European Network of Transmission System Operators for Electricity

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2020 Incident Classification Scale Annual Report

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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.

Table of Contents

List of Figures

List of Tables

1 Introduction

The 2020 Incident Classification Scale Annual Report is prepared according to the Incident Classification Scale Methodology [1] 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) [2, p. 19]. The latest ICS Methodology [1] was approved on 4 December 2019, and was used for the first time in the 2020 ICS Annual Report.

The Incident Classification Scale aims to:

- Provide an overview of operational security indicators specified in Article 15 of SOGL [2, p. 19].
- Identify any improvements necessary to support sustainable and long-term operational security.
- Identify any appropriate improvements to network operation tools required to maintain operational security and related to real-time operation and operational planning to support TSOs in their task identified in Article 55(e) of SOGL [2, p. 42].
- Provide explanations for the reasons behind incidents at the operational security ranking scales 2 and 3 as per the incident classification scale adopted by ENTSO for Electricity; those explanations are based on an investigation of the incidents by TSOs. The process of this investigation is set out in the Incident Classification Scale (ICS) Methodology [1, Ch. 6].

The Annual Report aggregates data prepared by each transmission system operator (TSO) at the synchronous area level and provides a high-level summary of scale 0 and scale 1 incidents and a detailed review of scale 2 and scale 3 incidents at a synchronous area level.

The 2020 Annual Report of the Incident Classification Scale covers incident reports from all of ENTSO-E's full members. Amprion provided information about incidents leading to frequency degradation in continental Europe for odd months and Swissgrid provided information for even months.

The Incident Classification Scale Methodology [1] has been updated several times since its creation in 2012 [3]. The latest changes made in 2018 and 2019 are presented in Section 2.1.

2 Incident Classification Scale

The criteria for incident classification are defined by using definitions from the Commission Regulation (EU) establishing a guideline on electricity transmission system operation (SOGL) [2] and IEC standards. Each criterion factually describes an incident or an observable situation.

Only significant incidents are recorded and classified according to a scale based on severity. Therefore, this report is not a compilation of all the incidents that occurred in 2020 but rather those that meet the criteria of the Incident Classification Scale Methodology [1].

The Incident Classification Scale (ICS) has 4 levels of increasing severity, ranging from noteworthy incidents up to significant or widespread incidents. System events which are not classified as incidents are recorded in a 'Below Scale' category. The severity levels are compliant with the system state definitions listed in the Commission Regulation (EU) 2017/1485 of 2 August 2017 [2]. 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 probability of wide area incident – the system is in an emergency state.
- Scale 3, for major incidents in the control area of a single transmission system operator – 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: The 'Below Scale' level has been added to report events that are needed to calculate operational security indicators that are relevant to operational security but these events are not included in the ICS scales of 0, 1, 2 and 3. These events are considered anomalies. 'Below Scale' only exists for reporting of violations of standards of voltage, incidents on power generating facilities and incidents leading to frequency degradation. For all other criteria the ICS scales of 0, 1, 2 and 3 are sufficient to calculate the operational security indicators

2.1 Changes in the Incident Classification Scale Methodology

The current ICS Methodology has been updated several times since its introduction. The latest update in 2019 [1] 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 is the 2020 ICS Annual Report.

The Methodology was also updated in 2018 [4] to align it with the requirements of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SOGL) [2]. The update refined definitions and thresholds to improve overall data quality, make the results comparable between synchronous areas and TSOs, improve analyses, and identify system operations improvements.

The updates made in 2018 and 2019 are described below. Each update has significantly changed the reported data. Therefore, the results gathered after each update cannot be directly compared to those from previous years.

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

ICS Methodology 2019 criteria updates

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

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

New ICS criteria

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

Incidents leading to frequency degradation (F)

The time thresholds for incidents leading to frequency degradation were changed. Scale 0 threshold times where increased by 2–4 minutes and scale 2 threshold times were added as they did not exist before. A below scale level was added to collect short frequency deviations between 0–5 minutes, which would have been scale 0 events previously. See the Incident Classification Scale Methodology for further details [1, p. 10].

Incidents on transmission network elements (T)

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

Violation on standards on voltage (OV)

All thresholds for violations on standards on voltage (OV) were revised. Prior to 2020, only voltage deviations longer than 30 minutes were registered. As of 2020, voltage deviations may already be registered after 5 minutes, or 30 seconds if they are major. See the Incident Classification Scale Methodology for further details [1, p. 18].

Reduction of reserve capacity (RRC)

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

ICS Methodology 2019 security indicator updates

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

ICS Methodology 2018 criteria updates

Incidents leading to frequency degradation (F)

The "Alert State Trigger Time" of an incident was removed in favour of defining duration thresholds for different frequency deviation magnitudes. For example, as of 2018, a scale 0 frequency incident in continental Europe requires either a frequency deviation of 50–100 mHz that lasts 3–15 minutes, or a frequency deviation of 100–200 mHz that lasts 0–5 minutes. Prior to 2018, frequency deviations had to last for at least 5 minutes to be categorised.

Incidents on transmission network elements (T)

The scale 0 threshold was updated to register all final trips of transmission network elements without any other ICS violations. The scale 1 threshold was changed to register only final trips of transmission network elements that trigger an N-1 violation. In addition, the 220–330 kV voltage range was added to the report; before 2018, only the 380–420 kV and 220 kV cross-border connections were included.

N and N-1 violations:

N-1 violations (ON1) without consequences to neighbouring TSOs were not to be registered anymore.

Loss of tools and facilities (LT)

Scale 0 incidents (LT0) were added to the Incident Classification Scale criteria.

Violations of standards on voltage (OV)

The time duration for an OV incident was increased to 30 minutes, and the criteria changed so that scale 0 incidents have a voltage violation in only one substation; a scale 1 incident involves more than one substation but only one TSO, and a scale 2 incident involves more than one substation and more than one TSO. Also, the exclusion of voltage violations exceeding 0.9–1.1 pu in the 300–400 kV range was removed.

ICS Methodology 2018 security indicator updates

Three new operational security indicators relevant to operational security were created, and three others were renamed in the 2018 ICS Methodology update. The changes were as follows:

- OS-D became OS-D1, and OS-D2 was created to calculate the number of individual OS-D1 occurrences.
- OS-E became OS-E1, and OS-E2 was created to calculate the number of individual OS-E1 occurrences.
- OS-F became OS-F2, and OS-F1 was created to calculate the time duration of all OS-F2 occurrences per TSO.

3 Pan-European Overview

According to data from the ENTSO-E Transparency Platform [5], the trend towards less dispatchable capacity continued in 2019 as renewable energy sources increased in importance. The overall generation capacity changed by +2.5 %.

The contribution to the overall change in generation capacity by dispatchable and non-dispatchable generation capacity was +0.13 % and +7.77 %, respectively. However, comparability between years is limited due to missing data from a few data providers. The analyses of installed capacity and load were completed with data as of 1 July 2021; values from previous years were used to fill in for missing values of the installed capacity.

Nevertheless, it can be concluded that consumption increased by 3.54 % from the load data on the ENTSO-E Transparency Platform mainly due to the COVID-19-lockdowns across Europe.

Due to the recent decommissioning of the statistical data collection 'Power Statistics' [6] by ENTSO-E, there is no readily available central data collection point for consumption and circuit length data.

According to the Copernicus project [7], 2020 was the warmest year in Europe on record with an exceptionally warm winter (3.4 °C above average) and several episodes of heat. Flooding due to storms affected the Mediterranean.

3.1 Number of classified events and incidents

This section presents the number of ICS events and ICS incidents that meet the ICS criteria. The numbers are shown per synchronous area and TSO and are distributed by scale or ICS criterion. The term ICS event is different from ICS incident, insofar as one incident may contain multiple events, that is, conditions that meet the ICS criteria thresholds. The ICS criteria used in this report are presented in Table 2.1.

As shown in Table 3.1, TSOs reported 2 846 ICS events in 2020; of which 2 517 were scale 0, 328 were scale 1, and one was scale 2. No scale 3 events were reported. The percentage distribution of scales 0, 1 and 2 ICS events were 88.4 %, 11.5 % and 0.0004 %, respectively. There were 106 more ICS events than ICS incidents. Of these, 94 were scale 0 events and 12 were scale 1 incidents. The similar number of ICS events and ICS incidents in the pan-European transmission grids indicates that most ICS incidents only had one ICS event.

Table 3.3 presents the total number of events per synchronous area and scale in 2020. Table 3.2 presents the same information but for incidents. Table 3.5 shows the percentage distribution of events meeting the ICS criteria in the pan-European power grid. Table 3.4 presents the same information but for incidents. Approximately 80 % of all events, as well as incidents, occurred in continental Europe. The high percentage is due to the significantly larger synchronous area in continental Europe than the others. However, it should be noted that in smaller synchronous areas, single incidents can have a disproportionate effect on the percentage distributions, since the total number of incidents within them is small. To allow for better comparisons, Section 3.2 presents these numbers normalised by consumption and circuit length in each region.

Table 3.7 shows the number of events per TSO and scale. Incidents classified as scale 0 and scale 1 are widely distributed across most TSOs. There was one scale 2 event in the Baltic area.

Table 3.9 displays the reported ICS events by criteria for each synchronous area. The most frequent events in 2020 were incidents on transmission network elements (T0) with 1 311 events, violations of standards on voltage (OV0) with 421 events, and incidents leading to frequency degradation (F0) with 357 events. A significant portion occurred in continental Europe and Great Britain.

The newly added ICS criteria incidents on load (L0) and reduction of reserve capacity (RRC0) were reported three times and zero times, respectively.

Although continental Europe, the Nordic synchronous area, and Great Britain reported 293, 62 and 2 events leading to frequency degradation (F0), respectively, this type of incident was not reported in the Baltic area nor the isolated systems.

Violations of standards on voltage (OV0 and OV1), reductions of reserve capacity (RRC1), and N violations (ON1) are mainly reported in continental Europe. Furthermore, loss of tools, means and facilities (LT) are mainly seen in continental Europe and Great Britain. TSOs in continental Europe and Great Britain would be advised to investigate the reasons behind this. On the other hand, LT and OV incidents have mostly local (TSO control area) consequences.

There were no scale 3 events in the ENTSO-E area in 2020. The responsible TSO for events leading to frequency degra-

dation (F0 and F1) is marked in most cases as 'Freq (CE)' in continental Europe 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 business hours.

Table 3.1: Number of ICS incidents and ICS events per scale in 2020 and their percentage (%) distribution. An ICS event is different from ICS incident, since an incident aggregates all related events, with the ICS criteria set to the event with the highest priority according to Table 2.1.

	Number of incidents	Percentage of total	Number of events	Percentage of total
Scale 0	2 423	88.4%	2 517	88.4%
Scale 1	316	11.5%	328	11.5%
Scale 2	1	0.0%	1	0.0%
Scale 3	0	0.0%	0	0.0%
Grand Total	2 740	100.0%	2 846	100.0%

Table 3.2: Number of ICS incidents per scale and synchronous area in 2020.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	44	5	1	-	50
Continental Europe	1 919	279	-	-	2 198
Great Britain	258	1	-	-	259
Ireland	27	3	-	-	30
Isolated systems	33	13	-	-	46
Nordic	142	15	-	-	157
Grand Total	2 423	316	1	-	2 740

Table 3.3: Number of ICS events per scale and synchronous area in 2020.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	46	9	1	-	56
Continental Europe	2 002	285	-	-	2 287
Great Britain	259	1	-	-	260
Ireland	27	3	-	-	30
Isolated systems	33	13	-	-	46
Nordic	150	17	-	-	167
Grand Total	2 517	328	1	-	2 846

Table 3.4: Percentage distribution of ICS incidents per scale and synchronous area in 2020.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	88.0%	10.0%	2.0%	-
Continental Europe	87.3%	12.7%	-	-
Great Britain	99.6%	0.4%	-	-
Ireland	90.0%	10.0%	-	-
Isolated systems	71.7%	28.3%	-	-
Nordic	90.4%	9.6%	-	-
Grand Total	88.4%	11.5%	0.0%	-

Table 3.5: Percentage distribution of ICS events per scale and synchronous area in 2020.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	82.1%	16.1%	1.8%	-
Continental Europe	87.5%	12.5%	-	-
Great Britain	99.6%	0.4%	-	-
Ireland	90.0%	10.0%	-	-
Isolated systems	71.7%	28.3%	-	-
Nordic	89.8%	10.2%	-	-
Grand Total	88.4%	11.5%	0.0%	-

Table 3.6: Number of ICS incidents per scale for each TSO in the pan-European transmission grid in 2020. An ICS event is different from ICS incident, since an incident aggregates all related events, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	AST	4	-	1	-	5
	Elering AS	29	-	-	-	29
	Litgrid AB	11	5	-	-	16
	Total	44	5	1	-	50
Continental Europe	50Hertz	40	9	-	-	49
	Amprion	47	4	-	-	51
	APG	25	5	-	-	30
	CEPS	22	12	-	-	34
	CGES	-	-	-	-	-
	ELES	-	9	-	-	9
	Elia	17	7	-	-	24
	EMS JSC	24	4	-	-	28
	Energinet (CE)	17	1	-	-	18
	ESO EAD	40	-	-	-	40
	HOPS	24	-	-	-	24
	IPTO	37	27	-	-	64
	MAVIR ZRt	288	63	-	-	351
	MEPSO	-	-	-	-	-
	NOS BiH	27	-	-	-	27
	PSE	90	1	-	-	91
	REE	234	1	-	-	235
	REN	13	-	-	-	13
	RTE	199	51	-	-	250
	SEPS	32	13	-	-	45
	Swissgrid	132	32	-	-	164
	TenneT TSO B.V.	68	2	-	-	70
	TenneT TSO GmbH	61	8	-	-	69
	TERNA	66	-	-	-	66
	Transelectrica	86	24	-	-	110
	TransnetBW GmbH	37	3	-	-	40
	Freq (CE)	293	3	-	-	296
	Total	1 919	279	-	-	2 198
Great Britain	National Grid ESO	258	1	-	-	259
	Total	258	1	-	-	259
Ireland	EirGrid	25	3	-	-	28
	SONI	2	-	-	-	2
	Total	27	3	-	-	30
Isolated systems	Cyprus TSO	-	-	-	-	-
	Landsnet	33	13	-	-	46
	Total	33	13	-	-	46
Nordic	Energinet (Nordic)	11	3	-	-	14
	Fingrid Oyj	5	-	-	-	5
	Statnett	13	3	-	-	16
	Svenska kraftnät	51	5	-	-	56
	Freq (Nordic)	62	4	-	-	66
	Total	142	15	-	-	157
Grand Total		2 423	316	1	-	2 740

Table 3.7: Number of ICS events per scale for each TSO in the pan-European transmission grid in 2020. An ICS event is different from ICS incident, since an incident aggregates all related events, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	AST	4	4	1	-	9
	Elering AS	30	-	-	-	30
	Litgrid AB	12	5	-	-	17
	Total	46	9	1	-	56
Continental Europe	50Hertz	40	9	-	-	49
	Amprion	47	4	-	-	51
	APG	25	5	-	-	30
	CEPS	25	13	-	-	38
	CGES	-	-	-	-	-
	ELES	-	9	-	-	9
	Elia	17	7	-	-	24
	EMS JSC	24	5	-	-	29
	Energinet (CE)	18	1	-	-	19
	ESO EAD	40	-	-	-	40
	HOPS	32	-	-	-	32
	IPTO	37	27	-	-	64
	MAVIR ZRt	298	63	-	-	361
	MEPSO	-	-	-	-	-
	NOS BiH	27	-	-	-	27
	PSE	91	1	-	-	92
	REE	263	1	-	-	264
	REN	13	-	-	-	13
	RTE	203	51	-	-	254
	SEPS	53	16	-	-	69
	Swissgrid	132	33	-	-	165
	TenneT TSO B.V.	68	2	-	-	70
	TenneT TSO GmbH	61	8	-	-	69
	TERNA	66	-	-	-	66
	Transelectrica	89	24	-	-	113
	TransnetBW GmbH	37	3	-	-	40
	Freq (CE)	296	3	-	-	299
	Total	2 002	285	-	-	2 287
Great Britain	National Grid ESO	259	1	-	-	260
	Total	259	1	-	-	260
Ireland	EirGrid	25	3	-	-	28
	SONI	2	-	-	-	2
	Total	27	3	-	-	30
Isolated systems	Cyprus TSO	-	-	-	-	-
	Landsnet	33	13	-	-	46
	Total	33	13	-	-	46
Nordic	Energinet (Nordic)	15	3	-	-	18
	Fingrid Oyj	5	-	-	-	5
	Statnett	17	5	-	-	22
	Freq (Nordic)	62	4	-	-	66
	Svenska kraftnät	51	5	-	-	56
	Total	150	17	-	-	167
Grand Total		2 517	328	1	-	2 846

Table 3.8: ICS incidents by dominating criteria for each synchronous in 2020. An ICS event is different from ICS incident, since an incident aggregates all related events, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	-	293	2	-	-	62	357
	Incidents on load (L0)	-	3	-	-	-	-	3
	Incidents on network elements (T0)	18	1 024	168	8	29	65	1 312
	Incidents on power generating facilities (G0)	26	79	12	19	3	5	144
	Loss of tools, means and facilities (LT0)	-	98	76	-	1	10	185
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-
	Separation from the grid (RS0)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	422	-	-	-	-	422
	Total	44	1 919	258	27	33	142	2 423
Scale 1	Incidents leading to frequency degradation (F1)	-	3	-	-	-	4	7
	Incidents on load (L1)	1	6	-	-	1	1	9
	Incidents on network elements (T1)	4	11	-	-	12	3	30
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	23	1	-	-	6	30
	N-1 violation (ON1)	-	54	-	3	-	-	57
	Reduction of reserve capacity (RRC1)	-	66	-	-	-	-	66
	Separation from the grid (RS1)	-	-	-	-	-	1	1
	Violation of standards on voltage (OV1)	-	116	-	-	-	-	116
	Total	5	279	1	3	13	15	316
Scale 2	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-
	Incidents on load (L2)	1	-	-	-	-	-	1
	Incidents on network elements (T2)	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-
	Total	1	-	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-
Grand Total		50	2 198	259	30	46	157	2 740

Table 3.9: ICS events by ICS criteria for each synchronous in 2020.

Scale	ICS criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	-	296	2	-	-	62	360
	Incidents on load (L0)	-	4	-	-	-	-	4
	Incidents on network elements (T0)	20	1 063	169	8	29	73	1 362
	Incidents on power generating facilities (G0)	26	81	12	19	3	5	146
	Loss of tools, means and facilities (LT0)	-	102	76	-	1	10	189
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-
	Separation from the grid (RS0)	-	2	-	-	-	-	2
	Violation of standards on voltage (OV0)	-	454	-	-	-	-	454
	Total	46	2 002	259	27	33	150	2 517
Scale 1	Incidents leading to frequency degradation (F1)	-	3	-	-	-	4	7
	Incidents on load (L1)	1	6	-	-	1	1	9
	Incidents on network elements (T1)	5	15	-	-	12	3	35
	Incidents on power generating facilities (G1)	1	-	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	23	1	-	-	6	30
	N-1 violation (ON1)	1	56	-	3	-	2	62
	Reduction of reserve capacity (RRC1)	-	66	-	-	-	-	66
	Separation from the grid (RS1)	-	-	-	-	-	1	1
	Violation of standards on voltage (OV1)	1	116	-	-	-	-	117
	Total	9	285	1	3	13	17	328
Scale 2	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-
	Incidents on load (L2)	1	-	-	-	-	-	1
	Incidents on network elements (T2)	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-
	Total	1	-	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-
Grand Total		56	2 287	260	30	46	167	2 846

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 2020.

The data concerning circuit length and energy consumption until 2018 is based on the discontinued ENTSO-E statistical data [6]. The consumption and circuit length after 2018 has been gathered directly from the TSOs. When updated data could not be retrieved, the value of the previous year was 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 2020 per consumption, the Baltic area has the highest value, at 1.7 ICS event per TWh of consumption, while the Nordic synchronous area has the lowest value, at 0.4 events per TWh of consumption. For scale 1, the minimum value is 0.004 events per TWh in Great Britain, and the maximum value is 0.55 events per TWh in the isolated systems. While the number of scale 2 events per TWh of consumption is marginal compared to the scale 0 and scale 1 events.

When the number of scale 0–3 events in 2020 is nor-

malised by circuit length, all synchronous areas except isolated systems had fewer than 1 event per 100 km of circuit length, even though Great Britain has only slightly fewer with 0.97 events per 100 km of circuit. Most of the events were of scale 0, and no more than 0.1 scale 1 events per 100 km of circuit are recorded in any synchronous area except for isolated systems, where there were 0.4 scale 1 events per 100 km. In short, most of the events were of scale 0 and did not degrade the normal operating conditions.

Incidents on transmission network elements (T0 and T1) caused a large part of the events in the transmission grid in 2020, which can be seen in the similarities between Figure 3.2 and Figure 3.3. Finally, it should be noted that TSOs may include only certain voltage level ranges in their circuit length calculations. For example, one TSO may include the whole 100–420 kV voltage range while another TSO uses only the 220–420 kV voltage range. The included voltage range depends usually of which voltage ranges the TSO owns or controls.

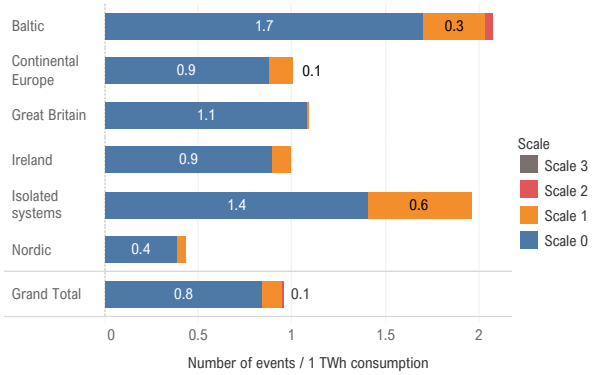

Figure 3.1: Number of ICS events per TWh of energy consumption in 2020.

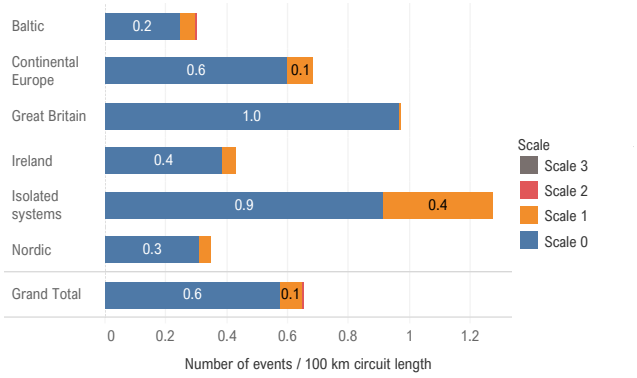

Figure 3.2: Number of ICS events per 100 km of circuit length in 2020.

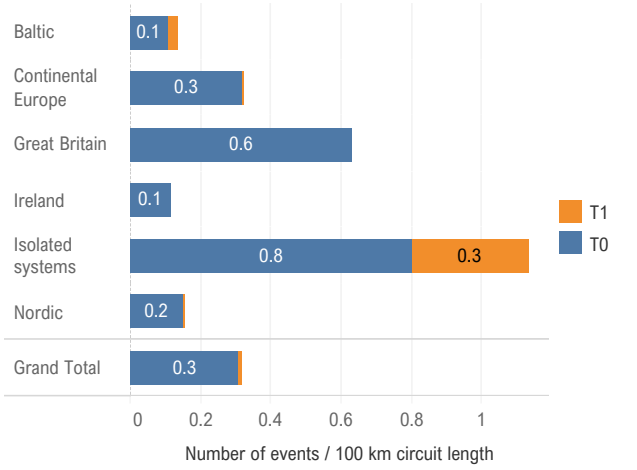

Figure 3.3: Number of ICS events on transmission network elements (T0 and T1) per 100 km of circuit length in 2020.

3.3 Evolution 2016–2020

This section presents classified events according to the Incident Classification Scale Methodology [1] as it developed between 2016–2020. Additionally, a detailed view of the ICS criteria F, T, G, OV, RRC, LT and ON is set forth in Sections 3.3.1–3.3.7.

