ICS 2019 Annual Report

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From: Incident Classification Scale Subgroup

European Network of
Transmission System Operators
for Electricity

entsoe

ICS 2019 Annual Report

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1 Introduction

The 2019 Annual Report of the Incident Classification Scale 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 (SO GL) [2]. The ICS methodology of 2018 was approved on 11 April 2018.

The previous ICS methodology [3] was approved by the ENTSO-E System Operations Committee on 10 April 2014 and the Assembly on 8 May 2014, and was submitted to ACER on 25 June 2014 for an opinion pursuant to Article 9(2) of Regulation (EC) 714/2009 [4]. Furthermore, the next Annual Report of 2020 will be based on an updated methodology [5] that was approved on 4 December 2019.

Recording of incidents, according to the mutual classifications, enables:

- monitoring the number of incidents and system performance during the year, comparable with previous years;
- identifying occurrences of high risk for system security breach;
- identification of incident investigations to be organised; and
- analysing of the incidents and the potential to improve system operation.

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 2019 Annual Report of the Incident Classification Scale covers the 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 for even months.

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 and IEC standards. Each criterion describes an incident or an observable situation factually.

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 which occurred in 2019 but rather the incidents which meet the criteria of the Incident Classification Scale Methodology.

The Incident Classification Scale has 4 levels of increasing severity, ranging from anomalies up to significant or widespread incidents. It is compliant with the system state definitions listed in the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation [2]. The scales used in the Annual Report are:

- scale 0 for anomalies, local incidents;
- scale 1 for noteworthy incidents;
- scale 2 for extensive incidents; and
- scale 3 for widespread or significant incidents in the control area of one TSO.

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

Scale 0 Anomaly		Scale 1 Noteworthy 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)
#20	Incidents leading to freequency degradation (F0)	#11	Incidents on load (L1)	#2	Incidents on load (L2)	#1	Blackout (OB3)
#21	Incidents on transmission network elements (T0)	#12	Incidents leading to frequency degradation (F1)	#3	Incidents leading to frequency degradation (F2)		
#22	Incidents on power generating facilities (G0)	#13	Incidents on transmission network elements (T1)	#4	Incidents on transmission network elements (T2)		
#23	Violation of standards on voltage (OV0)	#14	Incidents on power generating facilities (G1)	#5	Incidents on power generating facilities (G1)		
#24	Reduction of reserve capacity (RRC0)	#15	N-1 violation (ON1)	#6	N violation (ON2)		
#25	Loss of tools and facilities (LT0)	#17	Violation of standards on voltage (OV1)	#8	Violation of standards on voltage (OV2)		
		#18	Reduction of reserve capacity (RRC1)	#9	Reduction of reserve capacity (RRC2)		
		#19	Loss of tools and facilities (LT1)	#10	Loss of tools and facilities (LT2)		

2.1 Changes in the Incident Classification Scale Methodology

The current ICS methodology was updated in 2018 [1] 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 (SO GL) [2]. The update refined definitions and thresholds to improve the overall data quality, make results comparable between synchronous areas and TSOs, and improve analyses and identification of system operations improvements. Furthermore, as of 2018, annual workshops are organised to ensure further high-quality and consistent reporting for all TSOs.

The updated ICS methodology was collated for the first time in the 2018 ICS Annual Report, and those results cannot directly be compared to the previous years' results. In short, the 2018 methodology changes compared to the previous ICS methodology from 2014 [3] are the following:

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, the 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 380–420 kV and 220 kV cross-border 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) was 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 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 for operational security were created, and three others were renamed in the 2018 ICS methodology update. The changes were:

- 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 European Overview

According to data from the ENTSO-E Transparency Platform [6], the trend towards less dispatchable capacity continued in 2019 as renewable energy sources increased their importance.

The overall generation capacity changed by +1.23 %. The contribution to this value by dispatchable and non-dispatchable generation capacity was -1.47 % and +7.85 %, respectively. However, comparability between years is limited due to missing data from a few data providers. The analyses of installed capacity and load was completed with data as of 25 August 2020; however previous year's values were used to fill in for any missing values.

Due to the recent decommissioning of the statistical data collection [7] by ENTSO-E, there is no central data collection point for consumption and circuit length data readily available. Nevertheless, it can be concluded that the consumption increased by 1.74 % from the load data on the ENTSO-E Transparency Platform.

