European Network of
Transmission System Operators
for Electricity

entsoe

ICS 2024 ANNUAL REPORT

29 September 2025

From: Working Group Incident Classification Scale

ICS 2024 Annual Report

Report rendered 29 September 2025

ENTSO-E Mission Statement

Who we are

ENTSO-E, the European Network of Transmission System Operators for Electricity, is the association for the cooperation of the European transmission system operators (TSOs). The 42 member TSOs, representing 35 countries, are responsible for the secure and coordinated operation of Europe's electricity system, the largest interconnected electrical grid in the world. In addition to its core, historical role in technical cooperation, ENTSO-E is also the common voice of TSOs.

ENTSO-E brings together the unique expertise of TSOs for the benefit of European citizens by keeping the lights on, enabling the energy transition, and promoting the completion and optimal functioning of the internal electricity market, including via the fulfilment of the mandates given to ENTSO-E based on EU legislation.

Our mission

ENTSO-E and its members, as the European TSO community, fulfil a common mission: Ensuring the security of the inter-connected power system in all time frames at pan-European level and the optimal functioning and development of the European interconnected electricity markets, while enabling the integration of electricity generated from renewable energy sources and of emerging technologies.

Our vision

ENTSO-E plays a central role in enabling Europe to become the first climate-neutral continent by 2050 by creating a system that is secure, sustainable and affordable, and that integrates the expected amount of renewable energy, thereby offering an essential contribution to the European Green Deal. This endeavour requires sector integration and close cooperation among all actors.

Europe is moving towards a sustainable, digitalised, integrated and electrified energy system with a combination of centralised and distributed resources. ENTSO-E acts to ensure that this energy system keeps consumers at its centre and is operated and developed with climate objectives and social welfare in mind.

ENTSO-E is committed to use its unique expertise and system-wide view – supported by a responsibility to maintain the system's security – to deliver a comprehensive roadmap of how a climate-neutral Europe looks.

Our values

ENTSO-E acts in solidarity as a community of TSOs united by a shared responsibility.

As the professional association of independent and neutral regulated entities acting under a clear legal mandate, ENTSO-E serves the interests of society by optimising social welfare in its dimensions of safety, economy, environment, and performance.

ENTSO-E is committed to working with the highest technical rigour as well as developing sustainable and innovative responses to prepare for the future and overcoming the challenges of keeping the power system secure in a climate-neutral Europe. In all its activities, ENTSO-E acts with transparency and in a trustworthy dialogue with legislative and regulatory decision makers and stakeholders.

Our contributions

ENTSO-E supports the cooperation among its members at European and regional levels. Over the past decades, TSOs have undertaken initiatives to increase their cooperation in network planning, operation and market integration, thereby successfully contributing to meeting EU climate and energy targets.

To carry out its legally mandated tasks, ENTSO-E's key responsibilities include the following:

› Development and implementation of standards, network codes, platforms and tools to ensure secure system and market operation as well as integration of renewable energy; › Assessment of the adequacy of the system in different timeframes;

› Coordination of the planning and development of infrastructures at the European level (Ten-Year Network Development Plans, TYNDPs);

› Coordination of research, development and innovation activities of TSOs;

› Development of platforms to enable the transparent sharing of data with market participants.

ENTSO-E supports its members in the implementation and monitoring of the agreed common rules.

ENTSO-E is the common voice of European TSOs and provides expert contributions and a constructive view to energy debates to support policymakers in making informed decisions.

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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

ICS Incident Classification Scale

ICS event An ICS event indicates the occurrence of a single violation of an ICS criterion

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/violations.

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 2024 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 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 and the observer members Moldelectrica in Moldova and TEIAS in Türkiye. 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) [3].

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 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 changes introduced in 2019 are presented in more detail in the 2023 ICS Annual Report [4].

All data presented in this report are based on the ICS Methodology approved in 2019. As of 2018, annual workshops are organised to ensure high-quality and consistent reporting for all TSOs.

3 Pan-European Overview

This chapter provides a pan-European overview of the events and incidents in 2024 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 2020–2024.

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.

As shown in Table 3.1, TSOs reported 11892 ICS events in 2024, of which 8602 were of scale 0, 3260 of scale 1, 27 were scale 2 and 3 scale 3 events were reported. The percentage distribution of scales 0, 1 and 2 ICS events were 72.3%, 27.7% , 0.2%, respectively. There were 130 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 2024. 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 65% of all events, as well as incidents, occurred in Nordic synchronous area. The high percentage is due to the high volume of OV incidents in the control area of Svenska kraftnät. 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. 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 27 scale 2 violations and 3 scale 3 violations associated to the blackout incident in Balkan area on 21st of June 2024.

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 2024 were events on violation of standards on voltage (OV0 and OV1) with 8643 events, 1811 events on network elements (T0 and T1), and events leading to frequency degradation (F0) with 404 events. Scale 2 and scale 3 events are related to the same incident: the blackout in Montenegro. Chapter 4 describes the blackout incident in more detail.

Table 3.1: Number of incidents and events by scale for 2024 and their percentage distribution.

	Number of incidents	Percentage of total	Number of events	Percentage of total
Scale 0	8496	72.3%	8602	72.3%
Scale 1	3254	27.7%	3260	27.4%
Scale 2	0	0.0%	27	0.2%
Scale 3	1	0.0%	3	0.0%
Grand total	11751	100.0%	11892	100.0%

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Table 3.2: Number of incidents by scale and synchronous area for 2024.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand total
Baltic	47	3	-	-	50
Continental Europe	2729	1116	-	1	3846
Great Britain	-	-	-	-	-
Ireland	43	-	-	-	43
Isolated systems	14	2	-	-	16
Nordic	5663	2133	-	-	7796
Grand total	8496	3254	-	1	11751

Table 3.3: Number of events by scale and synchronous area for 2024.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand total
Baltic	48	3	-	-	51
Continental Europe	2824	1121	27	3	3975
Great Britain	-	-	-	-	-
Ireland	45	-	-	-	45
Isolated systems	14	2	-	-	16
Nordic	5671	2134	-	-	7805
Grand total	8602	3260	27	3	11892

Table 3.4: Percentage distribution of incidents by scale and synchronous area for 2024.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	94.0%	6.0%	-	-
Continental Europe	71.0%	29.0%	-	0.0%
Great Britain	-	-	-	-
Ireland	100.0%	-	-	-
Isolated systems	87.5%	12.5%	-	-
Nordic	72.6%	27.4%	-	-
Grand total	72.3%	27.7%	-	0.0%

Table 3.5: Percentage distribution of events by scale and synchronous area for 2024.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	94.1%	5.9%	-	-
Continental Europe	71.0%	28.2%	0.7%	0.1%
Great Britain	-	-	-	-
Ireland	100.0%	-	-	-
Isolated systems	87.5%	12.5%	-	-
Nordic	72.7%	27.3%	-	-
Grand total	72.3%	27.4%	0.2%	0.0%

Table 3.6: Number of ICS incidents by scale and TSO for 2024.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	AST	7	1	-	-	8
	Elering	21	1	-	-	22
	Litgrid	19	1	-	-	20
	Total	47	3	-	-	50
Continental Europe	50Hertz	45	2	-	-	47
	Amprion	91	16	-	-	107
	APG	9	20	-	-	29
	CEPS	80	104	-	-	184
	CGES	50	1	-	1	52
	ELES	121	116	-	-	237
	Elia	15	3	-	-	18
	EMS	27	148	-	-	175
	Energinet (CE)	39	2	-	-	41
	ESO	62	-	-	-	62
	Freq (CE)	269	5	-	-	274
	HOPS	1	8	-	-	9
	IPTO	94	2	-	-	96
	MAVIR	238	92	-	-	330
	Moldelectrica	4	150	-	-	154
	NOS BiH	28	-	-	-	28
	OST	65	5	-	-	70
	PSE	87	-	-	-	87
	Red Eléctrica	241	-	-	-	241
	REN	23	-	-	-	23
	RTE	356	48	-	-	404
	SEPS	10	5	-	-	15
	Swissgrid	92	12	-	-	104
	TEIAS	30	1	-	-	31
	TenneT DE	60	8	-	-	68
	TenneT NL	58	3	-	-	61
	Terna	57	-	-	-	57
	Transelectrica	254	87	-	-	341
	TransnetBW	28	5	-	-	33
	Ukrenergo	195	273	-	-	468
	Total	2729	1116	-	1	3846
Ireland and Northern Ireland	EirGrid	30	-	-	-	30
	SONI	13	-	-	-	13
	Total	43	-	-	-	43
Isolated system	Landsnet	14	2	-	-	16
	Total	14	2	-	-	16
Nordic	Energinet (Nordic)	13	3	-	-	16
	Fingrid	15	-	-	-	15
	Freq (Nordic)	114	11	-	-	125
	Statnett	21	13	-	-	34
	Svenska kraftnät	5500	2106	-	-	7606
	Total	5663	2133	-	-	7796
Grand total		8496	3254	-	1	11751

Table 3.7: Number of ICS events by scale and TSO for 2024.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	AST	7	2	-	-	9
	Elering	21	1	-	-	22
	Litgrid	19	1	-	-	20
	Total	47	4	-	-	51
Continental Europe	50Hertz	47	2	-	-	49
	Amprion	93	17	-	-	110
	APG	9	20	-	-	29
	CEPS	81	104	-	-	185
	CGES	50	1	4	2	57
	ELES	121	116	-	-	237
	Elia	18	4	-	-	22
	EMS	27	150	-	-	177
	Energinet (CE)	39	2	-	-	41
	ESO	74	-	-	-	74
	Freq (CE)	272	7	-	-	279
	HOPS	9	8	7	-	24
	IPTO	94	2	-	-	96
	MAVIR	238	92	-	-	330
	Moldelectrica	4	150	-	-	154
	NOS BiH	30	-	9	1	40
	OST	65	6	7	1	79
	PSE	87	-	-	-	87
	Red Eléctrica	269	-	-	-	269
	REN	24	-	-	-	24
	RTE	356	48	-	-	404
	SEPS	17	5	-	-	22
	Swissgrid	95	12	-	-	107
	TEIAS	31	2	-	-	33
	TenneT DE	62	8	-	-	70
	TenneT NL	59	3	-	-	62
	Terna	57	-	-	-	57
	Transelectrica	262	88	-	-	350
	TransnetBW	33	6	-	-	39
	Ukrenergo	195	273	-	-	468
	Total	2818	1126	27	4	3975
Ireland and Northern Ireland	EirGrid	32	-	-	-	32
	SONI	13	-	-	-	13
	Total	45	-	-	-	45
Isolated system	Landsnet	14	2	-	-	16
	Total	14	2	-	-	16
Nordic	Energinet (Nordic)	13	3	-	-	16
	Fingrid	15	1	-	-	16
	Freq (Nordic)	114	11	-	-	125
	Statnett	29	13	-	-	42
	Svenska kraftnät	5500	2106	-	-	7606
	Total	5671	2134	-	-	7805
Grand total		8595	3266	27	4	11892

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Table 3.8: Incidents by dominating criteria for each synchronous area for 2024.

Scale	ICS criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale0	Incidents on load (L0)	-	6	-	-	-	-	6
	Incidents leading to frequency degradation (F0)	-	269	-	-	-	114	383
	Incidents on network elements (T0)	35	1557	-	20	12	78	1702
	Incidents on power generating facilities (G0)	12	112	-	17	2	7	150
	Separation from the grid (RS0)	-	1	-	-	-	-	1
	Violation of standards on voltage (OV0)	-	514	-	-	-	5435	5949
	Reduction of reserve capacity (RRC0)	-	99	-	-	-	-	99
	Loss of tools, means and facilities (LT0)	-	171	-	6	-	29	206
	Total	47	2729	-	43	14	5663	8496
Scale1	Incidents on load (L1)	-	157	-	-	-	-	157
	Incidents leading to frequency degradation (F1)	-	5	-	-	-	11	16
	Incidents on network elements (T1)	-	12	-	-	-	12	24
	Incidents on power generating facilities (G1)	-	3	-	-	2	-	5
	N-1 violation (ON1)	1	143	-	-	-	19	163
	Separation from the grid (RS1)	-	1	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	618	-	-	-	2074	2692
	Reduction of reserve capacity (RRC1)	-	103	-	-	-	7	110
	Loss of tools, means and facilities (LT1)	2	74	-	-	-	10	86
	Total	3	1116	-	-	2	2133	3254
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)	-	1	-	-	-	-	1
	Total	-	1	-	-	-	-	1
Grand Total		50	3846	-	43	16	7796	11751

Table 3.9: Events by dominating criteria for each synchronous area for 2024.

Scale	ICS criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale0	Incidents on load (L0)	-	6	-	-	-	1	7
	Incidents leading to frequency degradation (F0)	-	274	-	-	-	114	388
	Incidents on network elements (T0)	36	1640	-	20	12	78	1786
	Incidents on power generating facilities (G0)	12	118	-	19	2	7	158
	Separation from the grid (RS0)	-	1	-	-	-	7	8
	Violation of standards on voltage (OV0)	-	514	-	-	-	5435	5949
	Reduction of reserve capacity (RRC0)	-	99	-	-	-	-	99
	Loss of tools, means and facilities (LT0)	-	172	-	6	-	29	207
	Total	48	2824	-	45	14	5671	8602
Scale1	Incidents on load (L1)	-	157	-	-	-	-	157
	Incidents leading to frequency degradation (F1)	-	5	-	-	-	11	16
	Incidents on network elements (T1)	-	13	-	-	-	12	25
	Incidents on power generating facilities (G1)	-	3	-	-	2	-	5
	N-1 violation (ON1)	1	144	-	-	-	19	164
	Separation from the grid (RS1)	-	1	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	619	-	-	-	2075	2694
	Reduction of reserve capacity (RRC1)	-	103	-	-	-	7	110
	Loss of tools, means and facilities (LT1)	2	76	-	-	-	10	88
	Total	3	1121	-	-	2	2134	3260
Scale2	Incidents on load (L2)	-	1	-	-	-	-	1
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	20	-	-	-	-	20
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-
	N violation (ON2)	-	4	-	-	-	-	4
	Separation from the grid (RS2)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	2	-	-	-	-	2
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-
	Total	-	27	-	-	-	-	27
Scale3	Blackout (OB3)	-	3	-	-	-	-	3
	Total	-	3	-	-	-	-	3
Grand Total		51	3975	-	45	16	7805	11892

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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 2024.

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 2024 per consumption, the Nordic area has the highest value, at 14.8 ICS events per TWh of consumption, whereas the isolated system (Iceland) has the lowest value at 0.6 events per TWh of consumption. For scale 1, the minimum value is 0 events per TWh in IE/NI and isolated system, and the maximum value is 0.2 events per TWh in Continental Europe.

When the number of scale 0–3 events in 2024 is normalised by circuit length, the values for the other synchronous areas improve compared to Continental Europe.

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.

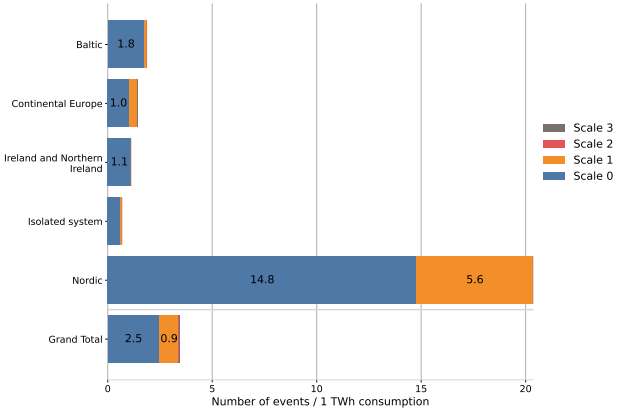

Figure 3.1: Number of events per 1 TWh of energy consumption for 2024.

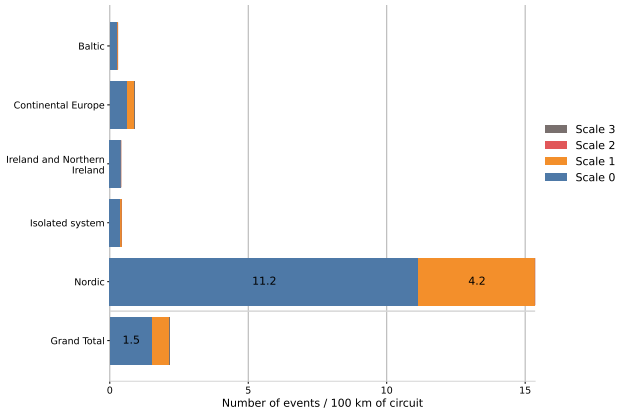

Figure 3.2: Number of events per 100 km of circuit length for 2024.

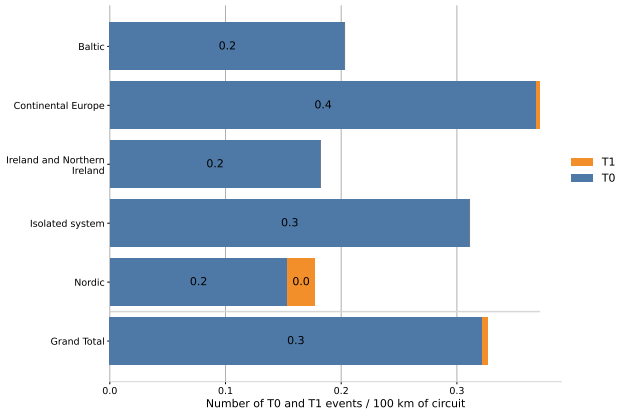

Figure 3.3: Number of events on transmission network elements (T0 and T1) per 100 km of circuit length for 2024.

3.3 Evolution 2020–2024

This section presents classified events according to the ICS Methodology [2] as it developed between 2020–2024. 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 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 2020 and 2024. 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 we have significant increase of incidents in 2024 compared to previous years due the increase in OV incidents in Nordic area. A detailed view of these incident category is presented in Section 3.3.4, respectively.

The number of scale 1 events in 2024 reaches a peak with 3260 events and is much higher than the highest level observed during the period (815 in 2021). This shift was mainly driven by the increased number of OV1 events.

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. This number of events per TWh of energy consumption is stable around 1.0 or below in all synchronous areas except the Nordic. For the Nordic area, this figure increases significantly in 2024 from close to zero to over 5 events per TWh.

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 consumption and per 100 km circuit length in 2024 increased significantly compared to 2023 in Nordic area due to the high increase of OV violations. The number of Scale 1 events per consumption and circuit length increased also in Continental Europe even though it is less visible in the graph due to the trend observed in Nordic area.

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.

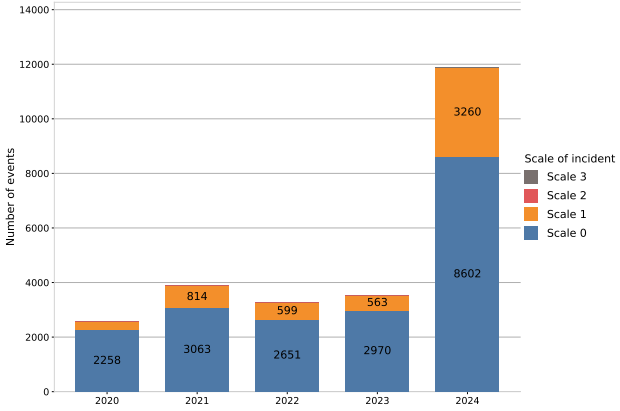

Figure 3.4: The annual number of events per scale from 2020–2024.

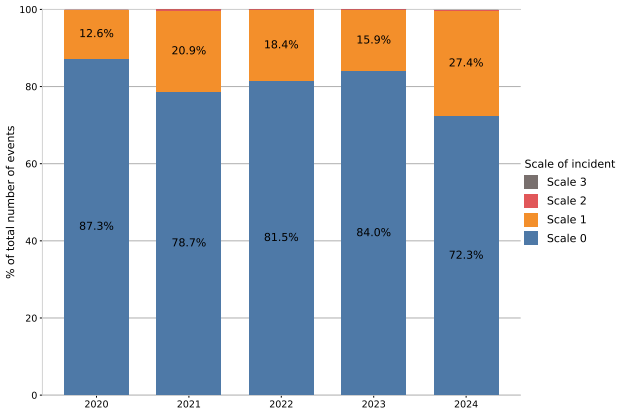

Figure 3.5: The annual percentage distribution of events per scale from 2020–2024.

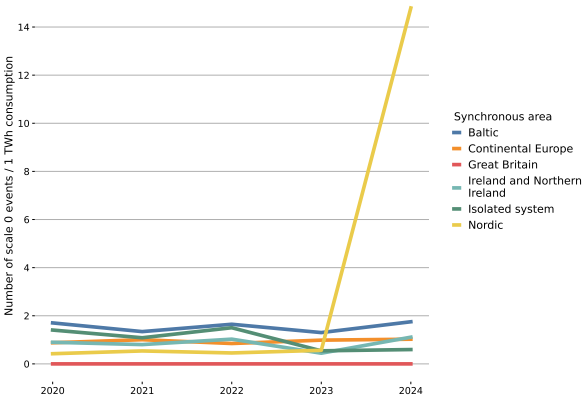

Figure 3.6: The annual number of scale 0 events per 1 TWh of energy consumption from 2020–2024.

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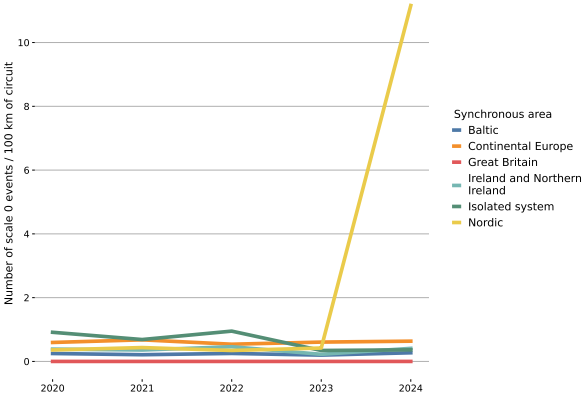

Figure 3.7: The annual number of scale 0 events per 100 km of circuit length from 2020–2024.