It should be noted that the 2015–2017 data were reported according to the 2014 ICS Methodology [8]. The data for 2018–2019 was reported according to the 2018 Methodology [4], and the data for 2020 was reported according to the Methodology updated in 2019 [1] Therefore, the results for individual years cannot directly be compared. Further, one of the important updates in 2020 was to register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

Furthermore, it should be noted that trends and impacts on the system must be interpreted according to specific considerations due to inherent differences in the way networks have been designed and are operated across separate synchronous areas.

The 2016–2020 events are shown in Figure 3.4 and Figure 3.5. Figure 3.4 presents the annual number of events grouped by scale, and Figure 3.5 shows the annual event scale distribution percentages. Both graphs showing annual per scale values indicate that the number of scale 0 events has increased significantly since 2017. However, rather than representing a substantial increase in events, the greater number of events is a result of the implementation of the updated Incident Classification Scale Method-

ology [4] mentioned above. The increase consists mainly of T0, F0, and OV0 events. A detailed view of these incident categories is presented in Section 3.3.2, Section 3.3.1 and Section 3.3.4, respectively. The decrease of scale 0 events in 2020 compared to 2019 is due to the updated ICS Methodology [1], which included changes such as updated F-criteria thresholds. The scale 0 F-criteria duration threshold was increased from 0 minutes to between 2 and 7 minutes (depending on the synchronous area), and the 'below scale' level was created to capture residual events. Therefore, the number of registered F0 events decreased from 841 in 2019 to 357 in 2020, and the number of below scale F events was reported as 359 in 2020. All 2019 ICS Methodology [1] changes are summarised in Section 2.1.

The number of scale 1 events in 2020 is similar compared to previous years, with 35 events fewer in 2020 than in 2019. Even so, the number of registered single criteria shifted from a considerable amount of F1 events to a considerable amount of OV1 events. The number of reported F1 events decreased by 107 events and the number of reported OV1 events increased by 109.

A detailed view of reported ICS events per TSO is presented in Chapter 12.

Figure 3.6 and Figure 3.7 present the annual number of scale 0 events by consumption and circuit length ratios. All synchronous areas except continental Europe show a slight increase in the number of scale 0 events per consumption, while the respective values scaled to circuit length are lower than the respective per consumption values. One exception is isolated systems, where the number of scale 0 events per 100 km of circuit has increased from 0.3 in 2019 to 0.9 in 2020. The increase is due to the ICS Methodology update in 2020 [1], which added an requirement to also report tripped network elements below 220 kV that are relevant for operational security.

Figure 3.8 and Figure 3.9 present the ratios of the number of scale 1 events to consumption and the number of scale 1 events to length of circuit, respectively. The ratio of scale 1 events to consumption is increasing in the Baltic area and Ireland, stable in continental Europe and Great Britain, and decreasing in the isolated systems and the Nordics.

A detailed view of the annual number of ICS events, grouped by ICS criterion, is shown in Table 3.10, respectively.

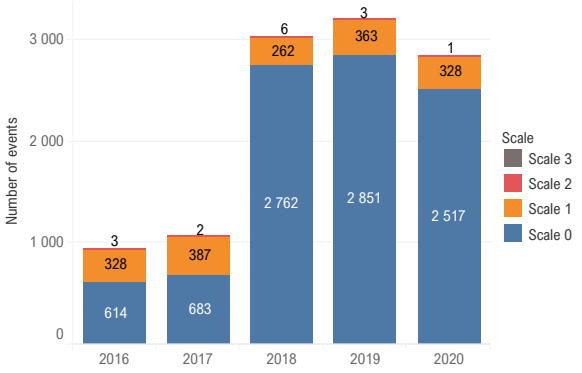

Figure 3.4: The annual number of ICS events per scale from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

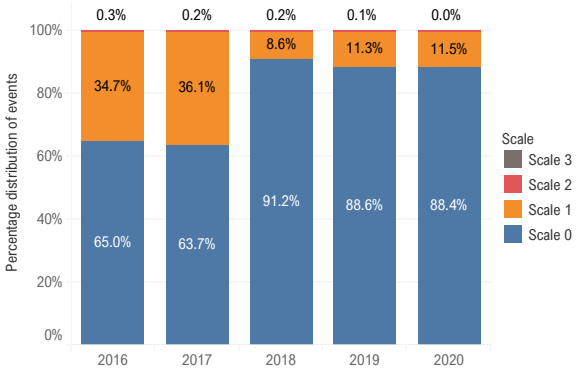

Figure 3.5: The annual percentage distribution of ICS events per scale from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

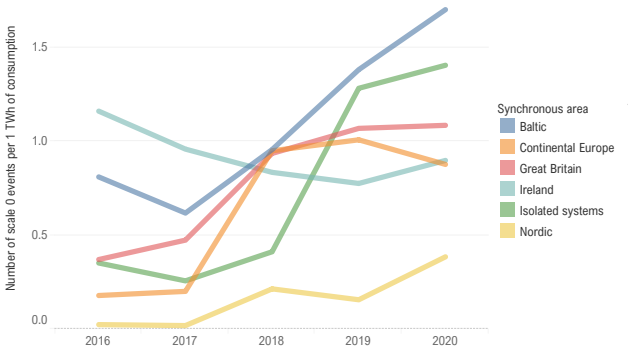

Figure 3.6: The annual number of scale 0 ICS events per TWh of energy consumption from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

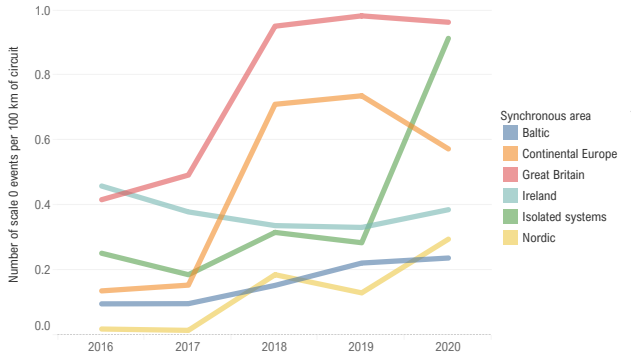

Figure 3.7: The annual number of scale 0 ICS events per 100 km of circuit length from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

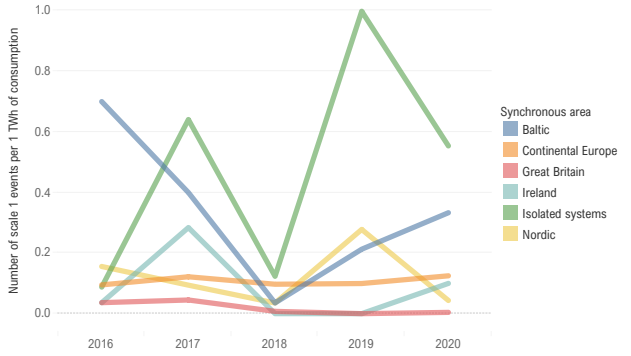

Figure 3.8: The annual number of scale 1 ICS events per TWh of energy consumption from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

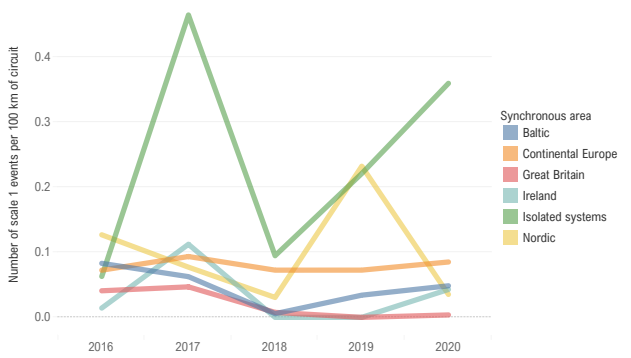

Figure 3.9: The annual number of scale 1 events per 100 km of circuit length from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Table 3.10: The annual number of ICS events per ICS criterion from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	4
	Incidents leading to frequency degradation (F0)	15	11	1 021	841	360
	Incidents on network elements (T0)	467	533	1 144	1 455	1 362
	Incidents on power generating facilities (G0)	110	111	126	119	146
	Separation from the grid (RS0)	-	-	-	-	2
	Violation of standards on voltage (OV0)	20	27	341	286	454
	Reduction of reserve capacity (RRC0)	2	1	-	1	-
	Loss of tools, means and facilities (LT0)	-	-	130	149	189
	Total	614	683	2 762	2 851	2 517
Scale 1	Incidents on load (L1)	6	10	6	4	9
	Incidents leading to frequency degradation (F1)	1	-	10	114	7
	Incidents on network elements (T1)	203	252	15	32	35
	Incidents on power generating facilities (G1)	3	2	-	-	1
	N-1 violation (ON1)	76	66	35	25	62
	Separation from the grid (RS1)	-	-	-	-	1
	Violation of standards on voltage (OV1)	15	21	50	9	117
	Reduction of reserve capacity (RRC1)	1	12	118	161	66
	Loss of tools, means and facilities (LT1)	23	24	28	18	30
	Total	328	387	262	363	328
Scale 2	Incidents on load (L2)	1	2	1	-	1
	Incidents leading to frequency degradation (F2)	-	-	1	1	-
	Incidents on network elements (T2)	-	-	-	1	-
	Incidents on power generating facilities (G2)	1	-	-	-	-
	N violation (ON2)	-	-	3	1	-
	Separation from the grid (RS2)	1	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	1	-	-
	Total	3	2	6	3	1
Scale 3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		945	1 072	3 030	3 217	2 846

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.

Table 3.11 presents the annual number of events leading to frequency degradation for each synchronous area, and Table 3.12 show the same distributed by cause for all synchronous areas combined. Figure 3.10 presents the annual number of F events normalised by the consumption in each synchronous area.

Before 2018, the scale 0 time threshold to report a frequency event was the "alert state trigger time", which was 5 or 10 minutes depending on the synchronous area. This was changed to 0 minutes in 2018, and in 2020 it was increased to 2–7 minutes (depending on the synchronous area magnitude of the frequency deviation) to avoid reporting occurrences which do not affect system security. Another important update in use as of 2020 was to also register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 ICS Methodology updates are summarised in Section 2.1.

The number of incidents leading to frequency degradations (F) is similar to previous years. Usually, frequency events are caused by a combination of different factors. The actual causes of many of the unknown F events are mainly deterministic frequency deviations (DFDs) caused by changes in generation and balance diagrams at the beginning and end of business hours.

If the main or primary cause of an event was not reported prior to 2018, N/A (not available) was substituted.

Table 3.11: The annual number of F events from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	2016	2017	2018	2019	2020
Baltic	1	-	-	1	-
Continental Europe	15	11	963	766	299
Great Britain	-	-	58	79	2
Ireland	-	-	9	4	-
Isolated systems	-	-	-	-	-
Nordic	-	-	2	106	66
Grand Total	16	11	1 032	956	367

Table 3.12: The annual number of F events per cause from 2016 to 2020.

Cause of event	2016	2017	2018	2019	2020
Environmental causes	-	-	-	1	-
Human error	-	-	-	1	-
Loss of generation	-	-	10	16	1
Previous event	-	-	-	-	1
Tripped network element	-	-	12	15	-
Unexpected discrepancies from load or generation forecasts	-	-	-	7	2
Unexpected flows	-	-	-	2	-
Other	-	-	-	2	1
Unknown	-	-	1 010	912	362
N/A	16	11	-	-	-
Grand Total	16	11	1 032	956	367

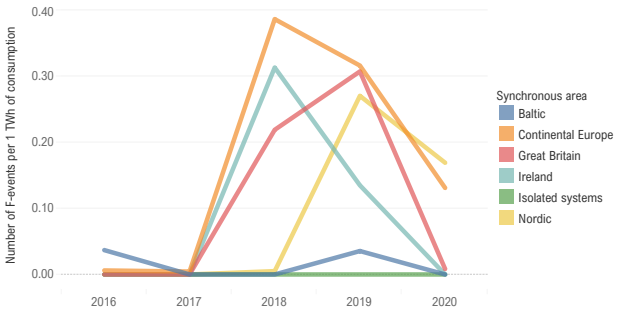

Figure 3.10: The annual number of F events per TWh of consumption in each synchronous area from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

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

Figure 3.12 presents the number of T0 events normalised by the installed circuit length in each synchronous area, and Figure 3.13 the same but for T1 events.

As seen in Table 3.14, T events are caused mostly by technical equipment and environmental causes. Common causes include external influences, operation and maintenance and failure of infrastructure, while there are also a lot of T events with an unknown cause.

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The increase in T events in 2018 is due to a change in the ICS Methodology [4], which added the 220–330 kV voltage range to the report. Before 2018, only 380–420 kV or 220 kV cross-border was included. Furthermore, the 2019 ICS Methodology update used as of 2020 [1] included parts of the 100–150 kV network relevant for the TSOs operational security. Another important update in use as of 2020 was to also register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

The number of T events between 2018 and 2020 do not show any indication of a decreasing or increasing pattern, and future reports should investigate this trend further.

If the main or primary cause of an event was not reported prior to 2018, N/A (not available) was substituted.

Table 3.13: The annual number of T events from 2016 to 2020 per synchronous area. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	2016	2017	2018	2019	2020
Baltic	32	28	25	31	25
Continental Europe	451	563	872	1 221	1 078
Great Britain	110	134	156	155	169
Ireland	11	9	9	9	8
Isolated systems	8	11	13	12	41
Nordic	58	40	84	60	76
Grand Total	670	785	1 159	1 488	1 397

Table 3.14: The annual number of T events per cause from 2016 to 2020.

Cause of event	2016	2017	2018	2019	2020
Environmental causes	-	-	231	266	306
External influences	-	-	-	-	95
Failure of infrastructure	-	-	-	-	65
Failure of protection device	-	-	66	76	4
Human error	-	-	20	36	2
Lack of remedial actions	-	-	1	-	-
Loss of tools or facilities	-	-	34	34	-
N-1 violation	-	-	-	5	-
Nature (animals, vegetation)	-	-	55	74	1
Operation and maintenance	-	-	-	-	88
Other	-	-	145	218	86
Previous event	-	-	-	-	32
Technical equipment	-	-	-	11	370
Tripped network element	-	-	523	605	53
Unavailability of reactive compensation	-	-	6	2	-
Unexpected discrepancies from load or generation forecasts	-	-	-	1	-
Unexpected flows	-	-	3	4	-
Unknown	-	-	75	156	295
N/A	670	785	-	-	-
Grand Total	670	785	1 159	1 488	1 397

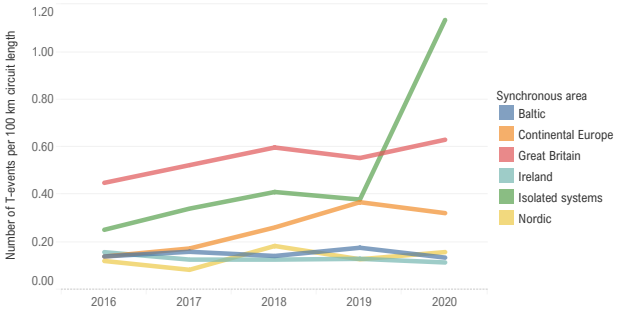

Figure 3.11: The annual number of T events per 100 km installed circuit length in each synchronous area from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

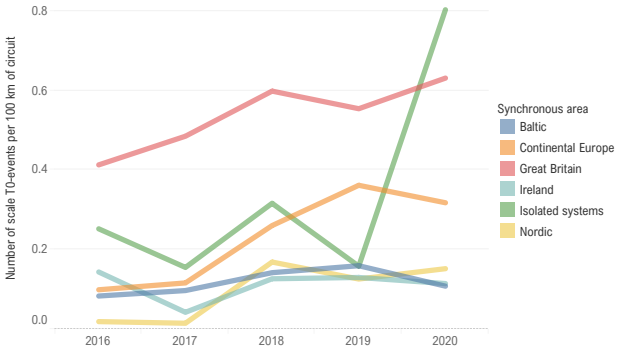

Figure 3.12: The annual number of T0 events per 100 km of circuit length from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

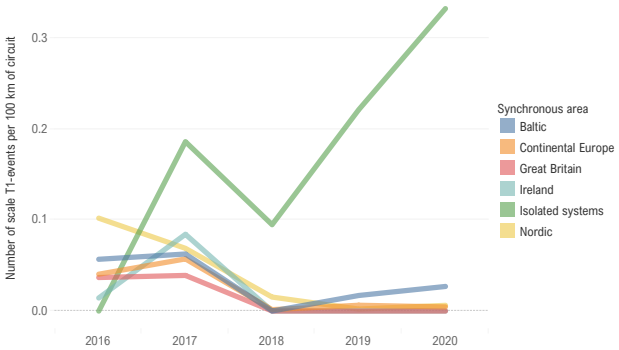

Figure 3.13: The annual number of T1 events per 100 km of circuit length from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

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 3.15 presents the annual number of events on power generating facilities for each synchronous area, and Table 3.16 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, most G events are caused by technical equipment or other tripped network elements. The increase in G events in the Baltic area is linked to the increased number of G events reported by Elering AS.

If the main or primary cause of an event was not reported prior to 2018, N/A (not available) was substituted. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Table 3.15: The annual number of G events from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	2016	2017	2018	2019	2020
Baltic	4	-	2	11	27
Continental Europe	86	84	113	93	81
Great Britain	1	2	3	-	12
Ireland	21	24	7	10	19
Isolated systems	1	3	-	4	3
Nordic	1	-	1	1	5
Grand Total	114	113	126	119	147

Table 3.16: The annual number of G events per cause from 2016 to 2020.

Cause of event	2016	2017	2018	2019	2020
Failure of infrastructure	-	-	-	-	24
Failure of protection device	-	-	4	1	-
Human error	-	-	1	-	-
Loss of generation	-	-	102	83	6
Other	-	-	8	3	2
Previous event	-	-	-	-	1
Technical equipment	-	-	-	1	61
Technical issues	-	-	-	-	12
Tripped network element	-	-	-	-	20
Unexpected discrepancies from load or generation forecasts	-	-	-	-	1
Unknown	-	-	11	31	18
N/A	114	113	-	-	2
Grand Total	114	113	126	119	147

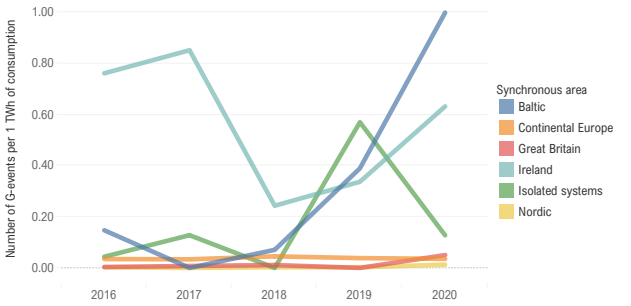

Figure 3.14: The annual number of G events per TWh of consumption for each synchronous area from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

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

This section presents a detailed view of scale 0–2 violations of standards on voltage, that is, OV0, OV1 and OV2 events.

Table 3.17 presents the annual number of violations of standards on voltage for each synchronous area. Table 3.18 show the same distributed by cause for all synchronous areas combined. Figure 3.15 presents the annual number of OV events normalised by the installed circuit length in each synchronous area.

As seen in Table 3.18, the number of OV events due to unavailable reactive compensation has decreased significantly in 2020 compared to 2019 and 2018. Instead, there are significantly more OV events caused by other or unknown causes. Most of the OV events are scale 0 events and do not endanger normal operating conditions, as shown in Table 3.10. Of the 118 scale 1 OV events that did raise the system state alert level, 84 were due to other causes and 26 were due to unavailable reactive compensation.

The increase in reported OV incidents in 2020 is due to the updated 2019 ICS Methodology used as of 2020 [1], which, among other things, revised all OV-criterion thresholds. Another important update in use as of 2020 was to also register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 Methodology updates are summarised in Section 2.1. Nevertheless, it is advised that TSOs in continental Europe investigate the reasons behind the increase in registered OV events.

If the main or primary cause of an event was not reported prior to 2018, N/A (not available) was substituted.

Table 3.17: The annual number of OV events from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	2016	2017	2018	2019	2020
Baltic	-	-	-	-	1
Continental Europe	34	48	386	295	570
Great Britain	-	-	-	-	-
Ireland	1	-	-	-	-
Isolated systems	-	-	-	-	-
Nordic	-	-	5	-	-
Grand Total	35	48	391	295	571

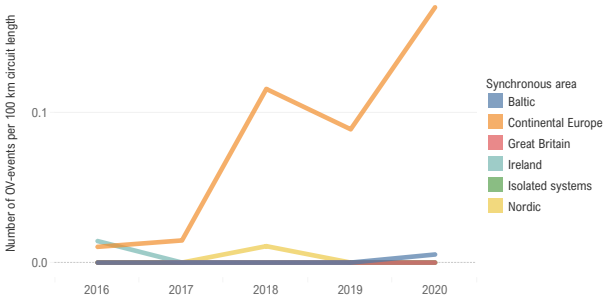

Figure 3.15: The annual number of OV events per 100 km of installed circuit length in each synchronous area from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Table 3.18: The annual number of OV events per cause from 2016 to 2020.

Cause of event	2016	2017	2018	2019	2020
Environmental causes	-	-	1	-	-
Operation and maintenance	-	-	-	-	2
Previous event	-	-	-	-	1
Technical equipment	-	-	-	-	2
Too low Mvar absorption	-	-	-	-	3
Tripped network element	-	-	-	-	1
Unavailability of reactive compensation	-	-	167	221	40
Unexpected flows	-	-	4	1	-
Other	-	-	132	30	229
Unknown	-	-	87	43	293
N/A	35	48	-	-	-
Grand Total	35	48	391	295	571

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 3.19 presents the annual number of reduced reserve capacity events for each synchronous area, and Table 3.20 show the same distributed per cause for all synchronous areas combined. Figure 3.16 presents the annual number of RRC events normalised by the consumption in each synchronous area.

All RRC events except 3 were reported by MAVIR ZRt in 2020, and they were caused by insufficient or exhausted FRR. The events registered by MAVIR ZRt were mostly caused by reaching the technical maximum ramping rate of the power plants. All RRC events in continental Europe were of scale 1. The reason that there are no scale 0 events and many scale 1 events is that most TSOs set 30 minutes as the minimum power generation scheduling resolution. Therefore, they exceed the scale 0 15–30 minute reduced reserve capacity threshold from the outset.

If the main or primary cause of an event was not reported prior to 2018, N/A (not available) was substituted. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Table 3.19: The annual number of RRC events from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	2016	2017	2018	2019	2020
Baltic	-	-	-	-	-
Continental Europe	3	13	118	162	66
Great Britain	-	-	-	-	-
Ireland	-	-	-	-	-
Isolated systems	-	-	-	-	-
Nordic	-	-	-	-	-
Grand Total	3	13	118	162	66

Table 3.20: The annual number of RRC events per cause from 2016 to 2020.

Cause of event	2016	2017	2018	2019	2020
External influences	-	-	-	-	1
Loss of generation	-	-	1	1	-
Not enough/exhausted FRR	-	-	114	158	63
Not enough/exhausted RR	-	-	3	-	-
Reduction of reserve capacity	-	-	-	-	1
Reduction of reserve capacity (RRC1)	-	-	-	1	-
Unexpected discrepancies from load or generation forecasts	-	-	-	2	-
N/A	3	13	-	-	1
Grand Total	3	13	118	162	66

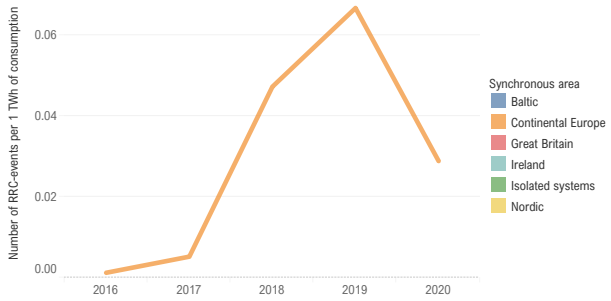

Figure 3.16: The annual number of RRC events per TWh of consumption in each synchronous area from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

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 3.21 presents the annual number of loss of tools and facilities events for each synchronous area, and Table 3.22 show the same distributed by cause for all synchronous areas combined. Figure 3.17 presents the annual number of LT events normalised by the installed circuit length in each synchronous area.