The summer of 2019 was distinguished by 13 incidents of above-average temperatures, both throughout Europe and globally, with temperature records being broken in multiple countries. The period between June and August became the fourth warmest summer since at least 1979, with temperatures averaging 1.1°C above the 1981–2010 norm. Concomitantly, lower-than-average precipitation was recorded in Austria and France.

The following chapters give the statistical overview of the incidents which occurred at the pan-European level in 2019.

3.1 Number of classified incidents

This section presents the number of incidents that meet the ICS criteria. The numbers are shown per synchronous area and TSO and are distributed by scale or dominating criterion. The dominating criteria used in this report are presented in Table 2.1.

As shown in Table 3.1, TSOs reported 3 217 incidents in 2019; of these 2 851 were scale 0, 363 were scale 1, and 3 were scale 2. No scale 3 incidents were reported. The percentage distribution of scales 0, 1 and 2 incidents were 88.6 %, 11.3 % and 0.1 %, respectively.

Table 3.2 presents the total number of incidents per synchronous area and scale in 2019. Table 3.3 shows the percentage distribution of incidents meeting the ICS criteria in the pan-European power grid. As can be seen, approximately 83 % of all incidents occurred in continental Europe. The high percentage is due 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 in the percentage distributions because 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 3.4 shows the number of incidents per TSO and scale. Incidents classified as scale 0 and scale 1 are widely distributed across most TSOs, while only 2 scale 2 incidents occurred in continental Europe and 1 in Great Britain.

Table 3.5 displays the reported incidents by dominant criteria for each synchronous area. All synchronous areas reported incidents involving transmission network elements (T0), for a total of 1 455 incidents.

Although continental Europe reported 759 incidents leading to frequency degradation (F0), this type of incident was not reported in the Baltic area, the Nordic synchronous area, nor the isolated systems. However, due to a lack of reported numbers, the number of F0-incidents in the Nordic synchronous area must be estimated, and it is assumed to be several hundred. The frequency data for the Nordics are extracted from a frequency report provided by Svenska kraftnät and Statnett. That report does not contain the F0-incidents. The Nordics are aware of this and will gather the data for the coming years.

Violations of standards on voltage (OV) and reductions of reserve capacity (RRC) are also mainly reported in continental Europe. On the other hand, OV-incidents have mostly local (TSO control area) consequences.

There has been no scale 3 incidents in the ENTSO-E statistical area. The responsible TSO for incidents leading to frequency degradation (F0 and F1) is marked in most cases as unknown in continental Europe because it is rarely possible to determine which TSO has caused a particular incident. The actual cause of many of the unknown F-incidents 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 incidents per scale in 2019 and the percentage distribution.

	Number of incidents	Percentage (%)
Scale 0	2 851	88.6%
Scale 1	363	11.3%
Scale 2	3	0.1%
Scale 3	0	0.0%
Grand Total	3 217	100.0%

Table 3.2: Number of incidents per scale and synchronous area in 2019.

	Scale 0	Scale 1	Scale 2	Scale 3	Grand Total
Baltic	39	6	0	0	45
Continental Europe	2 444	241	2	0	2 687
Great Britain	275	0	1	0	276
Ireland	23	0	0	0	23
Isolated systems	9	7	0	0	16
Nordic	61	109	0	0	170
Grand Total	2 851	363	3	0	3 217

Table 3.3: Percentage distribution of incidents per scale and synchronous area in 2019.

	Scale 0	Scale 1	Scale 2	Scale 3
Baltic	86.7%	13.3%	0.0%	0.0%
Continental Europe	91.0%	9.0%	0.1%	0.0%
Great Britain	99.6%	0.0%	0.4%	0.0%
Ireland	100.0%	0.0%	0.0%	0.0%
Isolated systems	56.3%	43.8%	0.0%	0.0%
Nordic	35.9%	64.1%	0.0%	0.0%
Grand Total	88.6%	11.3%	0.1%	0.0%

Table 3.4: Number of incidents per scale for each TSO in the pan-European transmission grid in 2019.

