents and the duration of all other incidents on below scale and scale 0–3 where voltage deviations exceed the ranges from SO GL Annex II [2] are reported, and dividing by the number of TSOs in the synchronous area.

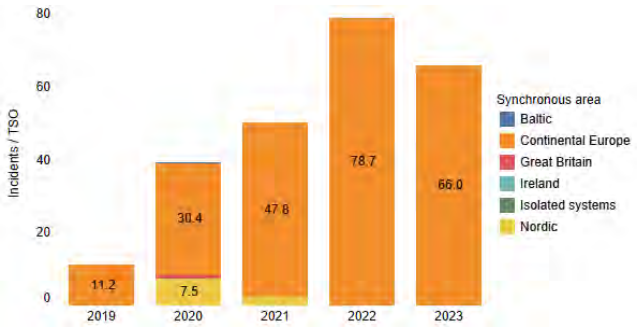

Figure 5.9: Operational security indicator OS-F2 from 2019–2023. It is calculated by counting the number of violation of standards of voltage incidents (OVBS,OV0, OV1 and OV2) and the number of all other below scale and scale 0–3 incidents in which the voltage standards are violated, and dividing by the number of TSOs in the synchronous area.

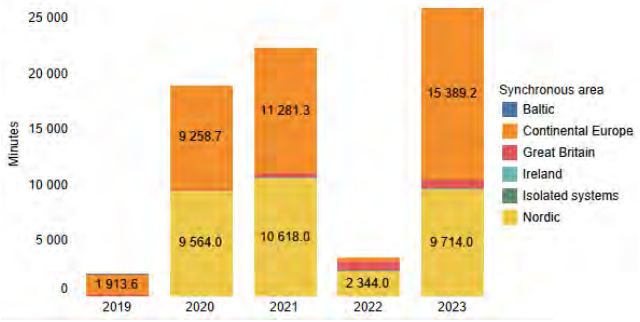

Figure 5.10: Operational security indicator OS-G1 from 2019–2023. It is calculated by adding up the number of minutes outside the standard frequency range for all scale 0–3 incidents.

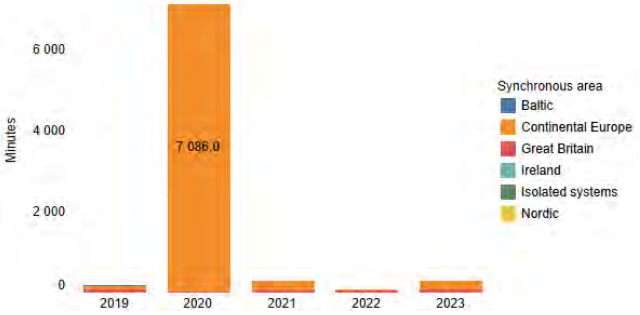

Figure 5.11: Operational security indicator OS-G2 from 2019–2023. It is calculated by adding up the number of minutes outside the 50 % of maximum steady-state frequency deviation for all scale 0–3 incidents.

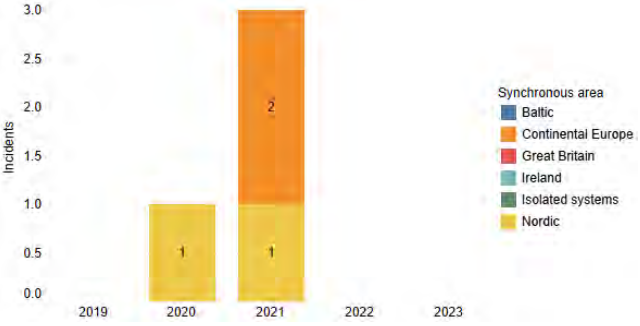

Figure 5.12: Operational security indicator OS-H from 2019–2023. It is calculated by counting the number of grid separation incidents (RS1 and RS2).

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) [2].	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) [2].	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) [2].	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) [2].	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 – SOGL Article 15(4)(e) [2].	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	1	-	1	-	-	2
	Total	1	-	1	-	-	2
Continental Europe	50Hertz	1	-	-	-	-	1
	Amprion	9	8	-	-	-	17
	APG	8	7	-	-	-	15
	CEPS	7	-	-	-	-	7
	CGES	3	-	3	-	-	6
	ELES	9	6	-	-	-	15
	Elia	1	-	-	-	-	1
	EMS	133	-	-	-	-	133
	Energinet (CE)	4	-	-	-	-	4
	ESO	-	-	-	-	-	-
	Freq (CE)	-	-	-	-	-	-
	HOPS	1	-	-	-	-	1
	IPTO	20	-	-	-	-	20
	MAVIR	-	-	-	-	-	-
	Moldelectrica	-	-	-	-	-	-
	NOS BiH	3	-	-	-	-	3
	OST	-	-	-	-	-	-
	PSE	-	-	-	-	-	-
	Red Eléctrica	13	-	-	-	-	13
	REN	-	-	-	-	-	-
	RTE	22	15	3	-	-	40
	SEPS	1	-	-	-	-	1
	Swissgrid	2	-	-	-	-	2
	TEIAS	1	-	-	-	-	1
	TenneT DE	11	-	1	-	-	12
	TenneT NL	10	4	-	-	-	14
	Terna	2	-	1	-	-	3
	Transelectrica	-	-	-	-	-	-
	TransnetBW	-	-	-	-	-	-
	Ukrenergo	18	-	2	-	-	20
	Total	279	40	10	-	-	329
Great Britain	National Grid ESO	1	-	-	-	-	1
	Total	1	-	-	-	-	1
Ireland and Northern Ireland	EirGrid	-	-	-	-	-	-
	SONI	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Isolated system	Landsnet	15	-	1	-	-	16
	Total	15	-	1	-	-	16
Nordic	Energinet (Nordic)	1	-	-	-	-	1
	Fingrid	-	-	-	-	-	-
	Freq (Nordic)	-	-	-	-	-	-
	Statnett	4	-	-	-	-	4
	Svenska kraftnät	-	-	-	-	-	-
	Total	5	-	-	-	-	5
Grand Total		301	40	12	-	-	353

5.2.1 Evolution of operational security indicators relevant for operational planning and scheduling, 2019–2023

This section presents the operational security indicators relevant to operational planning and scheduling (OPS) for 2019–2023. Figure 5.13 through Figure 5.17 show the annual calculated values for the OPS indicators OPS-A, OPS-B, OPSC, OPS-D and OPS-E, respectively.

The OPS-A indicator, which tracks the number of incidents due to a contingency from the contingency list, increased by more than 100% in 2023 compared to 2022. The significant increase is because EMS reported approximately 130 incidents due to violations of standards of voltage, which have until now not occurred due to contingencies in the contingency list.

OPS-B remains stable, showing that the system state in CE degraded more due to other causes than unexpected discrepancies from load and generation forecasts than previously.

The increased number of system state degradations is also visible in the indicator OPS-C, which shows that 10 incidents in CE in 2023 were due to exceptional contingencies when the annual average in CE during 2019–2022 is approximately 2. None of the exceptional contingencies were due to load and generation forecasts errors, as the indicator OPS-D was zero in 2023.

The indicator OPS-E remained zero in 2023 because no events, not even RRC events, were caused by reduced reserve capacity.

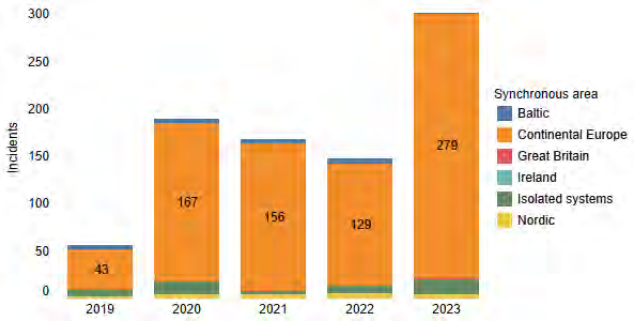

Figure 5.13: Operational security indicator OPS-A annually from 2019–2023. It is calculated by counting the number of scale 0–3 incidents where a contingency from the contingency list degraded the system operation state.

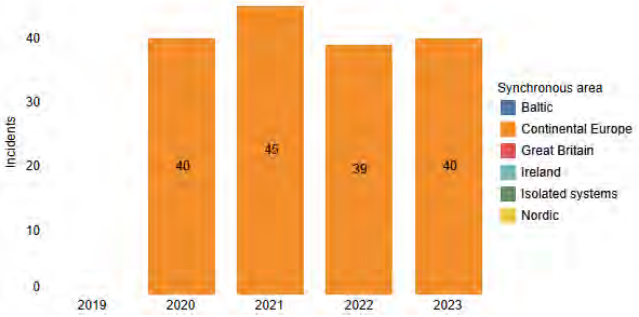

Figure 5.14: Operational security indicator OPS-B annually from 2019–2023. It is calculated by counting the number of OPS-A indicators where the cause was unexpected discrepancies from load and generation forecasts.

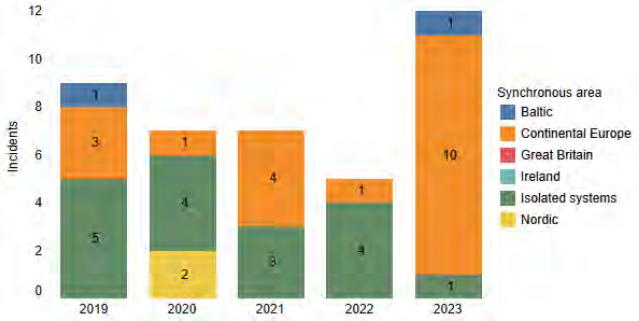

Figure 5.15: Operational security indicator OPS-C annually from 2019–2023. It is calculated by counting the number of scale 0–3 incidents where an exceptional contingency degraded the system operation state.

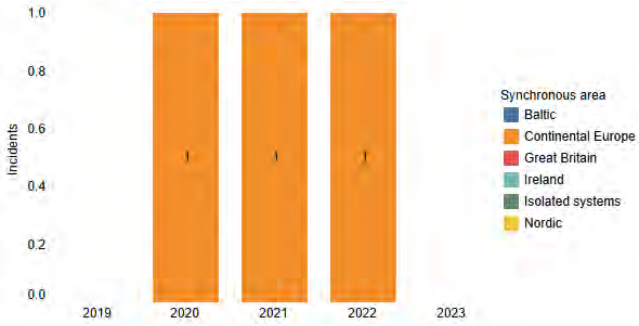

Figure 5.16: Operational security indicator OPS-D annually from 2019–2023. It is calculated by counting the number of OPS-C indicators caused by unexpected discrepancies from load and generation forecasts.

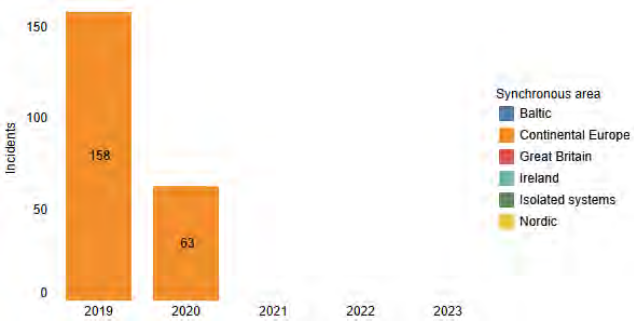

Figure 5.17: Operational security indicator OPS-E annually from 2019–2023. It is calculated by counting the number of scale 0–3 incidents caused by lack of active power reserves.

6 Events in Continental Europe

6.1 Overview of 2023

This section presents an overview of scale 0–3 ICS events in CE in 2023. 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 3248 ICS events meeting the ICS criteria were reported by TSOs in CE in 2023. Together, these events formed 3140 ICS incidents, meaning that most events only involved one ICS criteria violation. Approximately 82.8% of all scale 0–3 events were scale 0 events, 17.1% of all scale 0–3 events were scale 1 events and 0.1% of all scale 0-3 were scale 2 events. Scale 3 events were not reported.

Events on transmission network elements (T0) accounted for 54% of all events and violations on standards of voltage (OV0+OV1) for 24% of all events. Combined, these three ICS categories accounted for 78% of all events. The number of T0 events was higher from July to November, lower during spring. The number of OV0 and OV1 events was higher during spring and autumn, and ON1 events were mostly reported from May to September.

As shown in Table 6.2, approximately 50% of all scale 0 events and 18% 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 48% 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. 86% 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 2023 in Continental Europe.

		2023												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	7	-	1	1	-	-	1	-	-	-	-	10
	Incidents leading to frequency degradation (F0)	-	18	21	64	1	17	2	34	5	23	4	21	210
	Incidents on network elements (T0)	158	105	92	100	127	166	223	214	114	124	195	123	1741
	Incidents on power generating facilities (G0)	4	8	6	3	3	15	8	9	12	9	8	9	94
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	1	-	1
	Violation of standards on voltage (OV0)	20	22	48	54	30	32	46	47	51	25	40	21	436
	Reduction of reserve capacity (RRC0)	11	9	17	11	8	8	4	5	7	4	2	5	91
	Loss of tools, means and facilities (LT0)	12	9	5	4	10	12	10	10	7	16	7	5	107
	Total	205	178	189	237	180	250	293	320	196	201	257	184	2690
Scale1	Incidents on load (L1)	1	4	1	1	4	1	5	3	3	1	1	2	27
	Incidents leading to frequency degradation (F1)	-	-	2	7	-	2	-	-	-	-	-	2	13
	Incidents on network elements (T1)	-	1	2	-	6	-	3	2	2	1	1	1	19
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	2	-	2
	N-1 violation (ON1)	3	-	4	6	9	5	5	9	8	1	4	4	58
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	29	18	25	48	59	18	33	43	36	29	17	4	359
	Reduction of reserve capacity (RRC1)	12	5	12	5	4	5	1	9	1	3	-	3	60
	Loss of tools, means and facilities (LT1)	1	2	-	1	6	3	-	2	1	2	-	-	18
	Total	46	30	46	68	88	34	47	68	51	37	25	16	556
Scale2	Incidents on load (L2)	-	-	-	-	2	-	-	-	-	-	-	-	2
	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	-	-	-	-	2	-	-	-	-	-	-	-	2
Scale3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		251	208	235	305	270	284	340	388	247	238	282	200	3248

Table 6.2: Cumulative number of events by dominant criteria and duration in 2023 in Continental Europe.