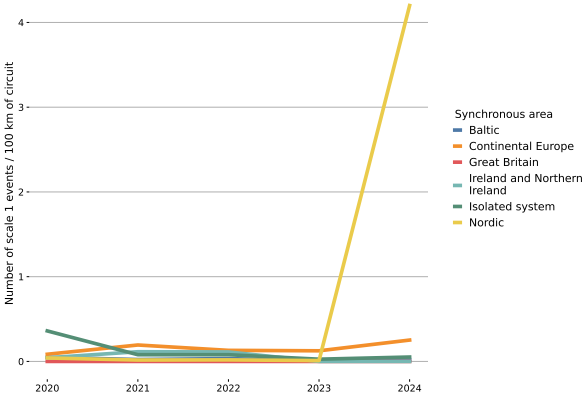

Figure 3.9: The annual number of scale 1 events per 100 km of circuit length from 2020–2024.

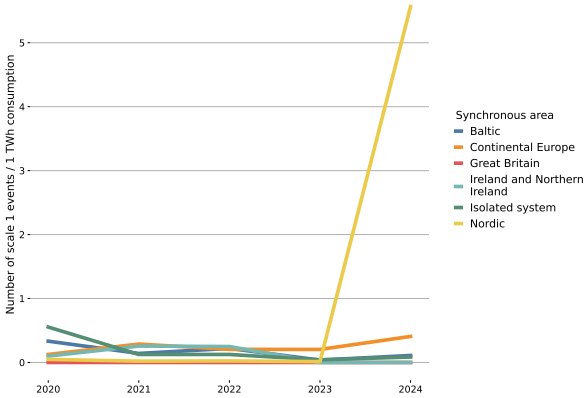

Figure 3.8: The annual number of scale 1 events per 1 TWh of energy consumption from 2020–2024.

Table 3.10: The annual number of incidents per dominating criteria from 2020–2024.

Scale	ICS criterion	2020	2021	2022	2023	2024
Scale0	Incidents on load (L0)	3	3	11	8	7
	Incidents leading to frequency degradation (F0)	355	809	268	291	383
	Incidents on network elements (T0)	1144	1344	1355	1786	1701
	Incidents on power generating facilities (G0)	132	174	165	129	150
	Separation from the grid (RS0)	-	-	-	2	1
	Violation of standards on voltage (OV0)	422	471	479	436	5949
	Reduction of reserve capacity (RRC0)	-	26	185	91	99
	Loss of tools, means and facilities (LT0)	109	89	90	121	206
	Total	2165	2916	2553	2864	8496
Scale1	Incidents on load (L1)	9	1	4	27	157
	Incidents leading to frequency degradation (F1)	7	95	7	13	16
	Incidents on network elements (T1)	30	30	28	17	24
	Incidents on power generating facilities (G1)	-	5	-	2	5
	N-1 violation (ON1)	57	67	68	58	163
	Separation from the grid (RS1)	1	1	-	-	1
	Violation of standards on voltage (OV1)	116	500	391	359	2692
	Reduction of reserve capacity (RRC1)	66	61	74	60	110
	Loss of tools, means and facilities (LT1)	29	31	21	19	86
	Total	315	791	593	555	3254
Scale2	Incidents on load (L2)	1	2	2	1	-
	Incidents leading to frequency degradation (F2)	-	1	-	-	-
	Incidents on network elements (T2)	-	3	1	1	-
	Incidents on power generating facilities (G2)	-	1	-	-	-
	N violation (ON2)	-	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	1	11	3	2	-
Scale3	Blackout (OB3)	-	-	-	-	1
	Total	-	-	-	-	1
Grand Total		2481	3718	3149	3421	11751

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Table 3.11: The annual number of events per dominating criteria from 2020–2024.

Scale	ICS criterion	2020	2021	2022	2023	2024
Scale0	Incidents on load (L0)	5	6	13	16	8
	Incidents leading to frequency degradation (F0)	358	815	272	296	386
	Incidents on network elements (T0)	1188	1439	1434	1869	1780
	Incidents on power generating facilities (G0)	134	183	169	134	158
	Separation from the grid (RS0)	2	2	3	2	8
	Violation of standards on voltage (OV0)	449	493	480	437	5949
	Reduction of reserve capacity (RRC0)	-	26	185	91	99
	Loss of tools, means and facilities (LT0)	113	91	90	121	207
	Total	2249	3055	2646	2966	8595
Scale1	Incidents on load (L1)	14	3	8	35	160
	Incidents leading to frequency degradation (F1)	7	96	8	15	18
	Incidents on network elements (T1)	34	35	28	17	24
	Incidents on power generating facilities (G1)	1	6	-	2	5
	N-1 violation (ON1)	60	69	70	59	165
	Separation from the grid (RS1)	2	1	1	-	2
	Violation of standards on voltage (OV1)	122	515	392	360	2694
	Reduction of reserve capacity (RRC1)	66	63	75	60	110
	Loss of tools, means and facilities (LT1)	29	31	22	19	88
	Total	335	819	604	567	3266
Scale2	Incidents on load (L2)	2	2	2	2	1
	Incidents leading to frequency degradation (F2)	-	2	-	-	-
	Incidents on network elements (T2)	-	4	1	1	20
	Incidents on power generating facilities (G2)	-	2	-	-	-
	N violation (ON2)	-	1	-	-	4
	Separation from the grid (RS2)	-	7	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	2
	Reduction of reserve capacity (RRC2)	-	1	-	-	-
	Loss of tools, means and facilities (LT2)	-	1	-	-	-
	Total	2	20	3	3	27
Scale3	Blackout (OB3)	-	-	-	-	4
	Total	-	-	-	-	4
Grand Total		2586	3894	3253	3536	11892

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 where it was not possible to identify the cause of the violation.

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.

In 2024, the incident identification process was substantially improved to remove the inconsistency between odd and even months.

The number of incidents leading to frequency degradations (F) in 2024 were 28% higher than in 2023. The differences are caused by Nordic Area where number of incidents increased for 42% and by significant increase of load and generation forecast (LGF) deviations.

LGF deviations are caused by increasing amount of uncontrollable generation sources in the system which was to be expected. Nevertheless, the need for increase in accuracy of the forecast is noticeable. F incidents in the Nordic SA grows significantly second year in a row. This can be beginning of the alarming trend and need to be noticed. 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 2020–2024.

Synchronous area	2020	2021	2022	2023	2024
Baltic	-	-	-	-	-
CE	299	840	226	223	279
GB	-	-	-	-	-
IE-NI	-	-	-	-	-
Isolated system	-	-	-	-	-
Nordic	66	73	54	88	125
Grand total	365	913	280	311	404

Table 3.13: The annual number of F-events per cause from 2020–2024.

Cause of event	2020	2021	2022	2023	2024
Loss of generation	1	-	-	-	1
Loss of load	-	-	-	-	3
Previous event	-	1	-	5	-
LGF deviations	1	-	-	-	115
Other	1	1	-	-	5
Unknown	362	911	280	306	280
Grand total	365	913	280	311	404

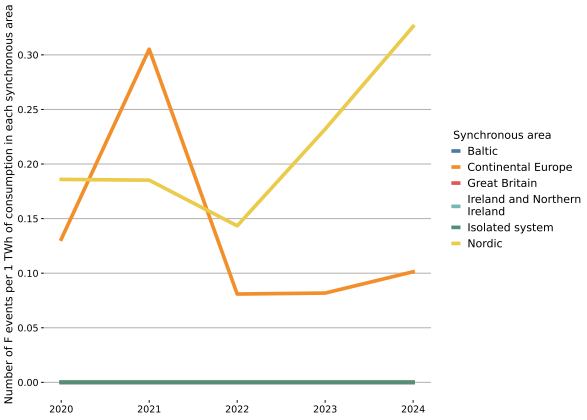

Figure 3.10: The annual number of F events per 1 TWh of consumption in each synchronous area from 2020–2024.

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 3.14, the overall amount of T events decreased in 2024 by 12% from the all-time high in 2023. Main driving synchronous area is CE (91%) which is consistent with previous years and can be explained by the bigger grid size compared to other synchronous areas.

As seen in Table 3.15, T events in 2024 are again, as in 2023, caused mostly by technical equipment reasons, which have considerably increased from 2022 to 2023 and only decreased by 4% from 2023 to 2024. As in 2023, also in 2024 this was the main cause of events (40% of all events). Environmental and unknown causes are once again representing two of the main causes behind this kind of events with ~17% of all T events, respectively.

The normalized values on circuit length show a decreasing trend for Isolated systems and Continental Europe. In Nordic, the amount of T0 events per 100 km circuit length is decreasing since 2021 while the values for T1 events normalized to 100 km circuit length increased due to the absolute increase from 3 to 12.

Table 3.14: The annual number of T-events from 2020–2024 per synchronous area.

Synchronous area	2020	2021	2022	2023	2024
Baltic	23	25	33	27	35
CE	1073	1312	1283	1752	1668
GB	-	-	-	-	-
IE-NI	8	11	18	5	20
Isolated system	41	27	32	14	12
Nordic	77	103	97	89	89
Grand total	1222	1478	1463	1887	1824

Table 3.15: The annual number of T-events per cause from 2020–2024.

Cause of event	2020	2021	2022	2023	2024
Nature (animals, vegetation)	1	-	-	-	-
Environmental causes	288	332	369	417	315
External influences	86	127	150	166	192
Operation and maintenance	66	140	69	95	93
Technical equipment	113	440	496	754	737
Tripped network element	53	2	1	2	2
Previous event	32	50	48	47	74
LGF deviations	-	-	-	4	-
Other	71	90	79	85	102
Unknown	512	297	251	317	309
Grand total	1222	1478	1463	1887	1824

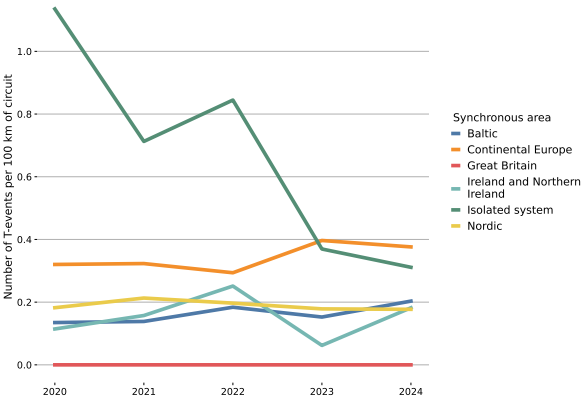

Figure 3.11: The annual number of T-events per 100 km installed circuit length in each synchronous area from 2020–2024.

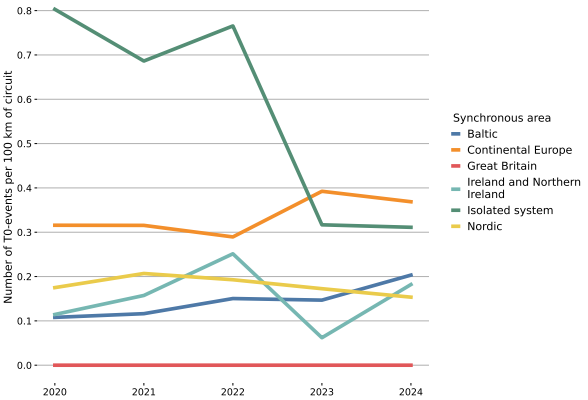

Figure 3.12: The annual number of T0-events per 100 km installed circuit length in each synchronous area from 2020–2024.

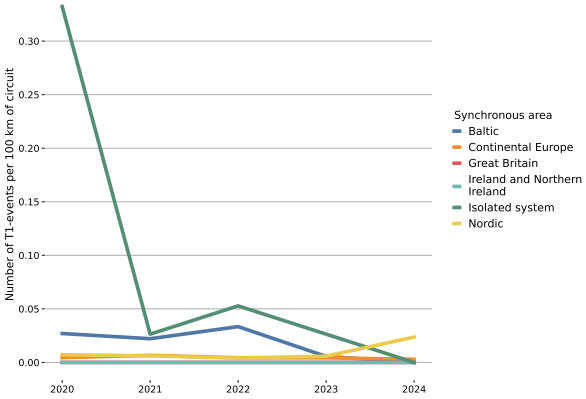

Figure 3.13: The annual number of T1-events per 100 km installed circuit length in each synchronous area from 2020–2024.

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 increased in 2024 when compared to the number of G events that was reported in 2023. However, it is still lower than in 2022 and 2021. The trend is the same for all synchronous areas except for the Nordic one, which has reported more than a half less than last year. It has to be considered that no GB information on G incidents has been added this year to the report, which leds to a reduction of the overall number of G events. Isolated systems have reported events on power generating facilities in 2024, after 2 years not registering this kind of events.

From Table 3.17, it can be seen that most G events are due to technical equipment reasons, and this is a trend that has been kept for more than 5 years. The number of T events has decreased in 2024, but the overall number of G events that are caused by tripped network elements has remain almost the same for the last 2 years.

The number of G events per TWh of consumption has increased in the Baltics, Ireland and Northern Ireland (IE/NI) and Isolated systems during the last year, being IE/NIs' ratio slightly higher because its consumption has remained the same for the last two years while consumption in the Baltics has moderately increased. The reason for the increased ratio associated to the Isolated system is that some G events have been registered this year, while not in 2023 nor 2022. On the other side, the G / TWh ratio has slighlty decreased in the Nordic area, while information is not available for GB in 2024. In CE, it is practically the same for 2023 and 2024 because both the number of G events and the consumption have slightly increased in 2024.

Table 3.16: The annual number of G-events from 2020–2024.

Synchronous area	2020	2021	2022	2023	2024
Baltic	27	16	18	9	12
CE	81	144	122	96	121
GB	-	-	-	-	-
IE-NI	19	14	15	13	19
Isolated system	3	2	-	-	4
Nordic	5	15	14	18	7
Grand total	135	191	169	136	163

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Table 3.17: The annual number of G-events per cause from 2020–2024.

Cause of event	2020	2021	2022	2023	2024
Loss of generation	6	-	-	1	-
Environmental causes	-	-	-	3	-
External influences	-	-	-	-	2
Operation and maintenance	-	2	-	-	-
Technical equipment	82	111	111	84	117
Tripped network element	20	43	16	7	7
Previous event	1	9	4	4	3
LGF deviations	1	-	-	1	-
Other	2	3	9	20	16
Unknown	23	23	29	16	18
Grand total	135	191	169	136	163

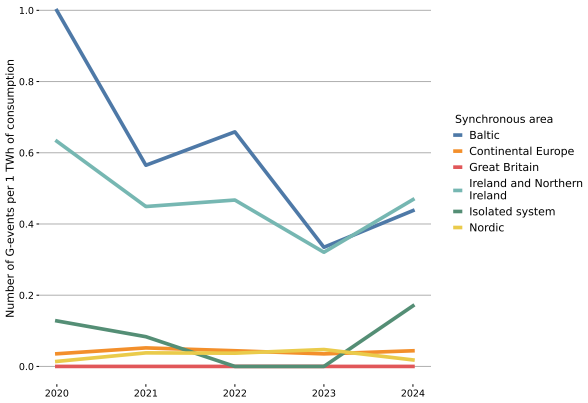

Figure 3.14: The annual number of G-events per 1 TWh of consumption for each synchronous area from 2020–2024.

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 2020 to 2024 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.

In 2024, there were 8645 reported OV events. This is a a significant increase of over 7 800 events (985%) compared to the previous year, making OV the most reported ICS criteria in 2024. Of the total number of events, 69% were OV0 and the remaining 31% were OV1 indicating a shift in the distribution towards OV0 events since the previous year.

This increase is predominately due to the increased number of reported events by Svenska kraftnät. In addition to observing more voltage violations in the past year, the data collection process was switched from a manual process to an automated data collection process. Measures have been put in place to negate voltage issues. Further details can be read in chapter 11.2.5. Additionally, there was a general increase in the number of reported OV events in 2024. In total, six TSOs reported more than 100 events with 4 of those reporting upwards of 200 events.

Notable increases in the number of reported events compared to the previous year were observed by ELES, where many violations, while being only slightly above the thresholds, still met the criteria for reporting. Also, Moldelectrica, reporting data in this criterion for the first time, saw a high number of OV events.

There was also a significant increase in the number of events reported by Transelectrica, primarily because of the challenges associated with the transition to renewable energy sources. It is planned to commission STATCOM systems in their control area in the coming years.

Decreases in the number of reported events could also be observed in 2024. At MAVIR, continued efforts to reduce the number of voltage violations, including effective use of shunt capacitors, has led to a reduction in the number of reported events for the second consecutive year. Also, at Red Eléctrica, Tennet NL and RTE the number of reported events were reduced to 0 in 2024.

Table 3.18: The annual number of OV-events from 2020–2024.

Synchronous area	2020	2021	2022	2023	2024
Baltic	1	-	-	-	-
CE	570	1008	872	796	1135
GB	-	-	-	-	-
IE-NI	-	-	-	-	-
Isolated system	-	-	-	-	-
Nordic	-	-	-	1	7510
Grand total	571	1008	872	797	8645

Table 3.19: The annual number of OV-events per cause from 2020–2024.

Cause of event	2020	2021	2022	2023	2024
Loss of generation	-	-	3	-	-
Unavailability of reactive compensation	40	-	-	-	-
Environmental causes	-	-	-	1	-
Operation and maintenance	2	-	-	-	1
Technical equipment	2	1	-	-	-
Tripped network element	1	-	-	-	-
Previous event	1	22	-	4	2
LGF deviations	-	1	7	9	15
Other	229	770	249	287	8285
Unknown	296	214	613	496	342
Grand total	571	1008	872	797	8645

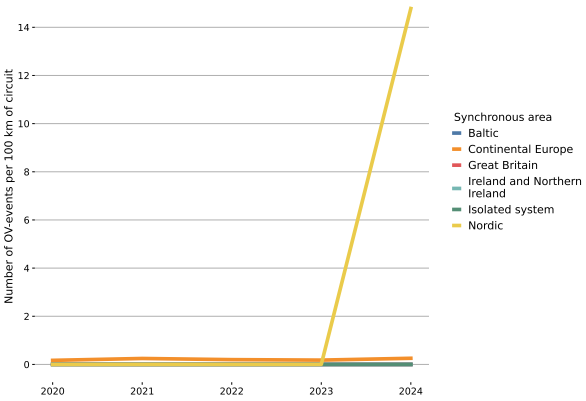

Figure 3.15: The annual number of OV-events per 100 km of installed circuit length in each synchronous area from 2020–2024.

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.

Majority of all reported RRC incidents in 2024 were reported by MAVIR and Ukrenergo. The high number of RRC incidents reported by Ukrenergo was due to the ongoing war with russia. From the 206 events reported, 96 were scale 0 (RRC0), 110 scale 1 (RRC1) and no scale 2 events (RRC2). Similarly to previous years, 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 2020–2024.

Synchronous area	2020	2021	2022	2023	2024
Baltic	-	-	-	-	-
CE	66	90	260	151	202
GB	-	-	-	-	-
IE-NI	-	-	-	-	-
Isolated system	-	-	-	-	-
Nordic	-	-	-	-	7
Grand total	66	90	260	151	209

Table 3.21: The annual number of RRC-events per cause from 2020–2024.

Cause of event	2020	2021	2022	2023	2024
Loss of generation	-	4	7	9	3
External influences	1	-	-	1	1
Technical equipment	-	-	1	1	-
Lack of reserves	64	-	-	-	-
Previous event	-	2	-	1	-
LGF deviations	-	62	242	131	119
Other	-	10	10	8	79
Unknown	1	12	-	-	7
Grand total	66	90	260	151	209

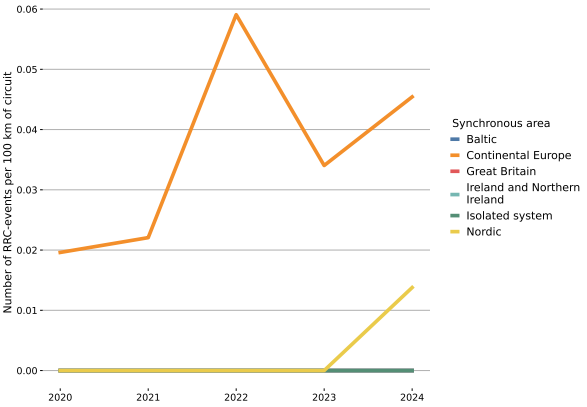

Figure 3.16: The annual number of RRC-events per 100 km of installed circuit length in each synchronous area from 2020–2024.

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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 2023, the number of LT events has increased from 164 to a total of 285. Energinet (CE) reported the most LT0 incidents in 2024. It can also be observed that the number of LT incidents in Energinet (Nordic) increased from 15 incidents in 2023 to 39 incidents in 2024. The issues seem to be a mix of causes, including internet disruptions, human errors, and unexpected outcomes from IT system updates. Another cause is that Energinet operates in two synchronous areas, meaning that when an IT issue occurs, it typically affects both DK1 and DK2, thus, being reported for both Energinet (CE) and Energinet (Nordic). Additionally, IE/NI increased from 0 incidents in 2023 to 6 incidents in 2024 as EirGrid has improved their reporting processes.

Most of the LT incidents were caused by other or unknown causes or by technical equipment, as seen in Table 3.23.

Table 3.22: The annual number of LT-events from 2020–2024.

Synchronous area	2020	2021	2022	2023	2024
Baltic	-	1	-	-	2
CE	125	98	105	125	248
GB	-	-	-	-	-
IE-NI	-	-	-	-	6
Isolated system	1	1	2	-	-
Nordic	16	23	5	15	39
Grand total	142	123	112	140	295

Table 3.23: The annual number of LT-events per cause from 2020–2024.

Cause of event	2020	2021	2022	2023	2024
Loss of tools or facilities	25	1	-	-	-
Environmental causes	1	-	-	-	-
External influences	-	-	-	-	23
Operation and maintenance	7	7	5	7	25
Technical equipment	17	49	35	33	97
Previous event	4	-	-	-	1
LGF deviations	1	-	-	-	-
Other	70	38	44	59	118
Unknown	17	28	28	41	31
Grand total	142	123	112	140	295

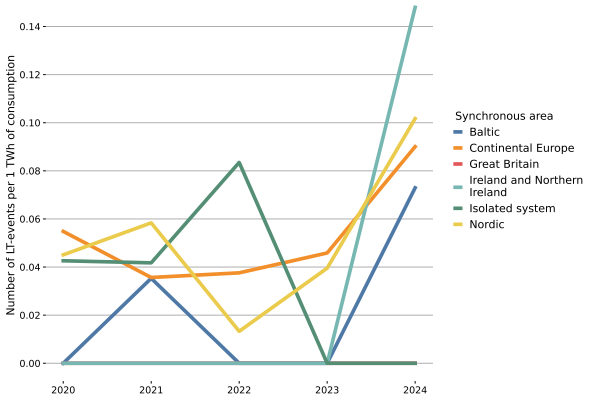

Figure 3.17: The annual number of LT-events per 1 TWh of consumption for each synchronous area from 2020–2024.