Synchronous area	TSO	Scale 0	Scale 1	Scale 2	Grand Total
Baltic	AST	7	1	0	8
	Elering AS	24	0	0	24
	Litgrid AB	8	5	0	13
	Total	39	6	0	45
Continental Europe	50Hertz	32	6	0	38
	APG	24	3	0	27
	Amprion	44	4	0	48
	CEPS	41	6	0	47
	CGES	71	0	0	71
	ELES	4	1	1	6
	EMS JSC	9	3	0	12
	ESO EAD	40	0	0	40
	Elia	13	9	0	22
	Energinet (CE)	19	1	0	20
	HOPS	31	0	0	31
	IPTO	19	4	0	23
	MAVIR ZRt	96	156	0	252
	MEPSO	0	5	0	5
	NOS BiH	20	0	0	20
	PSE	100	1	0	101
	REE	237	0	0	237
	REN	11	0	0	11
	RTE	328	13	0	341
	SEPS	17	2	0	19
	Swissgrid	54	10	1	65
	TERNA	86	0	0	86
	TenneT TSO B.V.	49	8	0	57
	TenneT TSO GmbH	58	2	0	60
	Transelectrica	240	0	0	240
	TransnetBW GmbH	43	2	0	45
	Unknown	758	5	0	763
	Total	2 444	241	2	2 687
Great Britain	National Grid ESO	275	0	1	276
	Total	275	0	1	276
Ireland	EirGrid	21	0	0	21
	SONI	2	0	0	2
	Total	23	0	0	23
Isolated systems	Cyprus TSO	0	0	0	0
	Landsnet	9	7	0	16
	Total	9	7	0	16
Nordic	Energinet (Nordic)	5	1	0	6
	Fingrid Oyj	7	0	0	7
	Statnett	13	2	0	15
	Svenska kraftnät	36	0	0	36
	Unknown	0	106	0	106
	Total	61	109	0	170
Grand Total		2 851	363	3	3 217

Table 3.5: Incidents by dominating criteria for each synchronous in 2019.

Scale	Dominating criterion	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	0	759	78	4	0	0	841
	Incidents on power generating facilities (G0)	11	93	0	10	4	1	119
	Incidents on transmission network elements (T0)	28	1 199	155	9	5	59	1 455
	Loss of tools and facilities (LT0)	0	106	42	0	0	1	149
	Reduction of reserve capacity (RRC0)	0	1	0	0	0	0	1
	Violation of standards on voltage (OV0)	0	286	0	0	0	0	286
	Total	39	2 444	275	23	9	61	2 851
Scale 1	Incidents leading to frequency degradation (F1)	1	7	0	0	0	106	114
	Incidents on load (L1)	2	0	0	0	0	2	4
	Incidents on power generating facilities (G1)	0	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	3	21	0	0	7	1	32
	Loss of tools and facilities (LT1)	0	18	0	0	0	0	18
	N-1 violation (ON1)	0	25	0	0	0	0	25
	Reduction of reserve capacity (RRC1)	0	161	0	0	0	0	161
	Separation from the grid (RS1)	0	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	9	0	0	0	0	9
	Total	6	241	0	0	7	109	363
Scale 2	Incidents leading to frequency degradation (F2)	0	0	1	0	0	0	1
	Incidents on load (L2)	0	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	1	0	0	0	0	1
	Loss of tools and facilities (LT2)	0	0	0	0	0	0	0
	N violation (ON2)	0	1	0	0	0	0	1
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0	0
	Total	0	2	1	0	0	0	3
Scale 3	Blackout (OB3)	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0
Grand Total		45	2 687	276	23	16	170	3 217

3.2 Incidents per length of circuit and energy consumption

The figures in this section present the number of incidents in proportion to consumption or length of circuit in the European synchronous areas in 2019.

The data concerning the length of circuits and energy consumption in 2018 is based on the discontinued ENTSO-E statistical data [7]. The consumption and circuit length of 2019 was gathered from individual TSOs. In case 2019 data could not be retrieved, the values of 2018 have been used in 2019 as well. Furthermore, 2015 consumption values use the reported 2016 consumption values.

Figure 3.1 shows the number of incidents per 1 TWh of energy consumption, and Figure 3.2 presents the number of incidents per 100 km of circuit length. Figure 3.3 presents the number of incidents on transmission network elements (T0 and T1) per 100 km of circuit length.