	2023						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	1	2	4	4	5	10
	Incidents leading to frequency degradation (F0)	210	210	210	210	210	210
	Incidents on network elements (T0)	557	742	1055	1220	1425	1741
	Incidents on power generating facilities (G0)	4	15	33	46	64	94
	Separation from the grid (RS0)	-	-	-	1	1	1
	Violation of standards on voltage (OV0)	432	434	435	436	436	436
	Reduction of reserve capacity (RRC0)	91	91	91	91	91	91
	Loss of tools, means and facilities (LT0)	51	76	93	101	105	107
	Total	1346	1570	1921	2109	2337	2690
Scale1	Incidents on load (L1)	13	16	21	23	25	27
	Incidents leading to frequency degradation (F1)	13	13	13	13	13	13
	Incidents on network elements (T1)	9	11	15	17	19	19
	Incidents on power generating facilities (G1)	-	-	-	-	-	2
	N-1 violation (ON1)	22	33	51	58	58	58
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	10	120	201	317	348	359
	Reduction of reserve capacity (RRC1)	29	43	50	58	58	60
	Loss of tools, means and facilities (LT1)	3	11	15	18	18	18
	Total	99	247	366	504	539	556
Scale2	Incidents on load (L2)	1	2	2	2	2	2
	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	2	2	2	2	2
Scale3	Blackout (OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		1446	1819	2289	2615	2878	3248

6.2 Evolution 2019–2023

This section presents the annual number of ICS events in CE from 2019 to 2023, distributed by scale and ICS criterion.

As shown in Table 6.3, scale 0 events in 2023 increased by 324 (+14%) compared to 2022 and decreased by 72 (-3%) compared to 2021. 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 17 (-3 %) compared to 2022 and decreased by 235 (-30%) compared to 2021. The largest changes in the number of scale 1 events are seen in incidents on Load (L1). L1 events increased from 4 events in 2022 to 27 events in 2023. All other scale 1 categories show similar numbers to previous years.

The number of scale 2 events increased from 0 events in 2022 to 2 events in 2023 and decreased from 16 events in 2021 to 0 events in 2022. The only change in the number of scale 2 events is seen in incidents on Load (L2). All other scale 2 categories show similar numbers (zeros) comparing to previous years.

No scale 3 events were reported in CE in 2023.

Table 6.3: The annual number of events by dominating criterion from 2019–2023.

Scale	ICS criterion	2019	2020	2021	2022	2023
Scale0	Incidents on load (L0)	-	4	2	4	10
	Incidents leading to frequency degradation (F0)	759	296	746	220	210
	Incidents on network elements (T0)	1199	1063	1287	1269	1741
	Incidents on power generating facilities (G0)	93	81	138	123	94
	Separation from the grid (RS0)	-	2	-	1	1
	Violation of standards on voltage (OV0)	286	454	495	480	436
	Reduction of reserve capacity (RRC0)	1	-	26	185	91
	Loss of tools, means and facilities (LT0)	106	102	68	84	107
	Total	2444	2002	2762	2366	2690
Scale1	Incidents on load (L1)	-	6	2	4	27
	Incidents leading to frequency degradation (F1)	7	3	92	6	13
	Incidents on network elements (T1)	21	15	27	19	19
	Incidents on power generating facilities (G1)	-	-	4	-	2
	N-1 violation (ON1)	25	56	60	57	58
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	9	116	513	392	359
	Reduction of reserve capacity (RRC1)	161	66	63	74	60
	Loss of tools, means and facilities (LT1)	18	23	30	21	18
	Total	241	285	791	573	556
Scale2	Incidents on load (L2)	-	-	2	-	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)	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	2	-	16	-	2
Scale3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		2687	2287	3569	2939	3248

6.3 Analysis of significant changes in trends

In 2023, 3248 events were reported in CE; an increase of 11% compared to 2022 but a decrease of 9% compared to 2021. This increase appears to be significant, and is mainly due to the increase in the number of reported T0 events.

The number of T0 events increased by over 37% relative to 2022 and the number of L1 events increased by over 575% (from 4 to 27 events) relative to 2022. However, there was a decrease of RRC0 events by over 51% relative to 2022. The decrease of RRC0 events was due to the decrease of RRC0 events in MAVIR (98% of all RRC0 was report by 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.

The trend of scale 1 events shifting to scale 0 events observed in 2019 continued in 2020 to 2023. 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.

The trend of scale 2 events remains the same, except the year 2021 (16 events). In years 2019 and 2023 there were 2 events in scale 2 in CE.

No scale 3 events were reported in CE.

7 Events in Nordic

7.1 Overview of 2023

This section presents an overview of ICS events in the Nordic synchronous area in 2023. The events are presented by ICS criterion and grouped by month and duration in Table 7.1 and Table 7.2, respectively.

In 2023, 219 scale 0–3 ICS events were reported in the Nordic synchronous area, of which 214 were scale 0 events and 5 scale 1 events. As shown in Table 7.1, F0 and T0 were the most common type with 88 events both. These T0 events on network elements were mainly due to tripped HVDC links and HVAC elements because of environmental causes (8) and faults in technical equipment (12). F0 events occurred more in winter and T0 in summertime.

As shown in Table 7.2, 58% of the events were resolved in less than an hour, and 86% of all events were resolved in less than 24 hours. All events leading to frequency degradation 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 2023 in Nordic.

		2023												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	-	1	-	1	-	-	-	1	-	3
	Incidents leading to frequency degradation (F0)	7	9	5	9	4	6	2	5	8	3	15	15	88
	Incidents on network elements (T0)	4	8	3	5	4	15	17	9	7	1	7	8	88
	Incidents on power generating facilities (G0)	1	-	2	2	1	-	1	5	1	1	3	1	18
	Separation from the grid (RS0)	-	-	-	-	1	-	-	-	-	-	1	-	2
	Violation of standards on voltage (OV0)	-	-	-	-	1	-	-	-	-	-	-	-	1
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	2	1	2	1	1	-	-	-	3	2	1	1	14
	Total	14	18	12	17	13	21	21	19	19	7	28	25	214
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	1	1	-	-	1	-	-	-	-	-	-	-	3
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-	-	-	-	1	-	-	1
	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	1	-	1	1	-	-	-	-	1	-	-	5
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		15	19	12	18	14	21	21	19	19	8	28	25	219

Table 7.2: Cumulative number of events by dominant criteria and duration in 2023 in Nordic.

	2023						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	2	2	3	3	3	3
	Incidents leading to frequency degradation (F0)	88	88	88	88	88	88
	Incidents on network elements (T0)	29	33	45	59	69	88
	Incidents on power generating facilities (G0)	2	3	4	5	7	18
	Separation from the grid (RS0)	1	1	2	2	2	2
	Violation of standards on voltage (OV0)	1	1	1	1	1	1
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	2	5	12	13	14	14
	Total	125	133	155	171	184	214
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	1	1	1	2	3	3
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	1	1	1	1	1	1
	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	1
	Total	2	2	3	4	5	5
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		127	135	158	175	189	219

7.2 Evolution 2019–2023

This section presents the annual number of ICS events in the Nordic synchronous area during 2019–2023, distributed by scale and ICS criterion. It should be noted that the recorded values for 2016–2019 aggregated 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 Introduction, 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 167 to 220 during 2019-2022. The number of scale 0 events in 2023 compared to 2022 increased by 25%. The largest increase was in F0 and LT0. The same F0 and LT0 decreased a lot from 2021 to 2022.

The number of scale 1 events decreased from 9 to 5 (2022 to 2023). There were no scale 2 nor 3 events.

Table 7.3: The annual number of events by dominating criterion from 2019–2023.

Scale	ICS criterion	2019	2020	2021	2022	2023
Scale0	Incidents on load (L0)	-	-	2	1	3
	Incidents leading to frequency degradation (F0)	-	62	70	53	88
	Incidents on network elements (T0)	59	73	101	96	88
	Incidents on power generating facilities (G0)	1	5	15	14	18
	Separation from the grid (RS0)	-	-	2	2	2
	Violation of standards on voltage (OV0)	-	-	-	-	1
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	1	10	22	5	14
	Total	61	150	212	171	214
Scale1	Incidents on load (L1)	2	1	-	1	-
	Incidents leading to frequency degradation (F1)	106	4	3	1	-
	Incidents on network elements (T1)	1	3	3	2	3
	Incidents on power generating facilities (G1)	-	-	-	-	-
	N-1 violation (ON1)	-	2	-	4	1
	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)	-	6	1	-	1
	Total	109	17	8	9	5
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		170	167	220	180	219

7.3 Analysis of significant changes in trends

There is no clear trend in the total number of events or in the numbers of any specific ICS criteria.

The total number of events has changed during the last three years as follows: 220 (2021), 180 (2022) and 219 (2023).

8 Events in Great Britain

8.1 Overview of 2023

This section presents an overview of ICS events in GB in 2023. 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 232 ICS events (220 ICS incidents) in 2023 (excluding Below Scale events), of which, one of them is scale 1 and the rest of them were scale 0. There were twelve ICS incidents in which multiple ICS events were registered.

- In one incident, two events were on Loss of tools, means and facilities (LT0)
- In one incident, events on frequency deviation (F0) and transmission network element (T0) were recorded
- In two incidents, events on power generating facilities (G0) and transmission network elements (T0) were coincident to each other
- In eight incidents, two events were on transmission network element (T0)

Of the 232 ICS events, 192 were associated with transmission network elements (T0), excluding planned manual disconnections and automatic re-closures. 24 events were due to loss of tools, means or facilities (LT0), 12 events were on power generating facilities, of which, 11 events were scale 0 (G0) and 1 as scale 1 (G1), and 4 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, 15% of the reported ICS events were resolved within one hour and 57% 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.

Around 48% (93 of the 192 events) on transmission network elements (T0) and 100% (24 of the 24 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 2023 in Great Britain.

		2023												
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	1	-	1	-	1	-	4
	Incidents on network elements (T0)	11	8	20	14	15	16	10	14	13	20	25	26	192
	Incidents on power generating facilities (G0)	-	-	2	-	1	3	1	-	1	-	-	3	11
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	6	1	2	-	1	2	2	2	4	-	3	1	24
	Total	17	9	24	14	17	22	14	16	19	20	29	30	231
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	1	-	1
	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
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		17	9	24	14	17	22	14	16	19	20	30	30	232

Table 8.2: Cumulative number of events by dominant criteria and duration in 2023 in Great Britain.

	2023						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	4	4	4	4	4	4
	Incidents on network elements (T0)	15	26	55	81	99	192
	Incidents on power generating facilities (G0)	-	1	6	6	6	11
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	15	19	23	23	24	24
	Total	34	50	88	114	133	231
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	1
	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
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	50	88	114	133	232

8.2 Evolution 2019–2023

This section presents the annual number of ICS events in GB from 2019 to 2023, 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 2019–2023 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 232 scale 0–3 ICS events (220 ICS incidents) in comparison to 188 ICS events (179 ICS incidents) in 2022, 252 events in 2021, 260 incidents in 2020 and 276 in 2019. In 2023, there were 231 scale 0 ICS events, and one scale 1–3 event.

Table 8.3 shows that yearly numbers of ICS events from 2019 to 2023 are quite similar.

In 2023, Great Britain recorded one scale 1 ICS event compared to zero in 2022, one in 2021, one in 2020 and zero in 2019. The first scale 2 incident in Great Britain, 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 2019–2023.

Scale	ICS criterion	2019	2020	2021	2022	2023
Scale0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	78	2	3	7	4
	Incidents on network elements (T0)	155	169	218	157	192
	Incidents on power generating facilities (G0)	-	12	14	9	11
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	42	76	16	15	24
	Total	275	259	251	188	231
Scale1	Incidents on load (L1)	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	1
	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	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		276	260	252	188	232

8.3 Analysis of significant changes in trends

In 2023, there were 232 scale 0–3 ICS events (220 ICS incidents) were reported in Great Britain's synchronous area. This number demonstrates a slight increase when compared to previous year's data. However, it is important to note that overall trend across the past four years has remained relatively stable. The dominant ICS criteria in 2023 were incidents on transmission system elements (T0) and loss of tools and facilities (LT0).

The number of scale 0 incidents in 2023 increased to 231 compared to 188 in 2022, and one scale 1 incident reported compared to zero in 2022, one in 2021, one in 2020 and zero in 2019.

There were no scale 2 events in 2023, 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).

9 Events in Baltic

9.1 Overview of 2023

This section presents an overview of ICS events in the Baltic area in 2023. The events are presented by ICS criterion and further grouped by month and duration in Table 9.1 and Table 9.2, respectively. In 2023, 36 ICS events were reported in the Baltic area. Of these, 35 were scale 0, 1 were scale 1. No scale 2 and 3 incidents were reported in 2023.

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 2023 has a uniform distribution during the year with a slight concentration of incidents in August. In 2023, there were 26 incidents on transmission network elements (T0) compared with 21 in 2021 and 27 in 2022. The distribution of incidents by duration shown in Table 9.2 indicates that 9 of the 36 events in 2023 were resolved in less than an hour, and 9 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 2023 in Baltic.