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 2024, the number of ON violations increased by around 100 compared to 2023 (166 vs 59). The increase is attributed to two TSOs reporting more ON1 violations (CEPS and RTE). The increase of incidents reported by CEPS is due expanded observability area that improved their capacity and N-1 calculations. For RTE, the increase occurred during the summer months and was mainly due to capacity calculation limits and the cross-effects between the Italy-North and CORE regions. An additional cause was unavoidable and repeated counter-trading between RTE and Red Eléctrica.

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.

Table 3.24: The annual number of ON-events from 2020–2024.

Synchronous area	2020	2021	2022	2023	2024
Baltic	1	-	-	-	2
CE	56	62	58	58	148
GB	-	-	-	-	-
IE-NI	3	8	8	-	-
Isolated system	-	-	-	-	-
Nordic	-	-	4	1	19
Grand total	60	70	70	59	169

Table 3.25: The annual number of ON-events per cause from 2020–2024.

Cause of event	2020	2021	2022	2023	2024
Unexpected flows	2	-	-	-	-
Loss of generation	-	-	-	2	-
Environmental causes	-	-	1	-	-
Operation and maintenance	2	-	-	-	-
Technical equipment	-	2	-	-	1
Tripped network element	1	-	-	-	-
Previous event	6	9	10	1	8
LGF deviations	39	44	37	37	82
Other	9	10	21	9	68
Unknown	1	5	1	10	10
Grand total	60	70	70	59	169

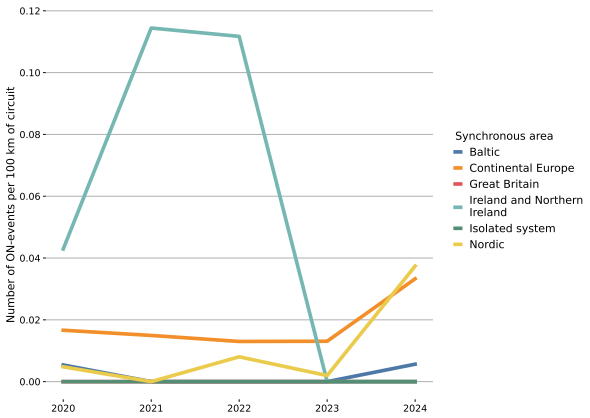

Figure 3.18: The annual number of ON-events per 100 km of installed circuit length in each synchronous area from 2020–2024.

4 Detailed view of scale 2 and scale 3 incidents

In 2024, there was one reported scale 3 incident in South-East Europe. On Friday, 21 June 2024, a significant incident occurred in South-East Europe (SEE), leading to a major disruption in the Continental Europe (CE) power system. The incident resulted in a substantial loss of load and generation, causing a blackout (OB3) in Albania (OST), Bosnia and Herzegovina (NOSBiH), Montenegro (CGES), and a scale 2 loss of load incident (L2) in Croatia (HOPS).

The incident started with the trip of the Podgorica 2 – Ribarevine 400 kV overhead line (T1) in Montenegro at 12:09 due to a short circuit caused by vegetation beneath the line. This resulted in a drop in voltages across the affected region, but the voltages stabilised quickly. However, the system was in N-1 violation (ON1) that was not detected in real-time. A second unrelated trip of the Zemblak–Kardia 400 kV overhead line (T1) between Albania and Greece occurred at 12:21, also due to vegetation beneath the line. This triggered a cascading effect at 12:24 with the trip of 220 kV lines and the HVDC link Monita (between Montenegro and Italy), overload and overcurrent protections activating and finally a voltage collapse that ended in a blackout.

As a result of the investigation, a number of recommendations were issued. Amongst the recommendations were the need for vegetation management, better detection of N-1 violations and voltage instabilities, and more automatic measures to prevent a voltage collapse. The full report of the incident and the recommendations can be found at the ENTSO-E webpage [5].

No scale 2 or scale 3 ICS incidents were reported in the synchronous areas of Baltic, Nordic, IE/NI nor the isolated systems in 2024.

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. Table 5.2 shows the calculated values for each security indicator for the year 2024.

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'.

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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) [6].	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) [6].	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) [6].	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) [6].	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) [6].	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) [6].	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) [6].	Add up the number of incidents reported under the criteria RRC0, RRC1 and RRC2; and the number of all other incidents on scale 0, 1, 2 and 3 in case the reduction of reserve capacity is reported.
OS-F1	Time duration of voltage deviations exceeding the ranges from Tables 1 and 2 of SOGL Annex II per year per TSO – SOGL article 15(3)(f) [6].	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 [6].
OS-F2	Number of voltage deviations exceeding the ranges from Tables 1 and 2 of SOGL [6] Annex II per year per TSO – SOGL article 15(3)(f) [6].	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 [6].
OS-G1	Number of minutes outside the standard frequency range per year per synchronous area – SOGL article 15(3)(g) [6].	Annual Load-Frequency Control Reporting will provide data for number of minutes outside the standard frequency range.
OS-G2	Number of minutes outside the 50 % of maximum steady-state frequency range per year per synchronous area – SOGL article 15(3)(g) [6].	Annual Load-Frequency Control reporting will provide data for number of minutes outside the 50 % of maximum steady state frequency deviation.
OS-H	Number of system-split separations or local blackout states per year – SOGL article 15(3)(h) [6].	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) [6].	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
Baltic	AST	10	6	-	420	1	-	-	-	-	-	-	-	-
	Elering	21	10	-	-	-	-	-	-	-	-	-	-	-
	Litgrid	20	1	-	-	-	-	-	-	-	-	-	-	-
	Total	51	17	-	420	1	-	-	-	-	-	-	-	-
Continental Europe	50Hertz	43	3	-	225	2	-	-	-	-	-	-	-	-
	Amprion	73	40	-	2608	21	-	-	2237	15	-	-	-	-
	APG	7	11	-	3948	20	-	-	-	-	-	-	-	-
	CEPS	98	9	-	-	-	-	-	9407	104	-	-	-	-
	CGES	57	3	695	3	1	-	-	1	-	-	-	-	-
	ELES	19	-	-	13479	109	-	-	25050	363	-	-	-	-
	Elia	20	1	-	262	2	-	-	201	3	-	-	-	-
	EMS	38	5	127	1136	10	546	7	139990	137	-	-	-	-
	Energinet (CE)	41	3	-	635	2	-	-	-	-	-	-	-	-
	ESO	74	-	-	-	-	-	-	-	-	-	-	-	-
	Freq (CE)	-	-	-	-	-	-	-	-	-	14670.48	188.83	-	-
	HOPS	16	1	1333	2293	8	-	-	28	-	-	-	-	-
	IPTO	15	4	10	-	-	-	-	3649	100	-	-	-	-
	MAVIR	3	-	-	-	-	3525	114	23215	723	-	-	-	-
	Moldelectrica	6	-	-	46500	150	-	-	46500	150	-	-	-	-
	NOS BiH	55	10	3075	3	1	-	-	25	1	-	-	-	-
	OST	90	16	373	18	3	-	-	-	-	-	-	-	-
	PSE	91	11	-	286	2	192	2	-	-	-	-	-	-
	Red Eléctrica	364	10	-	-	-	-	-	-	-	-	-	-	-
	REN	46	13	-	-	-	-	-	-	-	-	-	-	-
	RTE	374	18	505	-	-	3506	6	-	-	-	-	-	-
	SEPS	43	9	4	1565	4	1925	5	-	-	-	-	-	-
	Swissgrid	52	20	-	523	4	-	-	2955	166	-	-	-	-
	TEIAS	15	49	-	-	-	-	-	-	-	-	-	1	-
	TenneT DE	54	12	-	-	-	-	-	-	-	-	-	-	-
	TenneT NL	42	6	-	1104	5	-	-	-	-	-	-	-	-
	Terna	89	4	200	-	-	418	3	31	2	-	-	-	-
	Transelectrica	137	46	101	-	-	-	-	21939	307	-	-	-	-
	TransnetBW	27	9	-	1273	9	-	-	-	-	-	-	-	-
	Ukrenergo	252	3	10300348	168077	270	60451	68	-	-	-	-	-	-
	Total	2241	316	10306771	243938	623	70563	205	275228	2071	14670.48	188.83	1	-
Ireland and Northern Ireland	EirGrid	14	30	-	-	-	-	-	-	-	32.87	3.00	-	-
	SONI	6	12	-	-	-	-	-	-	-	-	-	-	-
	Total	20	42	-	-	-	-	-	-	-	32.87	3.00	-	-
Isolated system	Landsnet	46	13	201	226	2	-	-	-	-	-	-	-	-
	Total	46	13	201	226	2	-	-	-	-	-	-	-	-
Nordic	Energinet (Nordic)	3	7	-	650	3	-	-	-	-	-	-	-	-
	Fingrid	15	8	-	5	1	-	-	6	1	-	-	-	-
	Freq (Nordic)	-	-	-	-	-	-	-	-	-	10331	7	-	-
	Statnett	46	-	300	23	12	-	-	12	1	-	-	-	-
	Svenska kraftnät	69	26	-	1016	19	1080	7	663310	15748	-	-	-	-
	Total	133	41	300	1694	35	1080	7	663328	15750	10331	7	-	-
Grand Total		2491	429	10307272	246278	661	71643	212	938556	17821	25034.35	198.83	1	-

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5.1.1 Evolution of operational security indicators relevant for operational security, 2020–2024

Figure 5.1–Figure 5.12 show the annual calculated values for the OS indicators OS-A to OS-H for 2020–2024.

The security indicator OS-A, that is, the number of tripped transmission network elements, shows no significant increase or decrease for synchronous area. The indicator OS-B (number of tripped power generating facilities) increased slightly in Ireland compared to previous years. The decrease of OS-B after 2020 is because the GBS events retrieved from the ENTSO-E Transparency Platform [7] 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 high in continental Europe due to the war in Ukraine with Russia. It should be noted that both OS-B and OS-C will fluctuate depending on the occurrence of noteworthy incidents. OS-C decreased in isolated systems because extreme weather did not cause energy not supplied (ENS) in Iceland, as it had done in 2022 and 2023.

The indicators OS-D1 and OS-D2 (number of minutes and incidents with alert or emergency state, respectively) was very high in 2024 Continental Europe. The reason is a combination of improved reporting practices on actual times in alert or emergency state and the increase voltage violations. Specifically for APG and TransnetBW, the reason is also the increased number of challenging grid situations due to quickly changing flows due to unexpected deviations in forecasted RES generation. In addition, situations with high wind and PV infeed and low production from conventional power plants often limit available redispatch potential, which is further degraded by maintenance or decommissioning of the power plants that can provide these ancillary services. Last, exceptional weather events and downtime of tools and facilities have also contributed to reported OS-D1 and OS-D2 times.

The security indicators OS-E1 and OS-E2 measure reductions in reserve capacity and are mostly reported by a few TSOs in CE. In 2024, the indicator decreased for many TSOs. Ukrenergo reported the values for the first time and reached 60451 minutes of reduced reserve capacity due to the ongoing war with Russia.

The number and duration of voltage violations is measured by the security indicators OS-F1 and OS-F2 and are also mostly reported by a few TSOs in CE. Compared to 2023, reported voltage issues increased significantly with the same reasons as for OS-D1 and OS-D2. In the Nordics, OS-F1 and OS-F2 mainly reported by Svenska kraftnät. The number of reported voltage violations by Svenska kraftnät increased substantially due to a combination of improved IT tools to track and report voltage violations as of 2024 and high voltage issues on their system. Most voltage deviations occurred in individual stations when there was insufficient reactive power for voltage control during planned outages or low network loading. These factors can lead to overvoltages at certain stations when the grid is lightly loaded or when power-flow directions change compared to the historical norm. Northward flows emerged during periods of high solar and wind power generation on the continent — this is a relatively new operating condition for the Swedish system. Additional details on how Svenska kraftnät is working to mitigate and prevent these in the future is presented in Section 11.2.5.

Cabling at the DSO level has also contributed to a more capacitive characteristic of lower-voltage systems, which in turn raises voltage in the transmission grid. A lack of active voltage control from renewable energy sources in the distribution networks can amplify this problem.

WG ICS notes that the measures taken by the TSOs to mitigate voltage violations have helped in the past but additional actions need to be taken to prevent the situation from degrading further and to stabilise the grid as the integration of converter-based technology into the electrical system is not decelerating and challenges grid operations due to lack of reactive power and system inertia.

The reported OS-G1 minutes in 2024 decreased compared to 2023, and did not exceed 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 2024.

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), three times in 2021 (two RS2 events in CE and one RS1 event in Nordics) and once in 2024 (TEIAS).

The security indicator OS-I was recorded for the first time in the ICS reporting with the first occurrence of a blackout incident in South-East Europe on 21 June 2024 impacting Albania (OST), Bosnia and Herzegovina (NOSBiH), Montenegro (CGES) and Croatia (HOPS). More details on the blackout incident is presented in Chapter 4.

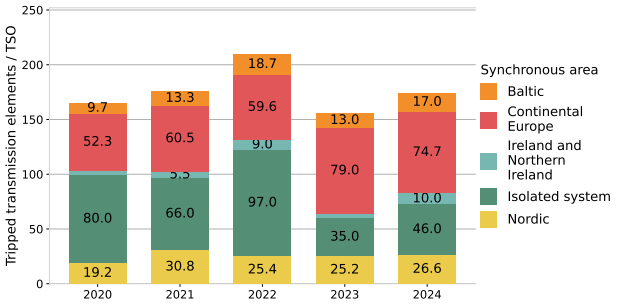

Figure 5.1: Operational security indicator OS-A from 2020–2024. It is calculated by adding up the number of tripped transmission system elements reported for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

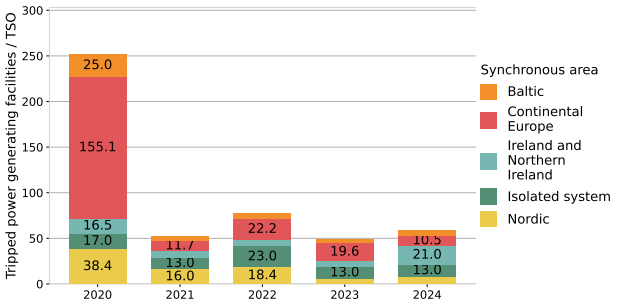

Figure 5.2: Operational security indicator OS-B from 2020–2024. It is calculated by adding up the number of tripped power generation facilities reported for scale 0–3 and below scale incidents and dividing by the number of TSOs in the synchronous area.

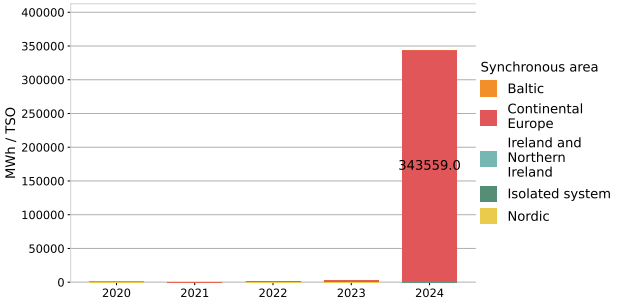

Figure 5.3: Operational security indicator OS-C from 2020–2024. It is calculated by adding up the reported energy not supplied due to unscheduled disconnection of demand facilities for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

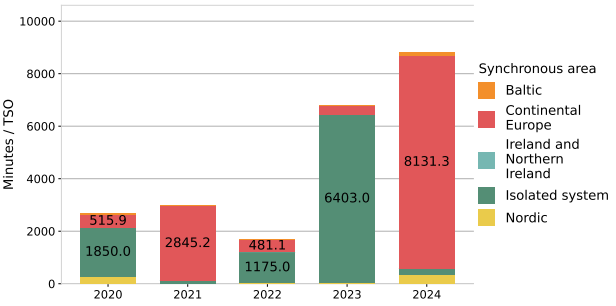

Figure 5.4: Operational security indicator OS-D1 from 2020–2024. It is calculated by adding up the number of minutes in alert and emergency states of all reported scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

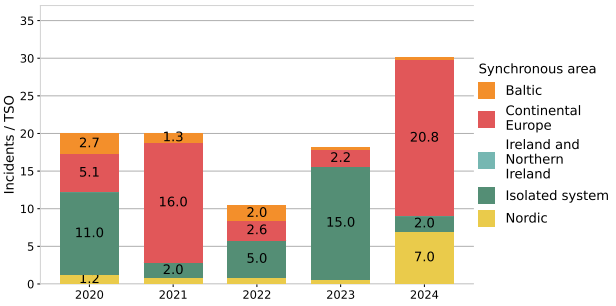

Figure 5.5: Operational security indicator OS-D2 from 2020–2024. It is calculated by counting the number of scale 0–3 incidents in which an alert or emergency state was reported, and dividing by the number of TSOs in the synchronous area.

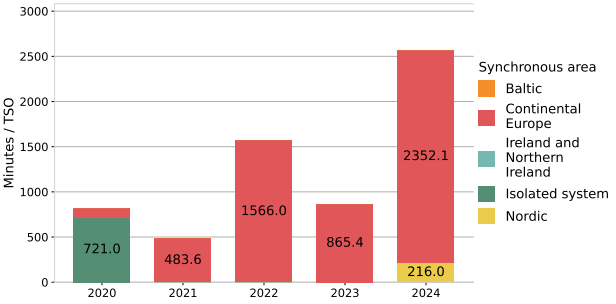

Figure 5.6: Operational security indicator OS-E1 from 2020–2024. It is calculated by adding up the duration of RRC0-, RRC1- and RRC2-incidents and the duration of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area.

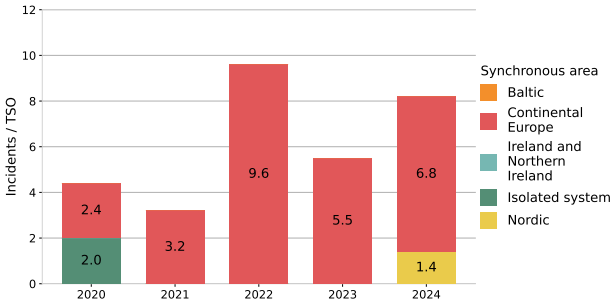

Figure 5.7: Operational security indicator OS-E2 from 2020–2024. It is calculated by counting the number RRC0-, RRC1- and RRC2-incidents and the number of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area.

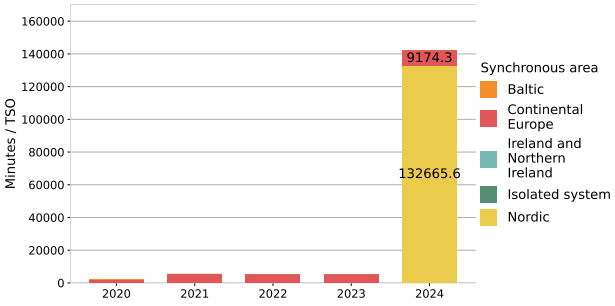

Figure 5.8: Operational security indicator OS-F1 from 2020–2024. It is calculated by adding up the duration of OVBS-, OV0-, OV1- and OV2-incidents and the duration of all other incidents on below scale and scale 0–3 where voltage deviations exceed the ranges from SOGL Annex II [6] are reported, and dividing by the number of TSOs in the synchronous area.

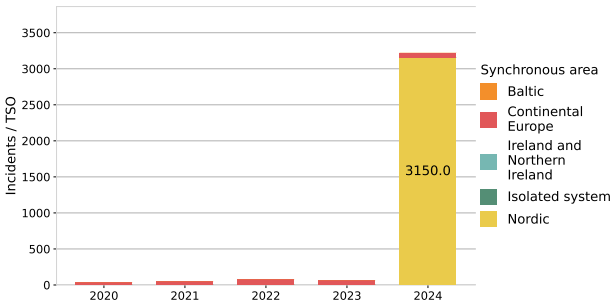

Figure 5.9: Operational security indicator OS-F2 from 2020–2024. It is calculated by counting the number of violation of standards of voltage incidents (OVBS,OV0, OV1 and OV2) and the number of all other below scale and scale 0–3 incidents in which the voltage standards are violated, and dividing by the number of TSOs in the synchronous area.

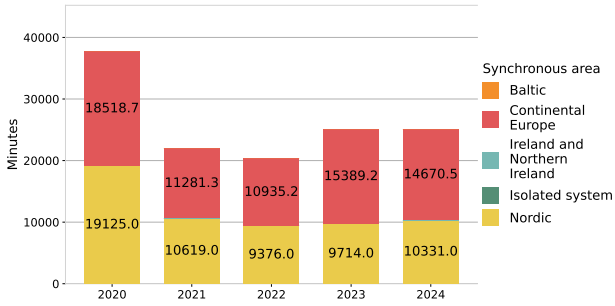

Figure 5.10: Operational security indicator OS-G1 from 2020–2024. It is calculated by adding up the number of minutes outside the standard frequency range for all scale 0–3 incidents.

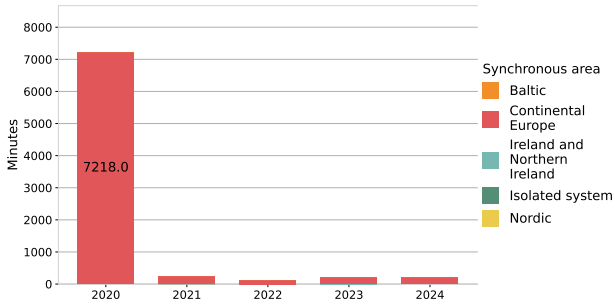

Figure 5.11: Operational security indicator OS-G2 from 2020–2024. It is calculated by adding up the number of minutes outside the 50 % of maximum steady-state frequency deviation for all scale 0–3 incidents.