For scale 0, the minimum value is 0.16 incidents per TWh of consumption in the Nordic synchronous area, and the maximum value is 1.38 incidents per TWh in the Baltic area. However, the number of scale 0 incidents leading to frequency degradation (F0) in the Nordic synchronous area is estimated to be several hundred. The frequency data for the Nordics are extracted from a frequency report provided by Svenska kraftnät and Statnett. That report does not contain the F0-incidents. The Nordics are aware of this and will gather the data for the coming years.

For scale 1, the minimum value is zero incidents per TWh in Great Britain and Ireland, and the maximum value is 0.29 incidents per TWh in isolated systems.

When the number of incidents is normalised with circuit length, the Baltics, Ireland and the Nordics have below 0.4 incidents per 100 km of circuit length. In contrast, continental Europe had more than double that value and Great Britain triple. All in all, most of the incidents were of scale 0 and did not aggravate the normal operating conditions.

Incidents on transmission network elements (T0 and T1) cause a large part of the incidents in the transmission grid, which can be seen as similarities between Figure 3.2 and Figure 3.3. Finally, it should be noted that TSOs may include distinctive voltage level ranges in their circuit length calculations. For example, one TSO may include the whole 100–420 kV voltage range while some other TSO only the 220–420 kV voltage range.

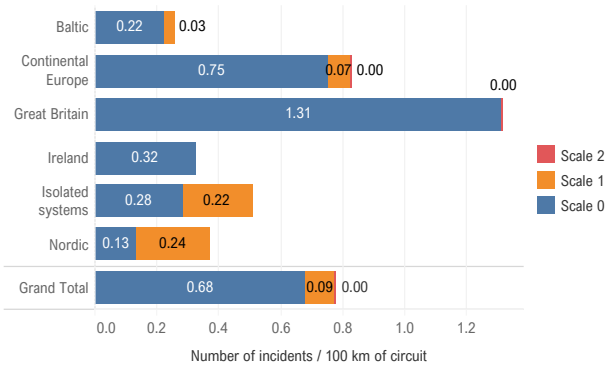

Figure 3.2: Number of incidents per 100 km of circuit length in 2019.

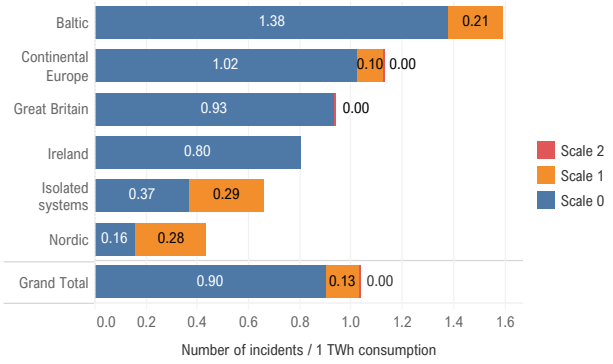

Figure 3.1: Number of incidents per 1 TWh of energy consumption in 2019.

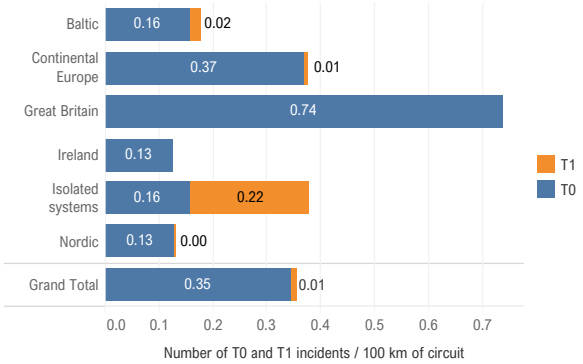

Figure 3.3: Number of incidents on transmission network elements (T0 and T1) per 100 km of circuit length in 2019.

3.3 Evolution 2015–2019

This section presents classified incidents according to the Incident Classification Scale Methodology [1] as it developed between 2015–2019. Furthermore, a detailed view of dominating criteria is set forth in Sections 3.3.3 through 3.3.6. Additionally, N- and N-1 violations (ON) are presented in Section 3.3.7.

It should be noted that the 2015–2017 data were reported according to the ICS methodology from 2014 [3]. The data since 2018 is reported according to an updated version of the methodology from 2018 [1]. Therefore, the results for individual years cannot directly be correlated. The updates are summarised in Section 2.1.