		2023												
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)	3	2	-	2	-	4	4	5	1	-	3	2	26
	Incidents on power generating facilities (G0)	2	-	-	1	1	-	1	3	-	-	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)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	5	2	-	3	1	4	5	8	1	-	4	2	35
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	1	-	-	-	-	-	-	-	-	1
	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
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		5	2	-	4	1	4	5	8	1	-	4	2	36

Table 9.2: Cumulative number of events by dominant criteria and duration in 2023 in Baltic.

	2023						
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)	8	13	17	20	22	26
	Incidents on power generating facilities (G0)	-	-	2	3	4	9
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-
	Total	8	13	19	23	26	35
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	1	1	1	1	1	1
	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	1	1	1	1
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	14	20	24	27	36

9.2 Evolution 2019–2023

This section presents the annual number of ICS events in the Baltic area power system from 2019 to 2023, 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 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 is showing annual decrease, as seen in Table 9.3. 16 of the 18 G0 events in 2022 and 9 of the 9 G0 events in 2023 occurred in Elering's power grid. These events should be followed up on in the future. The most common type of event with regular occurrences is incidents on network elements (T0).

Table 9.3: The annual number of events by dominating criterion from 2019–2023.

Scale	ICS criterion	2019	2020	2021	2022	2023
Scale0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	28	20	21	27	26
	Incidents on power generating facilities (G0)	11	26	16	18	9
	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	39	46	38	45	35
Scale1	Incidents on load (L1)	2	1	-	-	-
	Incidents leading to frequency degradation (F1)	1	-	-	-	-
	Incidents on network elements (T1)	3	5	4	6	1
	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)	-	-	-	-	-
	Total	6	9	4	6	1
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		45	56	42	51	36

9.3 Analysis of significant changes in trends

In 2023, a total of 36 scale 0–3 events were reported in the Baltic area. They were mostly caused by incidents on transmission network elements (T0) and incidents on power generating facilities (G0). While the number of T0 events was stable, the number of G0 events fluctuates.

The number of reported scale 1 events was lower in 2023 compared to 2022. Small differences in other criteria are 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 2023

This section presents an overview of ICS events in Ireland in 2023. The events are presented by ICS criterion and further grouped by month and duration in Table 10.1 and Table 10.2, respectively.

In 2023, 18 ICS events were reported in Ireland, and all of them were scale 0, 28% were incidents on transmission network elements (T0), 72% were incidents on power generating facilities (G0), and no N-1 violations (ON1), as seen in Table 10.1. Technical issues caused majority of the G0 events, and 'technical equipment' was the cause of most of the T0 events. The events showed uniform monthly distribution during the year.

All 18 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 2023 in Ireland and Northern Ireland.

		2023												
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	-	-	-	-	1	1	-	-	-	1	1	5
	Incidents on power generating facilities (G0)	1	-	-	1	-	3	2	1	1	3	-	1	13
	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	-	-	1	-	4	3	1	1	3	1	2	18
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		2	-	-	1	-	4	3	1	1	3	1	2	18

Table 10.2: Cumulative number of events by dominant criteria and duration in 2023 in Ireland and Northern Ireland.

	2023						
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)	2	2	3	3	3	5
	Incidents on power generating facilities (G0)	3	3	7	9	10	13
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-
	Total	5	5	10	12	13	18
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		5	5	10	12	13	18

10.2 Evolution 2019–2023

This section presents the annual number of ICS events in Ireland from 2018 to 2023, distributed by scale and ICS criteria. It should be noted that the recorded values for 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 2023 is similar to the five previous years, as seen in Table 10.3.

No scale 2 or scale 3 incidents were reported in Ireland in 2023. 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 2019–2023.

Scale	ICS criterion	2019	2020	2021	2022	2023
Scale0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	4	-	-	-	-
	Incidents on network elements (T0)	9	8	11	18	5
	Incidents on power generating facilities (G0)	10	19	14	15	13
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-
	Total	23	27	25	33	18
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)	-	-	-	-	-
	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		23	30	33	41	18

10.3 Analysis of significant changes in trends

In 2023, a total of 18 ICS events were reported in IE/NI. The dominant criteria in 2023 were events on network elements (T0) and events involving power generating facilities (G0).

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

No scale 2 or scale 3 events were reported in 2023, 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 2023

This section presents an overview of ICS events in isolated systems in 2023. The events are presented by ICS criterion and further grouped by month and duration in Table 11.1 and Table 11.2, respectively.

In 2023, a total of 15 ICS events were reported for the isolated systems of Iceland and Cyprus. All the events occurred in Iceland. One of the events were scale 2 events (T2), one scale 1 (T1), and the other events were of scale 0. The scale 2 incident was due to an overload when one 220kV line tripped because it sagged down to a tree and shorted. The scale 1 incident was due to extreme weather with high wind speeds and icing conditions, which caused three 220kV lines to trip.

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 and technical equipment. The cause of the scale 2 incident was reported as external influences. Only five 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 2023 in Isolated system.

		2023												
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)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	-	2	-	-	4	1	1	-	-	1	3	-	12
	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)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	1	2	-	-	4	1	1	-	-	1	3	-	13
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	1	-	-	1
	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
Scale2	Incidents on load (L2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	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	-	-	-	-	-	-	-	1	-	-	-	-	1
Scale3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		1	2	-	-	4	1	1	1	-	2	3	-	15

Table 11.2: Cumulative number of events by dominant criteria and duration in 2023 in Isolated system.

	2023						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	-	1	1	1
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-
	Incidents on network elements (T0)	2	2	3	6	7	12
	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)	-	-	-	-	-	-
	Total	2	2	3	7	8	13
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	1	1	1
	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	1
Scale2	Incidents on load (L2)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	1	1	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	1	1	1	1	1	1
Scale3	Blackout (OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		3	3	4	9	10	15

11.2 Evolution 2019–2023

This section presents the annual number of incidents in the isolated systems from 2019 to 2023, 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 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. The number of recorded scale 0 incidents dropped to approximately a third of the reported number of incidents in 2022 (36 to 13). However, there is no clear visible trend over the last few years, with the addition that the data must be interpreted cautiously as the overall number of events is low.

One scale 2 incident was reported in 2023. No scale 3 incidents were reported during 2019–2023.

All ICS incidents in the isolated systems during 2019–2023 were reported by Landsnet in Iceland.

Table 11.3: The annual number of events by dominating criterion from 2019–2023.

Scale	ICS criterion	2019	2020	2021	2022	2023
Scale0	Incidents on load (L0)	-	-	-	6	1
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	5	29	26	29	12
	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	9	33	26	36	13
Scale1	Incidents on load (L1)	-	1	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	7	12	1	2	1
	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	7	13	3	3	1
Scale2	Incidents on load (L2)	-	-	-	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)	-	-	1	-	-
	Total	-	-	1	3	1
Scale3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		16	46	30	42	15

11.3 Analysis of significant changes in trends

In 2023, a total of 15 ICS events were reported in isolated systems by Landsnet in Iceland and is the lowest number of incidents during the reporting period 2019–2023. The 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.

12 Overview of events per TSO

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

In total, 41 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 2019–2023 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
- Moldelectrica
- NOS BiH
- OST
- PSE
- Red Eléctrica
- REN
- RTE
- SEPS
- Swissgrid
- TEIAS
- TenneT DE
- TenneT NL
- Terna
- Transelectrica
- TransnetBW
- Ukrenergo

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 2023, and Table 12.2 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.1 presents the number of events grouped by duration in 2023.

Table 12.1: Monthly distribution of events by dominating criterion in 2023 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)	24	2	5	7	9	2	3	5	3	4	-	2	66
	Incidents on power generating facilities (G0)	-	-	-	-	-	1	-	-	-	-	1	1	3
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	-	-	-	1	1	1	1	5
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	2	-	-	-	-	-	2
	N-1 violation (ON1)	-	-	1	-	-	-	-	-	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	2	-	-	-	-	-	-	-	-	-	-	2
Grand total		25	4	6	7	9	3	5	5	4	5	2	4	79

Table 12.2: The annual number of events by dominating criterion from 2019–2023 for 50Hertz.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on load (L0)	-	-	1	-	-
	Incidents on network elements (T0)	24	29	40	36	66
	Incidents on power generating facilities (G0)	2	9	8	6	3
	Loss of tools, means and facilities (LT0)	6	2	1	4	5
Scale 1	Incidents on load (L1)	-	-	-	2	2
	N-1 violation (ON1)	3	-	9	8	1
	Loss of tools, means and facilities (LT1)	3	9	8	4	2
Grand total		38	49	67	60	79

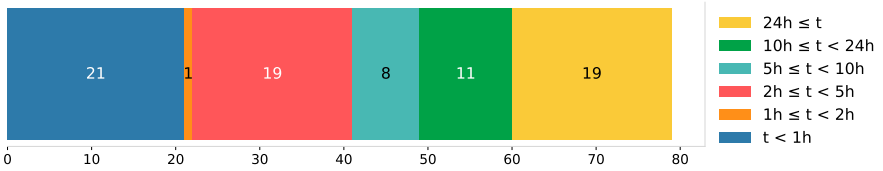

Figure 12.1: Number of events grouped by duration in 2023 for 50Hertz.

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 2023, and Table 12.4 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.2 presents the number of events grouped by duration in 2023.

Table 12.3: Monthly distribution of events by dominating criterion in 2023 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)	2	7	5	3	11	5	7	13	7	7	4	5	76
	Incidents on power generating facilities (G0)	-	1	2	-	-	1	-	-	1	3	-	2	10
	Loss of tools, means and facilities (LT0)	-	-	1	-	-	-	-	1	1	1	-	-	4
Scale 1	Incidents on network elements (T1)	-	-	1	-	-	-	-	-	-	-	-	-	1
	N-1 violation (ON1)	2	-	1	1	-	-	1	2	-	-	2	-	9
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		4	8	10	4	11	7	8	16	9	11	6	7	101

Table 12.4: The annual number of events by dominating criterion from 2019–2023 for Amprion.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	31	35	79	94	76
	Incidents on power generating facilities (G0)	7	9	19	18	10
	Violation of standards on voltage (OV0)	-	-	-	3	-
	Loss of tools, means and facilities (LT0)	6	3	4	14	4
Scale 1	Incidents on network elements (T1)	-	-	-	-	1
	N-1 violation (ON1)	3	4	3	12	9
	Violation of standards on voltage (OV1)	-	-	-	3	-
	Reduction of reserve capacity (RRC1)	1	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	1
Grand total		48	51	105	144	101

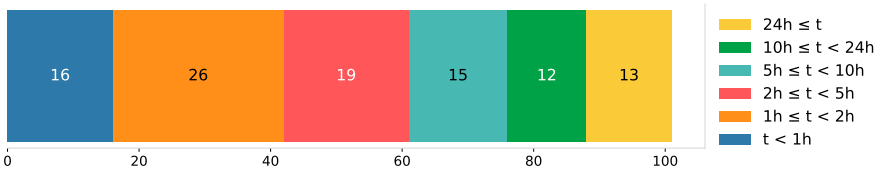

Figure 12.2: Number of events grouped by duration in 2023 for Amprion.

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 2023, and Table 12.6 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.3 presents the number of events grouped by duration in 2023.

Table 12.5: Monthly distribution of events by dominating criterion in 2023 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	-	3	3	1	1	-	2	4	16
	Loss of tools, means and facilities (LT0)	-	-	-	-	1	-	-	1	-	1	-	-	3
Scale 1	N-1 violation (ON1)	-	-	-	1	2	-	-	3	-	1	-	1	8
Grand total		1	-	-	2	3	3	3	5	1	2	2	5	27

Table 12.6: The annual number of events by dominating criterion from 2019–2023 for APG.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	24	24	17	13	16
	Loss of tools, means and facilities (LT0)	-	1	1	-	3
Scale 1	Incidents on network elements (T1)	-	-	-	1	-
	N-1 violation (ON1)	1	3	4	3	8
	Loss of tools, means and facilities (LT1)	2	2	-	1	-
Grand total		27	30	22	18	27

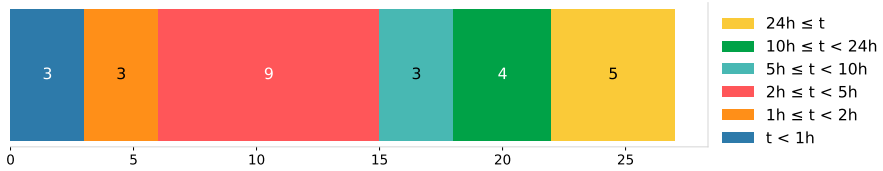

Figure 12.3: Number of events grouped by duration in 2023 for APG.

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 2023, and Table 12.8 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.4 presents the number of events grouped by duration in 2023.