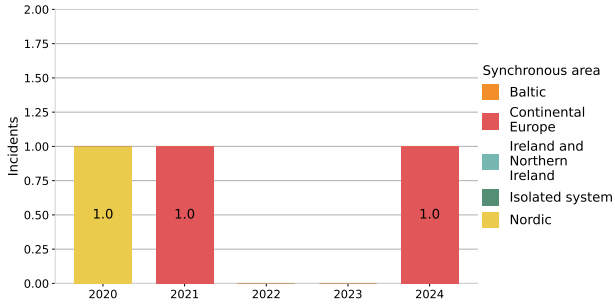

Figure 5.12: Operational security indicator OS-H from 2020–2024. It is calculated by counting the number of grid separation incidents (RS1 and RS2).

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) [6].	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) [6].	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) [6].	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) [6].	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) [6].	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
Baltic	AST	2	-	1	-	-
	Elering	-	-	-	-	-
	Litgrid	1	-	1	-	-
	Total	3	-	2	-	-
Continental Europe	50Hertz	1	-	-	-	-
	Amprion	20	20	-	-	-
	APG	12	10	-	-	-
	CEPS	48	-	-	-	-
	CGES	1	-	1	-	-
	ELES	116	10	1	1	-
	Elia	1	-	-	-	-
	EMS	141	-	-	-	-
	Energinet (CE)	-	-	-	-	-
	ESO	-	-	-	-	-
	Freq (CE)	-	-	-	-	-
	HOPS	7	-	-	-	-
	IPTO	2	-	-	-	-
	MAVIR	-	-	-	-	-
	Moldelectrica	-	-	-	-	-
	NOS BiH	-	-	-	-	-
	OST	5	-	-	-	-
	PSE	-	-	-	-	-
	Red Eléctrica	-	-	-	-	-
	REN	-	-	-	-	-
	RTE	44	39	12	10	-
	SEPS	-	-	-	-	-
	Swissgrid	6	-	-	-	-
	TEIAS	1	-	-	-	-
	TenneT DE	8	-	-	-	-
	TenneT NL	4	2	-	-	-
	Terna	-	-	-	-	-
	Transelectrica	1	-	-	-	-
	TransnetBW	5	4	-	-	-
	Ukrenergo	272	-	-	-	-
	Total	695	85	14	11	-
Ireland and Northern Ireland	EirGrid	-	-	-	-	-
	SONI	-	-	-	-	-
	Total	-	-	-	-	-
Isolated system	Landsnet	2	-	1	-	-
	Total	2	-	1	-	-
Nordic	Energinet (Nordic)	1	-	-	-	-
	Fingrid	-	-	-	-	-
	Freq (Nordic)	-	-	-	-	-
	Statnett	13	-	-	-	-
	Svenska kraftnät	18	13	-	-	-
	Total	32	13	-	-	-
Grand Total		732	98	17	11	-

5.2.1 Evolution of operational security indicators relevant for operational planning and scheduling, 2020–2024

This section presents the operational security indicators relevant to operational planning and scheduling (OPS) for 2020–2024. Figure 5.13 through Figure 5.16 show the annual calculated values for the OPS indicators OPS-A, OPS-B, OPS-C and OPS-D, respectively. The figure for indicator OPS-E is omitted because it has been zero during the observation period.

The OPS-A indicator, which tracks the number of incidents due to a contingency from the contingency list, increased slightly at TSOs who reported them in 2023 also. A significant increase in the OPS-A indicator was seen at ELES due to the number of reported violations of standards of voltage, which have until now not occurred due to contingencies in the contingency list. Ukrenergo also saw a high value in OPS-A due to the ongoing war with Russia.

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 15 incidents in 2024 in CE were due to exceptional contingencies. In 2023, the value was 10 and the before that between 1 and 4 per year. Out of the 15 exceptional contingencies in 2024, 11 were due to load and generation forecasts errors, as shown by the OPS-D indicator.

The indicator OPS-E remained zero because no events, not even RRC events, were caused by lack of active power reserves.

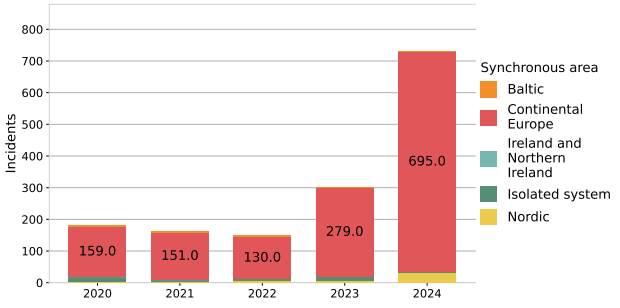

Figure 5.13: Operational security indicator OPS-A annually from 2020–2024. It is calculated by counting the number of scale 0–3 incidents where a contingency from the contingency list degraded the system operation state.

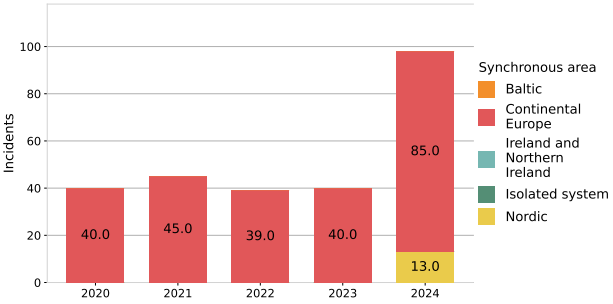

Figure 5.14: Operational security indicator OPS-B annually from 2020–2024. It is calculated by counting the number of OPS-A indicators where the cause was unexpected discrepancies from load and generation forecasts.

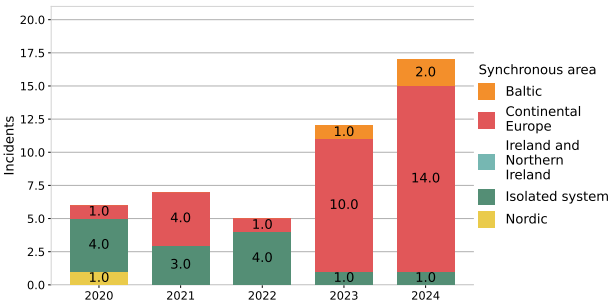

Figure 5.15: Operational security indicator OPS-C annually from 2020–2024. It is calculated by counting the number of scale 0–3 incidents where an exceptional contingency degraded the system operation state.

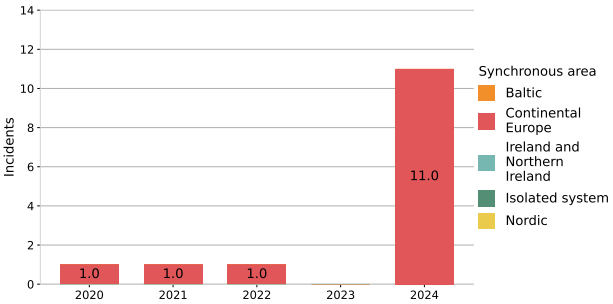

Figure 5.16: Operational security indicator OPS-D annually from 2020–2024. It is calculated by counting the number of OPS-C indicators caused by unexpected discrepancies from load and generation forecasts.

6 Events in Continental Europe

6.1 Overview of 2024

This section presents an overview of scale 0–3 ICS events in CE in 2024. 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 3975 ICS events were reported by TSOs in CE in 2024. Together, these events formed 3848 ICS incidents, meaning that most events only involved one ICS criteria violation. Approximately 71% of all scale 0–3 events were scale 0 events, 28.2% of all scale 0–3 events were scale 1 events and 0.1% of all scale 0-3 were scale 2 and scale 3 events.

Events on transmission network elements (T0) accounted for 41% of all events, and violations on standards of voltage (OV0+OV1) for 29% of all events. Combined, these ICS criteria accounted for 69.5% of all events. The number of T0 events was higher during April–September. The number of OV0 and OV1 events were higher during May, September and October. ON1 events were mostly reported from May to August.

As shown in Table 6.2, approximately 50% of all scale 0 events and 12.5% of all scale 1 were resolved within less than an hour. All frequency deviations in scale 0 (F0), almost all 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 55% 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. 78% 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 2019 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 2024 in Continental Europe.

		2024												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	1	-	1	1	1	2	-	6
	Incidents leading to frequency degradation (F0)	33	16	25	50	29	21	30	8	20	13	13	14	272
	Incidents on network elements (T0)	128	92	115	130	157	201	205	164	124	100	111	109	1636
	Incidents on power generating facilities (G0)	17	10	6	2	5	14	6	15	9	12	10	12	118
	Separation from the grid (RS0)	-	-	-	1	-	-	-	-	-	-	-	-	1
	Violation of standards on voltage (OV0)	33	20	50	39	102	38	30	41	66	40	26	29	514
	Reduction of reserve capacity (RRC0)	1	3	6	8	17	17	14	11	5	5	8	4	99
	Loss of tools, means and facilities (LT0)	22	9	8	18	15	23	25	12	18	9	5	8	172
	Total	234	150	210	248	325	315	310	252	243	180	175	176	2818
Scale1	Incidents on load (L1)	-	-	2	-	5	48	59	8	4	-	14	20	160
	Incidents leading to frequency degradation (F1)	-	-	2	2	-	-	-	-	-	3	-	-	7
	Incidents on network elements (T1)	1	1	1	-	1	3	2	1	2	-	-	-	12
	Incidents on power generating facilities (G1)	-	-	1	-	-	-	1	-	-	-	-	1	3
	N-1 violation (ON1)	2	3	9	7	34	14	12	25	13	10	7	8	144
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	2	-	2
	Violation of standards on voltage (OV1)	70	44	49	57	99	47	38	46	54	70	23	22	619
	Reduction of reserve capacity (RRC1)	1	-	2	2	6	8	28	6	8	-	18	24	103
	Loss of tools, means and facilities (LT1)	2	-	1	2	3	3	8	13	18	8	8	10	76
	Total	76	48	67	70	148	123	148	99	99	91	72	85	1126
Scale2	Incidents on load (L2)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	20	-	-	-	-	-	-	20
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	4	-	-	-	-	-	-	4
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	2	-	-	-	-	-	-	2
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	27	-	-	-	-	-	-	27
Scale3	Blackout (OB3)	-	-	-	-	-	4	-	-	-	-	-	-	4
	Total	-	-	-	-	-	4	-	-	-	-	-	-	4
Grand Total		310	198	277	318	473	469	458	351	342	271	247	261	3975

Table 6.2: Cumulative number of events by dominant criteria and duration in 2024 in Continental Europe.

	2024						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	3	4	5	5	5	6
	Incidents leading to frequency degradation (F0)	272	272	272	272	272	272
	Incidents on network elements (T0)	460	698	949	1146	1343	1636
	Incidents on power generating facilities (G0)	19	28	48	64	79	118
	Separation from the grid (RS0)	-	1	1	1	1	1
	Violation of standards on voltage (OV0)	500	514	514	514	514	514
	Reduction of reserve capacity (RRC0)	90	95	97	97	97	99
	Loss of tools, means and facilities (LT0)	58	101	147	158	166	172
	Total	1402	1713	2033	2257	2477	2818
Scale1	Incidents on load (L1)	5	18	43	84	144	160
	Incidents leading to frequency degradation (F1)	7	7	7	7	7	7
	Incidents on network elements (T1)	2	4	7	9	10	12
	Incidents on power generating facilities (G1)	1	1	1	2	3	3
	N-1 violation (ON1)	58	81	113	127	143	144
	Separation from the grid (RS1)	2	2	2	2	2	2
	Violation of standards on voltage (OV1)	35	163	352	515	593	619
	Reduction of reserve capacity (RRC1)	20	30	45	56	90	103
	Loss of tools, means and facilities (LT1)	13	24	47	72	74	76
	Total	143	330	617	874	1066	1126
Scale2	Incidents on load (L2)	-	-	1	1	1	1
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	20	20	20	20	20	20
	Incidents on power generating facilities (G2)	-	-	-	-	-	-
	N violation (ON2)	4	4	4	4	4	4
	Separation from the grid (RS2)	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	2	2	2	2	2	2
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-
	Total	26	26	27	27	27	27
Scale3	Blackout (OB3)	4	4	4	4	4	4
	Total	4	4	4	4	4	4
Grand Total		1575	2073	2681	3162	3574	3975

6.2 Evolution 2020–2024

This section presents the annual number of ICS events in CE from 2020 to 2024, distributed by scale and ICS criterion.

As shown in Table 6.3, scale 0 events in 2024 increased by 134 (+5.0%) compared to 2023 and increased by 458 (+19.4%) compared to 2022. The number of scale 1 events increased by 565 (+102%) compared to 2023 and increased by 548 (+96%) compared to 2022. The largest changes in the numbers of scale 1 events are seen in Violation of standards on voltage (OV1), N-1 violation (ON1) and incidents on Load (L1). OV1 events increased from 359 events in 2023 to 619 events in 2024, ON1 events increased from 58 events in 2023 to 144 events in 2024 and L1 events increased from 27 events in 2023 to 157 events in 2024. There were also increase in Reduction of reserve capacity (RRC1) and in Loss of tools, means and facilities (LT1).

The number of scale 2 events increased by 25 compared to 2023 and increased by 27 events in 2022. The number of scale 3 events increased by 3 compared to 2023.

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Table 6.3: The annual number of events by dominating criterion from 2020–2024.

Scale	ICS criterion	2020	2021	2022	2023	2024
Scale0	Incidents on load (L0)	5	3	6	9	6
	Incidents leading to frequency degradation (F0)	296	745	219	208	272
	Incidents on network elements (T0)	1060	1283	1265	1740	1636
	Incidents on power generating facilities (G0)	81	138	122	94	118
	Separation from the grid (RS0)	2	-	1	1	1
	Violation of standards on voltage (OV0)	449	493	480	436	514
	Reduction of reserve capacity (RRC0)	-	26	185	91	99
	Loss of tools, means and facilities (LT0)	102	68	84	107	172
	Total	1995	2756	2362	2686	2818
Scale1	Incidents on load (L1)	10	3	6	35	160
	Incidents leading to frequency degradation (F1)	3	93	7	15	7
	Incidents on network elements (T1)	13	25	18	12	12
	Incidents on power generating facilities (G1)	-	4	-	2	3
	N-1 violation (ON1)	56	61	58	58	144
	Separation from the grid (RS1)	-	-	-	-	2
	Violation of standards on voltage (OV1)	121	515	392	360	619
	Reduction of reserve capacity (RRC1)	66	63	75	60	103
	Loss of tools, means and facilities (LT1)	23	30	21	18	76
	Total	292	794	577	560	1126
Scale2	Incidents on load (L2)	-	2	-	2	1
	Incidents leading to frequency degradation (F2)	-	2	-	-	-
	Incidents on network elements (T2)	-	4	-	-	20
	Incidents on power generating facilities (G2)	-	2	-	-	-
	N violation (ON2)	-	1	-	-	4
	Separation from the grid (RS2)	-	7	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	2
	Reduction of reserve capacity (RRC2)	-	1	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	-	19	-	2	27
Scale3	Blackout (OB3)	-	-	-	-	4
	Total	-	-	-	-	4
Grand Total		2287	3569	2939	3248	3975

6.3 Analysis of significant changes in trends

In 2024, 3975 events were reported in CE; an increase of 22% compared to 2023 and in increase of 35% compared to 2022. This increase appears to be significant, and is mainly due to the increase in the number of reported Scale 1 events.

The number of L1 events increased by 480% (from 27 to 157 events) relative to 2023. The number of ON1 events increased by 148% (from 58 to 144 events) relative to 2023. The number of OV1 events increased by 72% (from 359 to 619 events) relative to 2023. The number of RRC1 events increased by 70% (from 60 to 103 events) and the number of LT1 events increased by over 320% (from 18 to 76 events) relative to 2023.

The trend of scale 0 events remains the same but the trend of scale 1 events between year 2023 and 2024 changed and there was a significant increase almost of all type of criterion. It is mostly caused by war in Ukraine with secondary impact on Romania, Moldova.

The trend of scale 2 events was increased in year 2024 (27 events), except the year 2021 (16 events). In year 2023, there were 2 events in scale 2 in CE.

The trend of scale 3 events were the same except the year 2024 where 3 events appeared.

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7 Events in Nordic

7.1 Overview of 2024

This section presents an overview of ICS events in the Nordic synchronous area in 2024. The events are presented by ICS criterion and grouped by month and duration in Table 7.1 and Table 7.2, respectively.

In 2024, 7,805 scale 0–3 ICS events were reported in the Nordic synchronous area, of which 5,671 were scale 0 events and 2,134 scale 1 events. As can be seen in Table 7.1, events are distributed moderately evenly throughout the year.

As shown in Table 7.2, 72% of the events were resolved in less than an hour, and 99.5% of all events were resolved in less than 24 hours. Some T, G, LT and OV events lasted longer than 24 h.

As shown in Table 7.3, the biggest increase has happened in reporting Voltage violations (OV). There were 5,435 scale 0 voltage violations and 2,075 scale 1 voltage violations. In addition, there was an increase in the number of F, LT, T1 and ON1 events.

The big increase in (OV) events is due to improved IT tools in Sweden to track and report voltage violations in 2024. Most voltage deviations occurred in individual stations when there was insufficient reactive power for voltage control during planned outages or low network loading.

In Nordic area, there has never been a scale 2 or scale 3 event.

Table 7.1: Number of events by dominant criteria distributed per month in 2024 in Nordic.

		2024												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	2	-	-	-	-	-	-	-	-	-	-	2
	Incidents leading to frequency degradation (F0)	11	5	9	19	11	5	6	8	11	8	11	10	114
	Incidents on network elements (T0)	8	8	9	6	8	8	5	4	9	2	5	5	77
	Incidents on power generating facilities (G0)	-	-	-	-	-	2	-	-	3	1	1	-	7
	Separation from the grid (RS0)	-	2	-	1	-	2	-	-	1	-	1	-	7
	Violation of standards on voltage (OV0)	512	303	362	413	634	553	487	455	430	390	314	582	5435
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	4	2	1	-	6	3	-	2	4	2	3	2	29
	Total	535	322	381	439	659	573	498	469	458	403	335	599	5671
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	1	2	-	-	2	2	-	1	1	-	1	1	11
	Incidents on network elements (T1)	-	1	1	-	1	1	1	2	2	1	2	-	12
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	3	1	1	1	4	3	-	1	-	-	4	1	19
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	156	101	116	164	217	188	225	190	171	177	125	245	2075
	Reduction of reserve capacity (RRC1)	-	3	-	4	-	-	-	-	-	-	-	-	7
	Loss of tools, means and facilities (LT1)	1	2	-	-	4	1	1	-	-	-	-	1	10
	Total	161	110	118	169	228	195	227	194	174	178	132	248	2134
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		696	432	499	608	887	768	725	663	632	581	467	847	7805

Table 7.2: Cumulative number of events by dominant criteria and duration in 2024 in Nordic.

	2024						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	-	-	2	2
	Incidents leading to frequency degradation (F0)	114	114	114	114	114	114
	Incidents on network elements (T0)	18	31	49	54	62	77
	Incidents on power generating facilities (G0)	-	1	1	3	4	7
	Separation from the grid (RS0)	2	3	5	5	6	7
	Violation of standards on voltage (OV0)	5432	5435	5435	5435	5435	5435
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	4	9	15	22	28	29
	Total	5570	5593	5619	5633	5651	5671
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	11	11	11	11	11	11
	Incidents on network elements (T1)	2	2	7	9	10	12
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	17	17	19	19	19	19
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	2	1089	1707	1962	2062	2075
	Reduction of reserve capacity (RRC1)	-	3	5	7	7	7
	Loss of tools, means and facilities (LT1)	3	6	7	9	9	10
	Total	35	1128	1756	2017	2118	2134
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		5605	6721	7375	7650	7769	7805

7.2 Evolution 2020–2024

This section presents the annual number of ICS events in the Nordic synchronous area during 2020–2024, distributed by scale and ICS criterion.

As mentioned in Chapter 1, the ICS Methodology has been changed several times, preventing a direct comparison of annual reporting results. Nevertheless, it is useful to examine recent incident reporting to identify potential trends. The update of the ICS Methodology has refined the definitions and thresholds to align with SOGL to improve the overall data quality, make results comparable between synchronous areas and TSOs, and ease the analysis and identification of improvements to system operations.

As seen in Table 7.3, the total number of events ranged from 167 to 7,805 during 2020–2024. The biggest and most obvious change is in the number of voltage violations (OV). During the years 2020–2023 there was only one in total. However, in 2024 there were 5,435 scale 0 voltage violations and 2,075 scale 1 voltage violations.

The significant increase in (OV) violations is due to improved IT tools in Sweden to track and report voltage violations in 2024. See Section 11.2.5 for more information. In addition, there was an increase in the number of F, LT, T1 and ON1 events.

No incidents were classified as scale 2 or 3.

Table 7.3: The annual number of events by dominating criterion from 2020–2024.

Scale	ICS criterion	2020	2021	2022	2023	2024
Scale0	Incidents on load (L0)	-	3	1	6	2
	Incidents leading to frequency degradation (F0)	62	70	53	88	114
	Incidents on network elements (T0)	72	100	95	86	77
	Incidents on power generating facilities (G0)	5	15	14	18	7
	Separation from the grid (RS0)	-	2	2	1	7
	Violation of standards on voltage (OV0)	-	-	-	1	5435
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	10	22	5	14	29
	Total	149	212	170	214	5671
Scale1	Incidents on load (L1)	1	-	2	-	-
	Incidents leading to frequency degradation (F1)	4	3	1	-	11
	Incidents on network elements (T1)	5	3	2	3	12
	Incidents on power generating facilities (G1)	-	-	-	-	-
	N-1 violation (ON1)	-	-	4	1	19
	Separation from the grid (RS1)	2	1	1	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	2075
	Reduction of reserve capacity (RRC1)	-	-	-	-	7
	Loss of tools, means and facilities (LT1)	6	1	-	1	10
	Total	18	8	10	5	2134
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		167	220	180	219	7805

7.3 Analysis of significant changes in trends

During last years a growing trend can be seen in the number of frequency events (F0). Last year there was a big jump in N-1 violations (ON1), reserve capacity (RRC1) and in Loss of tools (LT0 and LT1).

The number of voltage violations (OV0 and OV1) increased dramatically from year 2023 to 2024. This comes from improved IT tools in Sweden to track and report voltage violations in 2024. See Section 11.2.5 for more information on the voltage violations reported by Svenska kraftnät.

8 Events in Baltic

8.1 Overview of 2024

This section presents an overview of ICS events in the Baltic area in 2024. The events are presented by ICS criterion and further grouped by month and duration in Table 8.1 and Table 8.2, respectively. In 2024, 51 ICS events were reported in the Baltic area. Of these, 48 were scale 0, 3 were scale 1. No scale 2 and 3 incidents were reported in 2024.