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 2015–2019 incidents are shown in Figure 3.4 and Figure 3.5. Figure 3.4 presents the annual number of incidents grouped by scale, and Figure 3.5 shows the annual incident scale distribution percentages. Both graphs show that the number of scale 0 incidents has increased significantly since 2017. However, rather than representing a substantial increase in events, the greater number of incidents is a result of the implementation of the updated Incident Classification Scale methodology [1] mentioned above. The increase consists mainly of F0-, T0- and LT0-incidents. A detailed view of these incident categories is presented in Section 3.3.1, Section 3.3.3 and Section 3.3.4, respectively. The number of scale 1 incidents in 2019 is similar compared to previous years.

The difference in the number of reported incidents per TSO compared to the previous year is also visible in Chapter 12.

Figure 3.6 and Figure 3.7 present the annual number of scale 0 incidents by consumption and circuit length ratios. The graphs make it easy to see that in the Nordic synchronous area, Ireland, and isolated systems, both ratios are lower in 2019 than in 2018; in contrast, the ratio has increased in the other synchronous areas, and the overall

trend seems to be increasing. However, due to a lack of reported numbers, the number of F0-incidents in the Nordic synchronous area must be estimated, and it is assumed to be several hundred. The frequency data for the Nordics are extracted from a frequency report provided by Svenska kraftnät and Statnett. That report does not contain the F0-incidents. The Nordics are aware of this and will gather the data for the coming years.

Figure 3.8 and Figure 3.9 present the ratios of the number of scale 1 incidents to consumption and the number of scale 1 incidents to length of circuit, respectively. The ratio of scale 1 incidents is increasing in the Baltic area, the Nordic synchronous area and isolated systems, while the values in the other regions remain the same. However, there was a significant drop in the number of scale 1 incidents from 2017 to 2018.

Finally, a detailed view of the annual number of incidents, grouped by dominating criterion, is shown in Table 3.6.

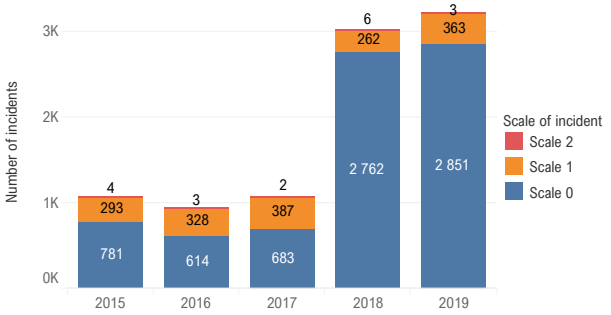

Figure 3.4: The annual number of incidents per scale from 2015–2019.

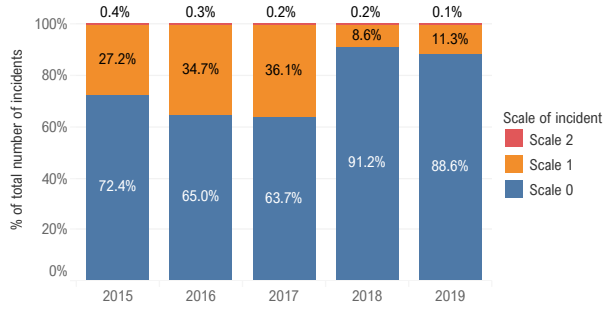

Figure 3.5: The annual percentage distribution of incidents per scale from 2015–2019.

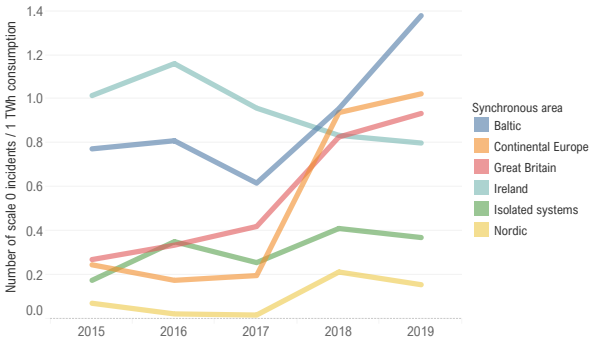

Figure 3.6: The annual number of scale 0 incidents per 1 TWh of energy consumption from 2016–2019.