Table 12.7: Monthly distribution of events by dominating criterion in 2023 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)	2	2	1	7	1	8	5	6	2	2	1	4	41
	Incidents on power generating facilities (G0)	-	-	-	-	-	2	1	-	-	-	-	-	3
	Violation of standards on voltage (OV0)	-	-	-	4	2	1	8	3	10	-	-	4	32
	Loss of tools, means and facilities (LT0)	-	1	-	-	-	2	1	1	1	4	1	-	11
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	2	1	1	1	1	1	7
	Incidents on network elements (T1)	-	-	-	-	-	-	2	1	1	1	1	1	7
	Violation of standards on voltage (OV1)	-	-	-	2	12	-	2	12	8	-	-	-	36
	Loss of tools, means and facilities (LT1)	-	-	-	-	1	-	-	-	-	1	-	-	2
Grand total		2	3	1	13	16	13	21	24	23	9	4	10	139

Table 12.8: The annual number of events by dominating criterion from 2019–2023 for CEPS.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on load (L0)	-	1	-	-	-
	Incidents on network elements (T0)	11	18	29	30	41
	Incidents on power generating facilities (G0)	6	3	6	2	3
	Separation from the grid (RS0)	-	2	-	1	-
	Violation of standards on voltage (OV0)	19	-	3	8	32
	Loss of tools, means and facilities (LT0)	5	1	1	1	11
Scale 1	Incidents on load (L1)	-	-	1	1	7
	Incidents on network elements (T1)	2	4	-	8	7
	N-1 violation (ON1)	-	2	-	1	-
	Violation of standards on voltage (OV1)	3	5	3	6	36
	Loss of tools, means and facilities (LT1)	1	2	1	3	2
Grand total		47	38	44	61	139

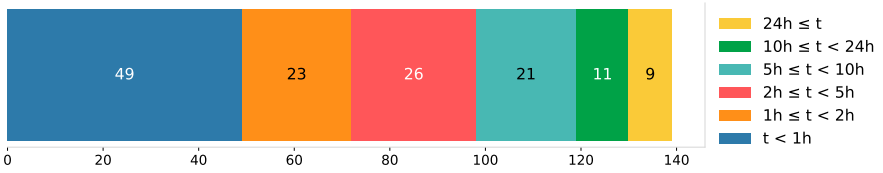

Figure 12.4: Number of events grouped by duration in 2023 for CEPS.

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 2023, and Table 12.10 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.5 presents the number of events grouped by duration in 2023.

Table 12.9: Monthly distribution of events by dominating criterion in 2023 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)	5	1	-	2	2	5	1	1	1	1	-	-	19
Scale 1	Incidents on network elements (T1)	-	-	-	-	3	-	-	-	-	-	-	-	3
Grand total		5	1	-	2	5	5	1	1	1	1	-	-	22

Table 12.10: The annual number of events by dominating criterion from 2019–2023 for CGES.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	71	-	-	22	19
Scale 1	Incidents on network elements (T1)	-	-	-	-	3
Grand total		71	-	-	22	22

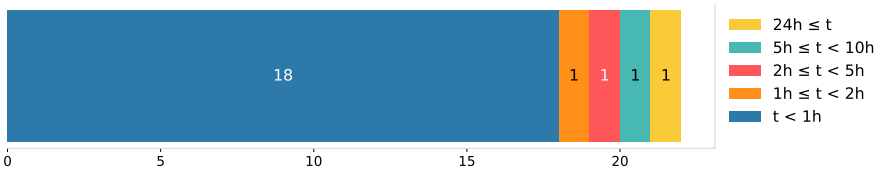

Figure 12.5: Number of events grouped by duration in 2023 for CGES.

12.1.6 Events reported by ELES

This section presents events for ELES, the TSO in Slovenia. Table 12.11 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.12 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.6 presents the number of events grouped by duration in 2023.

Table 12.11: Monthly distribution of events by dominating criterion in 2023 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	2	-	1	-	7
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	2	-	-	-	1	-	3
Scale 1	N-1 violation (ON1)	-	-	-	4	1	-	1	1	-	-	-	1	8
	Loss of tools, means and facilities (LT1)	-	-	-	-	2	-	-	-	-	-	-	-	2
Grand total		-	-	-	4	4	-	5	2	2	-	2	1	20

Table 12.12: The annual number of events by dominating criterion from 2019–2023 for ELES.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	4	-	5	7	7
	Loss of tools, means and facilities (LT0)	-	-	-	3	3
Scale 1	Incidents on network elements (T1)	-	2	-	-	-
	N-1 violation (ON1)	-	2	1	1	8
	Violation of standards on voltage (OV1)	1	5	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	1	-	2
Scale 2	N violation (ON2)	1	-	-	-	-
Grand total		6	9	7	11	20

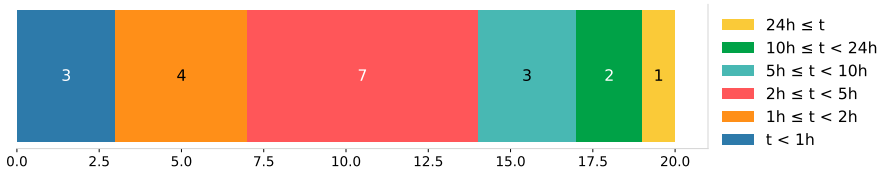

Figure 12.6: Number of events grouped by duration in 2023 for ELES.

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 2023, and Table 12.14 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.7 presents the number of events grouped by duration in 2023.

Table 12.13: Monthly distribution of events by dominating criterion in 2023 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	2	1	-	1	3	8
	Loss of tools, means and facilities (LT0)	1	1	-	-	-	-	-	-	-	-	-	1	3
Scale 1	N-1 violation (ON1)	-	-	-	-	1	-	-	-	-	-	-	-	1
Grand total		1	1	-	-	1	-	1	2	1	-	1	4	12

Table 12.14: The annual number of events by dominating criterion from 2019–2023 for Elia.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on load (L0)	-	2	-	-	-
	Incidents on network elements (T0)	6	12	9	6	8
	Incidents on power generating facilities (G0)	2	-	1	1	-
	Violation of standards on voltage (OV0)	1	-	1	-	-
	Loss of tools, means and facilities (LT0)	4	3	-	-	3
Scale 1	Incidents on network elements (T1)	-	-	3	-	-
	N-1 violation (ON1)	8	4	2	-	1
	Violation of standards on voltage (OV1)	-	3	-	-	-
	Reduction of reserve capacity (RRC1)	1	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	4	-	-
Grand total		22	24	20	7	12

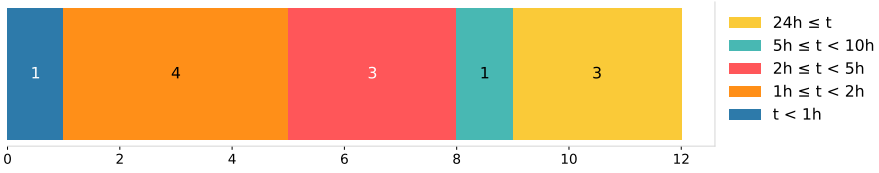

Figure 12.7: Number of events grouped by duration in 2023 for Elia.

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 2023, and Table 12.16 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.8 presents the number of events grouped by duration in 2023.

Table 12.15: Monthly distribution of events by dominating criterion in 2023 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)	5	5	3	-	-	3	12	3	-	1	1	-	33
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	-	1	-	-	-	1
	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	1	-	-	-	1
	Violation of standards on voltage (OV1)	9	4	12	20	19	6	10	13	16	15	7	1	132
	Reduction of reserve capacity (RRC1)	-	-	1	-	2	1	-	-	-	-	-	-	4
Grand total		14	9	16	20	21	10	22	16	18	16	8	1	171

Table 12.16: The annual number of events by dominating criterion from 2019–2023 for EMS.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	8	24	31	16	33
	Incidents on power generating facilities (G0)	-	-	2	-	-
	Violation of standards on voltage (OV0)	-	-	4	4	-
	Loss of tools, means and facilities (LT0)	1	-	-	-	-
Scale 1	Incidents on load (L1)	-	1	-	-	1
	Incidents on network elements (T1)	3	3	4	1	1
	Violation of standards on voltage (OV1)	-	-	109	119	132
	Reduction of reserve capacity (RRC1)	-	-	4	2	4
	Loss of tools, means and facilities (LT1)	-	1	2	-	-
Scale 2	Separation from the grid (RS2)	-	-	1	-	-
Grand total		12	29	157	142	171

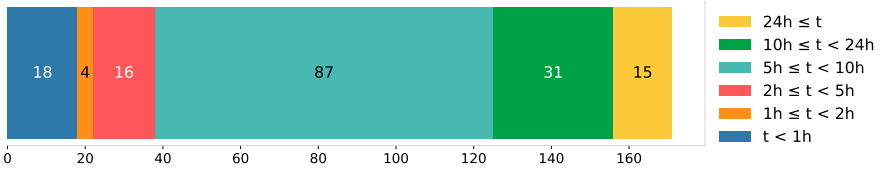

Figure 12.8: Number of events grouped by duration in 2023 for EMS.

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 2019–2023. Figure 12.9 presents the number of events grouped by duration in 2022.

Table 12.17: Monthly distribution of events by dominating criterion in 2023 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)	1	1	3	-	1	3	-	-	1	3	2	3	18
Scale 1	Loss of tools, means and facilities (LT1)	1	-	-	-	1	1	-	1	-	-	-	-	4
Grand total		2	1	3	-	2	4	-	1	1	3	2	3	22

Table 12.18: The annual number of events by dominating criterion from 2019–2023 for Energinet (CE).

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	15	15	35	15	18
	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	4
Grand total		20	19	38	19	22

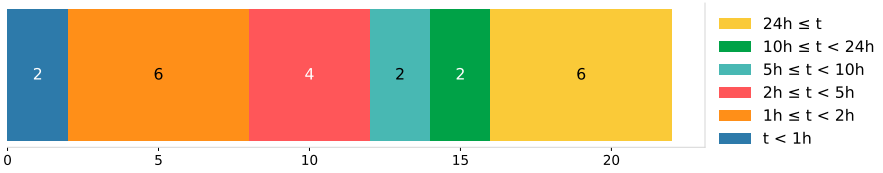

Figure 12.9: Number of events grouped by duration in 2023 for Energinet (CE).

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 2023, and Table 12.20 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.10 presents the number of events grouped by duration in 2023.

Table 12.19: Monthly distribution of events by dominating criterion in 2023 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)	2	2	5	9	4	16	24	18	7	7	42	6	142
Grand total		2	2	5	9	4	16	24	18	7	7	42	6	142

Table 12.20: The annual number of events by dominating criterion from 2019–2023 for ESO.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	38	40	38	91	142
	Incidents on power generating facilities (G0)	2	-	-	-	-
Grand total		40	40	38	91	142

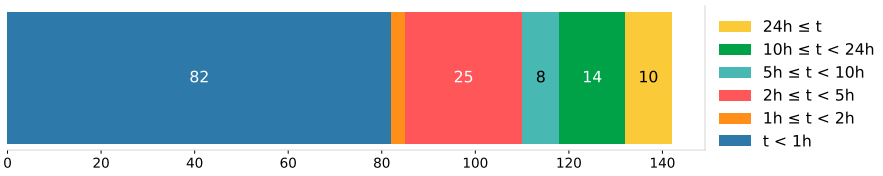

Figure 12.10: Number of events grouped by duration in 2023 for ESO.

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 2023, and Table 12.22 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.11 presents the number of events grouped by duration in 2023.

Table 12.21: Monthly distribution of events by dominating criterion in 2023 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)	-	18	21	64	1	17	2	34	5	23	4	21	210
Scale 1	Incidents leading to frequency degradation (F1)	-	-	2	7	-	2	-	-	-	-	-	2	13
Grand total		-	18	23	71	1	19	2	34	5	23	4	23	223

Table 12.22: The annual number of events by dominating criterion from 2019–2023 for Freq (CE).

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents leading to frequency degradation (F0)	758	296	746	220	210
Scale 1	Incidents leading to frequency degradation (F1)	5	3	92	6	13
Grand total		763	299	838	226	223

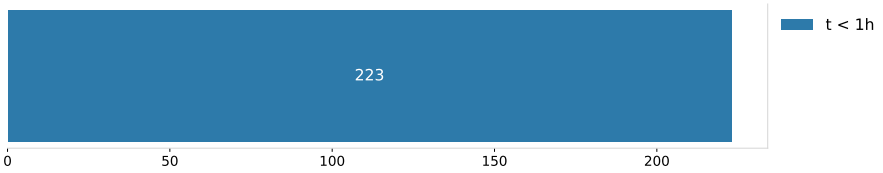

Figure 12.11: Number of events grouped by duration in 2023 for Freq (CE).

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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 2023, and Table 12.24 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.12 presents the number of events grouped by duration in 2023.

Table 12.23: Monthly distribution of events by dominating criterion in 2023 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)	5	5	10	1	3	1	11	5	3	4	3	1	52
Scale 1	N-1 violation (ON1)	-	-	1	-	-	-	-	-	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	-	1	-	-	1
Grand total		5	5	11	1	3	1	11	5	3	5	3	1	54

Table 12.24: The annual number of events by dominating criterion from 2019–2023 for HOPS.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	31	31	49	39	52
	Loss of tools, means and facilities (LT0)	-	1	11	-	-
Scale 1	Incidents on network elements (T1)	-	-	2	-	-
	N-1 violation (ON1)	-	-	-	-	1
	Reduction of reserve capacity (RRC1)	-	-	12	-	-
	Loss of tools, means and facilities (LT1)	-	-	2	1	1
Scale 2	Incidents on network elements (T2)	-	-	1	-	-
	Separation from the grid (RS2)	-	-	2	-	-
Grand total		31	32	79	40	54

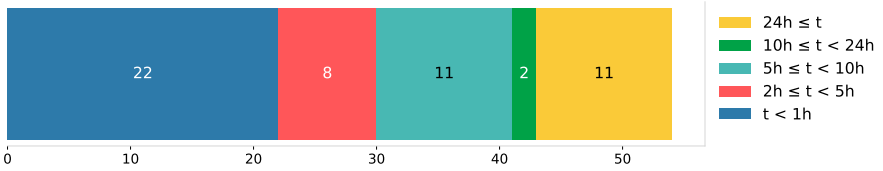

Figure 12.12: Number of events grouped by duration in 2023 for HOPS.

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 2023, and Table 12.26 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.13 presents the number of events grouped by duration in 2023.