The increase in LT events between 2017 and 2018 is due to updates in the ICS Methodology in 2018 [4], which included the addition of LT0 events to the Incident Classification Scale (ICS). Previously, only the loss of any tool, mean or facility for more than 30 minutes with consequences for neighbouring TSOs was registered. The added LT0-criteria was to capture the LT events that had no consequences for neighbouring TSOs. Another important update in use as of 2020 was to also register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

If the main or primary cause of an event was not reported prior to 2018, N/A (not available) was substituted.

Table 3.21: The annual number of LT events from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	2016	2017	2018	2019	2020
Baltic	4	-	1	-	-
Continental Europe	18	18	124	124	125
Great Britain	1	2	31	42	77
Ireland	-	2	-	-	-
Isolated systems	-	-	1	-	1
Nordic	-	2	2	1	16
Grand Total	23	24	159	167	219

Table 3.22: The annual number of LT events per cause from 2016 to 2020.

Cause of event	2016	2017	2018	2019	2020
Environmental causes	-	-	-	-	1
Failure of infrastructure	-	-	-	-	89
Human error	-	-	1	-	-
Loss of tools or facilities	-	-	147	134	25
Maintenance	-	-	-	-	7
Previous event	-	-	-	-	4
Technical equipment	-	-	-	-	5
Unexpected discrepancies from load or generation forecasts	-	-	-	-	1
Other	-	-	7	33	70
Unknown	-	-	4	-	17
N/A	23	24	-	-	-
Grand Total	23	24	159	167	219

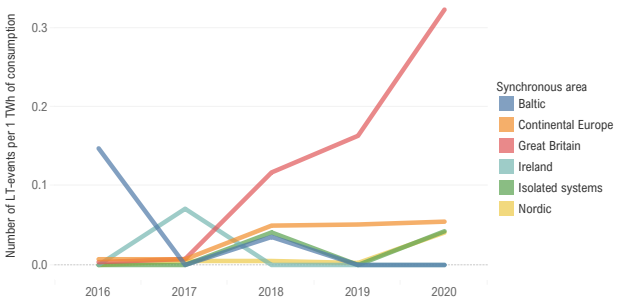

Figure 3.17: The annual number of LT events per TWh of consumption for each synchronous area from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

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 3.23 presents the annual number of ON1 and ON2 events for each synchronous area. Table 3.24 show the same distributed by cause for all synchronous areas combined. Figure 3.18 presents the annual number of ON events normalised by the installed circuit length in each synchronous area.

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

Great Britain has reported a high number of scale 0 events on transmission system elements (T0) compared to other synchronous areas. However, Great Britain's rate of N and N-1 violation (ON) events per TWh of consumption is similar to other synchronous areas indicating that Great Britain is operating within its operational security limits.

If the main or primary cause of an event was not reported prior to 2018, N/A (not available) was substituted. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Table 3.23: The annual number of ON events from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Synchronous area	2016	2017	2018	2019	2020
Baltic	-	-	-	-	1
Continental Europe	67	66	34	26	56
Great Britain	-	-	2	-	-
Ireland	-	-	-	-	3
Isolated systems	-	-	-	-	-
Nordic	9	-	2	-	2
Grand Total	76	66	38	26	62

Table 3.24: The annual number of ON events per cause from 2016 to 2020.

Cause of event	2016	2017	2018	2019	2020
Environmental causes	-	-	2	-	-
Failure of protection device	-	-	1	-	-
Human error	-	-	1	-	-
Operation and maintenance	-	-	-	-	3
Previous event	-	-	-	-	6
Technical equipment	-	-	-	-	1
Tripped network element	-	-	3	-	1
Unexpected discrepancies from load or generation forecasts	-	-	2	-	39
Unexpected flows	-	-	26	23	2
Other	-	-	3	3	9
Unknown	-	-	-	-	1
N/A	76	66	-	-	-
Grand Total	76	66	38	26	62

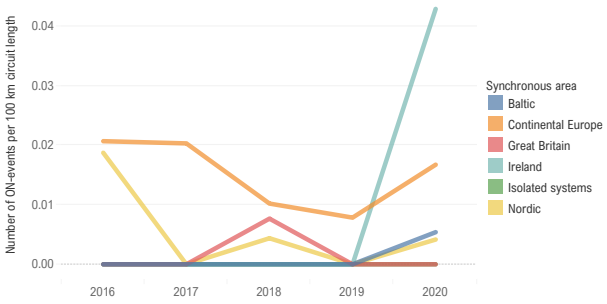

Figure 3.18: The annual number of ON events per 100 km of installed circuit length in each synchronous area from 2016 to 2020. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

4 A detailed view of scale 2 and scale 3 incidents

This chapter gives a detailed view of scale 2 and scale 3 incidents that occurred in the ENTSO-E area in 2020. One scale 2 incident and no scale 3 incidents were recorded in 2020. The recorded scale 2 incident occurred in the Baltic area, and is detailed below in Section 4.1.

4.1 The scale 2 incident in the Baltic area

At 9.33 on 8 June 2020, an earth fault occurred on a 330 kV power cable and the cable was automatically disconnected. The cable was carrying a load of 425 MW and 210 Mvar prior to the earth fault, and automatic reclosing was disabled since it was a cable. The load from the disconnected power cable was distributed to the 110 kV grid, since the power flow direction from the generation facilities remained the same. However, the increased load in the 110 kV grid overloaded several 110 kV lines, and the automatic overload protection failed to properly reduce the generation capacity by approximately 400 MW due to incorrect configurations. The individual 110 kV line overload protections gradually disconnected lines until the generation facility was fully disconnected. Russia provided the Baltic grid with 650 MW FCR capacity, and the Baltic area power balance was restored within 15 minutes.

Total losses included the outage of 27 substations (with an overall load of 240 MW, or 25 % of the load in Latvia), the outage of one larger and two smaller generation facilities (with an overall generation of 850 MW). In total, the incident affected 287 000 customers and resulted in 154.9 MWh of energy not supplied (ENS).

Transmission system normal state was restored at 11.14. Total duration of restoration process was 1 hour 41 minutes.

5 Operational Security Indicators

This chapter presents the operational security indicators relevant to operational security, planning and scheduling, as required by SOGL Article 15(3) and 15(4) [2, p. 19].

5.1 Operational security indicators relevant to operational security

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

Most security indicators are calculated with scale 0–3 ICS incidents. However, the OS-indicators OS-B, OS-F1 and OS-F2 also use the reported 'Below Scale' ICS events. OS-F1 and OS-F2 use below scale violations of standards on voltage (OVBS) reported by TSOs, while OS-B use GBS events retrieved from the ENTSO-E Transparency Platform [5]. It should be noted that the retrieved data from the Transparency Platform was not fully in line with the ICS requirements, because the provided 'Unavailability of Production and Generation Units 15.1' data in the Transparency Platform also includes forced outages of power generating facilities not connected to the grid. This leads to higher than expected calculated values of the operational security indicator OS-B. This issue will be followed up and resolved in the future.

Table 5.2 shows the calculated values for each security indicator for the year 2020.

Table 5.1: The operational security indicators relevant to operational security

Abbr.	Description of the operational security indicator	Calculation method
OS-A	Number of tripped transmission system elements per year per TSO – SOGL Article 15(3)(a) [2, p. 19].	Add up the number of transmission system elements tripped reported for all the incidents on scale 0, 1, 2 and 3.
OS-B	Number of tripped power generation facilities per year per TSO – SOGL Article 15(3)(b) [2, p. 19].	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 ENTSO-E transparency platform [5].
OS-C	Energy not supplied due to unscheduled disconnection of demand facilities per year per TSO – SOGL Article 15(3)(c) [2, p. 19].	Add up the energy not supplied reported for all incidents on scale 0, 1, 2 and 3 due to unscheduled disconnection of demand facilities.
OS-D1	Time duration of being in alert and emergency states per year per TSO – SOGL Article 15(3)(d) [2, p. 19].	Add up the time being in alert and emergency states reported for all incidents on scale 0, 1, 2 and 3.
OS-D2	Number of instances of being in alert and emergency states per year per TSO – SOGL Article 15(3)(d) [2, p. 19].	Add up the number of incidents on scale 0, 1, 2 and 3 if an alert or emergency state was reported.
OS-E1	Time duration within which there was a lack of reserve identified per year per TSO – SOGL Article 15(3)(e) [2, p. 19].	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 if the reduction of reserve capacity is reported.
OS-E2	Number of events within which there was a lack of reserve identified per year per TSO – SOGL Article 15(3)(e) [2, p. 19].	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 if 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) [2, p. 19].	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 if voltage deviations are reported which exceed the ranges from SOGL Annex II [2, p. 115].
OS-F2	Number of voltage deviations exceeding the ranges from Tables 1 and 2 of SOGL Annex II [2, p. 115] per year per TSO – SOGL Article 15(3)(f) [2, p. 19].	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 if voltage deviations are reported which exceed the ranges from SOGL Annex II [2, p. 115].
OS-G1	Number of minutes outside the standard frequency range per year per synchronous area – SOGL Article 15(3)(g) [2, p. 19].	Annual Load-Frequency Control Reporting (ALFC) [9] will provide data for number of minutes outside the standard frequency range.
OS-G2	Number of minutes outside the 50 % of maximum steady-state frequency range per year per synchronous area – SOGL Article 15(3)(g) [2, p. 19].	Annual Load-Frequency Control reporting [9] will provide data for number of minutes outside the 50 % of maximum steady state frequency deviation.
OS-H	Number of system-split separations or local blackout states per year – SOGL Article 15(3)(h) [2, p. 19].	Add up the number of incidents reported under the criteria RS1 and RS2.
OS-I	Number of blackouts involving two or more TSOs per year – SOGL Article 15(3)(i) [2, p. 19].	Add up the number of incidents reported under the criteria OB3, if two or more TSOs are involved.

Table 5.2: Operational security indicators relevant to operational security per synchronous area. PGF means Power Generating Facility. All security indicators except OS-B, OS-F1 and OS-F2 are calculated using scale 0–3 ICS incidents. OS-B also uses GBS events retrieved from the ENTSO-E Transparency Platform [5], and OS-F1 and OS-F2 also uses OVBS events reported by the TSOs. National Grid ESO in Great Britain reported their GBS events themselves.

	Synchronous area						
	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	ENTSO-E
OS-A [tripped elements/TSO]	9.7	54.3	205.0	4.0	40.0	24.0	48.2
OS-B [tripped PGF/TSO]	25.0	203.5	109.0	16.5	8.5	48.0	150.5
OS-C [MWh/TSO]	51.6	195.2	0.0	0.0	123.7	249.3	170.4
OS-D1 [minutes/TSO]	46.7	535.7	31.0	0.0	925.0	346.5	456.2
OS-D2 [incidents/TSO]	2.0	5.3	4.0	0.0	5.5	1.5	4.3
OS-E1 [minutes/TSO]	0.0	101.5	0.0	0.0	360.5	0.0	88.4
OS-E2 [incidents/TSO]	0.0	2.5	0.0	0.0	1.0	0.0	1.8
OS-F1 [minutes/TSO]	3.6	2 230.9	14.2	0.0	0.0	74.1	1 534.9
OS-F2 [incidents/TSO]	0.3	30.4	1.0	0.0	0.0	7.5	21.6
OS-G1 [minutes]	0.0	9 258.7	44.0	17.4	1.2	9 564.0	18 885.3
OS-G2 [minutes]	0.0	7 086.0	27.0	1.8	1.1	5.4	7 121.3
OS-H [incidents]	0.0	0.0	0.0	0.0	0.0	1.0	1.0
OS-I [incidents/TSO]	0.0	0.0	0.0	0.0	0.0	0.0	0.0

5.1.1 Evolution of operational security indicators relevant to operational security, 2016–2020

Figure 5.1 through Figure 5.12 show the annual calculated values for the operational security indicators OS-A to OS-H for the period 2016–2020. The operational security indicator OS-I has been omitted from this section since no scale 3 events were recorded in the ENTSO-E area from 2016 to 2020.

The substantial increases in the OS indicators for 2018 are a result of the updated 2018 Incident Classification Scale (ICS) Methodology [4], which was introduced for the 2018 Annual Report. Furthermore, some increases in 2020 are due to the updates in the 2019 ICS Methodology [1]. The 2018 and 2019 updates are summarised in Section 2.1.

However, not all changes are due to the Methodology updates. Energy not supplied (ENS) due to unscheduled disconnection of demand facilities recorded by the OS-C indicator seems to have an increasing trend for all synchronous areas combined, although its per-area variation fluctuates depending on the occurrence of noteworthy incidents. The same trend may be seen in OS-D1, yet comparing OS-D1 and OS-D2 shows that the number of incidents is not proportional to their combined duration.

The security indicators OS-E1 and OS-E2, which measure the availability of reserve capacity, and OS-F1 and OS-F2, which measure the duration and number of violations of standards on voltage, are mostly seen by a few TSOs in continental Europe. The extraordinary values in other synchronous areas are due to exceptional events that stand out from the rest.

The increase in reported OS-G1 and OS-G2 minutes in 2020 is prompted by the greater detail of frequency reporting in the Annual Load-Frequency Control (ALFC) Report [9]. Prior to 2020, the minutes outside the standard frequency range were registered separately for each ICS incident.

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 only registered in 2016 (RS2) and 2020 (RS1).

Thus, short incidents with low impact on the power system do contribute to the calculated security indicator values. However, it is the rarer, unexpected incidents that give greater impact on the grid and on the security indicators.

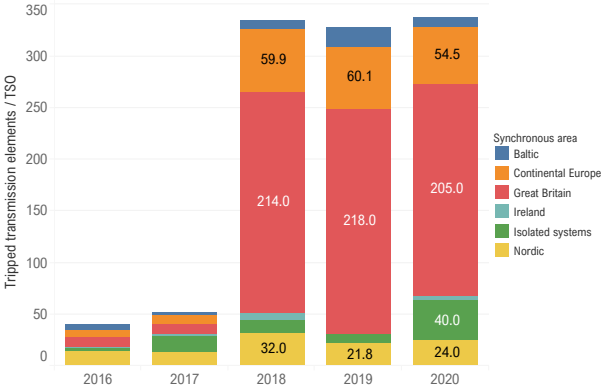

Figure 5.1: Operational security indicator OS-A from 2016 to 2020. It is calculated by adding up the number of tripped transmission system elements reported for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area. The increased OS-A value since 2018 is due to the 2018 ICS Methodology update [4], which added 220–330 kV network elements to the Incident Classification Scale. Prior to 2018, only 380–420 kV network element trips were registered as incidents on network elements (T). The increase in OS-A is due to the 2019 ICS Methodology update [1], which added 100–150 kV network elements relevant for maintaining operational security to the Incident Classification Scale.

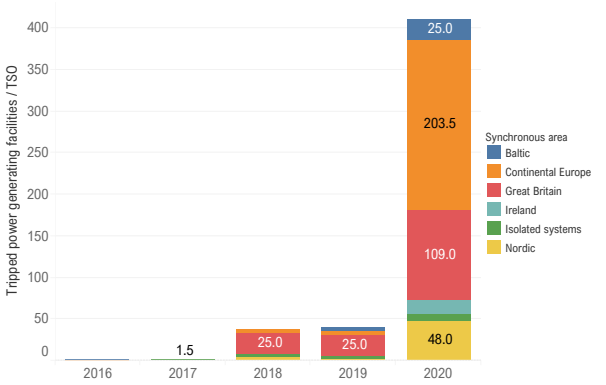

Figure 5.2: Operational security indicator OS-B from 2016 to 2020. It is calculated by adding up the number of tripped power generation facilities reported for below scale and scale 0–3 incidents and dividing by the number of TSOs in the synchronous area. The substantial increase in 2020 is due to the 2019 ICS Methodology update [1], which introduced below scale events on power generating facilities (GBS) to the report. It should be noted that the retrieved GBS data from the Transparency Platform [5] was not fully in line with the ICS requirements and may contain false positives. This issue will be followed up and resolved in the future. National Grid ESO in Great Britain reported their own GBS events.

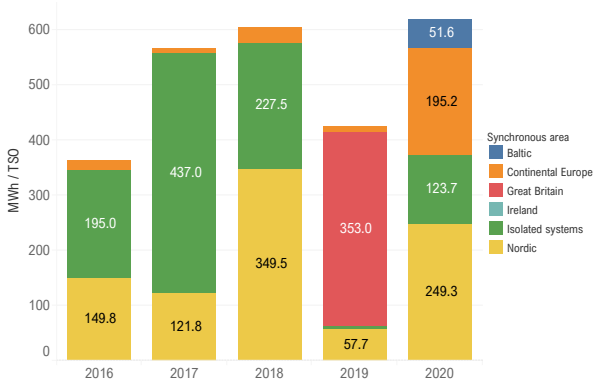

Figure 5.3: Operational security indicator OS-C from 2016 to 2020. It is calculated by adding up the reported energy not supplied (ENS) due to unscheduled disconnection of demand facilities for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area. The significant amount of ENS in Great Britain in 2019 is due to one scale 2 frequency incident (F2). Details of the F2 incident can be read in the 2019 ICS Annual Report [10, p. 19]. The high OS-C value in 2020 in the Baltic area is also due to one scale 2 incident. The Baltic scale 2 incident is described in more detail in Section 4.1. When ENS due to unscheduled disconnection of demand facilities is not caused by single, extensive incidents, it is caused by either incidents on load (L) or incidents on network elements (T).

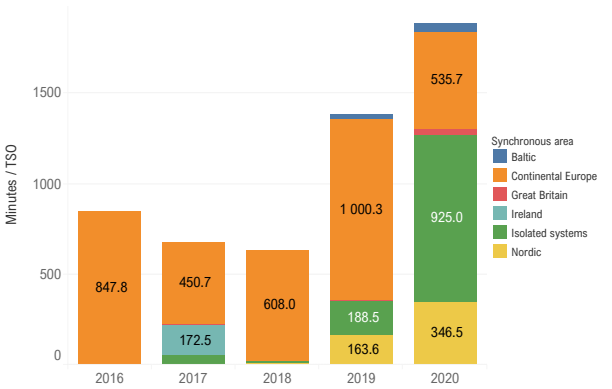

Figure 5.4: Operational security indicator OS-D1 from 2016 to 2020. It is calculated by adding up the number of minutes in alert and emergency states of all reported scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area. The increase in OS-D1 in 2019 is linked to using the duration of the whole scale 1 or scale 2 incident when alert or emergency state has not been reported. This was only done in 2019, and as of 2020 TSOs are obligated to report the actual duration spent in alert or emergency state for each registered event. The OS-D1 increase for isolated systems in 2020 is due to exceptional and long events.

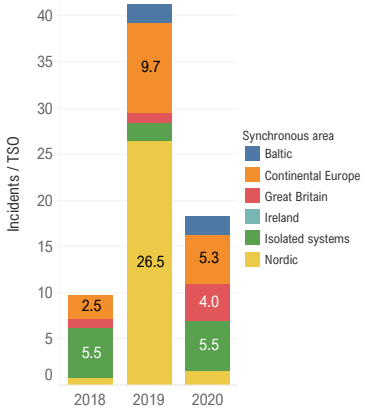

Figure 5.5: Operational security indicator OS-D2 from 2018–2020. It is calculated by counting the number of scale 0–3 incidents in which an alert or emergency state was reported, and dividing by the number of TSOs in the synchronous area. The security indicator OS-D2 was created in 2018. Comparing OS-D1 and OS-D2 shows that the number of incidents is not directly proportional to their combined duration.

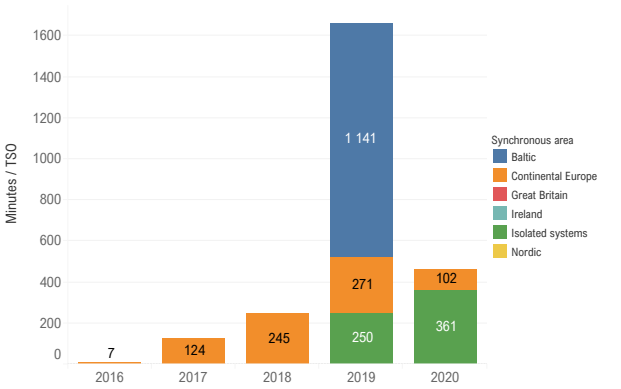

Figure 5.6: Operational security indicator OS-E1 from 2016 to 2020. It is calculated by adding up the duration of RRC0, RRC1 and RRC2 incidents and the duration of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area. The high number of OS-E1 minutes in 2019 for the Baltic area is due to one 2 day long T0 incident registered by Elering AS. The high high number of OS-E1 minutes in the isolated systems are mainly due to a few G0 incidents in 2019 and due to one T0 event in 2020. The 2018 OS-E1 value for continental Europe had a calculation error and was fixed for the 2020 ICS Annual Report.

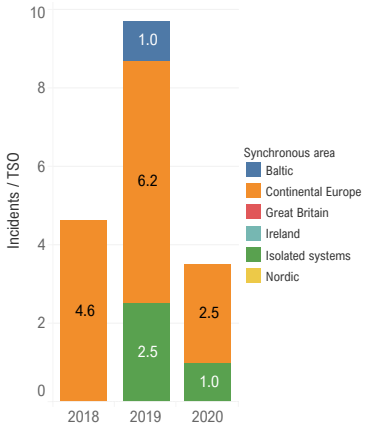

Figure 5.7: Operational security indicator OS-E2 from 2018 to 2020. It is calculated by counting the number RRC0, RRC1 and RRC2 incidents and the number of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area. The security indicator OS-E2 was created in 2018. Comparing OS-E1 and OS-E2 shows that incidents do not usually affect reserves, but when they do, they tend tend to be longer. In continental Europe, this is mainly due to the minimum power scheduling resolution being 30 minutes in most market areas. However, the amount of minutes is minimal on a yearly basis.

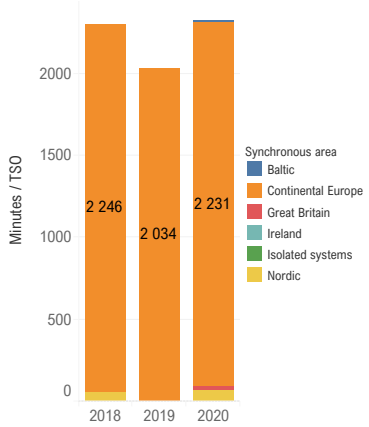

Figure 5.8: Operational security indicator OS-F1 from 2018 to 2020. It is calculated by adding up the duration of OVBS, OV0, OV1 and OV2 incidents and the duration of all other incidents on below scale and scale 0–3 where voltage deviations exceeding the ranges from SOGL Annex II [2, p. 115] are reported, and dividing by the number of TSOs in the synchronous area. The security indicator OS-F1 was created in 2018. As can be seen, a significant portion of the minutes are registered in continental Europe.

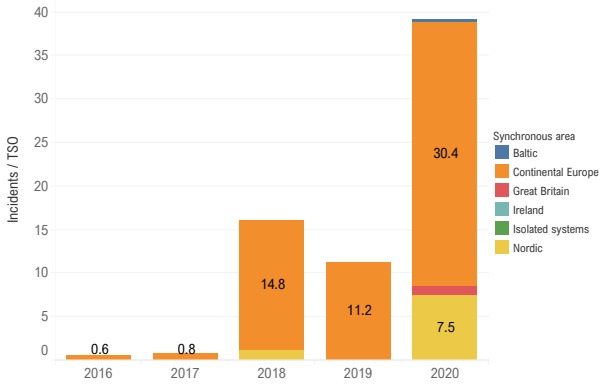

Figure 5.9: Operational security indicator OS-F2 from 2016 to 2020. It is calculated by counting the number of violation of standards of voltage incidents (OVBS, OV0, OV1 and OV2) and the number of all other below scale and scale 0–3 incidents in which the voltage standards are violated, and dividing by the number of TSOs in the synchronous area. The increased value of OS-F2 in 2020 is due to the ICS Methodology update in 2020 [1], which shortened the minimum voltage deviation duration from 30 minutes to 5 minutes, or 30 seconds if the deviation is major. Therefore, more incidents reached the threshold of the OS-F2 security indicator.