Incidents on transmission network elements (T0) and incidents on power generating facilities (G0) were the most frequent types of incidents, as shown in Table 8.1. Furthermore, the number of incidents recorded in 2024 has a uniform distribution during the year with a slight concentration of incidents in July. In 2024, there were 36 incidents on transmission network elements (T0) compared with 27 in 2022 and 26 in 2023. The distribution of incidents by duration shown in Table 8.2 indicates that 16 of the 51 events in 2024 were resolved in less than an hour, and 6 events took more than 24 hours to resolve. Approximately 88% of all events were resolved within 24 hours.

Table 8.1: Number of events by dominant criteria distributed per month in 2024 in Baltic.

		2024												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	2	-	2	4	3	6	5	4	2	-	4	3	35
	Incidents on power generating facilities (G0)	-	1	-	-	-	-	3	1	2	2	-	3	12
	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	2	4	3	6	8	5	4	2	4	6	47
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-	-	-	2	-	-	-	2
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	2	-	-	-	-	-	-	-	-	-	2
	Total	-	-	2	-	-	-	-	-	2	-	-	-	4
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	4	3	6	8	5	6	2	4	6	51

Table 8.2: Cumulative number of events by dominant criteria and duration in 2024 in Baltic.

	2024						
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)	14	17	24	31	31	35
	Incidents on power generating facilities (G0)	-	2	4	8	10	12
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-
	Total	14	19	28	39	41	47
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	2	2	2	2	2	2
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	2	2	2
	Total	2	2	2	4	4	4
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		16	21	30	43	45	51

8.2 Evolution 2020–2024

This section presents the annual number of ICS events in the Baltic area power system from 2020 to 2024, distributed by scale and ICS criterion. The ICS criteria used in this report are presented in Table 8.3.

The number of reported events is showing annual increase, as seen in Table 8.3. The most common type of event with regular occurrences is incidents on network elements (T0) and incidents on power generating facilities (G0).

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Table 8.3: The annual number of events by dominating criterion from 2020–2024.

Scale	ICS criterion	2020	2021	2022	2023	2024
Scale0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	19	19	27	26	35
	Incidents on power generating facilities (G0)	26	16	18	9	12
	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	45	36	45	35	47
Scale1	Incidents on load (L1)	2	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	4	6	6	1	-
	Incidents on power generating facilities (G1)	1	-	-	-	-
	N-1 violation (ON1)	1	-	-	-	2
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	1	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	2
	Total	9	6	6	1	4
Scale2	Incidents on load (L2)	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	-	-	-	-
Scale3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		56	42	51	36	51

8.3 Analysis of significant changes in trends

In 2024, a total of 51 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). Increase in total number of incidents is connected to rapid rise in incidents on transmission network elements (T0) in one TSO.

The number of reported scale 1 events was higher in 2024 compared to 2023. Differences in other criteria are more connected to the small size of the Baltic area and the probability of uncommon events.

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9 Events in Ireland and Northern Ireland

9.1 Overview of 2024

This section presents an overview of ICS events in Ireland in 2024. The events are presented by ICS criterion and further grouped by month and duration in Table 9.1 and Table 9.2, respectively.

In 2024, 45 ICS events were reported in Ireland/Northern Ireland, and all of them were scale 0, 44% were incidents on transmission network elements (T0), 42% were incidents on power generating facilities (G0), and the remainder was loss of tools (LT0) Table 9.1. Technical issues caused majority of the G0 events, and there was a variety of reasons for the T0 events including testing maloperations, technical issues and lightning/wind and vegetation. The events showed uniform monthly distribution during the year.

Table 9.1: Number of events by dominant criteria distributed per month in 2024 in Ireland and Northern Ireland.

		2024												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	-	-	2	-	2	2	2	3	2	4	2	1	20
	Incidents on power generating facilities (G0)	1	1	1	3	2	1	4	1	1	1	3	-	19
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	2	-	1	-	-	1	1	-	-	-	1	6
	Total	1	3	3	4	4	3	7	5	3	5	5	2	45
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		1	3	3	4	4	3	7	5	3	5	5	2	45

Table 9.2: Cumulative number of events by dominant criteria and duration in 2024 in Ireland and Northern Ireland.

	2024						
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-
	Incidents on network elements (T0)	1	7	9	10	13	20
	Incidents on power generating facilities (G0)	1	6	9	13	17	19
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	1	2	4	6	6
	Total	2	14	20	27	36	45
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	14	20	27	36	45

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9.2 Evolution 2020–2024

This section presents the annual number of ICS events in Ireland from 2020 to 2024, 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 2024 increased substantially from 2023, as seen in Table 9.3 and this mainly occurred on transmission elements..

No scale 2 or scale 3 incidents were reported in Ireland in 2024.

Table 9.3: The annual number of events by dominating criterion from 2020–2024.

Scale	ICS criterion	2020	2021	2022	2023	2024
Scale0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	8	11	18	5	20
	Incidents on power generating facilities (G0)	19	14	15	13	19
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	6
	Total	27	25	33	18	45
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		30	33	41	18	45

9.3 Analysis of significant changes in trends

In 2024, a total of 45 ICS events were reported in IE/NI. The dominant criteria in 2024 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. There has bee no Scale 1 events in IE/NI since 2022.

No scale 2 or scale 3 events were reported in 2024, which means that the reported ICS events were low impact and did not affect normal operating conditions.

10 Events in Isolated system

10.1 Overview of 2024

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 2024, a total of 16 ICS events were reported for the isolated systems of Iceland and Cyprus. All the events occurred in Iceland. Two of the events were scale 1 events and both (G1), and the other events were of scale 0. The first scale 1 incident was due to a lightning strike in 132kV transmission which resulted in blackout to Reykjanes peninsula. The other scale 1 incident was due to a volcano eruption, the lava flow under one 132kV transmission line and it tripped due to a heat from the lava. The line connects a geothermal power plant and the town Grindavik.

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 1 incident was reported as other. Only four incidents took longer than 24 hours to resolve, as seen in Table 11.2.

Table 10.1: Number of events by dominant criteria distributed per month in 2024 in Isolated system.

		2024												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	2	2	1	-	-	-	-	1	-	1	1	4	12
	Incidents on power generating facilities (G0)	-	-	-	1	-	-	1	-	-	-	-	-	2
	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	1	1	-	-	1	1	-	1	1	4	14
Scale1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	1	-	-	-	-	-	-	-	-	-	1	-	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)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	1	-	-	-	-	-	-	-	-	-	1	-	2
Scale2	Incidents on load (L2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		3	2	1	1	-	-	1	1	-	1	2	4	16

Table 10.2: Cumulative number of events by dominant criteria and duration in 2024 in Isolated system.

	2024						
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)	5	6	8	9	10	12
	Incidents on power generating facilities (G0)	-	1	1	2	2	2
	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	7	9	11	12	14
Scale1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-
	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)	-	-	-	-	-	-
	Total	-	-	-	-	-	2
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	7	9	11	12	16

10.2 Evolution 2020–2024

This section presents the annual number of incidents in the isolated systems from 2020 to 2024, distributed by scale and ICS criterion. The ICS criteria used in this report are presented in 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.

Two scale 1 incident was reported in 2024. No scale 3 incidents were reported during 2020–2024.

All ICS incidents in the isolated systems during 2020–2024 were reported by Landsnet in Iceland.

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Table 10.3: The annual number of events by dominating criterion from 2020–2024.

Scale	ICS criterion	2020	2021	2022	2023	2024
Scale0	Incidents on load (L0)	-	-	6	1	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	29	26	29	12	12
	Incidents on power generating facilities (G0)	3	-	-	-	2
	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	33	26	36	13	14
Scale1	Incidents on load (L1)	1	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	12	1	2	1	-
	Incidents on power generating facilities (G1)	-	2	-	-	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	13	3	3	1	2
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		46	30	42	15	16

10.3 Analysis of significant changes in trends

In 2024, a total of 16 ICS events were reported in isolated systems by Landsnet in Iceland and is the second lowest number of incidents during the reporting period 2020–2024. 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.

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11 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 2020–2024 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

Nordic:

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

11.1 Overview of events per TSOs in Continental Europe

11.1.1 Events reported by 50Hertz

This section presents events for 50Hertz, one of the TSOs in Germany. Table 11.1 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.2 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.1 presents the number of events grouped by duration in 2024.

Table 11.1: Monthly distribution of events by dominating criterion in 2024 for 50Hertz.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	6	2	2	3	3	3	2	2	2	1	5	-	31
	Incidents on power generating facilities (G0)	1	-	-	-	-	-	-	1	-	-	-	1	3
	Loss of tools, means and facilities (LT0)	2	-	-	3	1	-	1	1	1	2	-	2	13
Scale 1	N-1 violation (ON1)	-	-	-	-	1	-	-	-	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand total		9	2	2	6	5	3	3	4	4	3	5	3	49

Table 11.2: The annual number of events by dominating criterion from 2020–2024 for 50Hertz.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	-	2	-	-	-
	Incidents on network elements (T0)	29	39	34	66	31
	Incidents on power generating facilities (G0)	9	8	6	3	3
	Loss of tools, means and facilities (LT0)	2	1	4	5	13
Scale 1	Incidents on load (L1)	-	-	3	2	-
	N-1 violation (ON1)	-	9	9	1	1
	Loss of tools, means and facilities (LT1)	9	8	4	2	1
Grand total		49	67	60	79	49

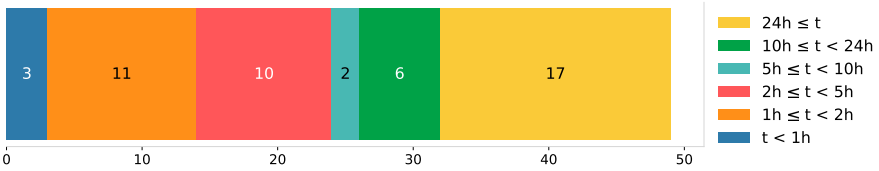

Figure 11.1: Number of events grouped by duration in 2024 for 50Hertz.

11.1.2 Events reported by Amprion

This section presents events for Amprion GmbH, one of the TSOs in Germany. Table 11.3 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.4 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.2 presents the number of events grouped by duration in 2024.

Table 11.3: Monthly distribution of events by dominating criterion in 2024 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)	4	-	2	5	5	4	4	7	5	3	4	11	54
	Incidents on power generating facilities (G0)	-	1	1	1	1	3	-	3	4	3	1	2	20
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	2	1	-	1	4
	Loss of tools, means and facilities (LT0)	1	1	-	2	6	1	1	1	-	1	1	-	15
Scale 1	N-1 violation (ON1)	-	-	-	-	2	-	-	2	-	1	-	-	5
	Violation of standards on voltage (OV1)	-	-	-	-	2	-	-	1	2	2	-	4	11
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand total		5	2	3	8	16	8	5	14	14	11	6	18	110

Table 11.4: The annual number of events by dominating criterion from 2020–2024 for Amprion.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	35	79	94	76	54
	Incidents on power generating facilities (G0)	9	19	18	10	20
	Violation of standards on voltage (OV0)	-	-	3	-	4
	Loss of tools, means and facilities (LT0)	3	4	14	4	15
Scale 1	Incidents on network elements (T1)	-	-	-	1	-
	N-1 violation (ON1)	4	3	12	9	5
	Violation of standards on voltage (OV1)	-	-	3	-	11
	Loss of tools, means and facilities (LT1)	-	-	-	1	1
Grand total		51	105	144	101	110

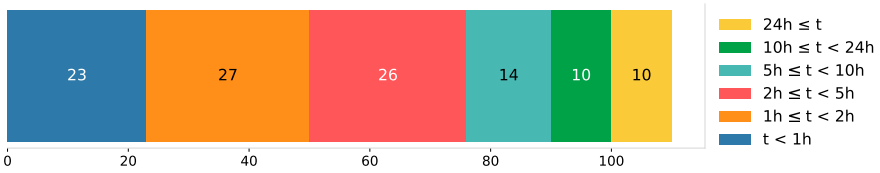

Figure 11.2: Number of events grouped by duration in 2024 for Amprion.

11.1.3 Events reported by APG

This section presents events for Austrian Power Grid AG (APG), the TSO in Austria. Table 11.5 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.6 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.3 presents the number of events grouped by duration in 2024.

Table 11.5: Monthly distribution of events by dominating criterion in 2024 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	-	2	2	-	-	-	-	2	-	-	-	7
	Incidents on power generating facilities (G0)	1	-	1	-	-	-	-	-	-	-	-	-	2
Scale 1	N-1 violation (ON1)	1	-	-	-	1	2	-	3	3	2	-	-	12
	Loss of tools, means and facilities (LT1)	-	-	-	2	2	-	-	3	-	-	1	-	8
Grand total		3	-	3	4	3	2	-	6	5	2	1	-	29

Table 11.6: The annual number of events by dominating criterion from 2020–2024 for APG.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	24	17	13	16	7
	Incidents on power generating facilities (G0)	-	-	-	-	2
	Loss of tools, means and facilities (LT0)	1	1	-	3	-
Scale 1	Incidents on network elements (T1)	-	-	1	-	-
	N-1 violation (ON1)	3	4	3	8	12
	Loss of tools, means and facilities (LT1)	2	-	1	-	8
Grand total		30	22	18	27	29

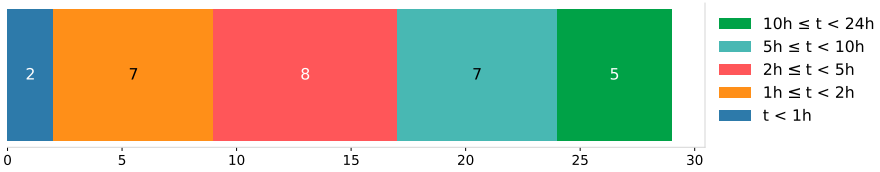

Figure 11.3: Number of events grouped by duration in 2024 for APG.

11.1.4 Events reported by CEPS

This section presents events for CEPS, the TSO in the Czech Republic. Table 11.7 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.8 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.4 presents the number of events grouped by duration in 2024.

ON1 incidents include only verified results of contingency analysis (i.e., potential outages of all ČEPS lines, including tie-lines, but only with impact on tie-lines). The results of contingency analysis have not been coordinated between neighbouring TSOs yet, and therefore the reported values may be different to what neighbouring TSOs have reported.

Table 11.7: Monthly distribution of events by dominating criterion in 2024 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)	5	2	5	4	4	4	2	4	8	-	5	2	45
	Incidents on power generating facilities (G0)	-	-	1	-	-	3	1	1	2	-	-	1	9
	Violation of standards on voltage (OV0)	15	-	-	-	-	4	-	-	-	-	-	-	19
	Loss of tools, means and facilities (LT0)	2	-	1	2	-	1	1	-	-	1	-	-	8
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	1	-	-	-	1
	N-1 violation (ON1)	1	-	3	-	5	3	1	17	4	2	4	8	48
	Violation of standards on voltage (OV1)	43	-	-	-	-	9	-	1	-	-	-	1	54
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand total		66	2	10	6	9	24	5	23	16	3	9	12	185

Table 11.8: The annual number of events by dominating criterion from 2020–2024 for CEPS.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	1	-	-	-	-
	Incidents on network elements (T0)	18	28	30	41	45
	Incidents on power generating facilities (G0)	3	6	2	3	9
	Separation from the grid (RS0)	2	-	1	-	-
	Violation of standards on voltage (OV0)	-	3	8	32	19
	Loss of tools, means and facilities (LT0)	1	1	1	11	8
Scale 1	Incidents on load (L1)	-	2	2	14	-
	Incidents on network elements (T1)	4	-	7	-	1
	N-1 violation (ON1)	2	-	1	-	48
	Violation of standards on voltage (OV1)	5	3	6	36	54
	Loss of tools, means and facilities (LT1)	2	1	3	2	1
Grand total		38	44	61	139	185

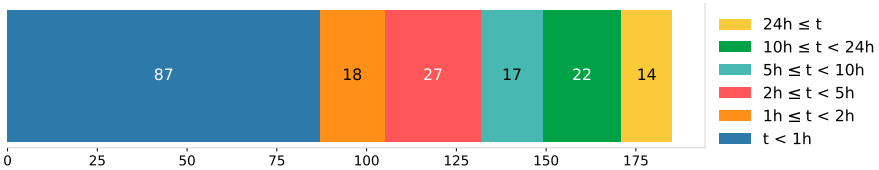

Figure 11.4: Number of events grouped by duration in 2024 for CEPS.

11.1.5 Events reported by CGES

This section presents events for CGES, the TSO in Montenegro. Table 11.9 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.10 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.5 presents the number of events grouped by duration in 2024.

Table 11.9: Monthly distribution of events by dominating criterion in 2024 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)	3	4	5	7	6	13	4	2	2	-	2	2	50
Scale 1	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Scale 2	Incidents on network elements (T2)	-	-	-	-	-	2	-	-	-	-	-	-	2
	N violation (ON2)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Violation of standards on voltage (OV2)	-	-	-	-	-	1	-	-	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	-	2	-	-	-	-	-	-	2
Grand total		3	4	5	7	6	20	4	2	2	-	2	2	57

Table 11.10: The annual number of events by dominating criterion from 2020–2024 for CGES.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	-	-	22	19	50
Scale 1	Incidents on network elements (T1)	-	-	-	3	-
	N-1 violation (ON1)	-	-	-	-	1
Scale 2	Incidents on network elements (T2)	-	-	-	-	2
	N violation (ON2)	-	-	-	-	1
	Violation of standards on voltage (OV2)	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	2
Grand total		-	-	22	22	57

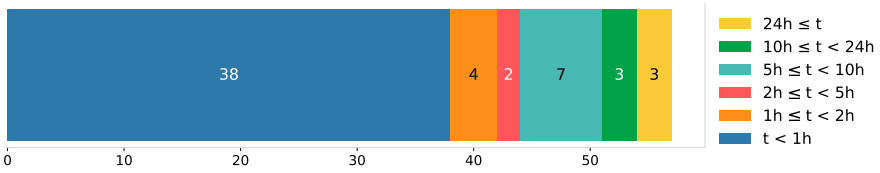

Figure 11.5: Number of events grouped by duration in 2024 for CGES.

11.1.6 Events reported by ELES

This section presents events for ELES, the TSO in Slovenia. Table 11.11 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.12 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.6 presents the number of events grouped by duration in 2024.

Table 11.11: Monthly distribution of events by dominating criterion in 2024 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	-	1	1	5	1	4	1	1	1	2	18
	Violation of standards on voltage (OV0)	4	3	9	10	31	6	1	9	10	7	5	8	103
Scale 1	N-1 violation (ON1)	-	-	1	1	3	1	-	1	-	3	-	-	10
	Violation of standards on voltage (OV1)	3	5	5	8	27	6	4	6	16	17	6	3	106
Grand total		7	9	15	20	62	18	6	20	27	28	12	13	237

Table 11.12: The annual number of events by dominating criterion from 2020–2024 for ELES.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	-	5	7	7	18
	Violation of standards on voltage (OV0)	-	-	-	-	103
	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	10
	Violation of standards on voltage (OV1)	5	-	-	-	106
	Loss of tools, means and facilities (LT1)	-	1	-	2	-
Grand total		9	7	11	20	237

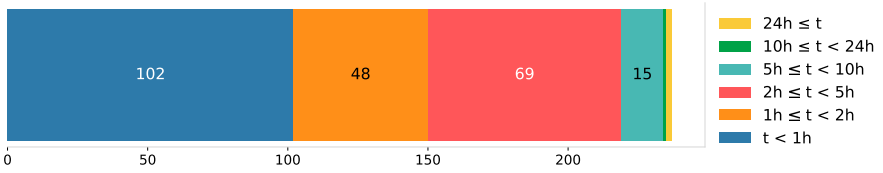

Figure 11.6: Number of events grouped by duration in 2024 for ELES.

11.1.7 Events reported by Elia

This section presents events for Elia, the TSO in Belgium. Table 11.13 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.14 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.7 presents the number of events grouped by duration in 2024.

Table 11.13: Monthly distribution of events by dominating criterion in 2024 for Elia.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	1	-	2	2	-	2	1	-	-	1	4	14
	Incidents on power generating facilities (G0)	1	1	-	-	-	-	-	-	-	-	-	-	2
	Violation of standards on voltage (OV0)	-	-	-	-	1	1	-	-	-	-	-	-	2
Scale 1	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	2	-	-	-	2
	Loss of tools, means and facilities (LT1)	-	-	1	-	-	-	-	1	-	-	-	-	2
Grand total		2	2	1	2	3	1	2	2	2	-	1	4	22

Table 11.14: The annual number of events by dominating criterion from 2020–2024 for Elia.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	2	-	-	-	-
	Incidents on network elements (T0)	12	9	6	8	14
	Incidents on power generating facilities (G0)	-	1	1	-	2
	Violation of standards on voltage (OV0)	-	1	-	-	2
	Loss of tools, means and facilities (LT0)	3	-	-	3	-
Scale 1	Incidents on network elements (T1)	-	3	-	-	-
	N-1 violation (ON1)	4	2	-	1	-
	Violation of standards on voltage (OV1)	3	-	-	-	2
	Loss of tools, means and facilities (LT1)	-	4	-	-	2
Grand total		24	20	7	12	22

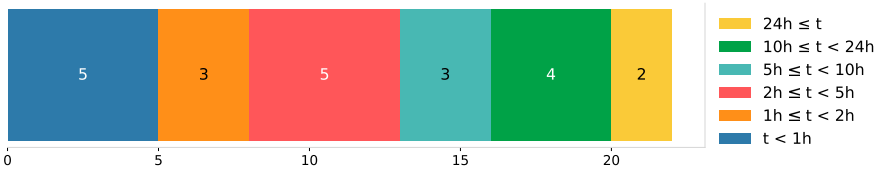

Figure 11.7: Number of events grouped by duration in 2024 for Elia.

11.1.8 Events reported by EMS

This section presents events for EMS JSC, the TSO of Serbia. Table 11.15 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.16 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.8 presents the number of events grouped by duration in 2024.