Table 12.25: Monthly distribution of events by dominating criterion in 2023 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)	2	1	-	1	4	-	11	15	11	1	4	8	58
	Violation of standards on voltage (OV0)	2	2	1	5	3	2	1	-	3	4	2	-	25
	Loss of tools, means and facilities (LT0)	-	2	1	2	3	1	-	-	-	1	-	-	10
Scale 1	Incidents on load (L1)	1	-	-	-	-	-	-	-	-	-	-	-	1
	Violation of standards on voltage (OV1)	6	-	1	-	6	2	-	-	2	1	-	-	18
	Loss of tools, means and facilities (LT1)	-	-	-	1	-	-	-	-	-	-	-	-	1
Grand total		11	5	3	9	16	5	12	15	16	7	6	8	113

Table 12.26: The annual number of events by dominating criterion from 2019–2023 for IPTO.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	17	23	35	35	58
	Incidents on power generating facilities (G0)	-	-	1	-	-
	Violation of standards on voltage (OV0)	2	14	14	22	25
	Loss of tools, means and facilities (LT0)	-	-	10	10	10
Scale 1	Incidents on load (L1)	-	-	-	-	1
	Incidents on network elements (T1)	3	1	-	-	-
	Violation of standards on voltage (OV1)	1	26	34	28	18
	Loss of tools, means and facilities (LT1)	-	-	-	-	1
Grand total		23	64	94	95	113

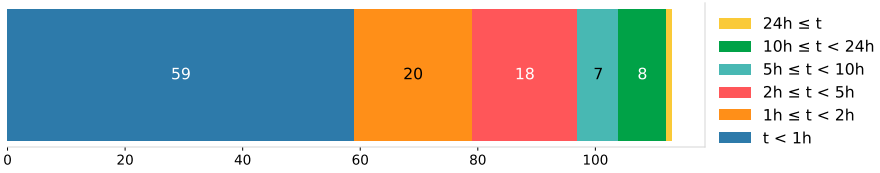

Figure 12.13: Number of events grouped by duration in 2023 for IPTO.

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 2023, and Table 12.28 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.14 presents the number of events grouped by duration in 2023.

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 2023 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)	3	-	1	-	-	-	-	3	-	-	-	2	9
	Violation of standards on voltage (OV0)	13	19	44	20	14	19	25	14	25	10	20	9	232
	Reduction of reserve capacity (RRC0)	11	9	17	11	8	8	4	4	6	4	2	5	89
Scale 1	Violation of standards on voltage (OV1)	7	13	11	12	12	2	12	5	5	3	9	1	92
	Reduction of reserve capacity (RRC1)	10	5	11	4	1	2	-	3	1	2	-	1	40
Grand total		44	46	84	47	35	31	41	29	37	19	31	18	462

Table 12.28: The annual number of events by dominating criterion from 2019–2023 for MAVIR.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	52	6	-	12	9
	Violation of standards on voltage (OV0)	43	292	249	329	232
	Reduction of reserve capacity (RRC0)	1	-	25	185	89
Scale 1	Incidents on network elements (T1)	-	-	15	-	-
	Violation of standards on voltage (OV1)	-	-	287	154	92
	Reduction of reserve capacity (RRC1)	155	63	35	53	40
	Loss of tools, means and facilities (LT1)	1	-	-	-	-
Grand total		252	361	611	733	462

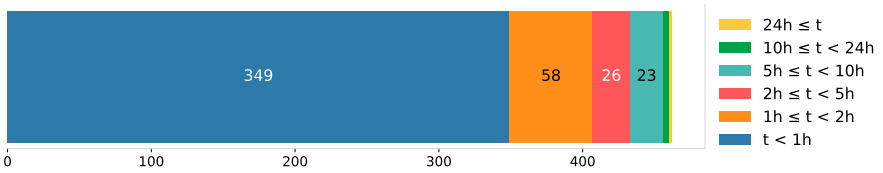

Figure 12.14: Number of events grouped by duration in 2023 for MAVIR.

12.1.15 Events reported by Moldelectrica

This section presents events for Moldelectrica, the TSO in Moldova. Table 12.29 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.30 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.15 presents the number of events grouped by duration in 2023.

Table 12.29: Monthly distribution of events by dominating criterion in 2023 for Moldelectrica.

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	-	-	2	2	2	5	-	-	1	-	15
Scale 2	Incidents on load (L2)	-	-	-	-	1	-	-	-	-	-	-	-	1
Grand total		2	1	-	-	3	2	2	5	-	-	1	-	16

Table 12.30: The annual number of events by dominating criterion from 2019–2023 for Moldelectrica.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	-	-	-	-	15
Scale 2	Incidents on load (L2)	-	-	-	-	1
Grand total		-	-	-	-	16

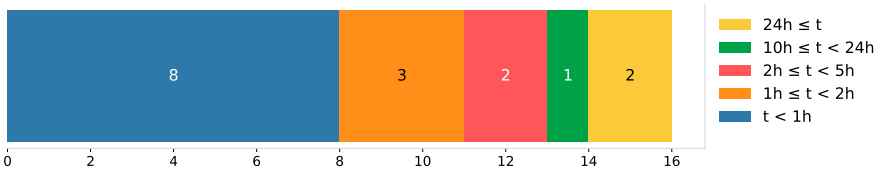

Figure 12.15: Number of events grouped by duration in 2023 for Moldelectrica.

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12.1.16 Events reported by NOS BiH

This section presents events for NOS BiH, the TSO in Bosnia and Herzegovina. Table 12.31 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.32 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.16 presents the number of events grouped by duration in 2023.

Table 12.31: Monthly distribution of events by dominating criterion in 2023 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	2	1	-	3	-	-	-	-	-	-	1	8
Scale 1	Incidents on network elements (T1)	-	-	-	-	3	-	-	-	-	-	-	-	3
Grand total		1	2	1	-	6	-	-	-	-	-	-	1	11

Table 12.32: The annual number of events by dominating criterion from 2019–2023 for NOS BiH.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	20	27	28	26	8
	Incidents on power generating facilities (G0)	-	-	1	-	-
Scale 1	Incidents on network elements (T1)	-	-	2	-	3
Scale 2	Incidents leading to frequency degradation (F2)	-	-	1	-	-
Grand total		20	27	32	26	11

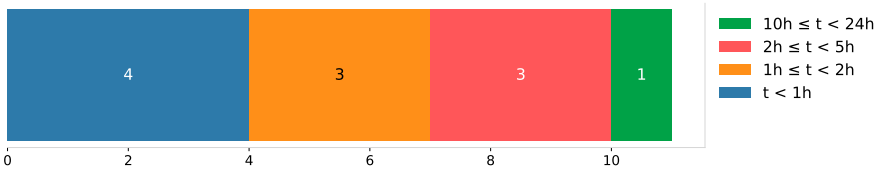

Figure 12.16: Number of events grouped by duration in 2023 for NOS BiH.

12.1.17 Events reported by OST

This section presents events for OST, the TSO in Albania. Table 12.33 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.34 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.17 presents the number of events grouped by duration in 2023.

Table 12.33: Monthly distribution of events by dominating criterion in 2023 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)	5	9	1	3	2	3	4	1	2	2	6	3	41
Grand total		5	9	1	3	2	3	4	1	2	2	6	3	41

Table 12.34: The annual number of events by dominating criterion from 2019–2023 for OST.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	-	-	61	32	41
Grand total		-	-	61	32	41

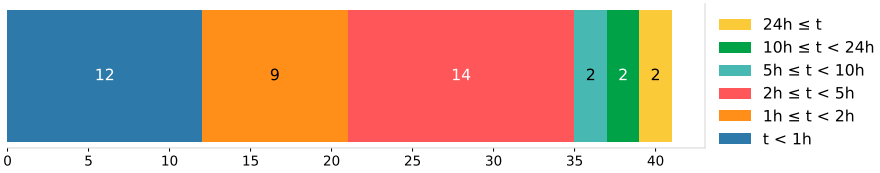

Figure 12.17: Number of events grouped by duration in 2023 for OST.

12.1.18 Events reported by PSE

This section presents events for PSE, the TSO in Poland. Table 12.35 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.36 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.18 presents the number of events grouped by duration in 2023.

Table 12.35: Monthly distribution of events by dominating criterion in 2023 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)	14	3	6	2	-	6	12	15	5	2	7	6	78
	Incidents on power generating facilities (G0)	-	1	-	-	-	3	-	2	2	-	-	1	9
Scale 1	Reduction of reserve capacity (RRC1)	-	-	-	1	-	-	-	-	-	-	-	-	1
Grand total		14	4	6	3	-	9	12	17	7	2	7	7	88

Table 12.36: The annual number of events by dominating criterion from 2019–2023 for PSE.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	89	76	100	138	78
	Incidents on power generating facilities (G0)	10	13	14	12	9
	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	1
	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		101	92	119	157	88

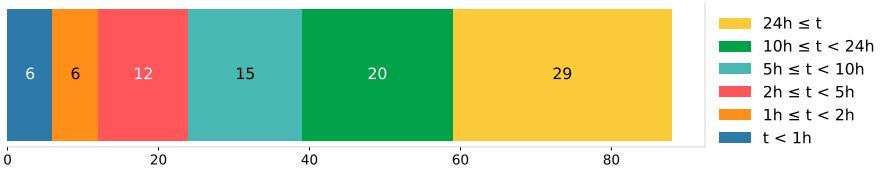

Figure 12.18: Number of events grouped by duration in 2023 for PSE.

12.1.19 Events reported by Red Eléctrica

This section presents events for Red Eléctrica, the TSO in Spain. Table 12.37 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.38 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.19 presents the number of events grouped by duration in 2023.

From 2020 to 2023, the number of events that were reported by RE was nearly the same, except for 2022, which was the year in which fewer events were reported. In 2023, the number of events related to violation of standards on voltage increased up to 26, 13 of them categorized as "Scale 1" events. No other kind of incident reached the Scale 1 categorization in Spain in 2023.

January, May and October were the months in which more events were reported by RE in 2023 (between 34 and 40), mainly related to the tripping of network elements and to the loss of power related to incidents on power generating facilities, while the number of incidents reported during those months was more or less the same. This means that during January, May and October, more cascade incidents were reported in Spain. The rest of the year, the monthly number of events registered by the Spanish TSO was more or less the same.

Regarding the events that lasted more than than 24 hours, most of them were caused by fallen insulators or conductors, which required to carry out works on the affected network elements.

Table 12.37: Monthly distribution of events by dominating criterion in 2023 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)	33	19	9	17	29	23	12	15	23	33	15	12	240
	Incidents on power generating facilities (G0)	-	-	-	-	1	-	-	1	2	3	1	-	8
	Violation of standards on voltage (OV0)	-	1	-	3	1	-	-	4	1	3	-	-	13
	Loss of tools, means and facilities (LT0)	1	-	2	-	-	1	-	-	1	1	-	-	6
Scale 1	Violation of standards on voltage (OV1)	-	-	-	2	5	-	-	4	2	-	-	-	13
Grand total		34	20	11	22	36	24	12	24	29	40	16	12	280

Table 12.38: The annual number of events by dominating criterion from 2019–2023 for Red Eléctrica.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	235	258	274	214	240
	Incidents on power generating facilities (G0)	-	-	-	3	8
	Violation of standards on voltage (OV0)	-	-	-	1	13
	Loss of tools, means and facilities (LT0)	2	5	-	5	6
Scale 1	Incidents on load (L1)	-	1	-	-	-
	Incidents on power generating facilities (G1)	-	-	1	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	13
Scale 2	Incidents on load (L2)	-	-	1	-	-
	Incidents on network elements (T2)	-	-	1	-	-
	Separation from the grid (RS2)	-	-	1	-	-
Grand total		237	264	278	223	280

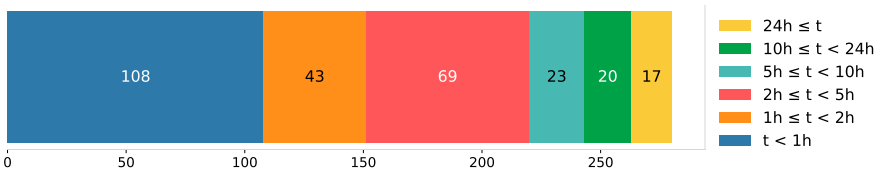

Figure 12.19: Number of events grouped by duration in 2023 for Red Eléctrica.

12.1.20 Events reported by REN

This section presents events for REN, the TSO in Portugal. Table 12.39 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.40 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.20 presents the number of events grouped by duration in 2023.

Table 12.39: Monthly distribution of events by dominating criterion in 2023 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	-	-	3	2	4	2	2	4	4	2	1	25
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	1	-	-	-	1
	Loss of tools, means and facilities (LT0)	-	1	-	-	-	-	-	-	-	-	-	-	1
Scale 1	Loss of tools, means and facilities (LT1)	-	-	-	-	1	1	-	-	-	-	-	-	2
Grand total		1	1	-	3	3	5	2	2	5	4	2	1	29

Table 12.40: The annual number of events by dominating criterion from 2019–2023 for REN.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	10	11	17	9	25
	Incidents on power generating facilities (G0)	-	-	1	1	1
	Loss of tools, means and facilities (LT0)	1	2	-	2	1
Scale 1	Loss of tools, means and facilities (LT1)	-	-	-	-	2
Scale 2	Incidents on load (L2)	-	-	1	-	-
	Separation from the grid (RS2)	-	-	1	-	-
Grand total		11	13	20	12	29

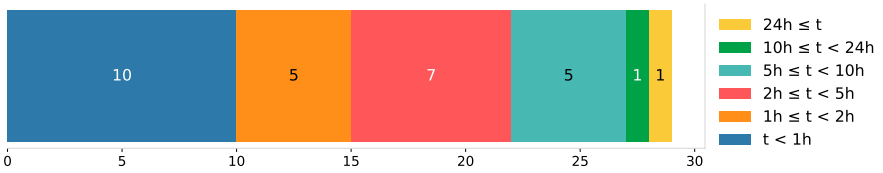

Figure 12.20: Number of events grouped by duration in 2023 for REN.