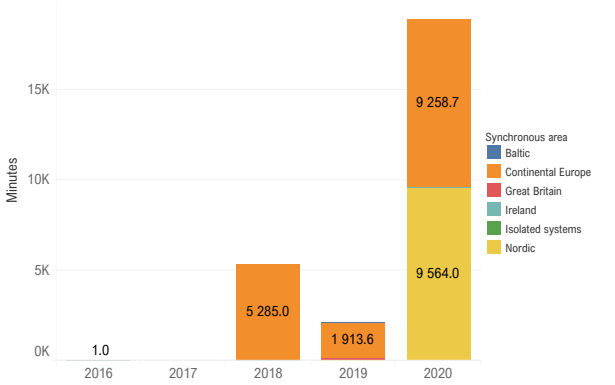

Figure 5.10: Operational security indicator OS-G1 from 2016 to 2020. It is calculated by adding up the number of minutes outside the standard frequency range for all scale 0–3 incidents. SOGL Article 127(4) [2, p. 76] sets a frequency quality target parameter for the maximum number of minutes the synchronous areas continental Europe, Great Britain, Ireland and the Nordic region shall be outside the standard frequency range. The threshold is 15 000 minutes, and each specified synchronous area passed the threshold in 2020. The number of minutes for 2020 was provided by the Annual Load-Frequency Control (ALFC) Report. The increase in reported minutes in 2020 is prompted by the greater detail of frequency reporting in the Annual Load-Frequency Control (ALFC) Report [9]. Prior to 2020, the minutes outside the standard frequency range were registered separately for each ICS incident, if at all.

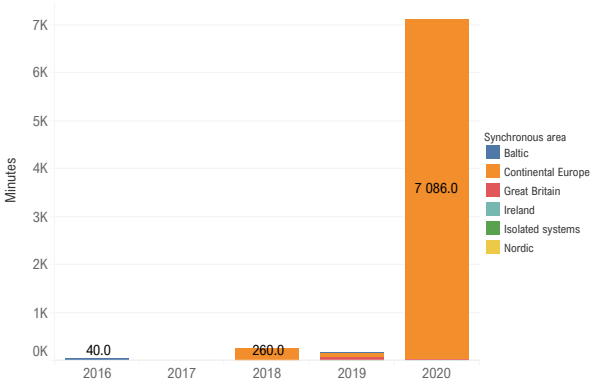

Figure 5.11: Operational security indicator OS-G2 from 2016 to 2020. It is calculated by adding up the number of minutes outside the 50 % of THE maximum steady-state frequency deviation for all scale 0–3 incidents. The increase in reported minutes in 2020 is prompted by the greater detail of frequency reporting in the ALFC Report [9]. Prior to 2020, the minutes outside the standard frequency range were registered separately for each ICS incident, if at all.

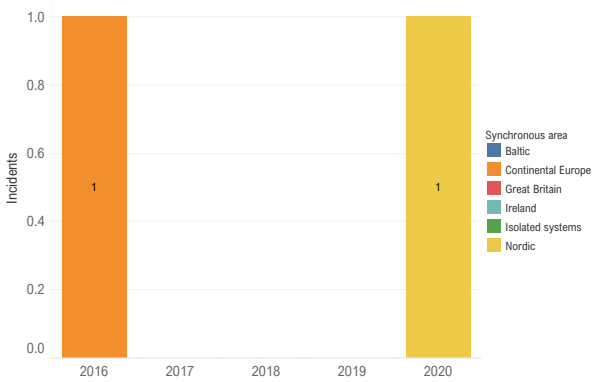

Figure 5.12: Operational security indicator OS-H from 2016 to 2020. It is calculated by counting the number of grid separation incidents (RS1 and RS2). As can be seen, RS incidents are rare and were only registered in 2016 (RS2) and 2020 (RS1).

5.2 Operational security indicators relevant to operational planning and scheduling

The operational security indicator relevant to operational planning and scheduling (OPS) are presented in Table 5.3. Table 5.4 presents the calculated value of each OPS-indicator for the year 2020.

As seen in Table 5.4, all operational security indicators relevant to operational planning and scheduling were zero in Great Britain and Ireland, and the only synchronous area with non-zero values in all security indicators was continental Europe. Isolated systems and the Nordic area showed non-zero values for OPS-A and OPS-C, and the Baltic area only showed non-zero values for OPS-A.

The OPS-indicators mainly track the occurrences of contingencies from the contingency list. OPS-A tracks the occurrences of single contingencies from the list, and OPS-B records whether the OPS-A occurrences were due to unexpected discrepancies from load and generation forecasts. OPS-C is similar to OPS-A, however, it tracks exceptional contingencies, that is, the simultaneous occurrence of multiple contingencies from the contingency list that share a common cause. OPS-D records OPS-C incidents caused by unexpected discrepancies from load and generation forecasts. As can be seen, most incidents due to contingencies from the contingency list are due to causes other than unexpected discrepancies from load and generation forecasts. However, improving the accuracy of load and generation forecasts would significantly decrease the number of incidents due to contingencies in the contingency list.

The calculated OPS-E values are mainly RRC incidents reported by MAVIR ZRt in Hungary. The RRC events registered by MAVIR ZRt were mostly caused by reaching the technical maximum ramping rate of the power plants.

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 in which an incident contained in the contingency list led to a degradation of the system operation state – SOGL Article 15(4)(a) [2, p. 19].	Sum the number of incidents on scale 0, 1, 2 and 3 if degradation of system operation state is reported and if the cause of the incident is a contingency from contingency list.
OPS-B	Number of events counted by indicator OPS-A (events in which an incident contained in the contingency list led to a degradation of the system operation state), in which a degradation of system operation conditions occurred as a result of unexpected discrepancies from load or generation forecasts – SOGL Article 15(4)(b) [2, p. 19].	Add up the number of incidents counted by indicator OPS-A if unexpected discrepancies from load and generation forecasts were reported as the cause of the incident.
OPS-C	Number of events in which there was a degradation in system operation conditions due to an exceptional contingency – SOGL Article 15(4)(c) [2, p. 19].	Sum the number of incidents on scale 0, 1, 2 and 3 if degradation of system operation state is reported and if the cause of the incident is an exceptional contingency.
OPS-D	Number of events counted by indicator OPS-C (events in which there was a degradation in system operation conditions due to an exceptional contingency), in which a degradation of system operation conditions occurred as a result of unexpected discrepancies from load or generation forecasts – SOGL Article 15(4)(d) [2, p. 19].	Add up the number of incidents counted by indicator OPS-C if unexpected discrepancies from load and generation forecasts were reported as the cause of the incident.
OPS-E	Number of events leading to a degradation in system operation conditions due to lack of active power reserves – SOGL Article 15(4)(e) [2, p. 19].	Sum the number of incidents on scale 0, 1, 2 and 3 if 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						
	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	ENTSO-E Total
OPS-A [incidents]	5	167	0	0	13	5	190
OPS-B [incidents]	0	40	0	0	0	0	40
OPS-C [incidents]	0	1	0	0	4	2	7
OPS-D [incidents]	0	1	0	0	0	0	1
OPS-E [incidents]	0	63	0	0	0	0	63

5.2.1 Evolution of operational security indicators relevant to operational planning and scheduling, 2016–2020

This section presents the operational security indicators relevant to operational planning and scheduling (OPS) for 2016–2020. Figures 5.13 through 5.16 show the annual calculated values for the operational security indicators OPS-A, OPS-B, OPS-C and OPS-E, respectively. The indicator OPS-D is omitted from this section because only one OPS-C incident was caused by unexpected discrepancies from load and generation forecasts during 2016–2019. The OPS-C incident occurred in continental Europe in 2020.

OPS-C sees a decreasing pattern for 2016–2020, while the indicators OPS-A and OPS-B see an increasing pattern. The operational security indicator OPS-E is decreasing after high reported values in 2019 and 2020. The calculated OPS-E values are mainly RRC incidents reported by MAVIR ZRt in Hungary. Section 12.1.13 presents detailed values from MAVIR ZRt. The RRC events registered by MAVIR ZRt were mostly caused by reaching the maximum ramping rate of the power plants.

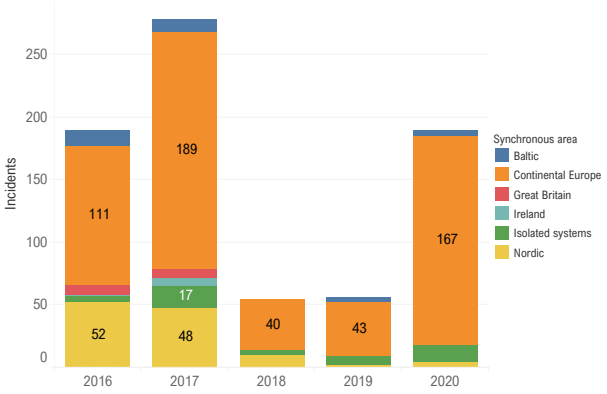

Figure 5.13: Operational security indicator OPS-A from 2016 to 2020. The indicator is calculated by counting the number of scale 0–3 incidents where a contingency from the contingency list degraded the system operation state. Most of the OPS-A incidents are due to ordinary contingencies, and only a few are due to exceptional contingencies or out-of-range contingencies. The decreased values in 2018 and 2019 are due to a better contingency definition in the 2018 ICS Methodology [4]. The increase in 2020 is a result of requiring TSOs to report the type of contingency for all reported events. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

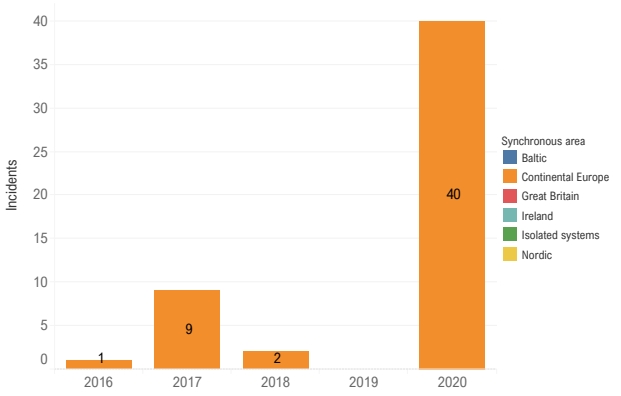

Figure 5.14: Operational security indicator OPS-B from 2016 to 2020. The indicator is calculated by counting the number of OPS-A indicators where the cause was unexpected discrepancies from load and generation forecasts. The increase in 2020 is a result of changes requiring TSOs to report the type of contingency for all reported events.

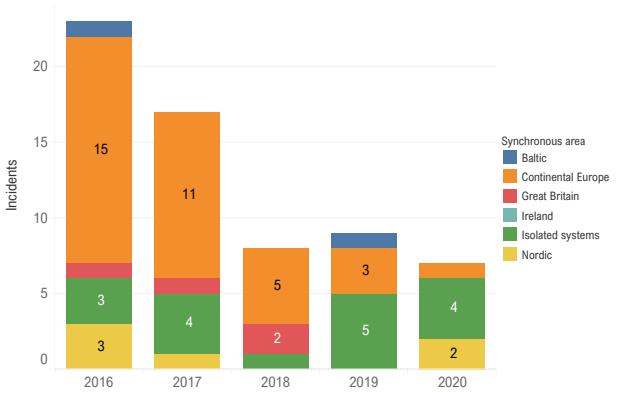

Figure 5.15: Operational security indicator OPS-C from 2016 to 2020. The indicator is calculated by counting the number of scale 0–3 incidents where an exceptional contingency degraded the system operation state. One of the 2020 incidents reaching the OPS-C threshold was a scale 1 incident leading to frequency degradation (F1) registered by AST in the Baltic area, another was a scale 1 reduction of reserve capacity (ON1) registered by TenneT TSO GmbH in continental Europe, and the rest were scale 1 incidents on network elements (T1).

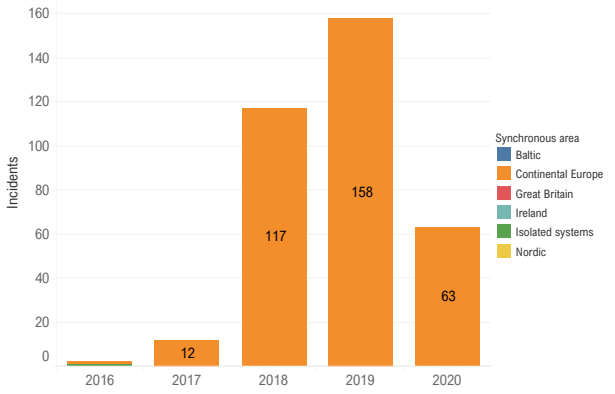

Figure 5.16: Operational security indicator OPS-E from 2016 to 2020. The indicator is calculated by counting the number of scale 0–3 incidents caused by lack of active power reserves. The OPS-E indicator value is directly correlated with the number of registered reduction of reserve capacity (RRC) incidents.

6 Events in continental Europe

6.1 Overview of 2020

This section presents an overview of scale 0–3 ICS events in continental Europe in 2020. 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, in 2020 a total of 2 287 ICS events meeting the ICS criteria were reported by TSOs in continental Europe. Together, these events formed 2 197 ICS incidents, meaning that most events only involved one ICS criteria violation.

Approximately 88 % of all scale 0–3 events were scale 0 events, and the rest were of scale 1. No scale 2 or scale 3 events were reported. Events on transmission network elements (T0) accounted for 46 % of the events, violations on standards of voltage (OV) for 25 %, and frequency degradations (F0) for 13 % of the events. Combined, these three ICS categories accounted for 84 % of all events.

Table 6.1 shows the monthly distribution of the number of incidents recorded in 2020. The number of T0 events was higher during the winter and summer and lower during spring and autumn. The number of OV0 and OV1 events were higher during spring and autumn, and ON1 events were mostly reported during the summer.

As shown in Table 6.2, approximately 67 % of all scale 0 events and 44 % of all scale 1 were resolved within less than an hour. All frequency deviations were cleared in less than an hour. However, T and G events were particularly likely to be resolved in more than 24 hours. The duration of T and G events depended mainly on the underlying cause of the trip. LT, OV and RRC events had a more diverse duration distribution, but approximately 78 % were resolved within less than two hours.

For most TSOs, 30 minutes is the minimum scheduling resolution of power generation. As such, in the 2018 ICS Methodology [4], RRC incidents that last for more than 30 minutes are automatically classified as scale 1 events. RRC0 events are, therefore, unusual in continental Europe.

Table 6.1: Number of ICS events by ICS criteria distributed per month in 2020 in continental Europe.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	3	-	1	-	-	-	-	-	-	-	-	4
	Incidents leading to frequency degradation (F0)	24	26	34	21	14	30	33	15	32	24	23	20	296
	Incidents on network elements (T0)	107	138	56	77	90	86	86	121	106	65	44	87	1 063
	Incidents on power generating facilities (G0)	13	8	6	4	6	7	12	6	4	5	3	7	81
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	1	-	1	-	2
	Violation of standards on voltage (OV0)	2	9	36	64	38	50	22	57	67	80	16	13	454
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	8	13	12	8	24	3	4	5	9	5	7	4	102
	Total	154	197	144	175	172	176	157	204	219	179	94	131	2 002
Scale 1	Incidents on load (L1)	1	-	-	-	-	1	1	1	-	1	1	-	6
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	3	-	-	-	-	-	3
	Incidents on network elements (T1)	-	1	-	2	-	1	2	2	2	-	2	3	15
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	3	-	-	3	5	13	10	9	3	1	6	3	56
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	1	7	13	21	26	14	4	7	8	9	4	2	116
	Reduction of reserve capacity (RRC1)	23	5	6	5	6	1	4	4	1	2	6	3	66
	Loss of tools, means and facilities (LT1)	3	1	-	2	2	1	5	3	4	-	2	-	23
	Total	31	14	19	33	39	31	29	26	18	13	21	11	285
Scale 2	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	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		185	211	163	208	211	207	186	230	237	192	115	142	2 287

Table 6.2: Cumulative Number of ICS events by ICS criteria and duration in 2020 in continental Europe.

		2020					
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents on load (L0)	2	2	2	4	4	4
	Incidents leading to frequency degradation (F0)	296	296	296	296	296	296
	Incidents on network elements (T0)	346	468	666	778	889	1 063
	Incidents on power generating facilities (G0)	13	14	28	39	46	81
	Separation from the grid (RS0)	2	2	2	2	2	2
	Violation of standards on voltage (OV0)	310	390	429	453	453	454
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	53	71	92	100	101	102
	Total	1 022	1 243	1 515	1 672	1 791	2 002
Scale 1	Incidents on load (L1)	3	5	5	5	5	6
	Incidents leading to frequency degradation (F1)	3	3	3	3	3	3
	Incidents on network elements (T1)	8	12	13	14	14	15
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	35	45	50	56	56	56
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	12	54	104	115	116	116
	Reduction of reserve capacity (RRC1)	58	65	66	66	66	66
	Loss of tools, means and facilities (LT1)	3	11	20	22	23	23
	Total	122	195	261	281	283	285
Scale 2	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	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		1 144	1 438	1 776	1 953	2 074	2 287

6.2 Evolution 2016–2020

This section presents the annual number of ICS events in continental Europe from 2016 to 2020, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in Table 2.1. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

As shown in Table 6.3, scale 0 incidents in 2020 decreased by 442 (-18 %) compared to 2019 and by 366 (-15 %) compared to 2018. Comparison with the years 2016 and 2017 can be misleading because of the substantial 2018 Incident Classification Scale Methodology [4] change that was introduced for the 2018 Annual Report. One of the important updates for 2020 was to register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The 2018 and 2019 Methodology updates are summarised in Section 2.1.

The number of scale 1 events increased by 44 (18 %) over 2019 and 43 (18 %) over 2018. The largest changes in the number of scale 1 events are seen in violations of standards on voltage (OV1), reduction of reserve capacity (RRC1) and N-1 violations (ON1). OV1 events increased from 9 events in 2019 to 116 events in 2020, RRC1 events decreased from 161 events in 2019 to 66 events in 2020, and ON1 events increased from 25 in 2019 to 56 in 2020. All other scale 1 categories show similar numbers to previous years.

No scale 2 or 3 events were reported in continental Europe in 2020.

Table 6.3: The annual number of ICS events by ICS criterion from 2016 to 2020 in continental Europe. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	4
	Incidents leading to frequency degradation (F0)	15	11	953	759	296
	Incidents on network elements (T0)	320	377	867	1 199	1 063
	Incidents on power generating facilities (G0)	85	84	113	93	81
	Separation from the grid (RS0)	-	-	-	-	2
	Violation of standards on voltage (OV0)	19	27	336	286	454
	Reduction of reserve capacity (RRC0)	2	1	-	1	-
	Loss of tools, means and facilities (LT0)	-	-	99	106	102
	Total	441	500	2 368	2 444	2 002
Scale 1	Incidents on load (L1)	2	1	3	-	6
	Incidents leading to frequency degradation (F1)	-	-	10	7	3
	Incidents on network elements (T1)	131	186	5	21	15
	Incidents on power generating facilities (G1)	1	-	-	-	-
	N-1 violation (ON1)	67	66	31	25	56
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	15	21	50	9	116
	Reduction of reserve capacity (RRC1)	1	12	118	161	66
	Loss of tools, means and facilities (LT1)	18	18	25	18	23
	Total	235	304	242	241	285
Scale 2	Incidents on load (L2)	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	1	-
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	3	1	-
	Separation from the grid (RS2)	1	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	1	-	3	2	-
Scale 3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		677	804	2 613	2 687	2 287

6.3 Analysis of significant changes in trends

In 2020, 2 287 events were reported in continental Europe; a decrease of 12 % compared to 2019 and a decrease of 15 % compared to 2018. This decrease appears to be significant, and is mainly due to the decrease in the number of reported F0 events. The decrease of F0 events was due to a change in the scale 0 thresholds for incidents leading to frequency degradations.

Furthermore, a decrease in reported reduction of reserve capacity (RRC1) events comparing to 2019 and 2018 was observed. The only observed increase in registered events in 2020 compared to 2019 was in the number of violations of standards on voltage and N-1 violations (ON1). The number of violation of standards on voltage (OV0 and OV1) incidents increased by over 60 % relative to 2019 and 2018. The number of N-1 violations increased from 25 in 2019 to 56 in 2020, however, the number was still lower than registered in 2016 and 2017. The changes in the number of reported OV- and RRC events is due to the recent methodology change in 2020.

The trend of scale 1 events shifting to scale 0 events observed in 2018 continued in 2019. This shift is due to clarifications and better alignment of the ICS Methodology with the SOGL [2]. The recent Incident Classification Scale Methodology updates are summarised in Section 2.1. The number of scale 2 events is similar to previous years, and no scale 3 events were reported in continental Europe.

7 Events in the Nordic synchronous area

7.1 Overview of 2020

This section presents an overview of ICS events in the Nordic synchronous area in 2020. The events are presented by ICS criterion and further grouped by month and duration in Table 7.1 and Table 7.2, respectively.

In 2020, 167 scale 0–3 ICS events were reported in the Nordic synchronous area, of which 150 were scale 0 events and 17 scale 1 events. There were no scale 2 or scale 3 events.

As shown in Table 7.1, incidents on network elements (T0) and incidents leading to frequency degradation (F0) were the most common type with 73 events and 62 events in 2020, respectively. These T0 events on network elements were mainly due to tripped HVDC links and HVAC-elements as a result of faults in operation and maintenance or technical equipment. Furthermore, all events were moderately spread throughout the year, though T0 events were concentrated around the summertime as a result of the warmer weather.

As shown in Table 7.2, 55 % of the scale 0–3 events were resolved in less than an hour, and 92 % of all scale 0–3 events were resolved in less than 24 hours. Most of the reported incidents that were resolved within an hour were incidents leading to frequency degradation (F). Incidents on network elements (T0), loss of tools, means and facilities (LT0) events and all scale 1 events except F1 events took longer to resolve.

Table 7.1: Number of ICS events by ICS criteria distributed per month in 2020 in the Nordic synchronous area.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	7	11	9	4	4	2	2	4	4	8	2	5	62
	Incidents on network elements (T0)	2	5	4	6	10	11	2	11	2	5	6	9	73
	Incidents on power generating facilities (G0)	-	-	1	-	-	-	-	1	1	1	-	1	5
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	1	4	-	2	3	10
	Total	9	16	14	10	14	13	4	17	11	14	10	18	150
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	1	-	1
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	2	-	-	2	4
	Incidents on network elements (T1)	-	-	1	1	-	-	-	-	-	1	-	-	3
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	1	-	-	-	-	-	-	1	-	-	2
	Separation from the grid (RS1)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	1	-	-	-	1	-	-	1	-	2	1	6
	Total	-	1	2	1	-	1	-	1	3	2	3	3	17
Scale 2	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	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		9	17	16	11	14	14	4	18	14	16	13	21	167

Table 7.2: Cumulative number of ICS events by ICS criteria and duration in 2020 in the Nordic synchronous area.

		2020					
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	62	62	62	62	62	62
	Incidents on network elements (T0)	21	28	45	61	65	73
	Incidents on power generating facilities (G0)	2	2	2	2	2	5
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	3	6	7	8	9	10
	Total	88	98	116	133	138	150
Scale 1	Incidents on load (L1)	-	-	1	1	1	1
	Incidents leading to frequency degradation (F1)	4	4	4	4	4	4
	Incidents on network elements (T1)	-	1	1	2	2	3
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	-	1	1	1	1	2
	Separation from the grid (RS1)	-	-	-	1	1	1
	Violation of standards on voltage (OV1)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	5	6	6	6
	Total	4	6	12	15	15	17
Scale 2	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	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		92	104	128	148	153	167

7.2 Evolution 2016–2020

This section presents the annual number of ICS events in the Nordic synchronous area from 2016 to 2020, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in Table 2.1. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

As mentioned in Chapter 1, the ICS Methodology has been changed several times, preventing 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 [2] to improve the overall data quality, make results comparable between synchronous areas and TSOs, and to ease the analysis and identification of improvements to system operations. One of the important updates for 2020 was to register individual ICS events instead of aggregating related events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. The Methodology updates are summarised in Section 2.1.