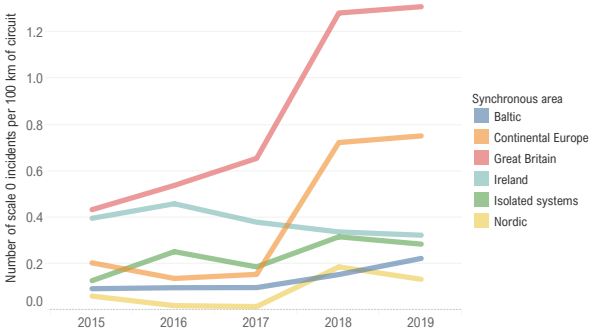

Figure 3.7: The annual number of scale 0 incidents per 100 km of circuit length from 2015–2019.

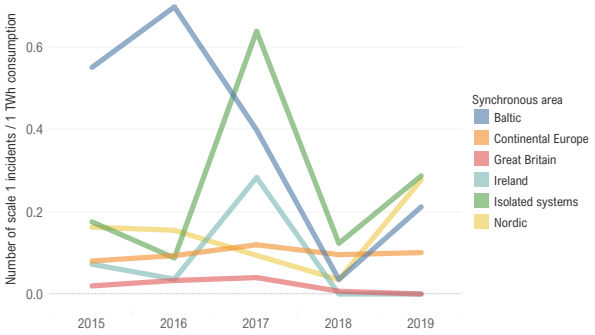

Figure 3.8: The annual number of scale 1 incidents per 1 TWh of energy consumption from 2016–2019.

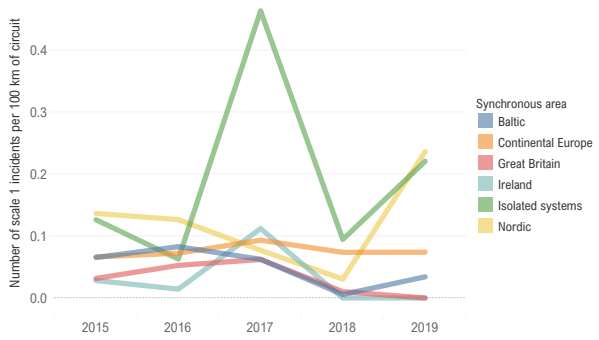

Figure 3.9: The annual number of scale 1 incidents per 100 km of circuit length from 2015–2019.

Table 3.6: The annual number of incidents by dominating criteria from 2015–2019.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	26	15	11	1 021	841
	Incidents on power generating facilities (G0)	161	110	111	126	119
	Incidents on transmission network elements (T0)	581	467	533	1 144	1 455
	Loss of tools and facilities (LT0)	0	0	0	130	149
	Reduction of reserve capacity (RRC0)	0	2	1	0	1
	Violation of standards on voltage (OV0)	13	20	27	341	286
	Total	781	614	683	2 762	2 851
Scale 1	Incidents leading to frequency degradation (F1)	0	1	0	10	114
	Incidents on load (L1)	11	6	10	6	4
	Incidents on power generating facilities (G1)	0	3	2	0	0
	Incidents on transmission network elements (T1)	144	203	252	15	32
	Loss of tools and facilities (LT1)	12	23	24	28	18
	N-1 violation (ON1)	102	76	66	35	25
	Reduction of reserve capacity (RRC1)	3	1	12	118	161
	Separation from the grid (RS1)	0	0	0	0	0
	Violation of standards on voltage (OV1)	21	15	21	50	9
	Total	293	328	387	262	363
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	1	1
	Incidents on load (L2)	4	1	2	1	0
	Incidents on power generating facilities (G2)	0	1	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	1
	Loss of tools and facilities (LT2)	0	0	0	1	0
	N violation (ON2)	0	0	0	3	1
	Reduction of reserve capacity (RRC2)	0	0	0	0	0
	Separation from the grid (RS2)	0	1	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0
	Total	4	3	2	6	3
Scale 3	Blackout (OB3)	0	0	0	0	0
	Total	0	0	0	0	0
Grand Total		1 078	945	1 072	3 030	3 217

3.3.1 Detailed view of incidents leading to frequency degradation

This section presents a detailed view of incidents leading to frequency degradation, that is, F0, F1 and F2 events.