12.1.21 Events reported by RTE

This section presents events for RTE, the TSO in France. Table 12.41 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.42 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.21 presents the number of events grouped by duration in 2023.

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

Table 12.41: Monthly distribution of events by dominating criterion in 2023 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	-	-	-	-	-	-	-	-	2
	Incidents on network elements (T0)	10	8	13	27	13	25	23	36	26	31	39	25	276
	Incidents on power generating facilities (G0)	-	-	-	2	-	2	2	4	3	1	3	2	19
	Violation of standards on voltage (OV0)	-	-	-	-	-	1	6	1	-	-	-	-	8
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	-	-	-	1	2	-	-	4
Scale 1	Incidents on network elements (T1)	-	1	-	-	-	-	1	-	-	-	-	-	2
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	2	-	2
	N-1 violation (ON1)	-	-	-	-	3	2	2	-	6	-	1	1	15
	Violation of standards on voltage (OV1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	2	-	-	-	-	2
Grand total		11	10	13	30	16	31	34	43	36	34	45	28	331

Table 12.42: The annual number of events by dominating criterion from 2019–2023 for RTE.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on load (L0)	-	1	1	3	2
	Incidents on network elements (T0)	270	154	159	190	276
	Incidents on power generating facilities (G0)	19	29	30	27	19
	Violation of standards on voltage (OV0)	10	15	39	13	8
	Loss of tools, means and facilities (LT0)	29	4	1	-	4
Scale 1	Incidents on network elements (T1)	3	-	-	-	2
	Incidents on power generating facilities (G1)	-	-	2	-	2
	N-1 violation (ON1)	-	30	31	12	15
	Violation of standards on voltage (OV1)	2	18	18	5	1
	Reduction of reserve capacity (RRC1)	1	2	2	4	2
	Loss of tools, means and facilities (LT1)	7	1	1	2	-
Scale 2	Incidents on network elements (T2)	-	-	1	-	-
Grand total		341	254	285	256	331

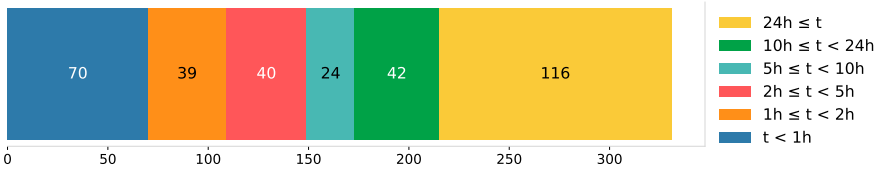

Figure 12.21: Number of events grouped by duration in 2023 for RTE.

12.1.22 Events reported by SEPS

This section presents events for SEPS, the TSO in Slovakia. Table 12.43 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.44 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.22 presents the number of events grouped by duration in 2023.

Table 12.43: Monthly distribution of events by dominating criterion in 2023 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)	-	-	2	-	-	3	-	-	1	-	1	1	8
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Reduction of reserve capacity (RRC1)	2	-	-	-	-	2	-	1	-	-	-	-	5
Grand total		2	-	2	-	-	5	-	2	1	-	1	1	14

Table 12.44: The annual number of events by dominating criterion from 2019–2023 for SEPS.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	2	4	8	8	8
	Violation of standards on voltage (OV0)	15	49	23	-	-
Scale 1	Incidents on network elements (T1)	-	3	-	-	1
	N-1 violation (ON1)	-	1	-	-	-
	Violation of standards on voltage (OV1)	2	11	12	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	8	5
	Loss of tools, means and facilities (LT1)	-	1	-	-	-
Grand total		19	69	43	16	14

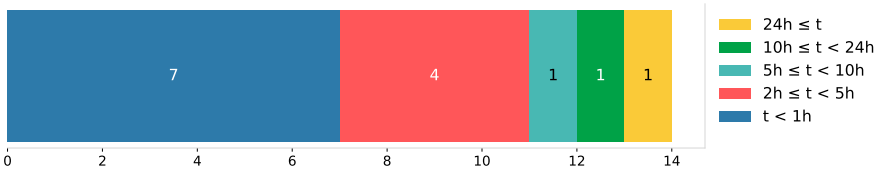

Figure 12.22: Number of events grouped by duration in 2023 for SEPS.

12.1.23 Events reported by Swissgrid

This section presents events for Swissgrid, the TSO in Switzerland. Table 12.45 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.46 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.23 presents the number of events grouped by duration in 2023.

Table 12.45: Monthly distribution of events by dominating criterion in 2023 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)	2	4	1	1	-	3	2	2	1	-	4	5	25
	Incidents on power generating facilities (G0)	-	-	-	-	-	1	-	-	-	-	1	-	2
	Violation of standards on voltage (OV0)	1	-	-	-	1	-	1	18	4	5	1	4	35
	Loss of tools, means and facilities (LT0)	2	1	-	-	-	2	1	-	-	-	-	1	7
Scale 1	Incidents on load (L1)	-	1	-	-	-	-	-	-	-	-	-	-	1
	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	4	-	2	-	1	7
Grand total		5	6	1	1	1	7	4	24	5	7	6	11	78

Table 12.46: The annual number of events by dominating criterion from 2019–2023 for Swissgrid.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents leading to frequency degradation (F0)	1	-	-	-	-
	Incidents on network elements (T0)	31	37	33	34	25
	Incidents on power generating facilities (G0)	6	2	2	2	2
	Violation of standards on voltage (OV0)	-	72	78	53	35
	Loss of tools, means and facilities (LT0)	16	21	13	13	7
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)	2	1	-	1	1
	Violation of standards on voltage (OV1)	-	27	12	5	7
	Reduction of reserve capacity (RRC1)	2	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	2	3	-	-
Scale 2	Incidents on network elements (T2)	1	-	-	-	-
Grand total		65	165	141	108	78

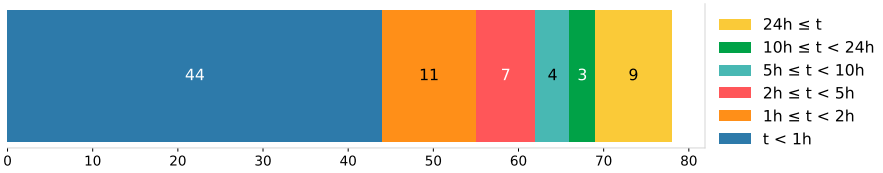

Figure 12.23: Number of events grouped by duration in 2023 for Swissgrid.

12.1.24 Events reported by TEIAS

This section presents events for TEIAS, the TSO in Turkey. Table 12.47 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.48 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.24 presents the number of events grouped by duration in 2023.

Table 12.47: Monthly distribution of events by dominating criterion in 2023 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)	-	6	-	-	-	-	-	-	-	-	-	-	6
	Incidents on network elements (T0)	-	6	-	-	-	-	-	1	1	-	2	-	10
	Incidents on power generating facilities (G0)	1	5	1	1	1	2	2	-	1	2	1	-	17
Scale 1	Violation of standards on voltage (OV1)	-	1	-	-	-	-	-	-	-	-	-	-	1
Grand total		1	18	1	1	1	2	2	1	2	2	3	-	34

Table 12.48: The annual number of events by dominating criterion from 2019–2023 for TEIAS.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on load (L0)	-	-	-	1	6
	Incidents on network elements (T0)	-	-	18	18	10
	Incidents on power generating facilities (G0)	-	-	23	8	17
Scale 1	Violation of standards on voltage (OV1)	-	-	-	-	1
Grand total		-	-	41	27	34

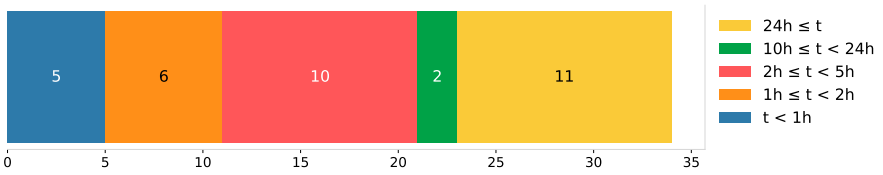

Figure 12.24: Number of events grouped by duration in 2023 for TEIAS.

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12.1.25 Events reported by TenneT DE

This section presents events for TenneT TSO GmbH, one of the TSOs in Germany. **??** presents the monthly distribution of ICS events by ICS criterion in 2023, and **??** presents the annual number of ICS events by ICS criterion from 2019–2023. **??** presents the number of events grouped by duration in 2023.

The changes in yearly numbers are nearly stable for consistent ICS Methodologies. The number of T0 events increased slightly in 2023 but is still lower than 2021. The number of T1 events decreased again to the same value of 2021 and the number of ON1 events remain on the same level. The variance during the year 2023 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 12.49: Monthly distribution of events by dominating criterion in 2023 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)	5	7	3	4	3	6	3	5	4	9	3	5	57
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	1	-	-	-	-	1	-	3
Scale 1	Incidents on network elements (T1)	-	-	1	-	-	-	-	-	-	-	-	-	1
	N-1 violation (ON1)	1	-	-	-	1	2	-	2	1	-	1	1	9
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand total		7	7	4	4	4	9	3	7	6	9	5	6	71

Table 12.50: The annual number of events by dominating criterion from 2019–2023 for TenneT DE.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	14	13	64	43	57
	Incidents on power generating facilities (G0)	12	6	-	2	-
	Loss of tools, means and facilities (LT0)	23	49	3	3	3
Scale 1	Incidents on network elements (T1)	1	-	1	9	1
	N-1 violation (ON1)	6	1	3	9	9
	Loss of tools, means and facilities (LT1)	1	1	2	-	1
Grand total		57	70	73	66	71

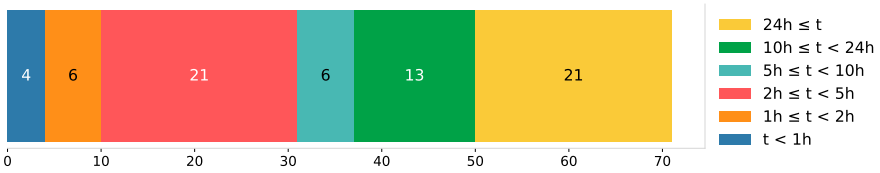

Figure 12.25: Number of events grouped by duration in 2023 for TenneT DE.

12.1.26 Events reported by TenneT NL

This section presents events for TenneT TSO B.V., the TSO in the Netherlands. Table 12.51 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.52 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.26 presents the number of events grouped by duration in 2023.

Table 12.51: Monthly distribution of events by dominating criterion in 2023 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)	1	1	1	-	2	3	-	3	-	1	3	1	16
	Incidents on power generating facilities (G0)	2	-	2	-	-	-	1	-	-	-	-	2	7
	Violation of standards on voltage (OV0)	3	-	-	-	-	2	-	-	-	-	-	1	6
	Loss of tools, means and facilities (LT0)	4	3	1	2	6	5	6	7	2	4	3	2	45
Scale 1	N-1 violation (ON1)	-	-	1	-	1	-	1	-	1	-	-	-	4
	Violation of standards on voltage (OV1)	2	-	-	-	-	4	-	-	-	-	-	-	6
Grand total		12	4	5	2	9	14	8	10	3	5	6	6	84

Table 12.52: The annual number of events by dominating criterion from 2019–2023 for TenneT NL.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	53	54	16	15	16
	Incidents on power generating facilities (G0)	-	1	11	22	7
	Violation of standards on voltage (OV0)	-	1	-	-	6
	Loss of tools, means and facilities (LT0)	5	5	21	26	45
Scale 1	Incidents on load (L1)	-	-	-	1	-
	Incidents on power generating facilities (G1)	-	-	1	-	-
	N-1 violation (ON1)	2	6	4	7	4
	Violation of standards on voltage (OV1)	-	-	-	1	6
	Loss of tools, means and facilities (LT1)	-	2	-	-	-
Grand total		60	69	53	72	84

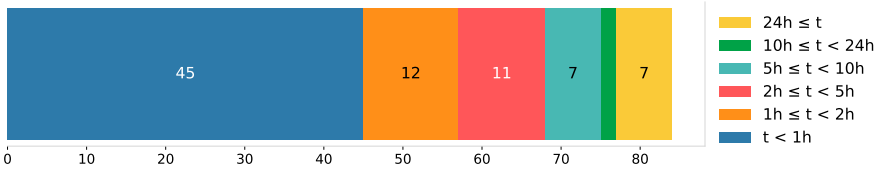

Figure 12.26: Number of events grouped by duration in 2023 for TenneT NL.

12.1.27 Events reported by Terna

This section presents events for TERNA, the TSO in Italy. 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 2019–2023. Figure 12.27 presents the number of events grouped by duration in 2022.