As seen in Table 7.3, the number of events in 2020 are fairly similar to those registered in 2019 and 2018, except for the increase in registered F1 events in 2019, which shifted to F0 events in 2020, and the increase in LT0- and LT1 events in 2020. The Nordic IT-system for collecting and calculating F events was not ready in time for the 2019 data, which

explains the exceptional numbers of F events. There has never been a scale 2 or scale 3 incident in the Nordic synchronous area.

Table 7.3: The annual number of ICS events by ICS criterion from 2016 to 2020 in the Nordic synchronous area. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	2	-	62
	Incidents on network elements (T0)	9	7	77	59	73
	Incidents on power generating facilities (G0)	-	-	1	1	5
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	5	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	1	10
	Total	9	7	85	61	150
Scale 1	Incidents on load (L1)	2	2	3	2	1
	Incidents leading to frequency degradation (F1)	-	-	-	106	4
	Incidents on network elements (T1)	49	33	7	1	3
	Incidents on power generating facilities (G1)	1	-	-	-	-
	N-1 violation (ON1)	9	-	2	-	2
	Separation from the grid (RS1)	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	2	2	-	6
	Total	61	37	14	109	17
Scale 2	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	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		70	44	99	170	167

7.3 Analysis of significant changes in trends

In 2020, 167 scale 0 and 1 events were reported in the Nordic synchronous area, representing a decrease of three events compared to 2019 and an increase in 68 events compared to 2018.

The most significant changes are due to an increase in reported incidents leading to frequency degradation (F), with 106 F1 events in 2019 and 62 F0 events in 2020. It seems, that the estimate of several hundred F0 events missing in 2019 was incorrect, and that the reporting thresholds were simply inaccurate. Since the F event thresholds were updated yet again for the ICS Annual Report of 2020 [1], the number of F events must be followed in the future. The Nordic TSOs are aware of this and will gather the data for the coming years.

8 Events in Great Britain

8.1 Overview of 2020

This section presents an overview of ICS events in Great Britain in 2020. The events are presented by ICS criterion and further grouped by month and duration in Table 8.1 and Table 8.2, respectively.

National Grid Electricity System Operator (National Grid ESO) of Great Britain reported 260 ICS events (259 ICS incidents) in 2020, of which 259 events (258 incidents) were scale 0 and 1 event (1 incident) were scale 1. There was one ICS incidents in which two ICS events were registered. In this incident, the event on a network element (T0) was suppressed by a concurrent event with a higher priority (F0).

There was one scale 1 ICS event and it due to loss of tools, means or facilities (LT1).

Out of the 259 scale 0 ICS events, 169 events were related to transmission network elements (T0), 76 events were due to loss of tools, means or facilities (LT0), 12 events were on power generating facilities (G0), and two events were frequency degradations (F0). All transmission events were secured by applying curative remedial actions within appropriate timescales. Disturbances on transmission network elements (T0), loss of tools, means and facilities (LT0) and power generating facilities (G0) accounted for a significant portion of the reported ICS events, as shown in Table 8.1 and Table 8.2. Most of the events on transmission system elements (T0) were caused by primary system faults that resulted in the automatic operation of circuit breakers following the detection of primary system fault current. The system remained secure following all events.

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

As shown in Table 8.2, 15 % of the reported ICS events were resolved within one hour and 27 % of the reported events lasted longer than 24 hours. Thorough site investigations were initiated, and mitigating actions were deployed in most instances to ensure that the network elements were reconditioned and maintained before re-energisation resulting in longer restoration times.

Around 69 % (116) of the 169 events on transmission network elements (T0) and 86 % (65) of the 76 events involving loss of tools, means and facilities (LT0) were resolved within 24 hours.

Table 8.1: Number of ICS events by ICS criteria distributed per month in 2020 in Great Britain.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	1	-	-	-	-	-	-	-	-	1	-	2
	Incidents on network elements (T0)	15	20	10	15	14	19	9	12	9	19	9	18	169
	Incidents on power generating facilities (G0)	-	-	1	1	1	1	-	3	2	2	-	1	12
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	4	8	8	4	7	7	1	6	7	9	10	5	76
	Total	19	29	19	20	22	27	10	21	18	30	20	24	259
Scale 1	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)	-	-	-	-	1	-	-	-	-	-	-	-	1
	Total	-	-	-	-	1	-	-	-	-	-	-	-	1
Scale 2	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	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		19	29	19	20	23	27	10	21	18	30	20	24	260

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Table 8.2: Cumulative number of ICS events by ICS criteria and duration in 2020 in Great Britain.

		2020					
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	2	2	2	2	2	2
	Incidents on network elements (T0)	19	33	71	92	116	169
	Incidents on power generating facilities (G0)	2	4	5	5	6	12
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	15	23	42	54	65	76
	Total	38	62	120	153	189	259
Scale 1	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)	-	-	1	1	1	1
	Total	-	-	1	1	1	1
Scale 2	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	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		38	62	121	154	190	260

8.2 Evolution 2016–2020

This section presents the annual number of ICS events in Great Britain from 2016 to 2020, distributed by scale and ICS criterion. The ICS criteria used in this report are presented in Table 2.1. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

National Grid Electricity System Operator (NGESO) from Great Britain (GB) recorded 260 scale 0–3 ICS events (259 ICS incidents) in comparison to 276 incidents in 2019, 250 in 2018. The reporting numbers are showing a steady increase in incidents since 2016. In 2020, there were 259 scale 0 ICS events, one scale 1 events and no scale 2–3 events.

Table 8.3 shows that yearly numbers of ICS events from 2018 to 2020 are quite similar. The large number of scale 0 incidents emerging in 2018 to 2020 are attributed to the change in the ICS Methodology. The sizeable increase in the number of incidents reported from 2017 to 2018 was due to the reporting scale change for frequency degradation (F0) and loss of tools and facilities (LT0). If F0- and LT0 events are excluded, the number of incidents is similar to those reported between 2016 and 2017. The ICS Methodology updates are summarised in Section 2.1.

In 2020, Great Britain recorded one scale 1 ICS events compared to zero in 2019, two in 2018, 12 in 2017 and 10 in 2016. The first scale 2 incident in Great Britain, recorded in 2019, was an incident leading to frequency degradation (F2). Details of the scale 2 incident can be found in the 2019 ICS Annual Report [10, Ch. 4.2].

Table 8.3: The annual number of ICS events by ICS criterion from 2016 to 2020 in Great Britain. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	58	78	2
	Incidents on network elements (T0)	101	124	156	155	169
	Incidents on power generating facilities (G0)	1	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)	-	-	31	42	76
	Total	102	126	248	275	259
Scale 1	Incidents on load (L1)	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	9	10	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-
	N-1 violation (ON1)	-	-	2	-	-
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	1	2	-	-	1
	Total	10	12	2	-	1
Scale 2	Incidents on load (L2)	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	1	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	-	-	-	1	-
Scale 3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		112	138	250	276	260

8.3 Analysis of significant changes in trends

In 2020, 260 scale 0–3 ICS events (259 ICS incidents) were reported in Great Britain's synchronous area, which is similar to the number of incidents reported in 2018 and 2019. The dominant ICS criteria in 2020 were incidents on transmission system elements (T0) and loss of tools and facilities (LT0).

The number of scale 0 incidents in 2020 decreased slightly compared to 2019, while scale 1 incidents were similar in number to previous years (one in 2020, zero in 2019 and two in 2018).

There were no scale 2 events in 2020, unlike in 2019, when the first scale 2 incident in Great Britain was recorded. The dominating ICS criterion of the scale 2 incident in 2019 was incidents leading to frequency degradation (F2).

The increased reporting of ICS incidents is primarily attributed to the ICS Methodology update in 2018 [4]. This evolving trend needs to be followed up when the methodology has stabilised.

9 Events in the Baltic Area

9.1 Overview of 2020

This section presents an overview of ICS events in the Baltic area in 2020. The events are presented by ICS criterion and further grouped by month and duration in Table 9.1 and Table 9.2, respectively.

In 2019, 56 ICS events were reported in the Baltic area. Of these, 46 were scale 0, 9 were scale 1 and 1 was scale 2. No scale 3 incidents were reported in 2020. The scale 2 incident was the only registered scale 2 incident between 2016 and 2020, and is described in further detail in Section 4.1.

Incidents on transmission network elements (T0) and incidents on power generating facilities (G0) were the most frequent types of incidents, as shown in Table 9.1. Furthermore, the number of incidents recorded in 2020 has a uniform distribution during the year with a slight concentration of incidents towards the summer.

In 2020, there were 26 incidents on power generating facilities (G0) compared with 2 in 2018 and 11 in 2019. The increase relates to issues at one generating facility.

The distribution of incidents by duration shown in Table 9.2 indicates that 12 of the 56 events in 2020 were resolved in less than an hour, and 10 events took more than 24 hours to resolve. Approximately 83 % of all events were resolved within 24 hours.

Table 9.1: Number of ICS events by ICS criteria distributed per month in 2020 in the Baltic area.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	1	-	1	-	2	2	2	3	3	3	-	3	20
	Incidents on power generating facilities (G0)	2	2	2	-	-	5	6	1	2	2	2	2	26
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	3	2	3	-	2	7	8	4	5	5	2	5	46
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	2	-	-	-	-	2	-	-	-	-	-	1	5
	Incidents on power generating facilities (G1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	2	-	-	-	-	5	-	1	-	-	-	1	9
Scale 2	Incidents on load (L2)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	1	-	-	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		5	2	3	-	2	13	8	5	5	5	2	6	56

Table 9.2: Cumulative number of ICS events by ICS criteria and duration in 2020 in the Baltic area.

		2020					
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-
	Incidents on network elements (T0)	6	11	17	17	17	20
	Incidents on power generating facilities (G0)	2	3	14	18	21	26
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-
	Total	8	14	31	35	38	46
Scale 1	Incidents on load (L1)	-	1	1	1	1	1
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	-	2	2	2	3	5
	Incidents on power generating facilities (G1)	1	1	1	1	1	1
	N-1 violation (ON1)	1	1	1	1	1	1
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	1	1	1	1	1	1
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-
	Total	3	6	6	6	7	9
Scale 2	Incidents on load (L2)	1	1	1	1	1	1
	Incidents leading to frequency degradation (F2)	-	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-	-
	Total	1	1	1	1	1	1
Scale 3	Blackout (OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		12	21	38	42	46	56

9.2 Evolution 2016–2020

This section presents the annual number of ICS events in the Baltic area power system from 2016 to 2020, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in Table 2.1. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

The number of reported events is showing a slight annual increase, as seen in Table 9.3. The reasons are different each year; in 2020 the rise is linked to specific events on power generating facilities (G0). The number of G0 events increased from 11 events in 2019 to 26 in 2020. 23 of the 26 G0 events in 2020 and 10 of the 11 G0 events in 2019 occurred in Elering's power grid. This increase should be followed up on in the future. The most common type of event with regular occurrences is incidents on network elements (T0).

Table 9.3: The annual number of ICS events by ICS criterion from 2016 to 2020 in the Baltic area. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	19	17	25	28	20
	Incidents on power generating facilities (G0)	3	-	2	11	26
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-
	Total	22	17	27	39	46
Scale 1	Incidents on load (L1)	-	-	-	2	1
	Incidents leading to frequency degradation (F1)	1	-	-	1	-
	Incidents on network elements (T1)	13	11	-	3	5
	Incidents on power generating facilities (G1)	1	-	-	-	1
	N-1 violation (ON1)	-	-	-	-	1
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	1
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	4	-	1	-	-
	Total	19	11	1	6	9
Scale 2	Incidents on load (L2)	-	-	-	-	1
	Incidents leading to frequency degradation (F2)	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	-	-	-	-	1
Scale 3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		41	28	28	45	56

9.3 Analysis of significant changes in trends

In 2020, a total of 56 scale 0–3 events were reported in the Baltic area. They were mostly caused by incidents on transmission network elements (T0) and incidents on power generating facilities (G0). While the number of T0 events was stable, the number of G0 events was exceptionally high. The higher number of events in 2020 compared to 2019 is linked to the increased number of events reported by Elering AS. This increase should be followed up on in the future.

The number of reported scale 1 events was higher in 2020 compared to 2019. They were mostly caused by events on transmission network elements (T1). One incident on load (L) reached scale 2. The incident was reported by AS Augstsprieguma tīkls and comprised several sequential events, which resulted in a loss of between 10 % and 50 % of the load in the TSO's control area. This scale 2 incident was the first registered scale 2 incident since 2016. It is described in further detail in Section 4.1.

In general, most of the events in 2020 were events on transmission system elements (T) and on power generating facilities (G). Small differences in other criteria are more connected to the small size of the Baltic area and the probability of uncommon events.

10 Events in Ireland

10.1 Overview of 2020

This section presents an overview of ICS events in Ireland in 2020. The events are presented by ICS criterion and further grouped by month and duration in Table 10.1 and Table 10.2, respectively.

In 2020, 30 ICS events were reported in Ireland, of which 27 were of scale 0 and three of scale 1. No scale 2 or scale 3 incidents were reported in 2020.

In 2020, 63 % of all ICS events in Ireland were incidents on power generating facilities (G0), 27 % were incidents transmission network elements (T0), and 10 % were N-1 violations (ON1), as can be seen in Table 10.1. The events did not show any nonuniform monthly distribution during the year. Furthermore, 19 events at power generating facilities (G0) were reported with an average generation disconnection of 320 MW. Eight events on transmission network elements (T0) were reported. Tripping of elements was considered to fall in the category of ordinary trips due to different reasons, such as those due to environmental causes or equipment failure.

83 % (24) of the 30 ICS events were cleared in under 24 hours, as seen in Table 10.2. The remainder, 6 in number, lasted longer than 24 hours.

Table 10.1: Number of ICS events by ICS criteria distributed per month in 2020 in Ireland.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	-	3	1	-	-	1	-	1	-	-	-	2	8
	Incidents on power generating facilities (G0)	2	1	-	2	1	1	2	3	4	1	1	1	19
	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	4	1	2	1	2	2	4	4	1	1	3	27
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-	-	1	1	-	-	1	3
	Separation from the grid (RS1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	1	1	-	-	1	3
Scale 2	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	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		2	4	1	2	1	2	2	5	5	1	1	4	30

Table 10.2: Cumulative number of ICS events by ICS criteria and duration in 2020 in Ireland.

		2020					
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-
	Incidents on network elements (T0)	-	-	3	3	4	8
	Incidents on power generating facilities (G0)	2	5	12	16	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)	-	-	-	-	-	-
	Total	2	5	15	19	21	27
Scale 1	Incidents on load (L1)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	-	-	-	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	-	1	3	3	3	3
	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	3	3	3	3
Scale 2	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	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		2	6	18	22	24	30

10.2 Evolution 2016–2020

This section presents the annual number of ICS events in Ireland from 2016 to 2020, distributed by scale and ICS criterion. The ICS criteria used in this report are presented in Table 2.1. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

The number of scale 0 ICS events reported in 2020 is comparable to that reported in 2019, as seen in Table 10.3. Three scale 1 ICS events were reported in 2020 and none in 2019. A total of 14 scale 1 events were registered between 2016 and 2020. A stable trend of reported incidents can be seen over the years. In 2019, 10 incidents on power generating facilities (G0) were reported. The number of incidents saw a considerable increase in 2020, however it is still comparable to previous years. No scale 2 or scale 3 incidents were reported in Ireland in 2020. The previous scale 2 incident was in 2018, and it was caused by a frequency deviation mainly due to a loss of generation.

Table 10.3: The annual number of ICS events by ICS criterion from 2016 to 2020 in Ireland. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	8	4	-
	Incidents on network elements (T0)	10	3	9	9	8
	Incidents on power generating facilities (G0)	21	24	7	10	19
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	1	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	-
	Total	32	27	24	23	27
Scale 1	Incidents on load (L1)	-	-	-	-	-
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	1	6	-	-	-
	Incidents on power generating facilities (G1)	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	3
	Separation from the grid (RS1)	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	2	-	-	-
	Total	1	8	-	-	3
Scale 2	Incidents on load (L2)	-	-	-	-	-
	Incidents leading to frequency degradation (F2)	-	-	1	-	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	Total	-	-	1	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		33	35	25	23	30

10.3 Analysis of significant changes in trends

In 2020, a total of 30 ICS events were reported in Ireland, which is comparable to 2019, when 23 events were reported. The dominant criteria in 2020 were events on power generating facilities (G0) and events involving transmission network elements (T0). The remaining three were N-1 violations (ON1).

The continuing trend of G0- and T0 events can still be seen in Ireland. However, in 2020 there were three scale 1 N-1 violations (ON1). The number of scale 1 incidents was zero in 2018 and 2019, when the ICS Methodology was updated [4]. The 2018 and 2019 Methodology updates are summarised in Section 2.1. No scale 2 or scale 3 events were reported in 2020, which means that the reported ICS events were low impact and did not affect normal operating conditions.

11 Incidents in isolated systems

11.1 Overview of 2020

This section presents an overview of ICS events in isolated systems in 2020. The events are presented by ICS criterion and further grouped by month and duration in Table 11.1 and Table 11.2, respectively.

In 2020, a total of 46 ICS events were reported for the isolated systems of Iceland and Cyprus. All the events occurred in Iceland, and they were all of either scale 0 or scale 1. No scale 2 or scale 3 events were recorded.

Most of the reported ICS events were events on transmission network elements (T0 and T1), as shown in Table 11.1. Events on transmission network elements (T0 and T1) were primarily due to technical equipment or environmental causes. Three events on power generating facilities (G0) and one event on load (L1) were also reported.

The analysis of the distribution of ICS events per duration shows a uniform distribution over the categories for scale 0 incidents. Approximately half of the events lasted less than 5 hours, and a quarter of the events lasted less than 1 hour. Only 5 events took longer than 24 hours to resolve, and all of them were of scale 0.

Table 11.1: Number of ICS events by ICS criteria distributed per month in 2020 in isolated systems.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T0)	7	8	2	-	1	3	-	2	3	1	-	2	29
	Incidents on power generating facilities (G0)	1	-	1	1	-	-	-	-	-	-	-	-	3
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	1	-	-	-	-	-	-	-	-	-	-	1
	Total	8	9	3	1	1	3	-	2	3	1	-	2	33
Scale 1	Incidents on load (L1)	-	1	-	-	-	-	-	-	-	-	-	-	1
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Incidents on network elements (T1)	4	2	-	-	-	-	-	1	2	-	1	2	12
	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	4	3	-	-	-	-	-	1	2	-	1	2	13
Scale 2	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	-	-	-	-	-	-	-	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		12	12	3	1	1	3	-	3	5	1	1	4	46

Table 11.2: Cumulative number of ICS events by ICS criteria and duration in 2020 in isolated systems.

		2020					
Scale	ICS criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents on load (L0)	-	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-	-
	Incidents on network elements (T0)	6	9	12	19	24	29
	Incidents on power generating facilities (G0)	3	3	3	3	3	3
	Separation from the grid (RS0)	-	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	1	1	1
	Total	9	12	15	23	28	33
Scale 1	Incidents on load (L1)	1	1	1	1	1	1
	Incidents leading to frequency degradation (F1)	-	-	-	-	-	-
	Incidents on network elements (T1)	1	4	7	11	12	12
	Incidents on power generating facilities (G1)	-	-	-	-	-	-
	N-1 violation (ON1)	-	-	-	-	-	-
	Separation from the grid (RS1)	-	-	-	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-
	Total	2	5	8	12	13	13
Scale 2	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	-	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Grand Total		11	17	23	35	41	46

11.2 Evolution 2016 to 2020

This section presents the annual number of incidents in the isolated systems from 2016 to 2020, distributed by scale and ICS criterion. The ICS criteria used in this report are presented in Table 2.1. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

The number of scale 0 ICS events reported in 2020 is significantly higher than that from 2016 to 2019, as seen in Table 11.3.

The significant increase is due to the number of scale 0 ICS events on network elements (T0), which increased from 5 in 2019 to 29 in 2020. This increase in T0 events in 2020 is a result of the recent ICS Methodology update [1], which included tripped 100–150 kV network elements which impact operational security. All other ICS criteria remained approximately on the same levels.

There were no scale 2 or scale 3 events in isolated systems in 2020. No scale 3 events have been reported from 2016 to 2020.

All ICS events during 2016–2020 in the isolated systems were reported by Landsnet in Iceland, except for one G2 event in 2016, and four L1 events and one L2 event in 2017.

Table 11.3: The annual number of ICS events by ICS criterion from 2016 to 2020 in isolated systems. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	-
	Incidents leading to frequency degradation (F0)	-	-	-	-	-
	Incidents on network elements (T0)	8	5	10	5	29
	Incidents on power generating facilities (G0)	-	1	-	4	3
	Separation from the grid (RS0)	-	-	-	-	-
	Violation of standards on voltage (OV0)	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	-	1
	Total	8	6	10	9	33
Scale 1	Incidents on load (L1)	2	7	-	-	1
	Incidents leading to frequency degradation (F1)	-	-	-	-	-
	Incidents on network elements (T1)	-	6	3	7	12
	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	15	3	7	13
Scale 2	Incidents on load (L2)	1	2	1	-	-
	Incidents leading to frequency degradation (F2)	-	-	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	1	-	-	-	-
	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	2	2	2	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-
	Total	-	-	-	-	-
Grand Total		12	23	15	16	46

11.3 Analysis of significant changes in trends

In 2020, a total of 46 ICS events were reported in isolated systems. There is no clear visible trend over the last years. In addition, the data must be interpreted cautiously since the overall number of events is low, and the isolated systems are only represented by two TSOs, Landsnet in Iceland and Cyprus TSO in Cyprus, which have very different operating environments.

The number of scale 0, Scale 1 and scale 2 events is not significant enough to make a relevant comparison with previous years. The only change in 2020 was the increase in reported T0 events, which was due to the recent ICS Methodology update [1] that included tripped 100–150 kV network elements which impact operational security.

Most of the events in the isolated systems occurred in Landsnet's transmission network, and the only finding that can be made is that overall, the number of scale 2 events is sporadic and that the year 2020 was a year without any scale 2 events.

12 Overview of events per TSO

This chapter presents detailed information about each TSO that reported data according to the Incident Classification Scale Methodology [4]. In total, 37 TSOs contributed data to the 2020 ICS report. The TSOs in each synchronous area are listed below.

TSOs were asked to comment on trends and out of average values. When comments have been received, they are presented in this report.

TSOs in continental Europe

- 50Hertz
- Amprion GmbH
- Austrian Power Grid AG (APG)
- CEPS
- CGES
- ELES
- Elia
- EMS JSC
- Energinet (CE)
- ESO EAD
- HOPS
- IPTO
- MAVIR ZRt
- MEPSO
- NOS BiH
- PSE
- REE
- REN
- RTE
- SEPS
- Swissgrid
- TenneT TSO B.V.
- TenneT TSO GmbH
- TERNA
- Transelectrica
- TransnetBW GmbH

Nordic TSOs

- Energinet (Nordic)
- Fingrid Oyj
- Statnett
- Svenska Kraftnät

TSO in Great Britain

- National Grid ESO

Baltic TSOs

- AS Augstsprieguma tīkls (AST)
- Elering AS
- Litgrid AB

TSOs in Ireland

- EirGrid
- SONI

TSOs in the isolated systems

- Cyprus TSO
- Landsnet

12.1 Overview of events per TSOs in continental Europe

12.1.1 Events reported by 50Hertz

This section presents events for 50Hertz, one of the TSOs in Germany. Table 12.1 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.2 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.1 presents the number of events grouped by duration in 2020.