Table 11.15: Monthly distribution of events by dominating criterion in 2024 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)	-	-	2	4	2	2	5	4	2	1	3	1	26
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	1	-	-	-	1
Scale 1	Incidents on load (L1)	-	-	2	-	2	-	-	-	-	-	-	-	4
	Incidents on network elements (T1)	1	-	-	-	-	-	-	-	1	-	-	-	2
	Violation of standards on voltage (OV1)	-	12	17	23	19	13	17	15	5	9	3	4	137
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	4	2	1	-	-	-	-	7
Grand total		1	12	21	27	23	19	24	20	9	10	6	5	177

Table 11.16: The annual number of events by dominating criterion from 2020–2024 for EMS.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	24	31	16	33	26
	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)	2	-	-	1	4
	Incidents on network elements (T1)	2	3	1	1	2
	Violation of standards on voltage (OV1)	-	109	119	132	137
	Reduction of reserve capacity (RRC1)	-	4	2	4	7
	Loss of tools, means and facilities (LT1)	1	2	-	-	-
Scale 2	Separation from the grid (RS2)	-	2	-	-	-
Grand total		29	157	142	171	177

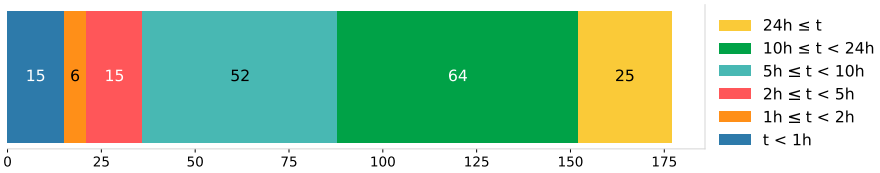

Figure 11.8: Number of events grouped by duration in 2024 for EMS.

11.1.9 Events reported by Energinet (CE)

This section presents events for Energinet (CE), the TSO in Denmark. Table 11.17 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 11.18 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.9 presents the number of events grouped by duration in 2024.

Table 11.17: Monthly distribution of events by dominating criterion in 2024 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)	2	3	3	2	1	3	1	3	2	3	3	3	29
	Loss of tools, means and facilities (LT0)	1	2	-	-	3	1	-	-	1	-	2	-	10
Scale 1	Loss of tools, means and facilities (LT1)	1	-	-	-	-	-	1	-	-	-	-	-	2
Grand total		4	5	3	2	4	4	2	3	3	3	5	3	41

Table 11.18: The annual number of events by dominating criterion from 2020–2024 for Energinet (CE).

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	15	35	15	18	29
	Violation of standards on voltage (OV0)	-	1	-	-	-
	Loss of tools, means and facilities (LT0)	3	2	1	-	10
Scale 1	Reduction of reserve capacity (RRC1)	1	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	3	4	2
Grand total		19	38	19	22	41

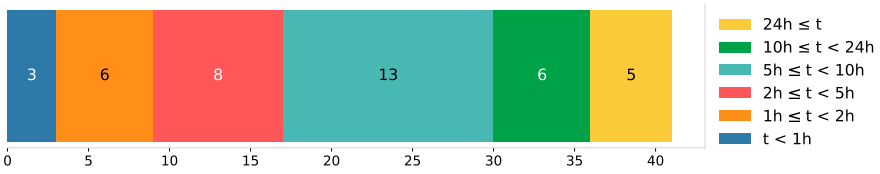

Figure 11.9: Number of events grouped by duration in 2024 for Energinet (CE).

11.1.10 Events reported by ESO

This section presents events for ESO EAD, the TSO in Bulgaria. Table 11.19 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.20 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.10 presents the number of events grouped by duration in 2024.

Table 11.19: Monthly distribution of events by dominating criterion in 2024 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)	5	1	6	1	2	11	19	10	6	6	5	1	73
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	-	-	1	1
Grand total		5	1	6	1	2	11	19	10	6	6	5	2	74

Table 11.20: The annual number of events by dominating criterion from 2020–2024 for ESO.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	40	38	91	142	73
	Loss of tools, means and facilities (LT0)	-	-	-	-	1
Grand total		40	38	91	142	74

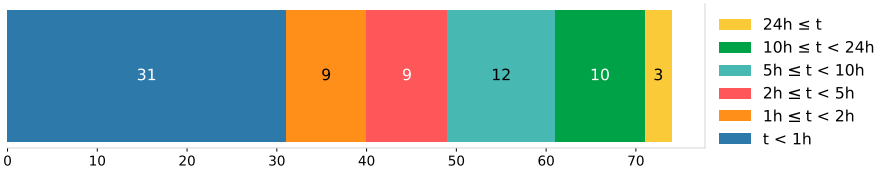

Figure 11.10: Number of events grouped by duration in 2024 for ESO.

11.1.11 Events reported by Freq (CE)

This section presents frequency violations in continental Europe. Table 11.21 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.22 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.11 presents the number of events grouped by duration in 2024.

Table 11.21: Monthly distribution of events by dominating criterion in 2024 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)	33	16	25	50	29	21	30	8	20	13	13	14	272
Scale 1	Incidents leading to frequency degradation (F1)	-	-	2	2	-	-	-	-	-	3	-	-	7
Grand total		33	16	27	52	29	21	30	8	20	16	13	14	279

Table 11.22: The annual number of events by dominating criterion from 2020–2024 for Freq (CE).

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents leading to frequency degradation (F0)	296	745	219	208	272
Scale 1	Incidents leading to frequency degradation (F1)	3	93	7	15	7
Grand total		299	838	226	223	279

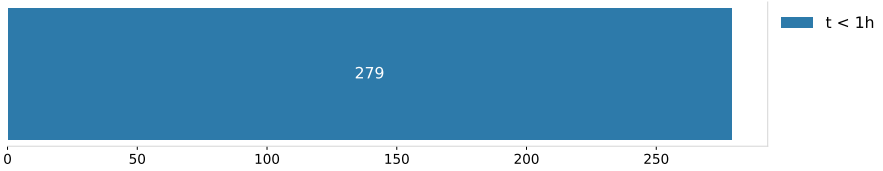

Figure 11.11: Number of events grouped by duration in 2024 for Freq (CE).

11.1.12 Events reported by HOPS

This section presents events for HOPS, the TSO in Croatia. Table 11.23 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.24 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.12 presents the number of events grouped by duration in 2024.

Table 11.23: Monthly distribution of events by dominating criterion in 2024 for HOPS.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	1	-	-	-	8	-	-	-	-	-	-	9
Scale 1	Incidents on network elements (T1)	-	1	1	-	-	1	-	-	-	-	-	-	3
	N-1 violation (ON1)	-	-	-	-	3	-	1	-	-	-	-	-	4
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	-	1	-	-	1
Scale 2	Incidents on load (L2)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Incidents on network elements (T2)	-	-	-	-	-	4	-	-	-	-	-	-	4
	N violation (ON2)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Violation of standards on voltage (OV2)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		-	2	1	-	3	16	1	-	-	1	-	-	24

Table 11.24: The annual number of events by dominating criterion from 2020–2024 for HOPS.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	31	49	39	52	9
	Loss of tools, means and facilities (LT0)	1	11	-	-	-
Scale 1	Incidents on network elements (T1)	-	2	-	-	3
	N-1 violation (ON1)	-	-	-	1	4
	Reduction of reserve capacity (RRC1)	-	12	-	-	-
	Loss of tools, means and facilities (LT1)	-	2	1	1	1
Scale 2	Incidents on load (L2)	-	-	-	-	1
	Incidents on network elements (T2)	-	1	-	-	4
	N violation (ON2)	-	-	-	-	1
	Separation from the grid (RS2)	-	2	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	1
Grand total		32	79	40	54	24

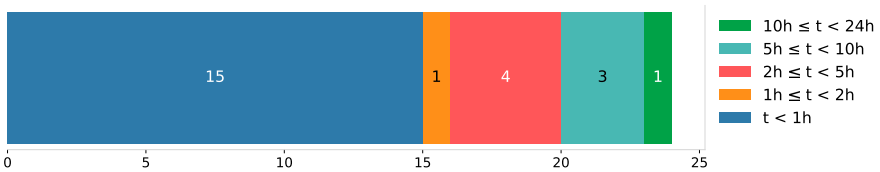

Figure 11.12: Number of events grouped by duration in 2024 for HOPS.

11.1.13 Events reported by IPTO

This section presents events for IPTO, the TSO in Greece. Table 11.25 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.26 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.13 presents the number of events grouped by duration in 2024.

Table 11.25: Monthly distribution of events by dominating criterion in 2024 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)	1	1	-	4	1	-	-	1	-	1	-	1	10
	Incidents on power generating facilities (G0)	-	1	-	-	-	-	-	-	-	-	-	-	1
	Separation from the grid (RS0)	-	-	-	1	-	-	-	-	-	-	-	-	1
	Violation of standards on voltage (OV0)	11	5	9	7	7	5	3	5	11	8	3	3	77
	Loss of tools, means and facilities (LT0)	-	1	1	-	-	-	-	2	-	-	1	-	5
Scale 1	Violation of standards on voltage (OV1)	1	-	-	1	-	-	-	-	-	-	-	-	2
Grand total		13	8	10	13	8	5	3	8	11	9	4	4	96

Table 11.26: The annual number of events by dominating criterion from 2020–2024 for IPTO.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	23	35	35	58	10
	Incidents on power generating facilities (G0)	-	1	-	-	1
	Separation from the grid (RS0)	-	-	-	-	1
	Violation of standards on voltage (OV0)	14	14	22	25	77
	Loss of tools, means and facilities (LT0)	-	10	10	10	5
Scale 1	Incidents on load (L1)	-	-	-	1	-
	Incidents on network elements (T1)	1	-	-	-	-
	Violation of standards on voltage (OV1)	26	34	28	18	2
	Loss of tools, means and facilities (LT1)	-	-	-	1	-
Grand total		64	94	95	113	96

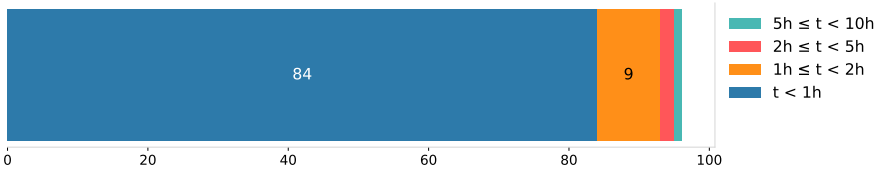

Figure 11.13: Number of events grouped by duration in 2024 for IPTO.

11.1.14 Events reported by MAVIR

This section presents events for MAVIR ZRt, the TSO in Hungary. Table 11.27 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.28 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.14 presents the number of events grouped by duration in 2024.

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 11.27: Monthly distribution of events by dominating criterion in 2024 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)	2	-	3	-	1	1	1	1	-	1	1	-	11
	Violation of standards on voltage (OV0)	-	7	28	13	14	12	10	7	17	10	9	9	136
	Reduction of reserve capacity (RRC0)	1	3	6	8	15	12	13	11	5	5	8	4	91
Scale 1	Violation of standards on voltage (OV1)	7	1	6	3	6	10	3	6	7	11	6	3	69
	Reduction of reserve capacity (RRC1)	1	-	2	-	-	-	8	3	3	-	6	-	23
Grand total		11	11	45	24	36	35	35	28	32	27	30	16	330

Table 11.28: The annual number of events by dominating criterion from 2020–2024 for MAVIR.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	6	-	12	9	11
	Violation of standards on voltage (OV0)	292	249	329	232	136
	Reduction of reserve capacity (RRC0)	-	25	185	89	91
Scale 1	Incidents on network elements (T1)	-	15	-	-	-
	Violation of standards on voltage (OV1)	-	287	154	92	69
	Reduction of reserve capacity (RRC1)	63	35	53	40	23
Grand total		361	611	733	462	330

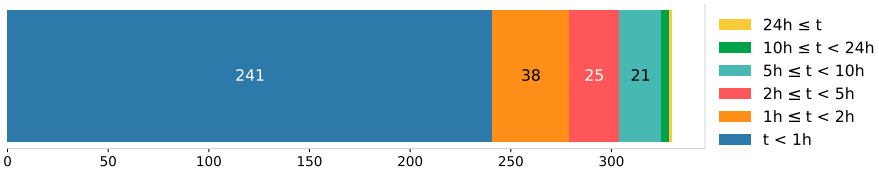

Figure 11.14: Number of events grouped by duration in 2024 for MAVIR.

11.1.15 Events reported by Moldelectrica

This section presents events for Moldelectrica, the TSO in Moldova. Table 11.29 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.30 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.15 presents the number of events grouped by duration in 2024.

Table 11.29: Monthly distribution of events by dominating criterion in 2024 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)	-	-	-	1	-	-	2	1	-	-	-	-	4
Scale 1	Violation of standards on voltage (OV1)	12	24	20	22	21	5	4	3	8	23	3	5	150
Grand total		12	24	20	23	21	5	6	4	8	23	3	5	154

Table 11.30: The annual number of events by dominating criterion from 2020–2024 for Moldelectrica.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	-	-	-	15	4
Scale 1	Violation of standards on voltage (OV1)	-	-	-	-	150
Scale 2	Incidents on load (L2)	-	-	-	1	-
Grand total		-	-	-	16	154

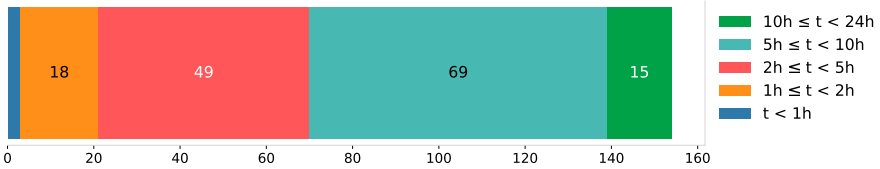

Figure 11.15: Number of events grouped by duration in 2024 for Moldelectrica.

11.1.16 Events reported by NOS BiH

This section presents events for NOS BiH, the TSO in Bosnia and Herzegovina. Table 11.31 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.32 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.16 presents the number of events grouped by duration in 2024.

Table 11.31: Monthly distribution of events by dominating criterion in 2024 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	4	3	3	3	4	4	3	-	1	28
	Incidents on power generating facilities (G0)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Violation of standards on voltage (OV0)	-	-	-	-	-	1	-	-	-	-	-	-	1
Scale 2	Incidents on network elements (T2)	-	-	-	-	-	8	-	-	-	-	-	-	8
	N violation (ON2)	-	-	-	-	-	1	-	-	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		1	-	2	4	3	15	3	4	4	3	-	1	40

Table 11.32: The annual number of events by dominating criterion from 2020–2024 for NOS BiH.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	27	28	26	8	28
	Incidents on power generating facilities (G0)	-	1	-	-	1
	Violation of standards on voltage (OV0)	-	-	-	-	1
Scale 1	Incidents on network elements (T1)	-	1	-	3	-
Scale 2	Incidents leading to frequency degradation (F2)	-	2	-	-	-
	Incidents on network elements (T2)	-	-	-	-	8
	N violation (ON2)	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	1
Grand total		27	32	26	11	40

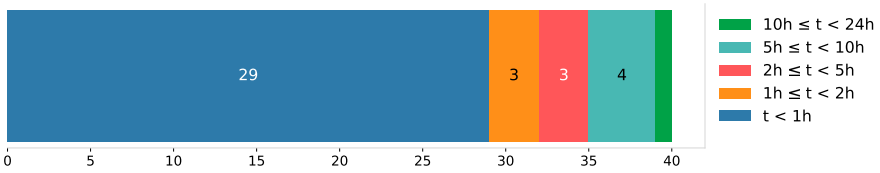

Figure 11.16: Number of events grouped by duration in 2024 for NOS BiH.

11.1.17 Events reported by OST

This section presents events for OST, the TSO in Albania. Table 11.33 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.34 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.17 presents the number of events grouped by duration in 2024.

Table 11.33: Monthly distribution of events by dominating criterion in 2024 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	4	9	4	11	2	5	6	3	-	4	8	61
	Incidents on power generating facilities (G0)	-	1	-	-	1	1	-	-	-	-	1	-	4
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	2	1	1	-	-	-	-	4
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	1	1
	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Scale 2	Incidents on network elements (T2)	-	-	-	-	-	6	-	-	-	-	-	-	6
	N violation (ON2)	-	-	-	-	-	1	-	-	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		5	5	9	4	12	14	6	7	3	-	5	9	79

Table 11.34: The annual number of events by dominating criterion from 2020–2024 for OST.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	-	61	32	41	61
	Incidents on power generating facilities (G0)	-	-	-	-	4
Scale 1	Incidents on network elements (T1)	-	-	-	-	4
	Incidents on power generating facilities (G1)	-	-	-	-	1
	N-1 violation (ON1)	-	-	-	-	1
Scale 2	Incidents on network elements (T2)	-	-	-	-	6
	N violation (ON2)	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	1
Grand total		-	61	32	41	79

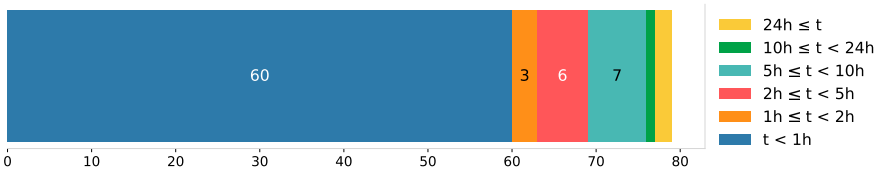

Figure 11.17: Number of events grouped by duration in 2024 for OST.

11.1.18 Events reported by PSE

This section presents events for PSE, the TSO in Poland. Table 11.35 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.36 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.18 presents the number of events grouped by duration in 2024.

Table 11.35: Monthly distribution of events by dominating criterion in 2024 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)	11	2	4	4	6	13	16	8	6	1	-	6	77
	Incidents on power generating facilities (G0)	2	1	-	-	-	-	-	1	-	1	2	1	8
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	2	-	-	-	-	2
Grand total		13	3	4	4	6	13	16	11	6	2	2	7	87

Table 11.36: The annual number of events by dominating criterion from 2020–2024 for PSE.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	76	99	138	78	77
	Incidents on power generating facilities (G0)	13	14	12	9	8
	Loss of tools, means and facilities (LT0)	2	-	1	-	2
Scale 1	N-1 violation (ON1)	1	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	1	6	1	-
	Loss of tools, means and facilities (LT1)	-	2	-	-	-
Scale 2	Incidents on power generating facilities (G2)	-	2	-	-	-
	Reduction of reserve capacity (RRC2)	-	1	-	-	-
Grand total		92	119	157	88	87

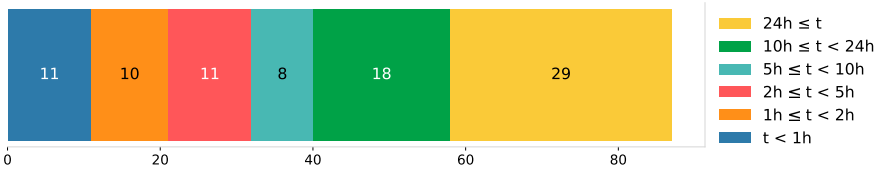

Figure 11.18: Number of events grouped by duration in 2024 for PSE.

11.1.19 Events reported by Red Eléctrica

This section presents events for Red Eléctrica, the TSO in Spain. Table 11.37 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.38 presents the annual number of ICS events by ICS criterion from 2020– 2024. Figure 11.19 presents the number of events grouped by duration in 2024.

From 2020 to 2024, 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 2024, the number of events related to incidents on power generating facilities increased up to 10, which is not a remarkable difference if compared to the previous year, and those related to loss of tools, means and facilities increased up to 26. All events reported in 2024 were categorized as "Scale 0", meaning that 13 less Scale 1 incidents were reported if compared with 2023.

July and October were the months in which more events were reported by RE in 2024 (above 30), mainly related to the tripping of network elements and to the loss of tools, means and facilities. The reason behind October being the month with the highest number of events is the DANA that affected Valencia in 2024. The heavy damage that the storm and the floods caused justifies the increased number of events that lasted more than 24 h in 2024 in Spain, as many network elements had to be declared out of service for repairing or replacing them which, in some cases, extended until the beginning of 2025 and compromised complete substations. Most of July incidents are related to fires in the nature.

Table 11.37: Monthly distribution of events by dominating criterion in 2024 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)	10	25	22	22	15	16	26	21	17	33	8	18	233
	Incidents on power generating facilities (G0)	2	1	1	1	-	1	1	-	-	-	3	-	10
	Loss of tools, means and facilities (LT0)	5	1	2	3	-	1	3	1	2	3	1	4	26
Grand total		17	27	25	26	15	18	30	22	19	36	12	22	269

Table 11.38: The annual number of events by dominating criterion from 2020–2024 for Red Eléctrica.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	258	274	214	240	233
	Incidents on power generating facilities (G0)	-	-	3	8	10
	Violation of standards on voltage (OV0)	-	-	1	13	-
	Loss of tools, means and facilities (LT0)	5	-	5	6	26
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		264	278	223	280	269

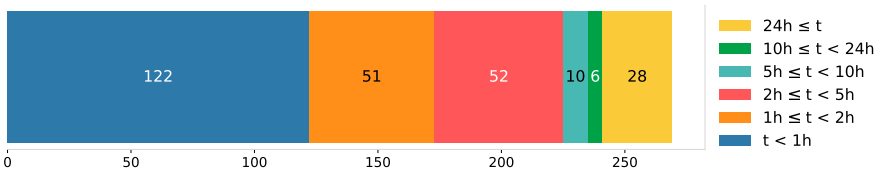

Figure 11.19: Number of events grouped by duration in 2024 for Red Eléctrica.

11.1.20 Events reported by REN

This section presents events for REN, the TSO in Portugal. Table 11.39 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.40 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.20 presents the number of events grouped by duration in 2024.

Table 11.39: Monthly distribution of events by dominating criterion in 2024 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)	3	1	1	-	2	2	2	2	4	2	1	3	23
	Incidents on power generating facilities (G0)	1	-	-	-	-	-	-	-	-	-	-	-	1
Grand total		4	1	1	-	2	2	2	2	4	2	1	3	24

Table 11.40: The annual number of events by dominating criterion from 2020–2024 for REN.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	11	17	9	25	23
	Incidents on power generating facilities (G0)	-	1	1	1	1
	Loss of tools, means and facilities (LT0)	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		13	20	12	29	24

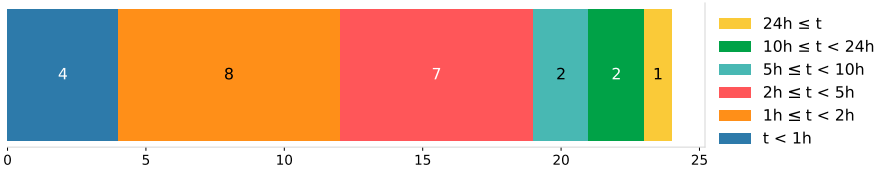

Figure 11.20: Number of events grouped by duration in 2024 for REN.