Table 3.7 presents the annual number of incidents leading to frequency degradation for each synchronous area, and Table 3.8 and Figure 3.10 show the same distributed per cause. Figure 3.11 presents the annual number of F-incidents normalised by the installed circuit length in each synchronous area.

Before 2018, the first time threshold to report a frequency incident 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. This will change in 2020 to avoid reporting occurrences which do not affect system security. The ICS 2018 methodology updates are summarised in Section 2.1.

The actual cause of many of the unknown F-incidents are mainly deterministic frequency deviations (DFDs) caused by changes of generation and balance diagrams at the beginning and end of business hours.

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

Table 3.7: The annual number of F-incidents from 2015–2019.

Synchronous area	2015	2016	2017	2018	2019
Baltic	0	1	0	0	1
Continental Europe	25	15	11	963	766
Great Britain	0	0	0	58	79
Ireland	0	0	0	9	4
Isolated systems	0	0	0	0	0
Nordic	1	0	0	2	106
Grand Total	26	16	11	1 032	956

Table 3.8: The annual number of F-incidents per cause from 2015–2019.

Main cause of the incident	2015	2016	2017	2018	2019
Human error	0	0	0	0	1
Tripped transmission network element	0	0	0	12	15
Unexpected discrepancies from load or generation forecasts	0	0	0	0	7
Unexpected flows	0	0	0	0	2
Weather conditions	0	0	0	0	1
Technical equipment	0	0	0	0	0
Other	0	0	0	0	2
Unknown	0	0	0	1 010	912
N/A	26	16	11	0	0
Grand Total	26	16	11	1 022	940

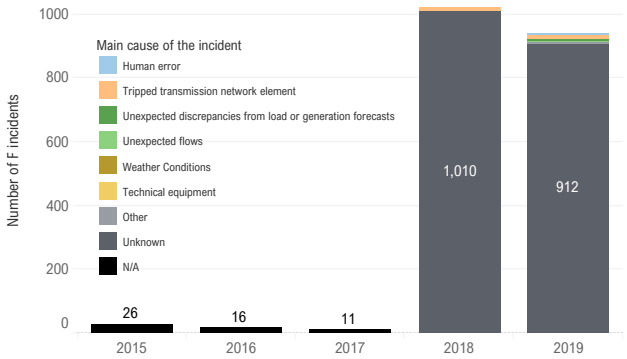

Figure 3.10: The annual number of F-incidents per cause from 2015–2019.

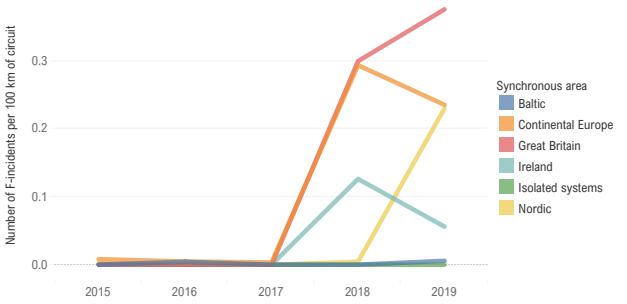

Figure 3.11: The annual number of F-incidents per 100 km of installed circuit length in each synchronous area from 2015–2019.

3.3.2 Detailed view of incidents on power generating facilities

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

Table 3.9 presents the annual number of incidents on power generating facilities for each synchronous area, and Table 3.10 and Figure 3.12 show the same distributed per cause. Figure 3.13 presents the annual number of G-incidents normalised by the consumption in each synchronous area.

As can be seen from Figure 3.12, most G-incidents are simply caused by loss of generators.

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

Table 3.9: The annual number of G-incidents from 2015–2019.

Synchronous area	2015	2016	2017	2018	2019
Baltic	3	4	0	2	11
Continental Europe	131	86	84	113	93
Great Britain	0	1	2	3	0
Ireland	27	21	24	7	10
Isolated systems	0	1	3	0	4
Nordic	0	1	0	1	1
Grand Total	161	114	113	126	119

Table 3.10: The annual number of G-incidents per cause from 2015–2019.