Table 12.1: Monthly distribution of ICS events by ICS criterion in 2020 for 50Hertz.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	1	-	3	3	2	2	9	5	1	-	3	29
	Incidents on power generating facilities (G0)	5	2	-	-	-	-	-	1	-	-	1	-	9
	Loss of tools, means and facilities (LT0)	1	-	-	-	1	-	-	-	-	-	-	-	2
Scale 1	Loss of tools, means and facilities (LT1)	2	1	-	-	1	-	3	1	1	-	-	-	9
Grand Total		8	4	-	3	5	2	5	11	6	1	1	3	49

Table 12.2: The annual number of ICS events by ICS criterion from 2016 to 2020 for 50Hertz. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	12	17	30	24	29
	Incidents on power generating facilities (G0)	-	1	-	2	9
	Loss of tools, means and facilities (LT0)	-	-	-	6	2
Scale 1	Incidents on network elements (T1)	3	1	-	-	-
	Loss of tools, means and facilities (LT1)	-	1	-	3	9
	N-1 violation (ON1)	15	16	5	3	-
Grand Total		30	36	35	38	49

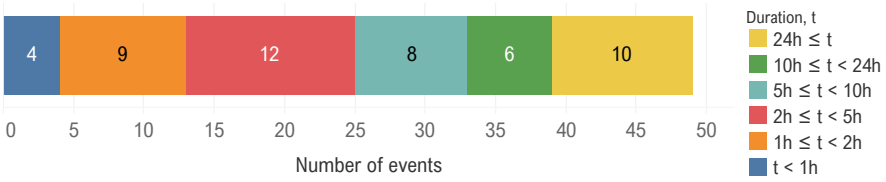

Figure 12.1: Number of events grouped by duration in 2020 for 50Hertz.

12.1.2 Events reported by Amprion GmbH

This section presents events for Amprion GmbH, one of the TSOs in Germany. Table 12.3 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.4 presents the annual number of ICS events by ICS criterion from 2016 to 2020.

Table 12.3: Monthly distribution of ICS events by ICS criterion in 2020 for Amprion GmbH.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	2	10	1	-	9	-	4	1	1	2	2	3	35
	Incidents on power generating facilities (G0)	-	-	-	-	1	-	3	1	1	1	-	2	9
	Loss of tools, means and facilities (LT0)	-	-	-	-	1	-	-	-	2	-	-	-	3
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	1	1	-	2	-	4
Grand Total		2	10	1	-	11	-	7	3	5	3	4	5	51

Table 12.4: The annual number of ICS events by ICS criterion from 2016 to 2020 for Amprion GmbH. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	12	25	47	31	35
	Incidents on power generating facilities (G0)	20	19	13	7	9
	Loss of tools, means and facilities (LT0)	-	-	-	6	3
Scale 1	Incidents on network elements (T1)	1	4	1	-	-
	Loss of tools, means and facilities (LT1)	-	4	6	-	-
	N-1 violation (ON1)	3	9	7	3	4
	Reduction of reserve capacity (RRC1)	-	-	-	1	-
Grand Total		36	61	74	48	51

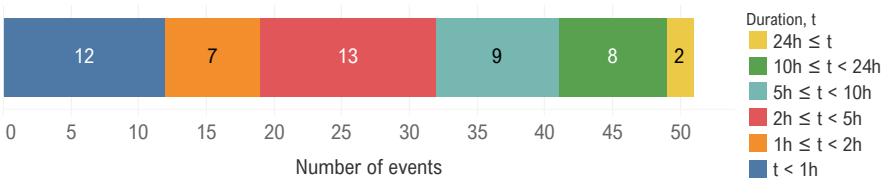

Figure 12.2: Number of events grouped by duration in 2020 for Amprion GmbH.

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12.1.3 Events reported by Austrian Power Grid AG (APG)

This section presents events for Austrian Power Grid AG (APG), the TSO in Austria. Table 12.5 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.6 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.3 presents the number of events grouped by duration in 2020.

Table 12.5: Monthly distribution of ICS events by ICS criterion in 2020 for Austrian Power Grid AG.

		2020												
Scale	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	5	1	-	-	4	6	1	-	2	24
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	-	1	-	1
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	2	-	-	1	-	3
	Loss of tools, means and facilities (LT1)	1	-	-	-	-	-	-	-	-	-	1	-	2
Grand Total		2	3	1	5	1	-	-	6	6	1	3	2	30

Table 12.6: The annual number of ICS events by ICS criterion from 2016 to 2020 for Austrian Power Grid AG. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	27	24	10	24	24
	Loss of tools, means and facilities (LT0)	-	-	-	-	1
Scale 1	Incidents on network elements (T1)	5	3	-	-	-
	Loss of tools, means and facilities (LT1)	-	-	-	2	2
	N-1 violation (ON1)	-	-	-	1	3
Grand Total		32	27	10	27	30

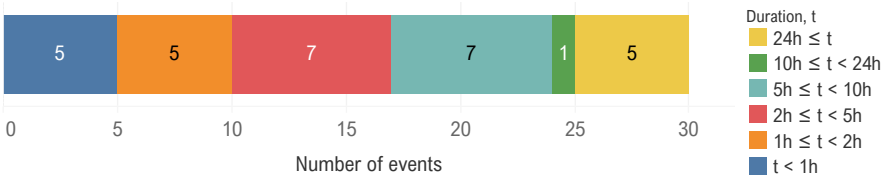

Figure 12.3: Number of events grouped by duration in 2020 for Austrian Power Grid AG.

12.1.4 Events reported by CEPS

This section presents events for CEPS, the TSO in the Czech Republic. Table 12.7 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.8 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.4 presents the number of events grouped by duration in 2020.

Table 12.7: Monthly distribution of ICS events by ICS criterion in 2020 for CEPS.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on load (L0)	-	-	-	1	-	-	-	-	-	-	-	-	1
	Incidents on network elements (T0)	4	-	-	-	2	1	2	4	3	1	-	1	18
	Incidents on power generating facilities (G0)	1	-	-	-	1	-	-	-	1	-	-	-	3
	Separation from the grid (RS0)	-	-	-	-	-	-	-	-	1	-	1	-	2
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	1	-	-	-	-	1
Scale 1	Incidents on network elements (T1)	-	-	-	1	-	-	-	-	1	-	2	-	4
	N-1 violation (ON1)	-	-	-	-	-	-	1	-	-	-	1	-	2
	Violation of standards on voltage (OV1)	-	-	-	-	1	-	1	-	-	3	-	-	5
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	1	-	-	-	-	1	-	2
Grand Total		5	-	-	2	4	2	4	5	6	4	5	1	38

Table 12.8: The annual number of ICS events by ICS criterion from 2016 to 2020 for CEPS. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	1
	Incidents on network elements (T0)	6	12	2	11	18
	Incidents on power generating facilities (G0)	4	-	2	6	3
	Loss of tools, means and facilities (LT0)	-	-	-	5	1
	Separation from the grid (RS0)	-	-	-	-	2
	Violation of standards on voltage (OV0)	-	-	31	19	-
Scale 1	Incidents on load (L1)	1	-	-	-	-
	Incidents on network elements (T1)	4	3	-	2	4
	Loss of tools, means and facilities (LT1)	2	3	1	1	2
	N-1 violation (ON1)	26	3	6	-	2
	Reduction of reserve capacity (RRC1)	1	2	-	-	-
	Violation of standards on voltage (OV1)	-	-	7	3	5
Grand Total		44	23	49	47	38

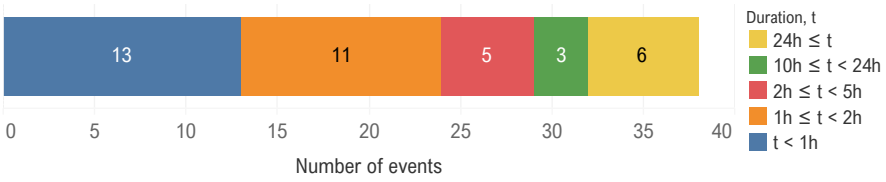

Figure 12.4: Number of events grouped by duration in 2020 for CEPS.

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12.1.5 Events reported by CGES

This section presents events for CGES, the TSO in Montenegro. Table 12.9 presents the annual number of ICS events by ICS criterion from 2016 to 2020. CGES did not report any ICS events in 2020.

Table 12.9: The annual number of ICS events by ICS criterion from 2016 to 2020 for CGES. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	26	22	84	71	-
Scale 1	Incidents on network elements (T1)	26	52	-	-	-
Grand Total		52	74	84	71	-

12.1.6 Events reported by ELES

This section presents events for ELES, the TSO in Slovenia. Table 12.10 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.11 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.5 presents the number of events grouped by duration in 2020.

Table 12.10: Monthly distribution of ICS events by ICS criterion in 2020 for ELES.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	-	-	2	-	-	-	-	2
	N-1 violation (ON1)	-	-	-	-	-	-	-	-	-	-	-	2	2
	Violation of standards on voltage (OV1)	1	-	-	2	2	-	-	-	-	-	-	-	5
Grand Total		1	-	-	2	2	-	-	2	-	-	-	2	9

Table 12.11: The annual number of ICS events by ICS criterion from 2016 to 2020 for ELES. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	2	5	4	4	-
Scale 1	Incidents on network elements (T1)	-	2	-	-	2
	N-1 violation (ON1)	-	-	-	-	2
	Violation of standards on voltage (OV1)	-	-	-	1	5
Scale 2	N violation (ON2)	-	-	-	1	-
Grand Total		2	7	4	6	9

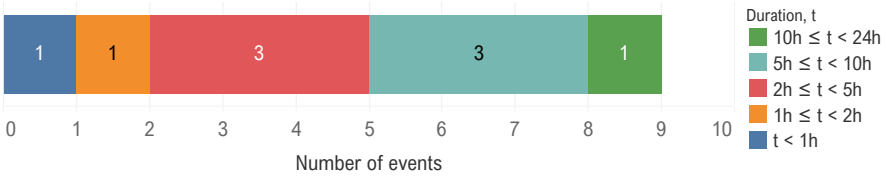

Figure 12.5: Number of events grouped by duration in 2020 for ELES.

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12.1.7 Events reported by Elia

This section presents events for Elia, the TSO in Belgium. Table 12.12 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.13 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.6 presents the number of events grouped by duration in 2020.

Table 12.12: Monthly distribution of ICS events by ICS criterion in 2020 for Elia.

		2020												
Scale	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	-	1	2	-	2	1	1	3	1	12
	Loss of tools, means and facilities (LT0)	-	-	-	-	2	-	-	-	-	1	-	-	3
Scale 1	N-1 violation (ON1)	-	-	-	-	-	1	1	-	1	-	1	-	4
	Violation of standards on voltage (OV1)	-	-	-	-	1	-	1	-	1	-	-	-	3
Grand Total		-	2	1	-	4	3	2	2	3	2	4	1	24

Table 12.13: The annual number of ICS events by ICS criterion from 2016 to 2020 for Elia. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on load (L0)	-	-	-	-	2
	Incidents on network elements (T0)	2	1	5	6	12
	Incidents on power generating facilities (G0)	6	6	1	2	-
	Loss of tools, means and facilities (LT0)	-	-	-	4	3
	Violation of standards on voltage (OV0)	1	-	1	1	-
Scale 1	Incidents on network elements (T1)	-	1	-	-	-
	Loss of tools, means and facilities (LT1)	1	3	4	-	-
	N-1 violation (ON1)	-	3	1	8	4
	Reduction of reserve capacity (RRC1)	-	3	-	1	-
	Violation of standards on voltage (OV1)	-	-	-	-	3
Grand Total		10	17	12	22	24

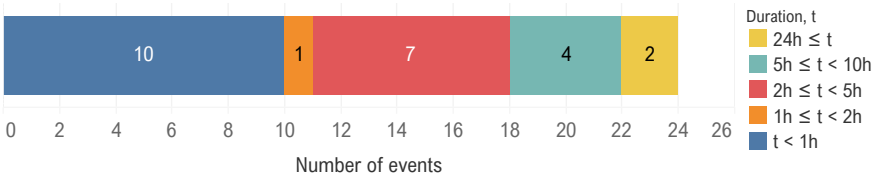

Figure 12.6: Number of events grouped by duration in 2020 for Elia.

12.1.8 Events reported by EMS JSC

This section presents events for EMS JSC, the TSO of Serbia. Table 12.14 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.15 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.7 presents the number of events grouped by duration in 2020.

Table 12.14: Monthly distribution of ICS events by ICS criterion in 2020 for EMS JSC.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	4	1	4	4	2	2	3	-	-	1	3	24
Scale 1	Incidents on load (L1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Incidents on network elements (T1)	-	-	-	1	-	1	1	-	-	-	-	-	3
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand Total		-	4	1	5	4	4	3	3	1	-	1	3	29

Table 12.15: The annual number of ICS events by ICS criterion from 2016 to 2020 for EMS JSC. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	2	4	4	8	24
	Incidents on power generating facilities (G0)	2	-	28	-	-
	Loss of tools, means and facilities (LT0)	-	-	-	1	-
	Violation of standards on voltage (OV0)	10	12	-	-	-
Scale 1	Incidents on load (L1)	1	1	-	-	1
	Incidents on network elements (T1)	-	3	-	3	3
	Loss of tools, means and facilities (LT1)	-	-	-	-	1
	Reduction of reserve capacity (RRC1)	-	1	-	-	-
Grand Total		15	21	32	12	29

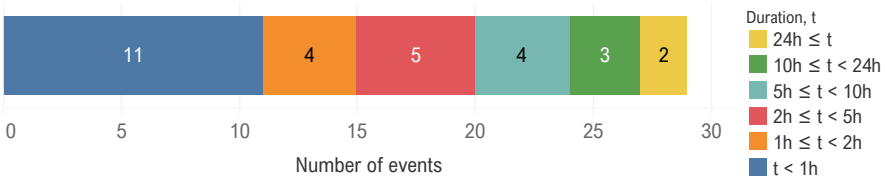

Figure 12.7: Number of events grouped by duration in 2020 for EMS JSC.

12.1.9 Events reported by Energinet (CE)

This section presents events for Energinet (CE), the TSO in Denmark. Table 12.16 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.17 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.8 presents the number of events grouped by duration in 2020.

Table 12.16: Monthly distribution of ICS events by ICS criterion in 2020 for Energinet (CE).

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	2	1	-	-	1	2	-	2	2	2	3	-	15
	Loss of tools, means and facilities (LT0)	-	1	-	-	-	1	-	-	-	-	1	-	3
Scale 1	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand Total		2	2	-	-	1	3	-	2	3	2	4	-	19

Table 12.17: The annual number of ICS events by ICS criterion from 2016 to 2020 for Energinet (CE). It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	1	1	6	15	15
	Loss of tools, means and facilities (LT0)	-	-	-	4	3
Scale 1	Incidents on network elements (T1)	6	6	-	-	-
	Loss of tools, means and facilities (LT1)	3	-	-	1	-
	Reduction of reserve capacity (RRC1)	-	-	-	-	1
Grand Total		10	7	6	20	19

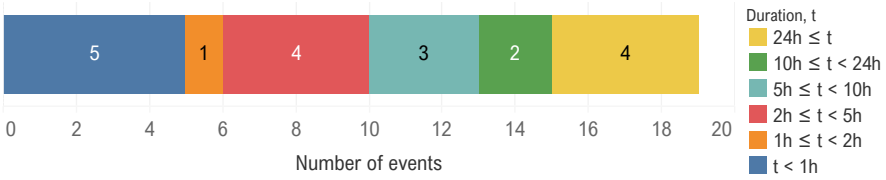

Figure 12.8: Number of events grouped by duration in 2020 for Energinet (CE).

12.1.10 Events reported by ESO EAD

This section presents events for ESO EAD, the TSO in Bulgaria. Table 12.18 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.19 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.9 presents the number of events grouped by duration in 2020.

Table 12.18: Monthly distribution of ICS events by ICS criterion in 2020 for ESO EAD.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	15	2	1	3	4	2	5	6	1	-	1	40
Grand Total		-	15	2	1	3	4	2	5	6	1	-	1	40

Table 12.19: The annual number of ICS events by ICS criterion from 2016 to 2020 for ESO EAD. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	16	25	29	38	40
	Incidents on power generating facilities (G0)	-	-	-	2	-
Scale 1	Incidents on network elements (T1)	10	11	-	-	-
Grand Total		26	36	29	40	40

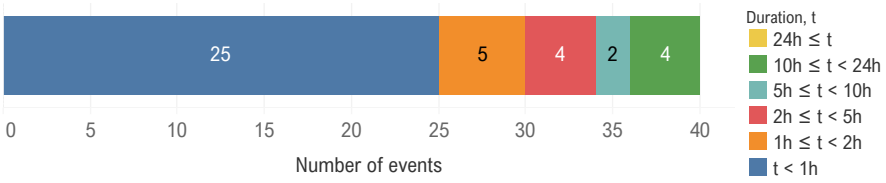

Figure 12.9: Number of events grouped by duration in 2020 for ESO EAD.

12.1.11 Events reported by HOPS

This section presents events for HOPS, the TSO in Croatia. Table 12.20 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.21 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.10 presents the number of events grouped by duration in 2020.

Table 12.20: Monthly distribution of ICS events by ICS criterion in 2020 for HOPS.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	2	1	-	-	-	4	3	9	2	3	-	7	31
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	-	-	1	1
Grand Total		2	1	-	-	-	4	3	9	2	3	-	8	32

Table 12.21: The annual number of ICS events by ICS criterion from 2016 to 2020 for HOPS. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1. HOPS did not have any events from 2015–2016.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	-	-	6	31	31
	Loss of tools, means and facilities (LT0)	-	-	-	-	1
Scale 1	N-1 violation (ON1)	-	11	-	-	-
Grand Total		-	11	6	31	32

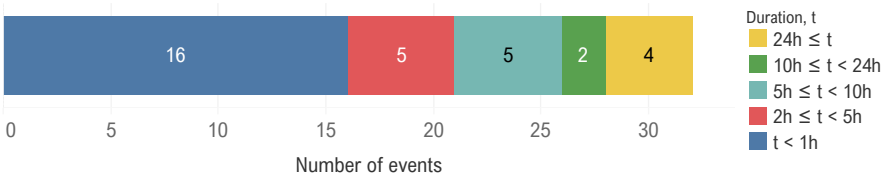

Figure 12.10: Number of events grouped by duration in 2020 for HOPS.

12.1.12 Events reported by IPTO

This section presents events for IPTO, the TSO in Greece. Table 12.22 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.23 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.11 presents the number of events grouped by duration in 2020.

Table 12.22: Monthly distribution of ICS events by ICS criterion in 2020 for IPTO.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	4	3	-	2	1	1	2	2	2	3	1	2	23
	Violation of standards on voltage (OV0)	2	1	5	2	3	-	-	-	1	-	-	-	14
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	1	-	-	-	1
	Violation of standards on voltage (OV1)	-	4	4	8	2	-	-	-	2	3	3	-	26
Grand Total		6	8	9	12	6	1	2	2	6	6	4	2	64

Table 12.23: The annual number of ICS events by ICS criterion from 2016 to 2020 for IPTO. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	16	8	22	17	23
	Violation of standards on voltage (OV0)	-	-	2	2	14
Scale 1	Incidents on load (L1)	-	-	1	-	-
	Incidents on network elements (T1)	8	17	-	3	1
	Violation of standards on voltage (OV1)	4	-	1	1	26
Grand Total		28	25	26	23	64

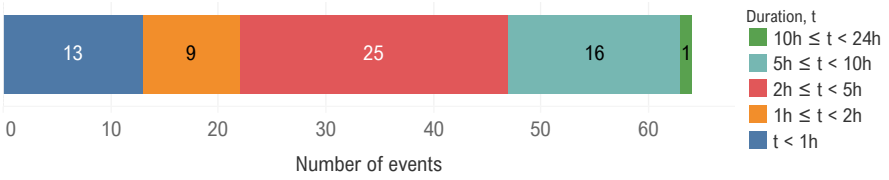

Figure 12.11: Number of events grouped by duration in 2020 for IPTO.

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12.1.13 Events reported by MAVIR ZRt

This section presents events for MAVIR ZRt, the TSO in Hungary. Table 12.24 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.25 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.12 presents the number of events grouped by duration in 2020.

The RRC events registered by MAVIR ZRt were mostly caused by reaching the technical maximum ramping rate of the power plants.

Table 12.24: Monthly distribution of ICS events by ICS criterion in 2020 for MAVIR ZRt.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	2	1	-	1	-	-	1	1	-	-	-	-	6
	Violation of standards on voltage (OV0)	-	1	7	38	21	26	18	30	57	71	12	11	292
Scale 1	Reduction of reserve capacity (RRC1)	23	5	6	5	6	1	3	4	-	2	6	2	63
Grand Total		25	7	13	44	27	27	22	35	57	73	18	13	361

Table 12.25: The annual number of ICS events by ICS criterion from 2016 to 2020 for MAVIR ZRt. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	-	-	72	52	6
	Reduction of reserve capacity (RRC0)	-	-	-	1	-
	Violation of standards on voltage (OV0)	-	-	77	43	292
Scale 1	Loss of tools, means and facilities (LT1)	1	-	-	1	-
	N-1 violation (ON1)	-	-	1	-	-
	Reduction of reserve capacity (RRC1)	-	3	112	155	63
Scale 2	Separation from the grid (RS2)	1	-	-	-	-
Grand Total		2	3	262	252	361

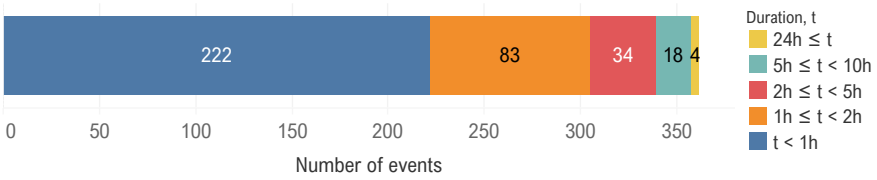

Figure 12.12: Number of events grouped by duration in 2020 for MAVIR ZRt.

12.1.14 Events reported by MEPSO

This section presents events for MEPSO, the TSO in Macedonia. Table 12.26 presents the annual number of ICS events by ICS criterion from 2016 to 2020. MEPSO did not report any ICS events in 2020.

Table 12.26: The annual number of ICS events by ICS criterion from 2016 to 2020 for MEPSO. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	1	-	4	-	-
Scale 1	Incidents on network elements (T1)	3	4	-	5	-
Grand Total		4	4	4	5	-

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12.1.15 Events reported by NOS BiH

This section presents events for NOS BiH, the TSO in Bosnia and Herzegovina. Table 12.27 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.28 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.13 presents the number of events grouped by duration in 2020.

Table 12.27: Monthly distribution of ICS events by ICS criterion in 2020 for NOS BiH.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	6	-	-	6	3	3	3	1	2	-	3	27
Grand Total		-	6	-	-	6	3	3	3	1	2	-	3	27

Table 12.28: The annual number of ICS events by ICS criterion from 2016 to 2020 for NOS BiH. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	-	5	80	20	27
Grand Total		-	5	80	20	27

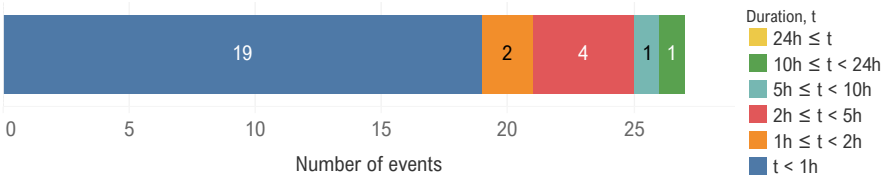

Figure 12.13: Number of events grouped by duration in 2020 for NOS BiH.

12.1.16 Events reported by PSE

This section presents events for PSE, the TSO in Poland. Table 12.29 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.30 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.14 presents the number of events grouped by duration in 2020.

The number of reported events by PSE has been consistent after 2017. Most of the events have been either incidents on network elements (T0) or incidents on power generating facilities (G0). However, other types of ICS events (LT0, ON1 and RRC1) have occurred occasionally.

Table 12.29: Monthly distribution of ICS events by ICS criterion in 2020 for PSE.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	3	11	8	3	1	11	9	7	8	4	5	6	76
	Incidents on power generating facilities (G0)	1	2	2	-	1	1	2	2	1	-	-	1	13
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	1	-	-	1	-	2
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	1	-	-	-	-	-	1
Grand Total		4	13	10	3	2	12	12	10	9	4	6	7	92

Table 12.30: The annual number of ICS events by ICS criterion from 2016 to 2020 for PSE. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	69	40	86	89	76
	Incidents on power generating facilities (G0)	1	-	14	10	13
	Loss of tools, means and facilities (LT0)	-	-	-	1	2
Scale 1	Incidents on network elements (T1)	14	5	-	-	-
	N-1 violation (ON1)	1	-	-	-	1
	Reduction of reserve capacity (RRC1)	-	-	-	1	-
Grand Total		85	45	100	101	92

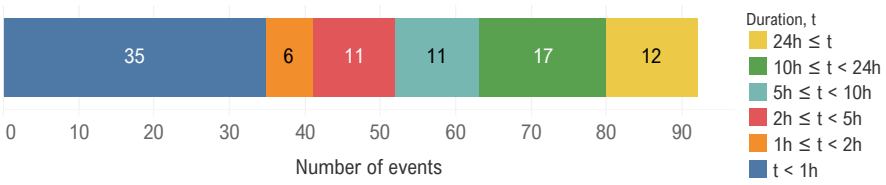

Figure 12.14: Number of events grouped by duration in 2020 for PSE.