Table 12.53: Monthly distribution of events by dominating criterion in 2023 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)	6	8	5	3	9	2	16	5	4	1	1	4	64
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	1	-	1
	Violation of standards on voltage (OV0)	-	-	-	1	-	-	-	-	-	-	-	1	2
	Loss of tools, means and facilities (LT0)	1	-	-	-	-	-	-	-	-	-	-	-	1
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	1	-	-	-	-	1
Grand total		7	8	5	4	9	2	16	7	4	1	2	5	70

Table 12.54: The annual number of events by dominating criterion from 2019–2023 for Terna.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	83	66	75	57	64
	Separation from the grid (RS0)	-	-	-	-	1
	Violation of standards on voltage (OV0)	-	-	12	-	2
	Reduction of reserve capacity (RRC0)	-	-	1	-	-
	Loss of tools, means and facilities (LT0)	3	-	-	-	1
Scale 1	N-1 violation (ON1)	-	-	-	-	1
	Reduction of reserve capacity (RRC1)	-	-	9	1	1
Grand total		86	66	97	58	70

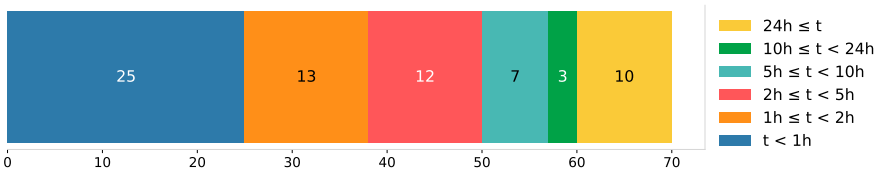

Figure 12.27: Number of events grouped by duration in 2023 for Terna.

12.1.28 Events reported by Transelectrica

This section presents events for Transelectrica, the TSO in Romania. 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 2019–2023. Figure 12.28 presents the number of events grouped by duration in 2022.

Table 12.55: Monthly distribution of events by dominating criterion in 2023 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)	5	-	3	-	6	14	26	23	3	1	32	3	116
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	2	2	-	-	-	-	4
	Violation of standards on voltage (OV0)	1	-	3	21	9	7	5	7	8	3	17	2	83
Scale 1	Violation of standards on voltage (OV1)	5	-	1	12	5	3	9	5	3	8	1	1	53
Grand total		11	-	7	33	20	24	42	37	14	12	50	6	256

Table 12.56: The annual number of events by dominating criterion from 2019–2023 for Transelectrica.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	44	77	56	59	116
	Incidents on power generating facilities (G0)	-	1	3	1	4
	Violation of standards on voltage (OV0)	196	11	71	47	83
	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	53
Scale 2	Incidents on network elements (T2)	-	-	1	-	-
	N violation (ON2)	-	-	1	-	-
	Separation from the grid (RS2)	-	-	1	-	-
Grand total		240	113	172	179	256

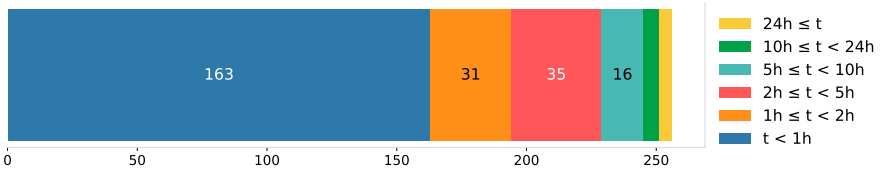

Figure 12.28: Number of events grouped by duration in 2023 for Transelectrica.

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12.1.29 Events reported by TransnetBW

This section presents events for TransnetBW GmbH, one of the TSOs in Germany. Table 12.57 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.58 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.29 presents the number of events grouped by duration in 2023.

Table 12.57: Monthly distribution of events by dominating criterion in 2023 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)	2	-	-	2	-	1	-	1	-	1	1	2	10
	Incidents on power generating facilities (G0)	1	-	1	-	1	2	-	-	2	-	1	1	9
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	1	-	-	1
Scale 1	Loss of tools, means and facilities (LT1)	-	-	-	-	1	-	-	1	-	-	-	-	2
Grand total		3	-	1	2	2	3	-	2	2	2	2	3	22

Table 12.58: The annual number of events by dominating criterion from 2019–2023 for TransnetBW.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	16	29	11	10	10
	Incidents on power generating facilities (G0)	27	8	16	18	9
	Loss of tools, means and facilities (LT0)	-	-	-	-	1
Scale 1	N-1 violation (ON1)	-	1	3	3	-
	Loss of tools, means and facilities (LT1)	2	2	4	7	2
Grand total		45	40	34	38	22

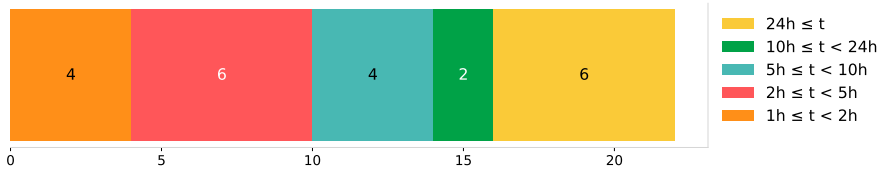

Figure 12.29: Number of events grouped by duration in 2023 for TransnetBW.

12.1.30 Events reported by Ukrenergo

This section presents events for Ukrenergo, the TSO in Ukraine. 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 2019–2023. Figure 12.30 presents the number of events grouped by duration in 2022.

Table 12.59: Monthly distribution of events by dominating criterion in 2023 for Ukrenergo.

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	-	-	-	-	2
	Incidents on network elements (T0)	19	11	14	7	20	25	41	27	1	9	17	16	207
	Incidents on power generating facilities (G0)	-	1	-	-	-	1	-	-	-	-	-	-	2
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	1	1	-	-	-	2
Scale 1	Incidents on load (L1)	-	3	1	1	4	1	1	2	1	-	-	1	15
	Reduction of reserve capacity (RRC1)	-	-	-	-	1	-	1	2	-	1	-	2	7
Scale 2	Incidents on load (L2)	-	-	-	-	1	-	-	-	-	-	-	-	1
Grand total		19	15	15	8	27	27	43	33	3	10	17	19	236

Table 12.60: The annual number of events by dominating criterion from 2019–2023 for Ukrenergo.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on load (L0)	-	-	-	-	2
	Incidents on network elements (T0)	-	-	-	-	207
	Incidents on power generating facilities (G0)	-	-	-	-	2
	Reduction of reserve capacity (RRC0)	-	-	-	-	2
Scale 1	Incidents on load (L1)	-	-	-	-	15
	Reduction of reserve capacity (RRC1)	-	-	-	-	7
Scale 2	Incidents on load (L2)	-	-	-	-	1
Grand total		-	-	-	-	236

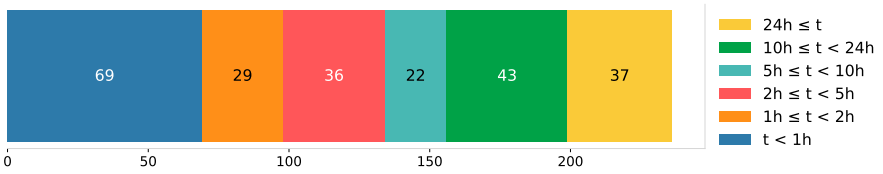

Figure 12.30: Number of events grouped by duration in 2023 for Ukrenergo.

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 12.61 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 2019–2023. Figure 12.31 presents the number of events grouped by duration in 2022.

Table 12.61: Monthly distribution of events by dominating criterion in 2023 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	-	1	-	1	-	1	-	5
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	-	-	1	-	-	1
Grand total		-	-	-	1	1	-	1	-	1	1	1	-	6

Table 12.62: The annual number of events by dominating criterion from 2019–2023 for Energinet (Nordic).

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	5	15	13	5	5
Scale 1	Incidents on network elements (T1)	1	-	-	-	-
	N-1 violation (ON1)	-	-	-	3	1
	Separation from the grid (RS1)	-	1	-	-	-
	Loss of tools, means and facilities (LT1)	-	2	-	-	-
Grand total		6	18	13	8	6

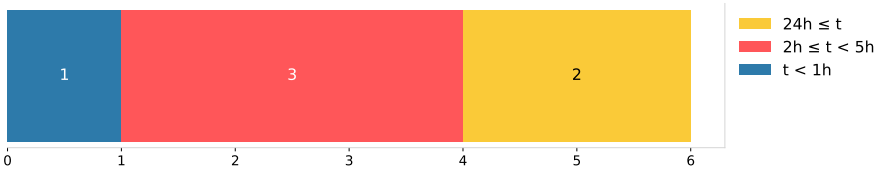

Figure 12.31: Number of events grouped by duration in 2023 for Energinet (Nordic).

12.2.2 Events reported by Fingrid

This section presents events for Fingrid Oyj, the TSO in Finland. Table 12.63 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.64 presents the annual number of ICS events by dominating ICS criterion from 2019–2023. Figure 12.32 presents the number of events grouped by duration in 2023.

Table 12.63: Monthly distribution of events by dominating criterion in 2023 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	-	-	2	-	-	-	1	-	4
	Incidents on power generating facilities (G0)	1	-	-	-	1	-	-	1	-	-	-	-	3
Grand total		1	-	-	1	1	-	2	1	-	-	1	-	7

Table 12.64: The annual number of events by dominating criterion from 2019–2023 for Fingrid.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	6	4	13	3	4
	Incidents on power generating facilities (G0)	-	1	-	2	3
	Loss of tools, means and facilities (LT0)	1	-	1	2	-
Grand total		7	5	14	7	7

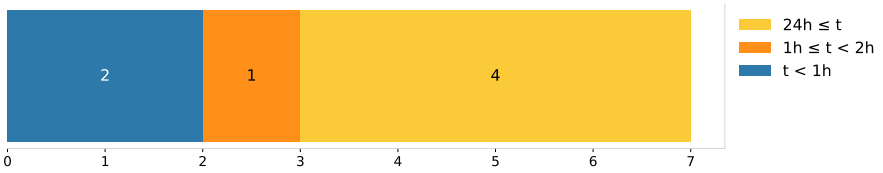

Figure 12.32: Number of events grouped by duration in 2023 for Fingrid.

12.2.3 Events reported by Freq (Nordic)

This section presents frequency events in the Nordics. Table 12.65 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.66 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.33 presents the number of events grouped by duration in 2023.

Table 12.65: Monthly distribution of events by dominating criterion in 2023 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)	7	9	5	9	4	6	2	5	8	3	15	15	88
Grand total		7	9	5	9	4	6	2	5	8	3	15	15	88

Table 12.66: The annual number of events by dominating criterion from 2019–2023 for Freq (Nordic).

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents leading to frequency degradation (F0)	-	62	70	53	88
Scale 1	Incidents leading to frequency degradation (F1)	106	4	3	1	-
Grand total		106	66	73	54	88

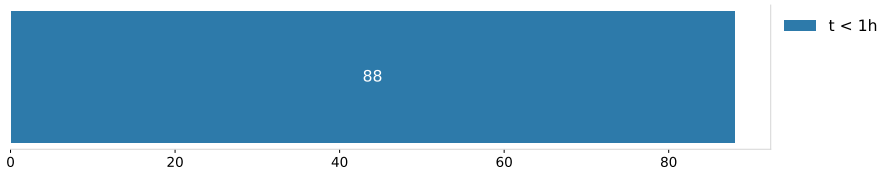

Figure 12.33: Number of events grouped by duration in 2023 for Freq (Nordic).

12.2.4 Events reported by Statnett

This section presents events for Statnett, the TSO in Norway. Table 12.67 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.68 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.34 presents the number of events grouped by duration in 2023.

Table 12.67: Monthly distribution of events by dominating criterion in 2023 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	-	-	-	1	-	3
	Incidents on network elements (T0)	3	4	3	-	-	3	1	-	3	1	4	4	26
	Incidents on power generating facilities (G0)	-	-	2	-	-	-	-	-	-	-	-	-	2
	Separation from the grid (RS0)	-	-	-	-	1	-	-	-	-	-	1	-	2
	Violation of standards on voltage (OV0)	-	-	-	-	1	-	-	-	-	-	-	-	1
	Loss of tools, means and facilities (LT0)	-	-	1	1	-	-	-	-	-	-	-	-	2
Scale 1	Incidents on network elements (T1)	1	1	-	-	1	-	-	-	-	-	-	-	3
	Loss of tools, means and facilities (LT1)	-	-	-	1	-	-	-	-	-	-	-	-	1
Grand total		4	5	6	2	4	3	2	-	3	1	6	4	40

Table 12.68: The annual number of events by dominating criterion from 2019–2023 for Statnett.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on load (L0)	-	-	2	1	3
	Incidents on network elements (T0)	12	14	19	34	26
	Incidents on power generating facilities (G0)	1	2	2	3	2
	Separation from the grid (RS0)	-	-	2	2	2
	Violation of standards on voltage (OV0)	-	-	-	-	1
	Loss of tools, means and facilities (LT0)	-	1	-	-	2
Scale 1	Incidents on load (L1)	2	1	-	1	-
	Incidents on network elements (T1)	-	2	2	1	3
	N-1 violation (ON1)	-	2	-	1	-
	Separation from the grid (RS1)	-	-	1	1	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	1
Grand total		15	22	28	44	40

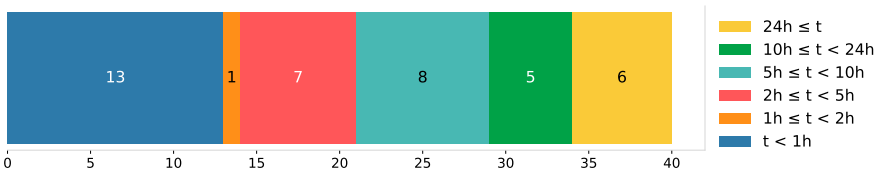

Figure 12.34: Number of events grouped by duration in 2023 for Statnett.

12.2.5 Events reported by Svenska kraftnät

This section presents events for Svenska Kraftät, the TSO in Sweden. Table 12.69 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.70 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.35 presents the number of events grouped by duration in 2023.