11.1.21 Events reported by RTE

This section presents events for RTE, the TSO in France. Table 11.41 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.42 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.21 presents the number of events grouped by duration in 2024.

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

Table 11.41: Monthly distribution of events by dominating criterion in 2024 for RTE.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	1	-	1	1	1	1	-	5
	Incidents on network elements (T0)	28	18	22	26	62	17	32	31	15	22	34	18	325
	Incidents on power generating facilities (G0)	5	3	1	-	2	1	-	2	1	1	1	2	19
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	7	-	-	-	7
Scale 1	Incidents on network elements (T1)	-	-	-	-	1	-	-	-	-	-	-	-	1
	N-1 violation (ON1)	-	2	4	6	9	4	10	1	2	-	3	-	41
	Reduction of reserve capacity (RRC1)	-	-	-	-	4	-	-	-	-	-	1	-	5
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand total		33	23	27	32	78	23	42	35	27	24	40	20	404

Table 11.42: The annual number of events by dominating criterion from 2020–2024 for RTE.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	2	1	4	2	5
	Incidents on network elements (T0)	153	158	189	276	325
	Incidents on power generating facilities (G0)	29	30	26	19	19
	Violation of standards on voltage (OV0)	15	39	13	8	-
	Loss of tools, means and facilities (LT0)	4	1	-	4	7
Scale 1	Incidents on network elements (T1)	-	-	-	2	1
	Incidents on power generating facilities (G1)	-	2	-	2	-
	N-1 violation (ON1)	30	32	12	15	41
	Violation of standards on voltage (OV1)	18	18	5	1	-
	Reduction of reserve capacity (RRC1)	2	2	5	2	5
	Loss of tools, means and facilities (LT1)	1	1	2	-	1
Scale 2	Incidents on network elements (T2)	-	1	-	-	-
Grand total		254	285	256	331	404

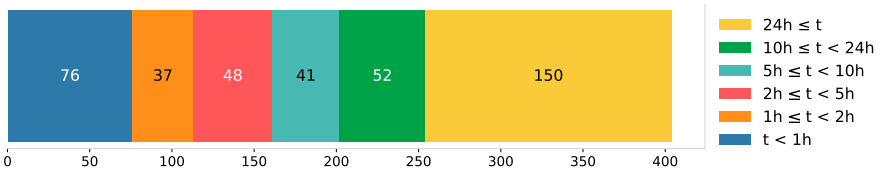

Figure 11.21: Number of events grouped by duration in 2024 for RTE.

11.1.22 Events reported by SEPS

This section presents events for SEPS, the TSO in Slovakia. Table 11.43 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.44 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.22 presents the number of events grouped by duration in 2024.

Table 11.43: Monthly distribution of events by dominating criterion in 2024 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)	3	2	-	-	6	1	-	1	1	1	-	-	15
	Loss of tools, means and facilities (LT0)	-	-	1	-	-	1	-	-	-	-	-	-	2
Scale 1	Reduction of reserve capacity (RRC1)	-	-	-	2	2	-	-	-	-	-	1	-	5
Grand total		3	2	1	2	8	2	-	1	1	1	1	-	22

Table 11.44: The annual number of events by dominating criterion from 2020–2024 for SEPS.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	4	8	8	8	15
	Violation of standards on voltage (OV0)	44	21	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	2
Scale 1	Incidents on network elements (T1)	3	-	-	1	-
	N-1 violation (ON1)	1	-	-	-	-
	Violation of standards on voltage (OV1)	16	14	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	8	5	5
	Loss of tools, means and facilities (LT1)	1	-	-	-	-
Grand total		69	43	16	14	22

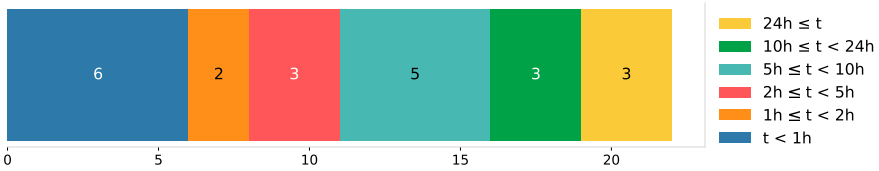

Figure 11.22: Number of events grouped by duration in 2024 for SEPS.

11.1.23 Events reported by Swissgrid

This section presents events for Swissgrid, the TSO in Switzerland. Table 11.45 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.46 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.23 presents the number of events grouped by duration in 2024.

As can be seen in the tables below, voltage violations in Swissgrid's control area occur mainly during the spring period. While the number of registered voltage violations have increased in Europe, Swissgrid has put in place the following voltage management measures to prevent and mitigate voltage violations in their control area:

- New contracts (activation of synchronous condenser operation mode of power plants) provide Swissgrid with additional resources of 400 MVar for voltage control since the end of 2024. Further power plants are under review.
- Swissgrid has publicly tendered the procurement of 10 compensation devices.
- Swissgrid is examining to strengthen the involvement with distribution network operators.
- Swissgrid has defined measures that can be used to resolve voltage violations – also in collaboration with neighboring TSOs.

Table 11.45: Monthly distribution of events by dominating criterion in 2024 for Swissgrid.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	3	5	3	2	4	10	2	2	-	1	4	36
	Incidents on power generating facilities (G0)	-	-	-	-	-	1	1	1	-	-	-	1	4
	Violation of standards on voltage (OV0)	-	2	-	9	21	1	5	2	-	5	-	1	46
	Loss of tools, means and facilities (LT0)	2	-	-	-	1	-	4	-	2	-	-	-	9
Scale 1	N-1 violation (ON1)	-	-	-	-	6	-	-	-	-	-	-	-	6
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	2	-	1	-	-	-	3
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	2	-	-	1	3
Grand total		2	5	5	12	30	6	22	5	7	5	1	7	107

Table 11.46: The annual number of events by dominating criterion from 2020–2024 for Swissgrid.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	37	33	34	24	36
	Incidents on power generating facilities (G0)	2	2	2	2	4
	Violation of standards on voltage (OV0)	72	78	53	35	46
	Loss of tools, means and facilities (LT0)	21	13	13	7	9
Scale 1	Incidents on load (L1)	2	-	-	2	-
	Incidents on network elements (T1)	1	-	-	-	-
	N-1 violation (ON1)	1	-	1	1	6
	Violation of standards on voltage (OV1)	27	12	5	7	3
	Loss of tools, means and facilities (LT1)	2	3	-	-	3
Grand total		165	141	108	78	107

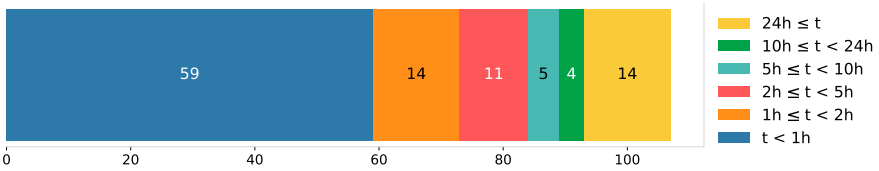

Figure 11.23: Number of events grouped by duration in 2024 for Swissgrid.

11.1.24 Events reported by TEIAS

This section presents events for TEIAS, the TSO in Turkey. Table 11.47 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.48 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.24 presents the number of events grouped by duration in 2024.

Table 11.47: Monthly distribution of events by dominating criterion in 2024 for TEIAS.

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	1	1	-	-	1	1	2	12
	Incidents on power generating facilities (G0)	2	1	1	-	1	2	1	4	1	2	2	2	19
Scale 1	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	2	-	2
Grand total		3	1	1	3	3	3	2	4	1	3	5	4	33

Table 11.48: The annual number of events by dominating criterion from 2020–2024 for TEIAS.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	-	-	2	5	-
	Incidents on network elements (T0)	-	18	17	10	12
	Incidents on power generating facilities (G0)	-	23	8	17	19
Scale 1	Separation from the grid (RS1)	-	-	-	-	2
	Violation of standards on voltage (OV1)	-	-	-	2	-
Grand total		-	41	27	34	33

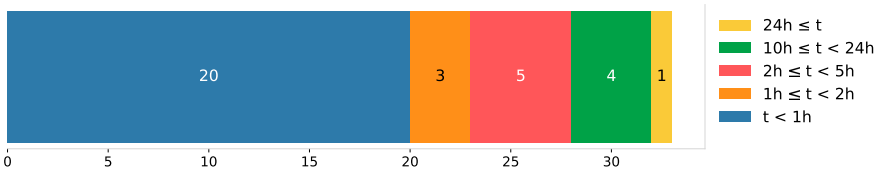

Figure 11.24: Number of events grouped by duration in 2024 for TEIAS.

11.1.25 Events reported by TenneT DE

This section presents events for TenneT TSO GmbH, one of the TSOs in Germany. Table 11.49 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.50 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.25 presents the number of events grouped by duration in 2024.

The changes in yearly numbers are nearly stable for consistent ICS Methodologies. The most common events for TenneT DE are T0 which account for more than 75% of all events. This ratio has remained stable in recent years. The absolute number of T0 events is also nearly constant over the past five years. The number of T1 events decreased again to 0 and the number of ON1 events remain on the same level as in recent years. The same applies to LT0 and LT1.

The variance during the year 2024 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 11.49: Monthly distribution of events by dominating criterion in 2024 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)	2	4	2	3	3	5	6	8	9	2	5	5	54
	Loss of tools, means and facilities (LT0)	-	-	-	3	-	2	1	2	-	-	-	-	8
Scale 1	N-1 violation (ON1)	-	-	1	-	1	2	-	1	2	1	-	-	8
Grand total		2	4	3	6	4	9	7	11	11	3	5	5	70

Table 11.50: The annual number of events by dominating criterion from 2020–2024 for TenneT DE.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	13	64	43	57	54
	Incidents on power generating facilities (G0)	6	-	2	-	-
	Loss of tools, means and facilities (LT0)	49	3	3	3	8
Scale 1	Incidents on network elements (T1)	-	1	9	1	-
	N-1 violation (ON1)	1	3	9	9	8
	Loss of tools, means and facilities (LT1)	1	2	-	1	-
Grand total		70	73	66	71	70

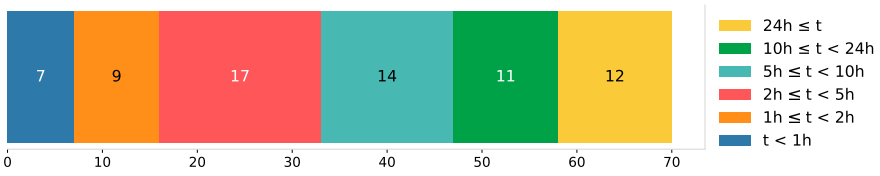

Figure 11.25: Number of events grouped by duration in 2024 for TenneT DE.

11.1.26 Events reported by TenneT NL

This section presents events for TenneT TSO B.V., the TSO in the Netherlands. Table 11.51 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.52 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.26 presents the number of events grouped by duration in 2024.

Table 11.51: Monthly distribution of events by dominating criterion in 2024 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)	7	-	-	3	4	3	1	2	1	1	4	2	28
	Incidents on power generating facilities (G0)	1	-	-	-	-	-	-	-	1	2	-	-	4
	Loss of tools, means and facilities (LT0)	9	3	-	4	-	3	6	-	2	-	-	-	27
Scale 1	N-1 violation (ON1)	-	1	-	-	1	-	-	-	1	-	-	-	3
Grand total		17	4	-	7	5	6	7	2	5	3	4	2	62

Table 11.52: The annual number of events by dominating criterion from 2020–2024 for TenneT NL.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	54	16	15	16	28
	Incidents on power generating facilities (G0)	1	11	22	7	4
	Violation of standards on voltage (OV0)	1	-	-	6	-
	Loss of tools, means and facilities (LT0)	5	21	26	45	27
Scale 1	Incidents on load (L1)	-	-	1	-	-
	Incidents on power generating facilities (G1)	-	1	-	-	-
	N-1 violation (ON1)	6	4	7	4	3
	Violation of standards on voltage (OV1)	-	-	1	6	-
	Loss of tools, means and facilities (LT1)	2	-	-	-	-
Grand total		69	53	72	84	62

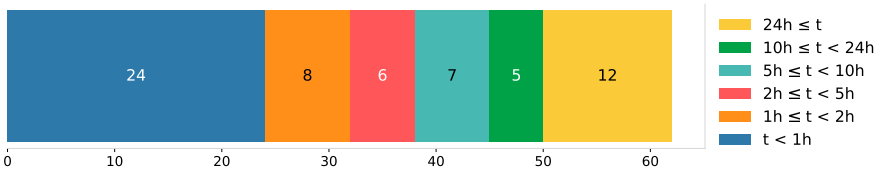

Figure 11.26: Number of events grouped by duration in 2024 for TenneT NL.

11.1.27 Events reported by Terna

This section presents events for Terna, the TSO in Italy. Table 11.53 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 11.54 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.27 presents the number of events grouped by duration in 2024.

Table 11.53: Monthly distribution of events by dominating criterion in 2024 for Terna.

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)	5	4	4	3	1	7	4	7	3	5	3	3	49
	Violation of standards on voltage (OV0)	-	-	-	-	1	-	-	-	-	-	1	-	2
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	2	1	-	-	-	-	-	3
	Loss of tools, means and facilities (LT0)	-	1	1	-	-	-	-	-	-	-	-	-	2
Grand total		5	5	5	3	2	9	5	7	3	5	5	3	57

Table 11.54: The annual number of events by dominating criterion from 2020–2024 for Terna.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	-	-	-	-	1
	Incidents on network elements (T0)	66	75	57	64	49
	Separation from the grid (RS0)	-	-	-	1	-
	Violation of standards on voltage (OV0)	-	12	-	2	2
	Reduction of reserve capacity (RRC0)	-	1	-	-	3
	Loss of tools, means and facilities (LT0)	-	-	-	1	2
Scale 1	N-1 violation (ON1)	-	-	-	1	-
	Reduction of reserve capacity (RRC1)	-	9	1	1	-
Grand total		66	97	58	70	57

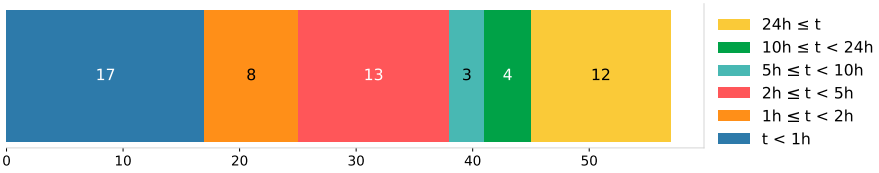

Figure 11.27: Number of events grouped by duration in 2024 for Terna.

11.1.28 Events reported by Transelectrica

This section presents events for Transelectrica, the TSO in Romania. Table 11.55 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 11.56 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.28 presents the number of events grouped by duration in 2024.

Table 11.55: Monthly distribution of events by dominating criterion in 2024 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)	8	4	7	7	5	50	18	7	10	8	5	7	136
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	1	-	-	-	-	-	1
	Violation of standards on voltage (OV0)	3	3	4	-	27	8	11	18	26	9	8	7	124
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	1	-	-	-	1
Scale 1	Incidents on load (L1)	-	-	-	-	-	2	1	-	-	-	-	-	3
	Violation of standards on voltage (OV1)	4	2	1	-	24	4	8	14	13	8	5	2	85
Grand total		15	9	12	7	56	64	39	39	50	25	18	16	350

Table 11.56: The annual number of events by dominating criterion from 2020–2024 for Transelectrica.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	75	56	59	116	136
	Incidents on power generating facilities (G0)	1	3	1	4	1
	Violation of standards on voltage (OV0)	11	71	47	83	124
	Loss of tools, means and facilities (LT0)	-	-	1	-	1
Scale 1	Incidents on load (L1)	5	1	-	-	3
	Violation of standards on voltage (OV1)	21	38	71	53	85
Scale 2	Incidents on network elements (T2)	-	1	-	-	-
	N violation (ON2)	-	1	-	-	-
	Separation from the grid (RS2)	-	1	-	-	-
Grand total		113	172	179	256	350

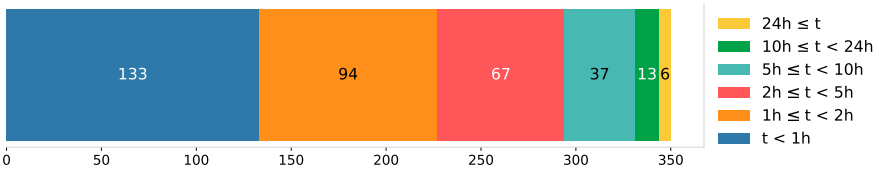

Figure 11.28: Number of events grouped by duration in 2024 for Transelectrica.

11.1.29 Events reported by TransnetBW

This section presents events for TransnetBW GmbH, one of the TSOs in Germany. Table 11.57 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.58 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.29 presents the number of events grouped by duration in 2024.

Table 11.57: Monthly distribution of events by dominating criterion in 2024 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)	3	1	1	1	2	1	2	2	4	1	2	1	21
	Incidents on power generating facilities (G0)	1	-	-	-	-	1	1	2	-	3	-	1	9
	Loss of tools, means and facilities (LT0)	-	-	2	1	-	-	-	-	-	-	-	-	3
Scale 1	N-1 violation (ON1)	-	-	-	-	2	-	-	-	1	1	-	-	4
	Loss of tools, means and facilities (LT1)	1	-	-	-	-	-	-	-	1	-	-	-	2
Grand total		5	1	3	2	4	2	3	4	6	5	2	2	39

Table 11.58: The annual number of events by dominating criterion from 2020–2024 for TransnetBW.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	29	11	10	10	21
	Incidents on power generating facilities (G0)	8	16	18	9	9
	Loss of tools, means and facilities (LT0)	-	-	-	1	3
Scale 1	N-1 violation (ON1)	1	3	3	-	4
	Loss of tools, means and facilities (LT1)	2	4	7	2	2
Grand total		40	34	38	22	39

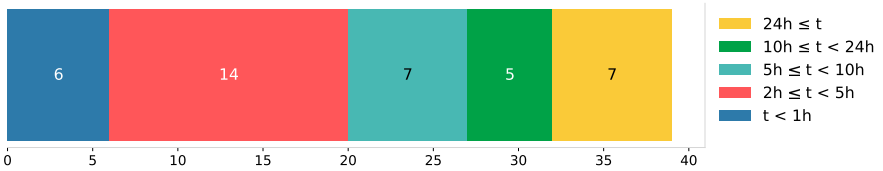

Figure 11.29: Number of events grouped by duration in 2024 for TransnetBW.

11.1.30 Events reported by Ukrenergo

This section presents events for Ukrenergo, the TSO in Ukraine. Table 11.59 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 11.60 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.30 presents the number of events grouped by duration in 2024.

Table 11.59: Monthly distribution of events by dominating criterion in 2024 for Ukrenergo.

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)	11	8	6	11	5	22	36	23	15	3	13	4	157
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	-	-	-	1	1
	Reduction of reserve capacity (RRC0)	-	-	-	-	2	3	-	-	-	-	-	-	5
	Loss of tools, means and facilities (LT0)	-	-	-	-	4	13	8	3	1	2	-	1	32
Scale 1	Incidents on load (L1)	-	-	-	-	3	46	58	8	4	-	14	20	153
	Incidents on network elements (T1)	-	-	-	-	-	-	1	-	-	-	-	-	1
	Incidents on power generating facilities (G1)	-	-	1	-	-	-	1	-	-	-	-	-	2
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	4	18	2	5	-	10	24	63
	Loss of tools, means and facilities (LT1)	-	-	-	-	1	3	7	9	11	7	7	9	54
Grand total		11	8	7	11	15	91	129	45	36	12	44	59	468

Table 11.60: The annual number of events by dominating criterion from 2020–2024 for Ukrenergo.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	-	-	-	2	-
	Incidents on network elements (T0)	-	-	-	207	157
	Incidents on power generating facilities (G0)	-	-	-	2	1
	Reduction of reserve capacity (RRC0)	-	-	-	2	5
	Loss of tools, means and facilities (LT0)	-	-	-	-	32
Scale 1	Incidents on load (L1)	-	-	-	15	153
	Incidents on network elements (T1)	-	-	-	-	1
	Incidents on power generating facilities (G1)	-	-	-	-	2
	Reduction of reserve capacity (RRC1)	-	-	-	7	63
	Loss of tools, means and facilities (LT1)	-	-	-	-	54
Scale 2	Incidents on load (L2)	-	-	-	1	-
Grand total		-	-	-	236	468

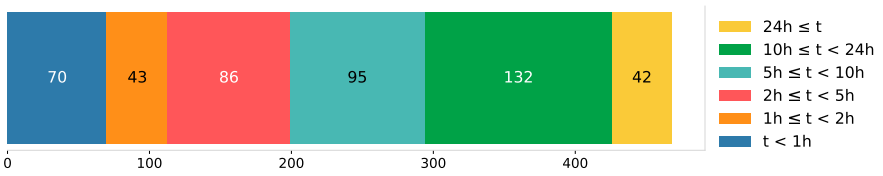

Figure 11.30: Number of events grouped by duration in 2024 for Ukrenergo.

11.2 Overview of events per TSOs in Nordic

11.2.1 Events reported by Energinet (Nordic)

This section presents events for Energinet (Nordic), the TSO in Denmark. Table 11.61 presents the monthly distribution of ICS events by ICS criterion in 2022, and Table 11.62 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.31 presents the number of events grouped by duration in 2024.

Table 11.61: Monthly distribution of events by dominating criterion in 2024 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)	-	-	-	-	-	-	2	-	-	-	1	-	3
	Loss of tools, means and facilities (LT0)	1	2	-	-	3	1	-	-	1	-	2	-	10
Scale 1	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	1	-	-	-	-	-	1	-	-	-	-	-	2
Grand total		2	2	-	-	3	2	3	-	1	-	3	-	16

Table 11.62: The annual number of events by dominating criterion from 2020–2024 for Energinet (Nordic).