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12.1.17 Events reported by REE

This section presents events for REE, the TSO in Spain. Table 12.31 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.32 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.15 presents the number of events grouped by duration in 2020.

The ICS Methodology update in 2018 caused the number of events that REE reported in 2019 to increase significantly in comparison to the previous years. Since the same criteria was used for 2019 and 2020, the difference between the number of events reported for these years is minimal. The overwhelming majority of the events that REE reported in 2020 were related to scale 0 incidents on network elements, which represent more than 97 % of the grand total. Only one scale 1 incident was registered in Spain during 2020.

January was the month with most incidents reported by REE in 2020 (49), mainly because of strong weather conditions. The weather, together with concomitant fires, made September the second month with most reported T0 incidents (31). The rest of the year, the monthly number of events registered by the Spanish TSO was kept between 10 and 24.

Table 12.31: Monthly distribution of ICS events by ICS criterion in 2020 for REE.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	63	15	24	10	16	10	15	23	33	16	10	23	258
	Loss of tools, means and facilities (LT0)	4	-	-	-	-	-	-	-	-	-	1	-	5
Scale 1	Incidents on load (L1)	1	-	-	-	-	-	-	-	-	-	-	-	1
Grand Total		68	15	24	10	16	10	15	23	33	16	11	23	264

Table 12.32: The annual number of ICS events by ICS criterion from 2016 to 2020 for REE. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	-	-	90	235	258
	Incidents on power generating facilities (G0)	-	2	-	-	-
	Loss of tools, means and facilities (LT0)	-	-	1	2	5
Scale 1	Incidents on load (L1)	-	-	1	-	1
	Incidents on network elements (T1)	-	14	-	-	-
	Loss of tools, means and facilities (LT1)	-	1	1	-	-
Grand Total		-	17	93	237	264

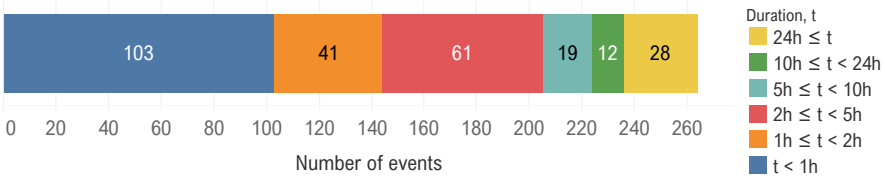

Figure 12.15: Number of events grouped by duration in 2020 for REE.

12.1.18 Events reported by REN

This section presents events for REN, the TSO in Portugal. Table 12.33 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.34 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.16 presents the number of events grouped by duration in 2020.

Table 12.33: Monthly distribution of ICS events by ICS criterion in 2020 for REN.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	-	3	-	1	3	1	-	2	1	-	11
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	-	-	1	1	2
Grand Total		-	-	-	3	-	1	3	1	-	2	2	1	13

Table 12.34: The annual number of ICS events by ICS criterion from 2016 to 2020 for REN. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	23	38	15	10	11
	Incidents on power generating facilities (G0)	1	-	1	-	-
	Loss of tools, means and facilities (LT0)	-	-	1	1	2
Scale 1	Incidents on network elements (T1)	8	2	-	-	-
Grand Total		32	40	17	11	13

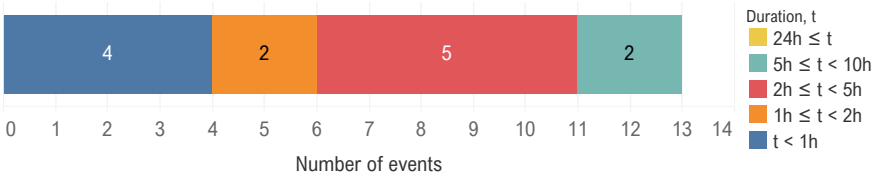

Figure 12.16: Number of events grouped by duration in 2020 for REN.

12.1.19 Events reported by RTE

This section presents events for RTE, the TSO in France. Table 12.35 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.36 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.17 presents the number of events grouped by duration in 2020.

Events on transmission networks elements (T0) are mainly due to weather conditions, particularly thunderstorms during the summer period. However, the system state did not degrade after those events. The change on the ON1-criteria in the 2019 ICS Methodology [1] explains the increase in ON1 events in 2020.

Table 12.35: Monthly distribution of ICS events by ICS criterion in 2020 for RTE.

		2020												
Scale	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)	11	17	6	19	22	17	10	19	9	10	7	7	154
	Incidents on power generating facilities (G0)	4	4	2	4	-	4	3	1	-	2	2	3	29
	Violation of standards on voltage (OV0)	-	5	2	1	3	1	-	2	-	1	-	-	15
	Loss of tools, means and facilities (LT0)	-	2	-	-	1	1	-	-	-	-	-	-	4
Scale 1	N-1 violation (ON1)	1	-	-	3	5	10	5	3	1	1	1	-	30
	Violation of standards on voltage (OV1)	-	3	-	3	4	3	2	2	-	1	-	-	18
	Reduction of reserve capacity (RRC1)	-	-	-	-	-	-	1	-	-	-	-	1	2
	Loss of tools, means and facilities (LT1)	-	-	-	1	-	-	-	-	-	-	-	-	1
Grand Total		16	32	10	31	35	36	21	27	10	15	10	11	254

Table 12.36: The annual number of ICS events by ICS criterion from 2016 to 2020 for RTE. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents leading to frequency degradation (F0)	15	11	-	-	-
	Incidents on load (L0)	-	-	-	-	1
	Incidents on network elements (T0)	16	38	75	270	154
	Incidents on power generating facilities (G0)	27	32	30	19	29
	Loss of tools, means and facilities (LT0)	-	-	14	29	4
	Violation of standards on voltage (OV0)	-	3	68	10	15
Scale 1	Incidents on network elements (T1)	11	21	4	3	-
	Loss of tools, means and facilities (LT1)	3	-	8	7	1
	N-1 violation (ON1)	1	-	4	-	30
	Reduction of reserve capacity (RRC1)	-	1	5	1	2
	Violation of standards on voltage (OV1)	-	1	38	2	18
Grand Total		73	107	246	341	254

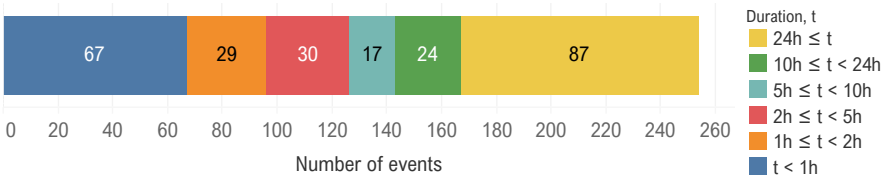

Figure 12.17: Number of events grouped by duration in 2020 for RTE.

12.1.20 Events reported by SEPS

This section presents events for SEPS, the TSO in Slovakia. Table 12.37 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.38 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.18 presents the number of events grouped by duration in 2020.

Table 12.37: Monthly distribution of ICS events by ICS criterion in 2020 for SEPS.

		2020												
Scale	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	-	-	-	4
	Violation of standards on voltage (OV0)	-	-	-	13	4	15	2	12	3	-	-	-	49
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	-	-	-	-	-	-	3	3
	N-1 violation (ON1)	-	-	-	-	-	-	-	-	-	-	-	1	1
	Violation of standards on voltage (OV1)	-	-	-	2	-	5	-	2	-	-	-	2	11
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	1	-	-	-	1
Grand Total		1	-	-	15	4	20	3	14	6	-	-	6	69

Table 12.38: The annual number of ICS events by ICS criterion from 2016 to 2020 for SEPS. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	-	-	6	2	4
	Violation of standards on voltage (OV0)	-	-	-	15	49
Scale 1	Incidents on network elements (T1)	-	2	-	-	3
	Loss of tools, means and facilities (LT1)	-	-	-	-	1
	N-1 violation (ON1)	4	2	-	-	1
	Reduction of reserve capacity (RRC1)	-	1	-	-	-
	Violation of standards on voltage (OV1)	-	-	-	2	11
Grand Total		4	5	6	19	69

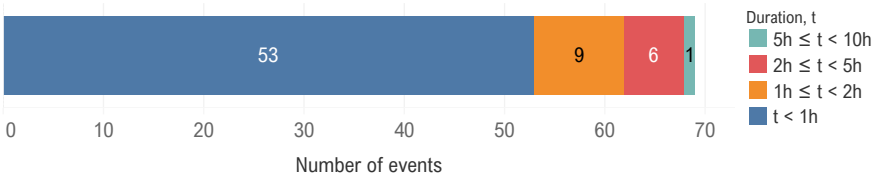

Figure 12.18: Number of events grouped by duration in 2020 for SEPS.

12.1.21 Events reported by Swissgrid

This section presents events for Swissgrid, the TSO in Switzerland. Table 12.39 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.40 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.19 presents the number of events grouped by duration in 2020.

Table 12.39: Monthly distribution of ICS events by ICS criterion in 2020 for Swissgrid.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	8	1	7	1	3	6	2	2	3	1	3	37
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	-	1	-	1	2
	Violation of standards on voltage (OV0)	-	2	22	4	2	8	2	13	6	7	4	2	72
	Loss of tools, means and facilities (LT0)	1	5	4	2	3	1	-	-	2	1	1	1	21
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	1	-	-	-	-	-	1
	Incidents on network elements (T1)	-	1	-	-	-	-	1	-	-	-	-	-	2
	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	-	9	1	2	6	-	3	4	1	1	-	27
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	1	1	-	-	-	2
Grand Total		1	16	36	14	8	19	10	19	15	13	7	7	165

Table 12.40: The annual number of ICS events by ICS criterion from 2016 to 2020 for Swissgrid. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents leading to frequency degradation (F0)	-	-	-	1	-
	Incidents on network elements (T0)	14	7	12	31	37
	Incidents on power generating facilities (G0)	-	2	1	6	2
	Loss of tools, means and facilities (LT0)	-	-	5	16	21
	Violation of standards on voltage (OV0)	1	1	-	-	72
Scale 1	Incidents leading to frequency degradation (F1)	-	-	-	2	-
	Incidents on load (L1)	-	-	1	-	1
	Incidents on network elements (T1)	4	2	-	4	2
	Incidents on power generating facilities (G1)	1	-	-	-	-
	Loss of tools, means and facilities (LT1)	2	1	-	-	2
	N-1 violation (ON1)	1	3	1	2	1
	Reduction of reserve capacity (RRC1)	-	1	-	2	-
	Violation of standards on voltage (OV1)	-	-	-	-	27
Scale 2	Incidents on network elements (T2)	-	-	-	1	-
	N violation (ON2)	-	-	3	-	-
Grand Total		23	17	23	65	165

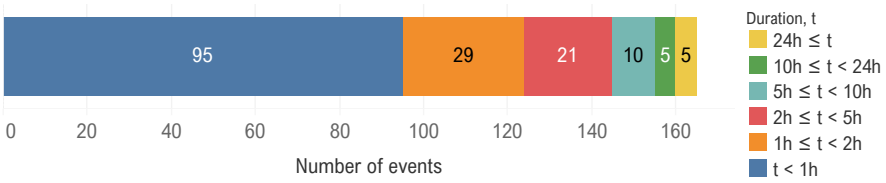

Figure 12.19: Number of events grouped by duration in 2020 for Swissgrid.

12.1.22 Events reported by TenneT TSO B.V.

This section presents events for TenneT TSO B.V., the TSO in the Netherlands. Table 12.41 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.42 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.20 presents the number of events grouped by duration in 2020.

Table 12.41: Monthly distribution of ICS events by ICS criterion in 2020 for TenneT TSO B.V.

		2020												
Scale	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	2	2	2	-	-	1	13
	Incidents on power generating facilities (G0)	2	-	1	-	-	1	1	-	1	-	-	-	6
	Loss of tools, means and facilities (LT0)	2	4	8	6	15	-	4	1	4	3	1	1	49
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	1	-	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	-	-	1	-	-	-	-	-	-	-	1
Grand Total		6	4	9	6	17	4	8	3	7	3	1	2	70

Table 12.42: The annual number of ICS events by ICS criterion from 2016 to 2020 for TenneT TSO B. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	10	4	13	14	13
	Incidents on power generating facilities (G0)	20	16	19	12	6
	Loss of tools, means and facilities (LT0)	-	-	68	23	49
	Violation of standards on voltage (OV0)	3	11	-	-	-
Scale 1	Incidents on network elements (T1)	8	4	-	1	-
	Loss of tools, means and facilities (LT1)	3	-	3	1	1
	N-1 violation (ON1)	3	1	3	6	1
	Violation of standards on voltage (OV1)	11	19	-	-	-
Grand Total		58	55	106	57	70

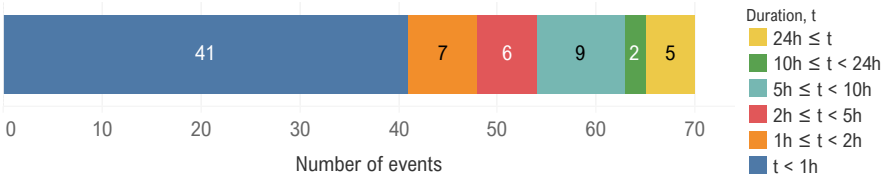

Figure 12.20: Number of events grouped by duration in 2020 for TenneT TSO B.V.

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12.1.23 Events reported by TenneT TSO GmbH

This section presents events for TenneT TSO GmbH, one of the TSOs in Germany. Table 12.43 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.44 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.21 presents the number of events grouped by duration in 2020.

The changes in yearly numbers have stabilized due to a consistent ICS Methodology in 2019 and 2020. Only the N-1 violations increased on a low level. The variance during the year 2020 is insignificant.

Table 12.43: Monthly distribution of ICS events by ICS criterion in 2020 for TenneT TSO GmbH.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	5	8	2	6	6	7	4	6	4	-	2	4	54
	Incidents on power generating facilities (G0)	-	-	-	-	1	-	-	-	-	-	-	-	1
	Violation of standards on voltage (OV0)	-	-	-	-	-	-	-	-	-	1	-	-	1
	Loss of tools, means and facilities (LT0)	-	1	-	-	1	-	-	2	1	-	-	-	5
Scale 1	N-1 violation (ON1)	2	-	-	-	-	1	1	2	-	-	-	-	6
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	1	1	-	-	-	-	2
Grand Total		7	9	2	6	8	8	6	11	5	1	2	4	69

Table 12.44: The annual number of ICS events by ICS criterion from 2016 to 2020 for TenneT TSO GmbH. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	13	26	24	53	54
	Incidents on power generating facilities (G0)	3	2	-	-	1
	Loss of tools, means and facilities (LT0)	-	-	10	5	5
	Violation of standards on voltage (OV0)	4	-	-	-	1
Scale 1	Incidents on network elements (T1)	-	2	-	-	-
	Loss of tools, means and facilities (LT1)	3	3	-	-	2
	N-1 violation (ON1)	11	13	1	2	6
	Violation of standards on voltage (OV1)	-	1	4	-	-
Grand Total		34	47	39	60	69

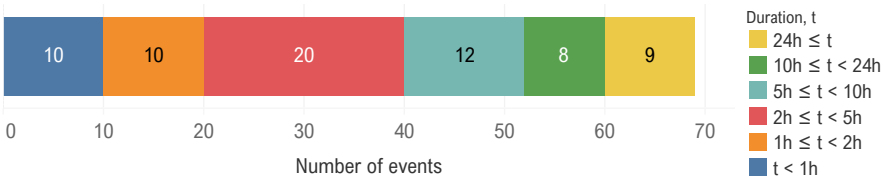

Figure 12.21: Number of events grouped by duration in 2020 for TenneT TSO GmbH.

12.1.24 Events reported by TERNA

This section presents events for TERNA, the TSO in Italy. Table 12.45 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.46 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.22 presents the number of events grouped by duration in 2020.

Table 12.45: Monthly distribution of ICS events by ICS criterion in 2020 for TERNA.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	9	5	1	7	2	4	6	8	7	3	13	66
Grand Total		1	9	5	1	7	2	4	6	8	7	3	13	66

Table 12.46: The annual number of ICS events by ICS criterion from 2016 to 2020 for TERNA. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	1	-	63	83	66
	Loss of tools, means and facilities (LT0)	-	-	-	3	-
Scale 1	Incidents on network elements (T1)	19	17	-	-	-
Grand Total		20	17	63	86	66

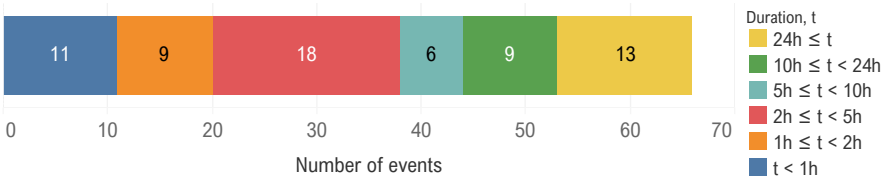

Figure 12.22: Number of events grouped by duration in 2020 for TERNA.

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12.1.25 Events reported by Transelectrica

This section presents events for Transelectrica, the TSO in Romania. Table 12.47 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.48 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.23 presents the number of events grouped by duration in 2020.

Table 12.47: Monthly distribution of ICS events by ICS criterion in 2020 for Transelectrica.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	3	18	3	6	-	10	8	9	8	5	4	3	77
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Violation of standards on voltage (OV0)	-	-	-	6	5	-	-	-	-	-	-	-	11
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	1	-	1	1	-	3
	Violation of standards on voltage (OV1)	-	-	-	5	14	-	-	-	1	1	-	-	21
Grand Total		3	18	3	17	19	10	8	11	9	7	5	3	113

Table 12.48: The annual number of ICS events by ICS criterion from 2016 to 2020 for Transelectrica. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	22	47	64	44	77
	Incidents on power generating facilities (G0)	1	3	4	-	1
	Reduction of reserve capacity (RRC0)	2	1	-	-	-
	Violation of standards on voltage (OV0)	-	-	157	196	11
Scale 1	Incidents on load (L1)	-	-	-	-	3
	Incidents on network elements (T1)	-	6	-	-	-
	Reduction of reserve capacity (RRC1)	-	-	1	-	-
	Violation of standards on voltage (OV1)	-	-	-	-	21
Grand Total		25	57	226	240	113

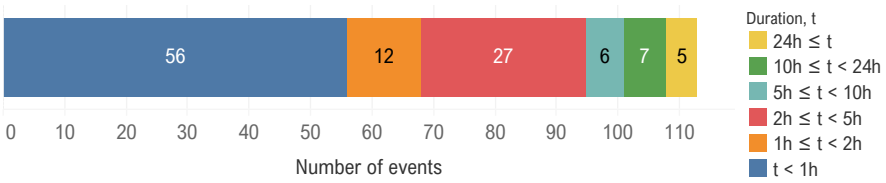

Figure 12.23: Number of events grouped by duration in 2020 for Transelectrica.

12.1.26 Events reported by TransnetBW GmbH

This section presents events for TransnetBW GmbH, one of the TSOs in Germany. Table 12.49 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.50 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.24 presents the number of events grouped by duration in 2020.

Table 12.49: Monthly distribution of ICS events by ICS criterion in 2020 for TransnetBW GmbH.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	7	1	6	5	1	3	1	1	1	1	1	29
	Incidents on power generating facilities (G0)	-	-	1	-	2	1	3	-	-	1	-	-	8
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	-	1	-	-	1	-	-	-	-	-	2
Grand Total		1	7	2	7	7	2	7	2	1	2	1	1	40

Table 12.50: The annual number of ICS events by ICS criterion from 2016 to 2020 for TransnetBW GmbH. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	29	28	14	16	29
	Incidents on power generating facilities (G0)	-	1	-	27	8
Scale 1	Incidents on network elements (T1)	1	4	-	-	-
	Loss of tools, means and facilities (LT1)	-	2	2	2	2
	N-1 violation (ON1)	2	5	2	-	1
Grand Total		32	40	18	45	40

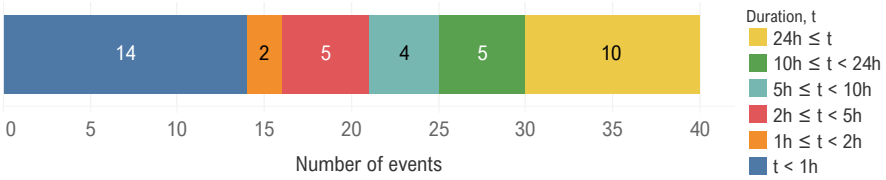

Figure 12.24: Number of events grouped by duration in 2020 for TransnetBW GmbH.

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12.2 Overview of events per TSOs in the Nordic synchronous area

12.2.1 Events reported by Energinet (Nordic)

This section presents events for Energinet (Nordic), the TSO in Denmark. Table 12.51 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.52 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.25 presents the number of events grouped by duration in 2020.

Table 12.51: Monthly distribution of ICS events by ICS criterion in 2020 for Energinet (Nordic).

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	-	-	3	-	-	-	7	-	2	1	1	15
Scale 1	Separation from the grid (RS1)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	1	-	-	-	1	-	-	-	-	-	-	2
Grand Total		1	1	-	3	-	1	-	8	-	2	1	1	18

Table 12.52: The annual number of ICS events by ICS criterion from 2016 to 2020 for Energinet (Nordic). It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	-	1	2	5	15
Scale 1	Incidents on network elements (T1)	7	3	1	1	-
	Loss of tools, means and facilities (LT1)	-	-	2	-	2
	Separation from the grid (RS1)	-	-	-	-	1
Grand Total		7	4	5	6	18

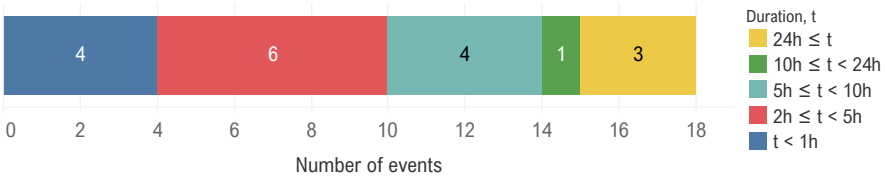

Figure 12.25: Number of events grouped by duration in 2020 for Energinet (Nordic).

12.2.2 Events reported by Fingrid Oyj

This section presents events for Fingrid Oyj, the TSO in Finland. Table 12.53 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.54 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.26 presents the number of events grouped by duration in 2020.

Table 12.53: Monthly distribution of ICS events by ICS criterion in 2020 for Fingrid Oyj.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	1	-	1	1	-	-	-	-	-	-	1	4
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	-	-	-	-	1	1
Grand Total		-	1	-	1	1	-	-	-	-	-	-	2	5

Table 12.54: The annual number of ICS events by ICS criterion from 2016 to 2020 for Fingrid Oyj. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	-	-	4	6	4
	Incidents on power generating facilities (G0)	-	-	1	-	1
	Loss of tools, means and facilities (LT0)	-	-	-	1	-
	Violation of standards on voltage (OV0)	-	-	5	-	-
Scale 1	Incidents on network elements (T1)	9	4	3	-	-
	N-1 violation (ON1)	8	-	-	-	-
Grand Total		17	4	13	7	5

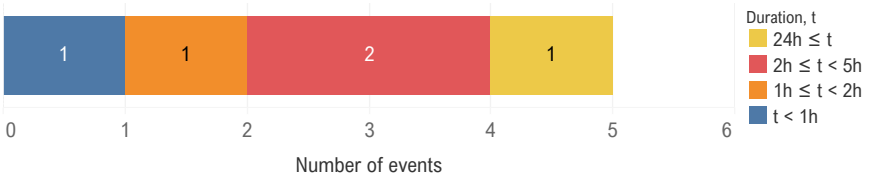

Figure 12.26: Number of events grouped by duration in 2020 for Fingrid Oyj.