Table 12.69: Monthly distribution of events by dominating criterion in 2023 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)	1	4	-	3	3	12	13	9	3	-	1	4	53
	Incidents on power generating facilities (G0)	-	-	-	2	-	-	1	4	1	1	3	1	13
	Loss of tools, means and facilities (LT0)	2	1	1	-	1	-	-	-	3	2	1	1	12
Grand total		3	5	1	5	4	12	14	13	7	3	5	6	78

Table 12.70: The annual number of events by dominating criterion from 2019–2023 for Svenska kraftnät.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	36	40	56	54	53
	Incidents on power generating facilities (G0)	-	2	13	9	13
	Loss of tools, means and facilities (LT0)	-	9	21	3	12
Scale 1	Incidents on network elements (T1)	-	1	1	1	-
	Loss of tools, means and facilities (LT1)	-	4	1	-	-
Grand total		36	56	92	67	78

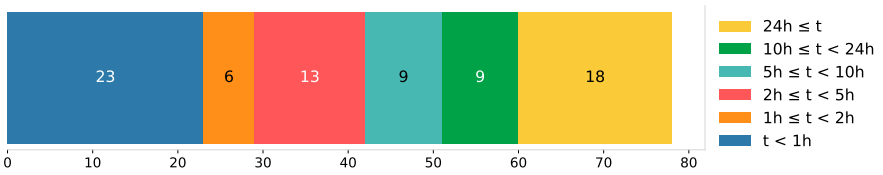

Figure 12.35: Number of events grouped by duration in 2023 for Svenska kraftnät.

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 12.71 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.72 presents the annual number of ICS events by ICS criterion from 2019 to 2023. Figure 12.36 presents the number of events grouped by duration in 2023.

Table 12.71: Monthly distribution of events by dominating criterion in 2023 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	1	-	1	-	1	-	4
	Incidents on network elements (T0)	11	8	20	14	15	16	10	14	13	20	25	26	192
	Incidents on power generating facilities (G0)	-	-	2	-	1	3	1	-	1	-	-	3	11
	Loss of tools, means and facilities (LT0)	6	1	2	-	1	2	2	2	4	-	3	1	24
Scale 1	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	1	-	1
Grand total		17	9	24	14	17	22	14	16	19	20	30	30	232

Table 12.72: The annual number of events by dominating criterion from 2019–2023 for National Grid ESO.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents leading to frequency degradation (F0)	78	2	3	7	4
	Incidents on network elements (T0)	155	169	218	157	192
	Incidents on power generating facilities (G0)	-	12	14	9	11
	Loss of tools, means and facilities (LT0)	42	76	16	15	24
Scale 1	Incidents on power generating facilities (G1)	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	1	1	-	-
Scale 2	Incidents leading to frequency degradation (F2)	1	-	-	-	-
Grand total		276	260	252	188	232

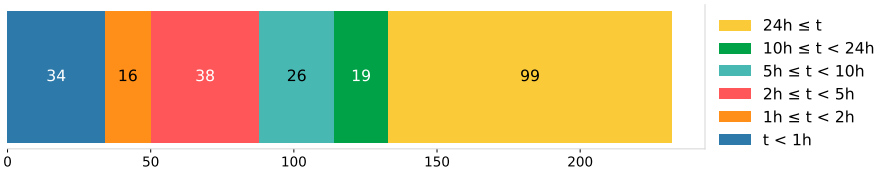

Figure 12.36: Number of events grouped by duration in 2023 for National Grid ESO.

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 12.73 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.74 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.37 presents the number of events grouped by duration in 2023.

Table 12.73: Monthly distribution of events by dominating criterion in 2023 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	-	-	1	-	-	-	6
Grand total		1	2	-	1	-	1	-	-	1	-	-	-	6

Table 12.74: The annual number of events by dominating criterion from 2019–2023 for AST.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	6	4	6	5	6
	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	-	-	-
Scale 2	Incidents on load (L2)	-	1	-	-	-
Grand total		8	9	7	6	6

Figure 12.37: Number of events grouped by duration in 2023 for AST.

12.4.2 Events reported by Elering

This section presents events for Elering, the TSO in Estonia. Table 12.75 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.76 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.38 presents the number of events grouped by duration in 2023.

Table 12.75: Monthly distribution of events by dominating criterion in 2023 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)	-	-	-	-	-	2	4	2	-	-	3	-	11
	Incidents on power generating facilities (G0)	2	-	-	1	1	-	1	3	-	-	1	-	9
Grand total		2	-	-	1	1	2	5	5	-	-	4	-	20

Table 12.76: The annual number of events by dominating criterion from 2019–2023 for Elering.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	14	7	8	16	11
	Incidents on power generating facilities (G0)	10	23	15	16	9
Grand total		24	30	23	32	20

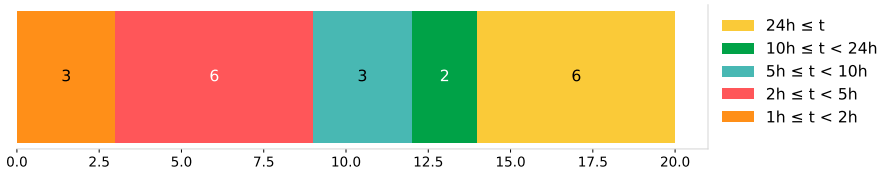

Figure 12.38: Number of events grouped by duration in 2023 for Elering.

12.4.3 Events reported by Litgrid

This section presents events for Litgrid AB, the TSO in Lithuania. Table 12.77 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.78 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.39 presents the number of events grouped by duration in 2023.

Table 12.77: Monthly distribution of events by dominating criterion in 2023 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)	2	-	-	1	-	1	-	3	-	-	-	2	9
Scale 1	Incidents on network elements (T1)	-	-	-	1	-	-	-	-	-	-	-	-	1
Grand total		2	-	-	2	-	1	-	3	-	-	-	2	10

Table 12.78: The annual number of events by dominating criterion from 2019–2023 for Litgrid.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	8	9	7	6	9
	Incidents on power generating facilities (G0)	-	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	1
Grand total		13	17	12	13	10

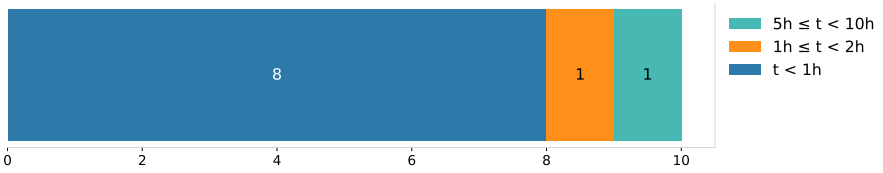

Figure 12.39: Number of events grouped by duration in 2023 for Litgrid.

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 12.79 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.80 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.40 presents the number of events grouped by duration in 2023.

Table 12.79: Monthly distribution of events by dominating criterion in 2023 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)	1	-	-	-	-	1	1	-	-	-	1	-	4
	Incidents on power generating facilities (G0)	1	-	-	1	-	3	2	1	1	3	-	1	13
Grand total		2	-	-	1	-	4	3	1	1	3	1	1	17

Table 12.80: The annual number of events by dominating criterion from 2019–2023 for EirGrid.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents leading to frequency degradation (F0)	4	-	-	-	-
	Incidents on network elements (T0)	9	6	8	16	4
	Incidents on power generating facilities (G0)	8	19	14	12	13
Scale 1	N-1 violation (ON1)	-	3	7	8	-
Grand total		21	28	29	36	17

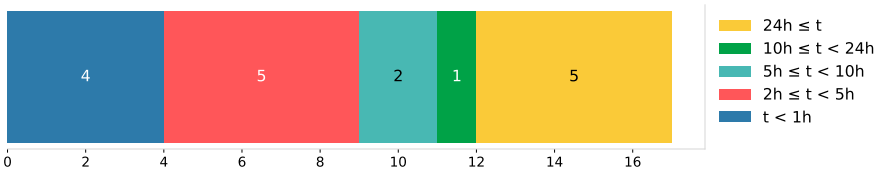

Figure 12.40: Number of events grouped by duration in 2023 for EirGrid.

12.5.2 Events reported by SONI

This section presents events for SONI, the TSO in Northern Ireland. Table 12.81 presents the monthly distribution of ICS events by ICS criterion in 2023, and Table 12.82 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.41 presents the number of events grouped by duration in 2023.

Table 12.81: Monthly distribution of events by dominating criterion in 2023 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
Grand total		-	-	-	-	-	-	-	-	-	-	-	1	1

Table 12.82: The annual number of events by dominating criterion from 2019–2023 for SONI.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on network elements (T0)	-	2	3	2	1
	Incidents on power generating facilities (G0)	2	-	-	3	-
Scale 1	N-1 violation (ON1)	-	-	1	-	-
Grand total		2	2	4	5	1

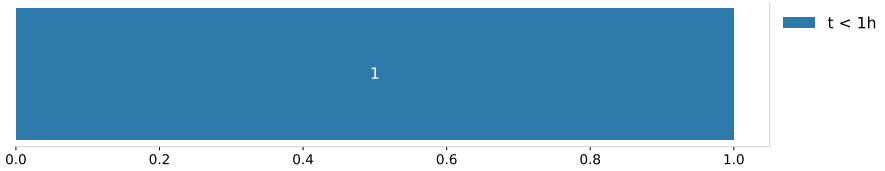

Figure 12.41: Number of events grouped by duration in 2023 for SONI.

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 12.83 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 12.84 presents the annual number of ICS events by ICS criterion from 2019–2023. Figure 12.42 presents the number of events grouped by duration in 2022.

Table 12.83: Monthly distribution of events by dominating criterion in 2023 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)	1	-	-	-	-	-	-	-	-	-	-	-	1
	Incidents on network elements (T0)	-	2	-	-	4	1	1	-	-	1	3	-	12
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	1	-	-	1
Scale 2	Incidents on network elements (T2)	-	-	-	-	-	-	-	1	-	-	-	-	1
Grand total		1	2	-	-	4	1	1	1	-	2	3	-	15

Table 12.84: The annual number of events by dominating criterion from 2019–2023 for Landsnet.

Scale	Main event ICS criterion	2019	2020	2021	2022	2023
Scale 0	Incidents on load (L0)	-	-	-	6	1
	Incidents on network elements (T0)	5	29	26	29	12
	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)	7	12	1	2	1
	Incidents on power generating facilities (G1)	-	-	2	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	1	-
Scale 2	Incidents on load (L2)	-	-	-	2	-
	Incidents on network elements (T2)	-	-	-	1	1
	Loss of tools, means and facilities (LT2)	-	-	1	-	-
Grand total		16	46	30	42	15

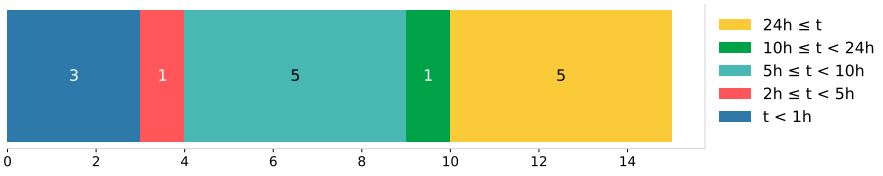

Figure 12.42: Number of events grouped by duration in 2023 for Landsnet.

13 Conclusion

The ENTSO-E ICS Methodology has been revised multiple times since its initial publication in 2014. The 2023 ICS Annual Report follows the most recent version, the 2019 ICS Methodology [2]. The Annual Report provides a clear overview of the incidents that occurred within the control area of each TSO, and 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 3768 ICS events in 2023, of which 3201 were scale 0, 564 were scale 1 and 3 were scale 2. No scale 3 incidents were reported. There were 376 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 describes each occurrence of an ICS criteria violation, while ICS incident groups all related criteria violations into one incident.

Approximately 86% of all ICS events took place in CE, which is expected as 30 of the 42 TSOs are located there. Of the 3 scale 2 incidents, 2 occurred in CE and one in Iceland. The number of reported ICS events in 2023 increased compared to 2022, but was still lower than the number reported in 2021. As in 2022, the most common registered ICS criteria are events on network elements (T), violations of standards on voltage (OV) and frequency degradation (F). The number of events on network elements (T) and frequency degradation (F) increased compared to 2022 while the violations of standards on voltage (OV) slightly decreased. The number of scale 2 incidents remains in a similar range over the past five years.

Recommendations from Working Group ICS

As required by the SOGL [1], WG ICS should provide recommendations to improve operational security in the European power grids. WG ICS has identified a continuously high number of ICS events due to violations of standards on voltage (OV0 and OV1) with only a slight trend of decrease. Furthermore, trips of network elements (T0) increased significantly . All voltage violations except one was registered in CE, and T events were mainly registered in CE but also occurred in other synchronous areas.

The WG ICS 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 been notified of the trend and begun to take actions to prevent these in the future.

Of the 301 incidents due to contingencies from the contingency list (OPS-A), 40 were 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. The indicator OPS-A increased by approximately 100% in 2023, which is attributed to the high number of occurred contingencies from the contingency list by EMS. The contingencies were voltage violations.

WG ICS also noted the increase of incidents where an exceptional contingency degraded the system operation state. While the overall number of 12 is rather small, the increase of 100% from 2022 should be investigated by the affected TSOs.

References

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

[2] Subgroup Incident Classification Scale, "Incident Classification Scale Methodology 2019." https://eepublicdownloads.entsoe.eu/clean-documents/SOC%20documents/Incident_Classification_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] WG Annual Load-Frequency Control, "Annual Load-Frequency Control Reports." https://www.entsoe.eu/network_codes/sys-ops/annual-reports/, September 2024.

[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/, March 2024.

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