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	14	13	5	5	3
	Loss of tools, means and facilities (LT0)	-	-	-	-	10
Scale 1	N-1 violation (ON1)	-	-	3	1	1
	Separation from the grid (RS1)	2	-	-	-	-
	Loss of tools, means and facilities (LT1)	2	-	-	-	2
Grand total		18	13	8	6	16

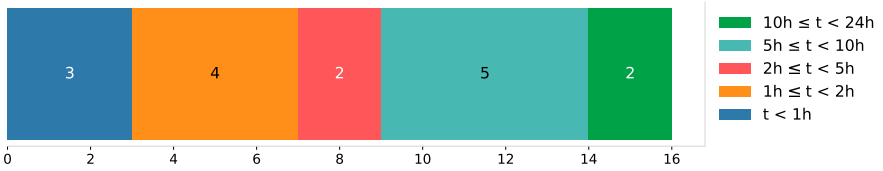

Figure 11.31: Number of events grouped by duration in 2024 for Energinet (Nordic).

11.2.2 Events reported by Fingrid

This section presents events for Fingrid Oyj, the TSO in Finland. Table 11.63 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.64 presents the annual number of ICS events by dominating ICS criterion from 2020–2024. There is no clear trend in number of events.

Figure 11.32 presents the number of events grouped by duration in 2024.

Table 11.63: Monthly distribution of events by dominating criterion in 2024 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)	3	-	2	1	-	1	-	1	-	-	2	1	11
	Incidents on power generating facilities (G0)	-	-	-	-	-	1	-	-	1	1	1	-	4
Scale 1	Violation of standards on voltage (OV1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		3	-	2	1	-	3	-	1	1	1	3	1	16

Table 11.64: The annual number of events by dominating criterion from 2020–2024 for Fingrid.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	4	13	3	4	11
	Incidents on power generating facilities (G0)	1	-	2	3	4
	Loss of tools, means and facilities (LT0)	-	1	2	-	-
Scale 1	Violation of standards on voltage (OV1)	-	-	-	-	1
Grand total		5	14	7	7	16

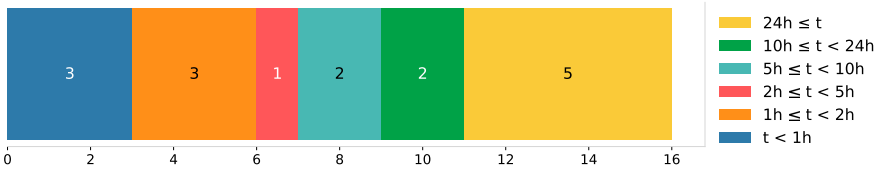

Figure 11.32: Number of events grouped by duration in 2024 for Fingrid.

11.2.3 Events reported by Freq (Nordic)

This section presents frequency violations in the Nordics. Table 11.65 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.66 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.33 presents the number of events grouped by duration in 2024.

Table 11.65: Monthly distribution of events by dominating criterion in 2024 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)	11	5	9	19	11	5	6	8	11	8	11	10	114
Scale 1	Incidents leading to frequency degradation (F1)	1	2	-	-	2	2	-	1	1	-	1	1	11
Grand total		12	7	9	19	13	7	6	9	12	8	12	11	125

Table 11.66: The annual number of events by dominating criterion from 2020–2024 for Freq (Nordic).

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents leading to frequency degradation (F0)	62	70	53	88	114
Scale 1	Incidents leading to frequency degradation (F1)	4	3	1	-	11
Grand total		66	73	54	88	125

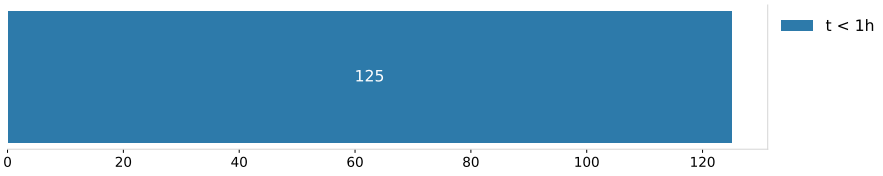

Figure 11.33: Number of events grouped by duration in 2024 for Freq (Nordic).

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11.2.4 Events reported by Statnett

This section presents events for Statnett, the TSO in Norway. Table 11.67 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.68 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.34 presents the number of events grouped by duration in 2024.

Table 11.67: Monthly distribution of events by dominating criterion in 2024 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)	-	2	-	-	-	-	-	-	-	-	-	-	2
	Incidents on network elements (T0)	1	4	1	3	-	2	-	1	2	1	2	3	20
	Separation from the grid (RS0)	-	2	-	1	-	2	-	-	1	-	1	-	7
Scale 1	Incidents on network elements (T1)	-	1	1	-	1	1	1	2	2	1	2	-	12
	Violation of standards on voltage (OV1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand total		1	9	2	4	1	6	1	3	5	2	5	3	42

Table 11.68: The annual number of events by dominating criterion from 2020–2024 for Statnett.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	-	3	1	6	2
	Incidents on network elements (T0)	14	18	33	24	20
	Incidents on power generating facilities (G0)	2	2	3	2	-
	Separation from the grid (RS0)	-	2	2	1	7
	Violation of standards on voltage (OV0)	-	-	-	1	-
	Loss of tools, means and facilities (LT0)	1	-	-	2	-
Scale 1	Incidents on load (L1)	1	-	2	-	-
	Incidents on network elements (T1)	4	2	1	3	12
	N-1 violation (ON1)	-	-	1	-	-
	Separation from the grid (RS1)	-	1	1	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	-	1	-
Grand total		22	28	44	40	42

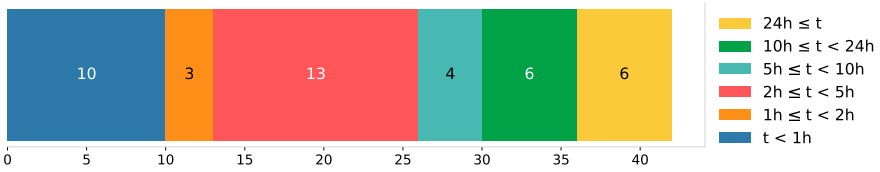

Figure 11.34: Number of events grouped by duration in 2024 for Statnett.

11.2.5 Events reported by Svenska kraftnät

This section presents events for Svenska Kraftnät, the TSO in Sweden. Table 11.69 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.70 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.35 presents the number of events grouped by duration in 2024.

As can be seen, the number of reported violations of standards on voltage has increased significantly in Sweden. The increase is due to improved IT tools to track and report voltage violations as of 2024. Most voltage deviations occurred in individual stations when there was insufficient reactive power for voltage control during planned outages or low network loading. These factors can lead to overvoltages at certain stations when the grid is lightly loaded or when power-flow directions change compared to the historical norm. Northward flows emerged during periods of high solar and wind power generation on the continent - this is a relatively new operating condition for the Swedish system.

Svenska kraftnät has several planned measures to mitigate voltage issues:

1. Expansion of Reactive Compensation. Contracts have been signed for up to 52 new shunt reactors through 2032.
2. New STATCOM Facilities. Projects are underway to install STATCOM units in three substations.
3. Tighter Connection Requirements. Stricter requirements for connected RES to actively provide voltage support rather than operating at a unity power factor.
4. New Tariff Components. A reactive power charge is planned for the transmission tariff to incentivize both network operators and producers to maintain proper voltage and reactive levels (implementation targeted for 2026/2027).
5. Penalty Fees. A proposed sanction fee will apply to grid customers that fail to meet reactive power and voltage obligations in their connection agreements.
6. Further Method Development. Enhanced data collection, key metrics, and methods to identify where additional voltage-support investments are needed, as well as tracking reactive power exchange among connected parties.

Taken together, these measures aim to add reactive compensation equipment in the transmission system, tighten connection rules for RES, and develop a pricing/tariff structure that rewards proactive voltage control.

Table 11.69: Monthly distribution of events by dominating criterion in 2024 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)	4	4	6	2	8	5	3	2	7	1	-	1	43
	Incidents on power generating facilities (G0)	-	-	-	-	-	1	-	-	2	-	-	-	3
	Violation of standards on voltage (OV0)	512	303	362	413	634	553	487	455	430	390	314	582	5435
	Loss of tools, means and facilities (LT0)	3	-	1	-	3	2	-	2	3	2	1	2	19
Scale 1	N-1 violation (ON1)	3	1	1	1	4	2	-	1	-	-	4	1	18
	Violation of standards on voltage (OV1)	156	101	116	164	217	186	225	190	171	177	125	245	2073
	Reduction of reserve capacity (RRC1)	-	3	-	4	-	-	-	-	-	-	-	-	7
	Loss of tools, means and facilities (LT1)	-	2	-	-	4	1	-	-	-	-	-	1	8
Grand total		678	414	486	584	870	750	715	650	613	570	444	832	7606

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Table 11.70: The annual number of events by dominating criterion from 2020–2024 for Svenska kraftnät.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	40	56	54	53	43
	Incidents on power generating facilities (G0)	2	13	9	13	3
	Violation of standards on voltage (OV0)	-	-	-	-	5435
	Loss of tools, means and facilities (LT0)	9	21	3	12	19
Scale 1	Incidents on network elements (T1)	1	1	1	-	-
	N-1 violation (ON1)	-	-	-	-	18
	Violation of standards on voltage (OV1)	-	-	-	-	2073
	Reduction of reserve capacity (RRC1)	-	-	-	-	7
	Loss of tools, means and facilities (LT1)	4	1	-	-	8
Grand total		56	92	67	78	7606

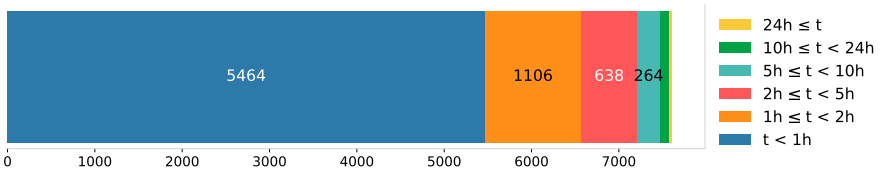

Figure 11.35: Number of events grouped by duration in 2024 for Svenska kraftnät.

11.3 Overview of events per TSOs in Baltic

11.3.1 Events reported by AST

This section presents events for AS Augstsprieguma tikls (AST), the TSO in Latvia. Table 11.69 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.70 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.35 presents the number of events grouped by duration in 2024.

Table 11.71: Monthly distribution of events by dominating criterion in 2024 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	-	3	-	-	-	1	1	6
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	1	-	-	-	-	-	1
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	-	1	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	1	-	-	-	-	-	-	-	-	-	1
Grand total		-	-	1	-	1	-	4	-	1	-	1	1	9

Table 11.72: The annual number of events by dominating criterion from 2020–2024 for AST.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	4	6	5	6	6
	Incidents on power generating facilities (G0)	-	1	1	-	1
Scale 1	Incidents on power generating facilities (G1)	1	-	-	-	-
	N-1 violation (ON1)	1	-	-	-	1
	Violation of standards on voltage (OV1)	1	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	1
Scale 2	Incidents on load (L2)	2	-	-	-	-
Grand total		9	7	6	6	9

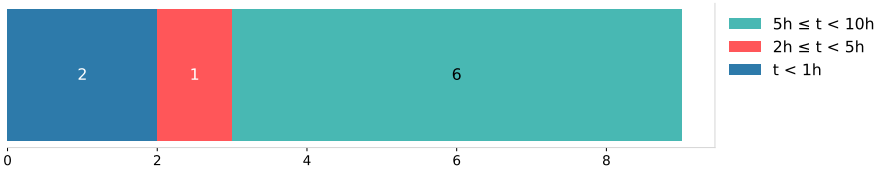

Figure 11.36: Number of events grouped by duration in 2024 for AST.

11.3.2 Events reported by Elering

This section presents events for Elering, the TSO in Estonia. Table 11.75 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.76 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.38 presents the number of events grouped by duration in 2024.

Table 11.73: Monthly distribution of events by dominating criterion in 2024 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	-	1	3	-	1	-	2	-	-	1	1	11
	Incidents on power generating facilities (G0)	-	1	-	-	-	-	2	-	2	2	-	3	10
Scale 1	Loss of tools, means and facilities (LT1)	-	-	1	-	-	-	-	-	-	-	-	-	1
Grand total		2	1	2	3	-	1	2	2	2	2	1	4	22

Table 11.74: The annual number of events by dominating criterion from 2020–2024 for Elering.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	7	8	16	11	11
	Incidents on power generating facilities (G0)	23	15	16	9	10
Scale 1	Loss of tools, means and facilities (LT1)	-	-	-	-	1
Grand total		30	23	32	20	22

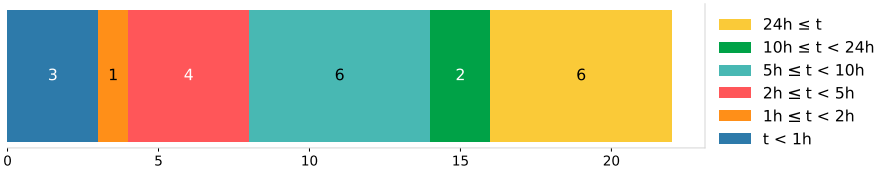

Figure 11.37: Number of events grouped by duration in 2024 for Elering.

11.3.3 Events reported by Litgrid

This section presents events for Litgrid AB, the TSO in Lithuania. Table 11.77 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.78 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.39 presents the number of events grouped by duration in 2024.

Table 11.75: Monthly distribution of events by dominating criterion in 2024 for Litgrid.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	1	1	2	5	2	2	2	-	2	1	18
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	1	-	-	-	-	1
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand total		-	-	1	1	2	5	2	3	3	-	2	1	20

Table 11.76: The annual number of events by dominating criterion from 2020–2024 for Litgrid.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	8	5	6	9	18
	Incidents on power generating facilities (G0)	3	-	1	-	1
	Loss of tools, means and facilities (LT0)	-	1	-	-	-
Scale 1	Incidents on load (L1)	2	-	-	-	-
	Incidents on network elements (T1)	4	6	6	1	-
	N-1 violation (ON1)	-	-	-	-	1
Grand total		17	12	13	10	20

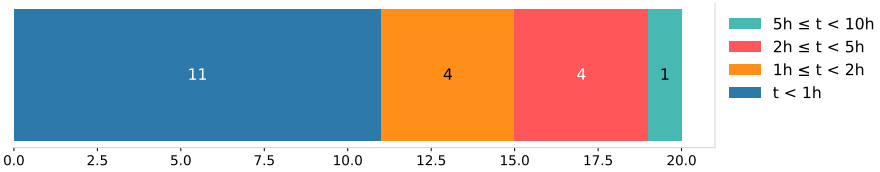

Figure 11.38: Number of events grouped by duration in 2024 for Litgrid.

11.4 Overview of events per TSOs in Ireland and Northern Ireland

11.4.1 Events reported by EirGrid

This section presents events for EirGrid, the TSO in Ireland. Table 11.79 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.80 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.40 presents the number of events grouped by duration in 2024.

Table 11.77: Monthly distribution of events by dominating criterion in 2024 for EirGrid.

Scale	Main event ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	2	-	1	2	1	2	1	3	1	1	14
	Incidents on power generating facilities (G0)	1	1	-	1	1	1	2	1	1	1	2	-	12
	Loss of tools, means and facilities (LT0)	-	2	-	1	-	-	1	1	-	-	-	1	6
Grand total		1	3	2	2	2	3	4	4	2	4	3	2	32

Table 11.78: The annual number of events by dominating criterion from 2020–2024 for EirGrid.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	6	8	16	4	14
	Incidents on power generating facilities (G0)	19	14	12	13	12
	Loss of tools, means and facilities (LT0)	-	-	-	-	6
Scale 1	N-1 violation (ON1)	3	7	8	-	-
Grand total		28	29	36	17	32

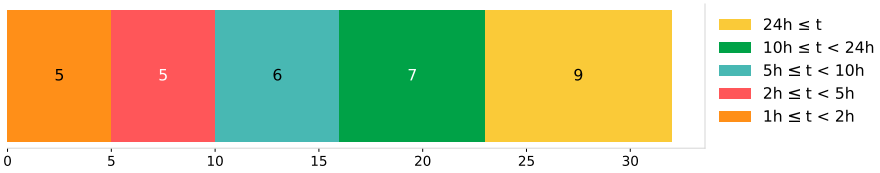

Figure 11.39: Number of events grouped by duration in 2024 for EirGrid.

11.4.2 Events reported by SONI

This section presents events for SONI, the TSO in Northern Ireland. Table 11.81 presents the monthly distribution of ICS events by ICS criterion in 2024, and Table 11.82 presents the annual number of ICS events by ICS criterion from 2020–2024. Figure 11.41 presents the number of events grouped by duration in 2024.

Table 11.79: Monthly distribution of events by dominating criterion in 2024 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	1	1	1	1	-	6
	Incidents on power generating facilities (G0)	-	-	1	2	1	-	2	-	-	-	1	-	7
Grand total		-	-	1	2	2	-	3	1	1	1	2	-	13

Table 11.80: The annual number of events by dominating criterion from 2020–2024 for SONI.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on network elements (T0)	2	3	2	1	6
	Incidents on power generating facilities (G0)	-	-	3	-	7
Scale 1	N-1 violation (ON1)	-	1	-	-	-
Grand total		2	4	5	1	13

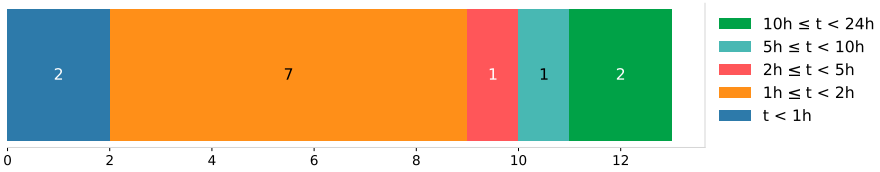

Figure 11.40: Number of events grouped by duration in 2024 for SONI.

11.5 Overview of events per TSOs in Isolated system

11.5.1 Events reported by Landsnet

This section presents events for Landsnet, the TSO in Iceland. ?? presents the monthly distribution of ICS events by ICS criterion in 2022, and ?? presents the annual number of ICS events by ICS criterion from 2020–2024. ?? presents the number of events grouped by duration in 2024.

Table 11.81: Monthly distribution of events by dominating criterion in 2024 for Landsnet.

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	4	12
	Incidents on power generating facilities (G0)	-	-	-	1	-	-	1	-	-	-	-	-	2
Scale 1	Incidents on power generating facilities (G1)	1	-	-	-	-	-	-	-	-	-	1	-	2
Grand total		3	2	1	1	-	-	1	1	-	1	2	4	16

Table 11.82: The annual number of events by dominating criterion from 2020–2024 for Landsnet.

Scale	Main event ICS criterion	2020	2021	2022	2023	2024
Scale 0	Incidents on load (L0)	-	-	6	1	-
	Incidents on network elements (T0)	29	26	29	12	12
	Incidents on power generating facilities (G0)	3	-	-	-	2
	Loss of tools, means and facilities (LT0)	1	-	1	-	-
Scale 1	Incidents on load (L1)	1	-	-	-	-
	Incidents on network elements (T1)	12	1	2	1	-
	Incidents on power generating facilities (G1)	-	2	-	-	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		46	30	42	15	16

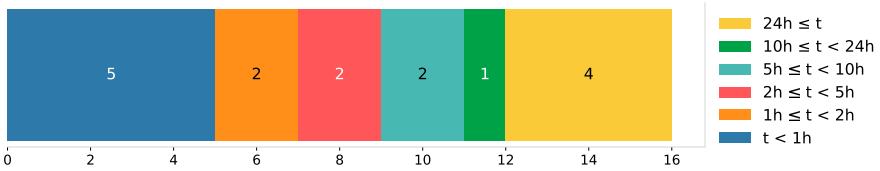

Figure 11.41: Number of events grouped by duration in 2024 for Landsnet.

12 Conclusion

The 2024 ICS Annual Report follows the 2019 version ICS Methodology [2]. The included ENTSO-E Members and Observer Members reported a total of 11,751 ICS incidents in 2024, of which 8496 were scale 0, 3254 were scale 1 and none were scale 2, and one scale 3 incident. There were 141 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 one occurrence of an ICS criteria violation, while ICS incident groups all related criteria violations into one incident.

Approximately 33% of all ICS events took place in CE, and 66% of all ICS events in the Nordics. One scale 3 incident occurred in 2024. It occurred in Continental Europe and resulted in 27 scale 2 violations and three scale 3 violations for the involved TSOs. More details on the scale 3 incident can be read in Chapter 4.

The number of reported ICS incidents in 2024 increased substantially compared to 2023. The increase is mainly due to the increased number of reported incidents by Svenska kraftnät. In addition to observing more voltage violations, the data collection process was more automated. Measures have been put in place to negate voltage issues, but it should also be noted that the voltage standards in the Nordics are stricter than in Continental Europe. The voltage thresholds are presented in detail in the ICS methodology on pages 20 to 22. Further details of the measures Svenska kraftnät has put in place can be read in chapter 11.2.5.

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 (OV). A significant part of the increases are due to improved reporting tools and processes.

WG ICS notes that many TSOs are facing increasing difficulties to cope with high-voltage situations. Furthermore, WG ICS highlights that it is important for the system security that TSOs continue to implement measures addressing the voltage violations, also in a coordinated approach at regional level.

WG ICS will continue to improve and harmonise available tools and processes to register ICS incidents for the European TSOs. High-quality reporting of voltage violations is important so coordinated and efficient preventive and mitigating actions can be taken.

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References

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

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[3] WG Annual Load-Frequency Control, "Annual Load-Frequency Control Reports." https://www.entsoe.eu/network_codes/sys-ops/annual-reports/, September 2025.

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[5] ICS Investigation Expert Panel, "Grid Incident in South-East Europe on 21 June 2024." https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/Publications/2024/entso-e_incident_report_240621_250225_02.pdf, February 2025.

[6] European Commission, "COMMISSION REGULATION (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation." https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R1485, Aug 2017. [Online; accessed 05.01.2019].

[7] ENTSO-E, "ENTSO-E Transparency Platform." https://transparency.entsoe.eu/, December 2025.

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