12.2.3 Events reported by Statnett

This section presents events for Statnett, the TSO in Norway. Table 12.55 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.56 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.27 presents the number of events grouped by duration in 2020.

Table 12.55: Monthly distribution of ICS events by ICS criterion in 2020 for Statnett.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	2	1	-	4	2	-	-	1	2	2	-	14
	Incidents on power generating facilities (G0)	-	-	1	-	-	-	-	-	-	1	-	-	2
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	1	-	-	-	-	1
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	-	-	-	1	-	1
	Incidents on network elements (T1)	-	-	1	-	-	-	-	-	-	1	-	-	2
	N-1 violation (ON1)	-	-	1	-	-	-	-	-	-	1	-	-	2
Grand Total		-	2	4	-	4	2	-	1	1	5	3	-	22

Table 12.56: The annual number of ICS events by ICS criterion from 2016 to 2020 for Statnett. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	7	2	23	12	14
	Incidents on power generating facilities (G0)	-	-	-	1	2
	Loss of tools, means and facilities (LT0)	-	-	-	-	1
Scale 1	Incidents on load (L1)	2	2	3	2	1
	Incidents on network elements (T1)	6	9	2	-	2
	Incidents on power generating facilities (G1)	1	-	-	-	-
	Loss of tools, means and facilities (LT1)	-	2	-	-	-
	N-1 violation (ON1)	1	-	2	-	2
Grand Total		17	15	30	15	22

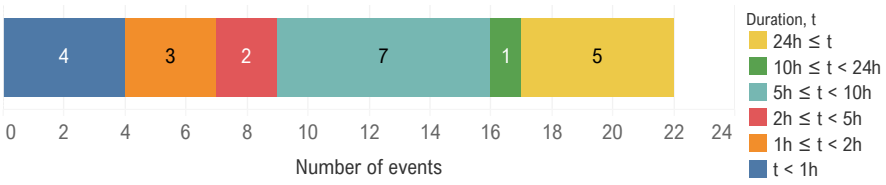

Figure 12.27: Number of events grouped by duration in 2020 for Statnett.

12.2.4 Events reported by Svenska Kraftnät

This section presents events for Svenska Kraftnät, the TSO in Sweden. Table 12.57 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.58 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.28 presents the number of events grouped by duration in 2020.

Table 12.57: Monthly distribution of ICS events by ICS criterion in 2020 for Svenska Kraftnät.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	2	3	2	5	9	2	4	1	1	3	7	40
	Incidents on power generating facilities (G0)	-	-	-	-	-	-	-	1	1	-	-	-	2
	Loss of tools, means and facilities (LT0)	-	-	-	-	-	-	-	-	4	-	2	3	9
Scale 1	Incidents on network elements (T1)	-	-	-	1	-	-	-	-	-	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	-	-	-	-	-	-	1	-	2	1	4
Grand Total		1	2	3	3	5	9	2	5	7	1	7	11	56

Table 12.58: The annual number of ICS events by ICS criterion from 2016 to 2020 for Svenska Kraftnät. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents leading to frequency degradation (F0)	-	-	2	-	-
	Incidents on network elements (T0)	2	4	48	36	40
	Incidents on power generating facilities (G0)	-	-	-	-	2
	Loss of tools, means and facilities (LT0)	-	-	-	-	9
Scale 1	Incidents on network elements (T1)	27	17	1	-	1
	Loss of tools, means and facilities (LT1)	-	-	-	-	4
Grand Total		29	21	51	36	56

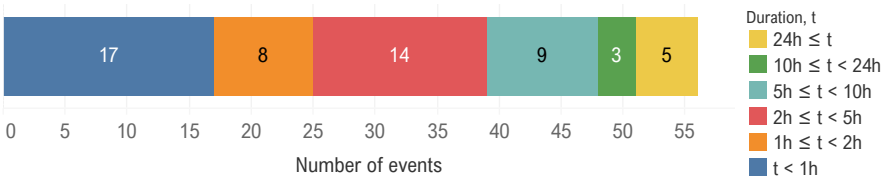

Figure 12.28: Number of events grouped by duration in 2020 for Svenska Kraftnät.

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12.3 Overview of events per TSOs in Great Britain

12.3.1 Events reported by National Grid ESO

This section presents events for National Grid ESO, the TSO in Great Britain. Table 12.59 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.60 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.29 presents the number of events grouped by duration in 2020.

Table 12.59: Monthly distribution of ICS events by ICS criterion in 2020 for National Grid ESO.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents leading to frequency degradation (F0)	-	1	-	-	-	-	-	-	-	-	1	-	2
	Incidents on network elements (T0)	15	20	10	15	14	19	9	12	9	19	9	18	169
	Incidents on power generating facilities (G0)	-	-	1	1	1	1	-	3	2	2	-	1	12
	Loss of tools, means and facilities (LT0)	4	8	8	4	7	7	1	6	7	9	10	5	76
Scale 1	Loss of tools, means and facilities (LT1)	-	-	-	-	1	-	-	-	-	-	-	-	1
Grand Total		19	29	19	20	23	27	10	21	18	30	20	24	260

Table 12.60: The annual number of ICS events by ICS criterion from 2016 to 2020 for National Grid ESO. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents leading to frequency degradation (F0)	-	-	58	78	2
	Incidents on network elements (T0)	101	124	156	155	169
	Incidents on power generating facilities (G0)	1	2	3	-	12
	Loss of tools, means and facilities (LT0)	-	-	31	42	76
Scale 1	Incidents on network elements (T1)	9	10	-	-	-
	Loss of tools, means and facilities (LT1)	1	2	-	-	1
	N-1 violation (ON1)	-	-	2	-	-
Scale 2	Incidents leading to frequency degradation (F2)	-	-	-	1	-
Grand Total		112	138	250	276	260

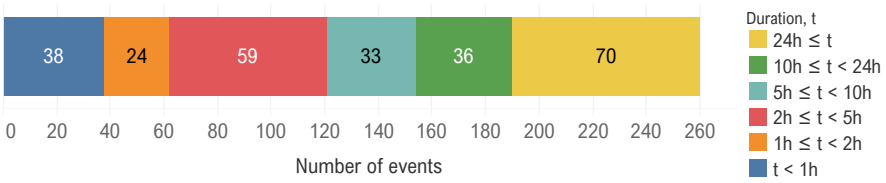

Figure 12.29: Number of events grouped by duration in 2020 for National Grid ESO.

12.4 Overview of events per TSOs in the Baltic area

12.4.1 Events reported by AS Augstsprieguma tīkls (AST)

This section presents events for AS Augstsprieguma tīkls (AST), the TSO in Latvia. Table 12.61 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.62 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.30 presents the number of events grouped by duration in 2020.

Table 12.61: Monthly distribution of ICS events by ICS criterion in 2020 for AS Augstsprieguma tīkls.

		2020												
Scale	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	-	-	4
Scale 1	Incidents on network elements (T1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Incidents on power generating facilities (G1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	N-1 violation (ON1)	-	-	-	-	-	1	-	-	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	-	-	-	-	1	-	-	-	-	-	-	1
Scale 2	Incidents on load (L2)	-	-	-	-	-	1	-	-	-	-	-	-	1
Grand Total		-	-	-	-	-	6	-	-	1	2	-	-	9

Table 12.62: The annual number of ICS events by ICS criterion from 2016 to 2020 for AS Augstsprieguma tīkls. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	6	6	7	6	4
	Incidents on power generating facilities (G0)	-	-	-	1	-
Scale 1	Incidents leading to frequency degradation (F1)	1	-	-	1	-
	Incidents on network elements (T1)	-	-	-	-	1
	Incidents on power generating facilities (G1)	1	-	-	-	1
	Loss of tools, means and facilities (LT1)	-	-	1	-	-
	N-1 violation (ON1)	-	-	-	-	1
	Violation of standards on voltage (OV1)	-	-	-	-	1
Scale 2	Incidents on load (L2)	-	-	-	-	1
Grand Total		8	6	8	8	9

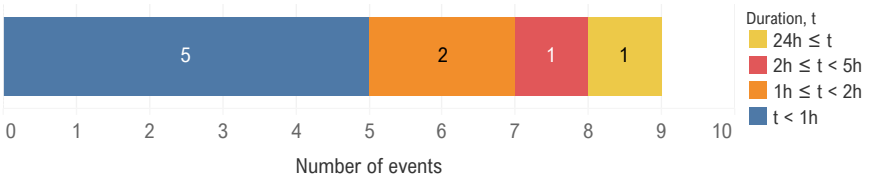

Figure 12.30: Number of events grouped by duration in 2020 for AS Augstsprieguma tīkls.

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12.4.2 Events reported by Elering AS

This section presents events for Elering AS, the TSO in Estonia. Table 12.63 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.64 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.31 presents the number of events grouped by duration in 2020.

Table 12.63: Monthly distribution of ICS events by ICS criterion in 2020 for Elering AS.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	-	-	-	2	1	1	1	1	1	-	-	7
	Incidents on power generating facilities (G0)	2	1	2	-	-	4	6	1	2	1	2	2	23
Grand Total		2	1	2	-	2	5	7	2	3	2	2	2	30

Table 12.64: The annual number of ICS events by ICS criterion from 2016 to 2020 for Elering AS. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	2	5	6	14	7
	Incidents on power generating facilities (G0)	-	-	1	10	23
Scale 1	Incidents on network elements (T1)	4	3	-	-	-
	Loss of tools, means and facilities (LT1)	1	-	-	-	-
Grand Total		7	8	7	24	30

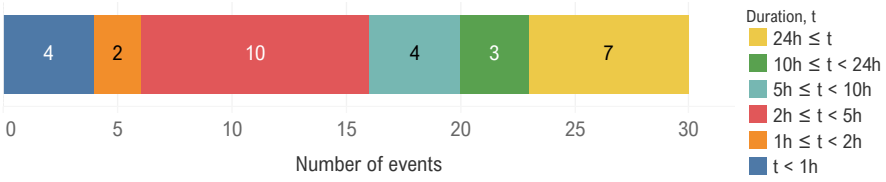

Figure 12.31: Number of events grouped by duration in 2020 for Elering AS.

12.4.3 Events reported by Litgrid AB

This section presents events for Litgrid AB, the TSO in Lithuania. Table 12.65 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.66 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.32 presents the number of events grouped by duration in 2020.

Table 12.65: Monthly distribution of ICS events by ICS criterion in 2020 for Litgrid AB.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	1	-	1	-	-	-	1	2	1	-	-	3	9
	Incidents on power generating facilities (G0)	-	1	-	-	-	1	-	-	-	1	-	-	3
Scale 1	Incidents on load (L1)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Incidents on network elements (T1)	2	-	-	-	-	1	-	-	-	-	-	1	4
Grand Total		3	1	1	-	-	2	1	3	1	1	-	4	17

Table 12.66: The annual number of ICS events by ICS criterion from 2016 to 2020 for Litgrid AB. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	11	6	12	8	9
	Incidents on power generating facilities (G0)	3	-	1	-	3
Scale 1	Incidents on load (L1)	-	-	-	2	1
	Incidents on network elements (T1)	9	8	-	3	4
	Loss of tools, means and facilities (LT1)	3	-	-	-	-
Grand Total		26	14	13	13	17

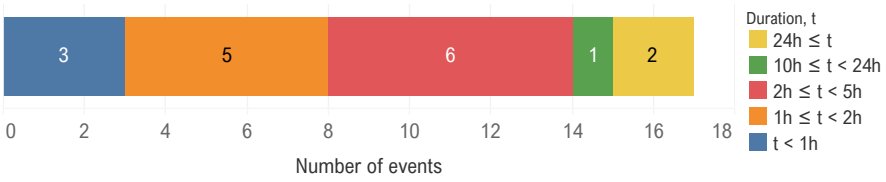

Figure 12.32: Number of events grouped by duration in 2020 for Litgrid AB.

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12.5 Overview of events per TSOs in Ireland

12.5.1 Events reported by EirGrid

This section presents events for EirGrid, the TSO in Ireland. Table 12.67 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.68 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.33 presents the number of events grouped by duration in 2020.

Table 12.67: Monthly distribution of ICS events by ICS criterion in 2020 for EirGrid.

		2020												
Scale	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	-	-	-	2	6
	Incidents on power generating facilities (G0)	2	1	-	2	1	1	2	3	4	1	1	1	19
Scale 1	N-1 violation (ON1)	-	-	-	-	-	-	-	1	1	-	-	1	3
Grand Total		2	2	1	2	1	2	2	5	5	1	1	4	28

Table 12.68: The annual number of ICS events by ICS criterion from 2016 to 2020 for EirGrid. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents leading to frequency degradation (F0)	-	-	7	4	-
	Incidents on network elements (T0)	7	3	8	9	6
	Incidents on power generating facilities (G0)	17	23	7	8	19
	Violation of standards on voltage (OV0)	1	-	-	-	-
Scale 1	Incidents on network elements (T1)	1	2	-	-	-
	Loss of tools, means and facilities (LT1)	-	2	-	-	-
	N-1 violation (ON1)	-	-	-	-	3
Scale 2	Incidents leading to frequency degradation (F2)	-	-	1	-	-
Grand Total		26	30	23	21	28

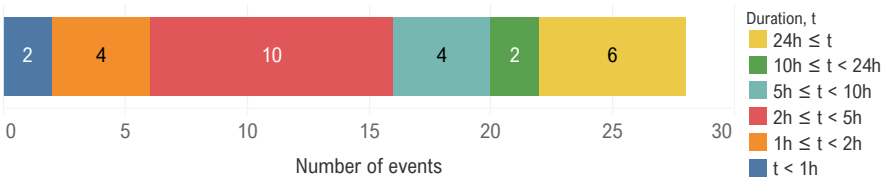

Figure 12.33: Number of events grouped by duration in 2020 for EirGrid.

12.5.2 Events reported by SONI

This section presents events for SONI, the TSO in Northern Ireland. Table 12.69 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.70 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.34 presents the number of events grouped by duration in 2020.

Table 12.69: Monthly distribution of ICS events by ICS criterion in 2020 for SONI.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	-	2	-	-	-	-	-	-	-	-	-	-	2
Grand Total		-	2	-	-	-	-	-	-	-	-	-	-	2

Table 12.70: The annual number of ICS events by ICS criterion from 2016 to 2020 for SONI. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents leading to frequency degradation (F0)	-	-	1	-	-
	Incidents on network elements (T0)	3	-	1	-	2
	Incidents on power generating facilities (G0)	4	1	-	2	-
Scale 1	Incidents on network elements (T1)	-	4	-	-	-
Grand Total		7	5	2	2	2

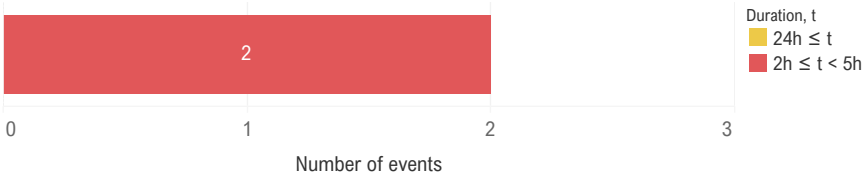

Figure 12.34: Number of events grouped by duration in 2020 for SONI.

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12.6 Overview of events per TSOs in isolated systems

12.6.1 Events reported by Cyprus TSO

This section presents events for Cyprus TSO, the TSO in Cyprus. Table 12.71 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Cyprus TSO had no events in 2018, 2019 or 2020.

Table 12.71: The annual number of ICS events by ICS criterion from 2016 to 2020 for Cyprus TSO. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Null	-	-	-	-	-
	Reduction of reserve capacity (RRC0)	-	-	-	-	-
Scale 1	Incidents on load (L1)	-	4	-	-	-
Scale 2	Incidents leading to frequency degradation (F2)	-	-	-	-	-
	Incidents on load (L2)	-	1	-	-	-
	Incidents on network elements (T2)	-	-	-	-	-
	Incidents on power generating facilities (G2)	1	-	-	-	-
	Loss of tools, means and facilities (LT2)	-	-	-	-	-
	N violation (ON2)	-	-	-	-	-
	Reduction of reserve capacity (RRC2)	-	-	-	-	-
	Separation from the grid (RS2)	-	-	-	-	-
	Violation of standards on voltage (OV2)	-	-	-	-	-
Scale 3	Blackout (OB3)	-	-	-	-	-
Grand Total		1	5	-	-	-

12.6.2 Events reported by Landsnet

This section presents events for Landsnet, the TSO in Iceland. Table 12.72 presents the monthly distribution of ICS events by ICS criterion in 2020, and Table 12.73 presents the annual number of ICS events by ICS criterion from 2016 to 2020. Figure 12.35 presents the number of events grouped by duration in 2020.

Table 12.72: Monthly distribution of ICS events by ICS criterion in 2020 for Landsnet.

		2020												
Scale	ICS criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on network elements (T0)	7	8	2	-	1	3	-	2	3	1	-	2	29
	Incidents on power generating facilities (G0)	1	-	1	1	-	-	-	-	-	-	-	-	3
	Loss of tools, means and facilities (LT0)	-	1	-	-	-	-	-	-	-	-	-	-	1
Scale 1	Incidents on load (L1)	-	1	-	-	-	-	-	-	-	-	-	-	1
	Incidents on network elements (T1)	4	2	-	-	-	-	-	1	2	-	1	2	12
Grand Total		12	12	3	1	1	3	-	3	5	1	1	4	46

Table 12.73: The annual number of ICS events by ICS criterion from 2016 to 2020 for Landsnet. It should be noted that the recorded values for 2016–2019 aggregate all related ICS events into ICS incidents, with the ICS criteria set to the event with the highest priority according to Table 2.1.

Scale	ICS criterion	2016	2017	2018	2019	2020
Scale 0	Incidents on network elements (T0)	8	5	10	5	29
	Incidents on power generating facilities (G0)	-	1	-	4	3
	Loss of tools, means and facilities (LT0)	-	-	-	-	1
Scale 1	Incidents on load (L1)	2	3	-	-	1
	Incidents on network elements (T1)	-	6	3	7	12
	Incidents on power generating facilities (G1)	-	2	-	-	-
Scale 2	Incidents on load (L2)	1	1	1	-	-
	Loss of tools, means and facilities (LT2)	-	-	1	-	-
Grand Total		11	18	15	16	46

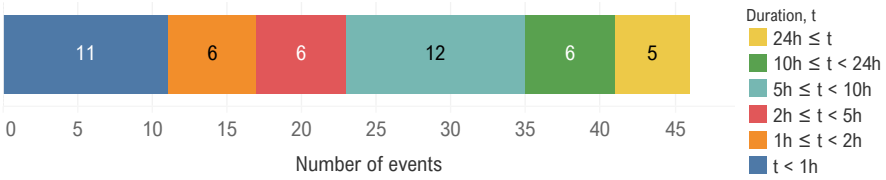

Figure 12.35: Number of events grouped by duration in 2020 for Landsnet.

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13 Conclusion

The ENTSO-E Incident Classification Scale (ICS) Methodology has been revised multiple times since its initial publication in 2014. The 2020 ICS Annual Report follows the most recent version, the 2019 ICS Methodology [1]. The 2020 Annual Report provides a clear overview of the incidents that took place within each TSO.

The ENTSO-E Members reported a total of 2 740 incidents for the year 2020, of which 2 423 were scale 0, 316 were classified as scale 1, and only one incident was classified as scale 2. No scale 3 incidents were reported for the past year. There were 106 more events than incidents. The similar number of ICS events and ICS incidents in the pan-European transmission grids indicates that most ICS incidents only had one ICS event.

Approximately 80 % of all incidents took place in continental Europe, which is expected as 26 of the 36 TSOs also reside there. The region dominated the number of incidents at all scales. The only scale 2 event reported for 2020 took place in the Baltic area.

Overall, between the 2019 and 2020 reporting cycles, the number of scale 0 incidents and the number of scale 1 incidents dropped by 15 % each, and the number of scale 2 incidents dropped from three incidents to one. In both cycles, no scale 3 incidents were reported. The drop in scale 0 incidents is directly linked to the 2019 ICS Methodology revision, wherein changes such as updated F-criteria thresholds were implemented. The trend changes for the past years are described in more detail in Section 3.3.

Incidents on network elements (T) constituted the leading cause for scale 0 incidents. The dominant reason for scale 1 incidents was violations of standards on voltage (OV1). The only case of a scale 2 incident was caused by an incident on load (L2).

Despite the significant number of incidents, only a few were significant, thus demonstrating that TSOs have, in general, proven to have secure and highly reliable grid operations.

13.1 Recommendations from the ICS subgroup

As required by the SOGL [2], the ICS subgroup should provide recommendations to improve operational security in the European power grids. The ICS subgroup has identified that loss of tools, means and facilities (LT) is mainly seen in continental Europe and Great Britain. Therefore, it is recommended that TSOs in continental Europe and Great Britain investigate the reasons behind this.

Furthermore, violations of standards on voltage (OV0 and OV1) are only reported in continental Europe, and TSOs in continental Europe would be advised to analyse why the number of registered OV events has increased.

Finally, most of the incidents due to contingencies from the contingency list are due to causes other than unexpected discrepancies from load and generation forecasts, as seen from the operational security indicator relevant to operational planning and scheduling (OPS) in Section 5.2. However, improving the accuracy of load and generation forecasts would significantly decrease the number of incidents due to contingencies in the contingency list. Therefore, the ICS subgroup would recommend that TSOs review their current forecast models to find potential areas of improvement, as well as collaborate with other TSOs in the matter.

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Glossary

ACER European Union Agency for the Cooperation of Energy Regulators. 3
ALFC Annual Load-Frequency Control. 21, 22, 25

Contingency list "the list of contingencies to be simulated in order to test the compliance with the operational security limits" [2, p. 4]. 26, 87

Energy not supplied "the estimated energy which would have been supplied to end-users if no interruption and no transmission restrictions had occurred" [11, p. 18]. 21
ENS energy not supplied. 20, 22, 23, *see* energy not supplied
ENTSO-E European Network of Transmission System Operators for Electricity. i, 1, 3, 5, 9, 20–22, 87
Exceptional contingency "the simultaneous occurrence of multiple contingencies with a common cause" [2, p. 6]. 26, 27

FCR " 'frequency restoration reserves' or 'FCR' means the active power reserves available to restore system frequency to the nominal frequency and, for a synchronous area consisting of more than one LFC area, to restore power balance to the scheduled value" [2, p. 5]. 20, *see also* LFC area
FRR " 'frequency restoration reserves' or 'FRR' means the active power reserves to restore system frequency to the nominal frequency and, for a synchronous area consisting of more than one LFC area, to restore power balance to the scheduled value" [2, p. 5]. 17, *see also* LFC area

HVAC High-voltage alternating current. 32
HVDC High-voltage direct current. 32

ICS Incident Classification Scale.
ICS event An ICS event indicates the occurrence of a single ICS criteria violation. iv, vii, 5–19, 21, 29–47, 49–87, 89
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. 5–8, 10–19, 21, 22, 25, 29–31, 33–35, 37, 38, 40, 41, 43, 44, 46, 47, 49–87, *see also* ICS event
IEC International Electrotechnical Commission. 2

LFC area " 'load-frequency control area' or 'LFC area' means a part of a synchronous area or an entire synchronous area, physically demarcated by points of measurement at interconnectors to other LFC areas, operated by one or more TSOs fulfilling the obligations of load-frequency control" [2, p. 5].

OPS operational security indicator relevant to operational planning and scheduling. 26, 27, 87
Ordinary contingency "the occurrence of a contingency of a single branch or injection" [2, p. 7]. 27
OS operational security indicator relevant to operational security. 21, 22
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" [2, p. 7]. 27

PGF Power Generating Facility. 22

RR " 'replacement reserves' or 'RR' means the active power reserves available to restore or support the required level of FRR to be prepared for additional system imbalances, including generation reserves" [2, p. 5].

SOGL System Operation Guideline, or Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation [2]. 1–3, 21, 24–26, 31, 33, 87

TSO Transmission System Operator.

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