Main cause of the incident	2015	2016	2017	2018	2019
Failure of protection device	0	0	0	4	1
Human error	0	0	0	1	0
Loss of generation	0	0	0	102	83
Technical equipment	0	0	0	0	1
Unexpected flows	0	0	0	0	0
Other	0	0	0	8	3
Unknown	0	0	0	11	31
N/A	161	114	113	0	0
Grand Total	161	114	113	126	119

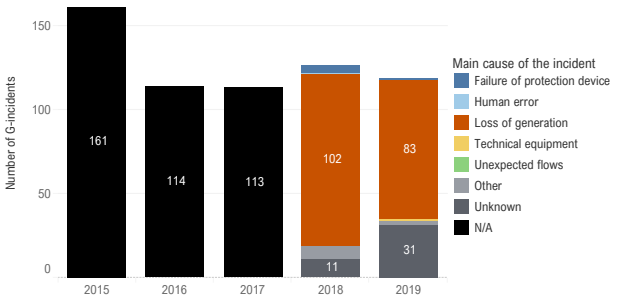

Figure 3.12: The annual number of G-incidents per cause from 2015–2019.

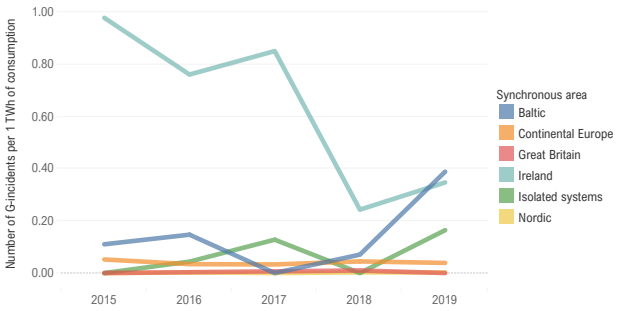

Figure 3.13: The annual number of G-incidents per 1 TWh of consumption for each synchronous area from 2016–2019.

3.3.3 Detailed view of incidents on transmission system elements

This section presents a detailed view of incidents on transmission system elements, that is, T0, T1 and T2 events.

Table 3.11 presents the annual number of incidents on transmission network elements for each synchronous area, and Table 3.12 and Figure 3.14 show the same distributed per cause. Figure 3.15 presents the annual number of T-incidents normalised by the installed circuit length in each synchronous area.

Furthermore, Figure 3.16 presents the number of T0-incidents normalised by the installed circuit length in each synchronous area, and Figure 3.17 the same but for T1-incidents.

As can be seen in Figure 3.14, T-incidents are caused mostly by tripped transmission network elements and weather conditions. Loss of tools is sometimes mentioned as the main cause of a T-incident. It seems not to be correct and can be linked to a parallel problem on tools or facilities. These incompatible combinations of causes and incidents have been removed in the next methodology, which will be used as of 2020.

The increase in T-incidents after 2018 is due to a change in the methodology [1], which added the 220–330 kV voltage range to the report. Before 2018, only 380–420 kV or 220 kV cross-border was included. All updates are summarised in Section 2.1.

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

Table 3.11: The annual number of T-incidents from 2015–2019 per synchronous area.

Synchronous area	2015	2016	2017	2018	2019
Baltic	33	32	28	25	31
Continental Europe	519	451	563	872	1 221
Great Britain	87	110	134	156	155
Ireland	3	11	9	9	9
Isolated systems	5	8	11	13	12
Nordic	78	58	40	84	60
Grand Total	725	670	785	1 159	1 488

Table 3.12: The annual number of T-incidents per cause from 2015–2019.

Main cause of the incident	2015	2016	2017	2018	2019
Failure of protection device	0	0	0	66	76
Human error	0	0	0	20	36
Lack of remedial actions	0	0	0	1	0
Tripped transmission network element	0	0	0	523	605
Unexpected discrepancies from load or generation forecasts	0	0	0	0	1
Unexpected flows	0	0	0	3	4
Weather conditions	0	0	0	227	260
Technical equipment	0	0	0	0	11
Environmental causes	0	0	0	0	6
Loss of tools or facilities	0	0	0	34	34
N-1 violation	0	0	0	0	5
Nature (animals, vegetation)	0	0	0	55	74
Unavailability of reactive compensation	0	0	0	6	2
Other	0	0	0	145	218
Unknown	0	0	0	75	156
N/A	725	670	785	0	0
Grand Total	725	670	785	1 155	1 488

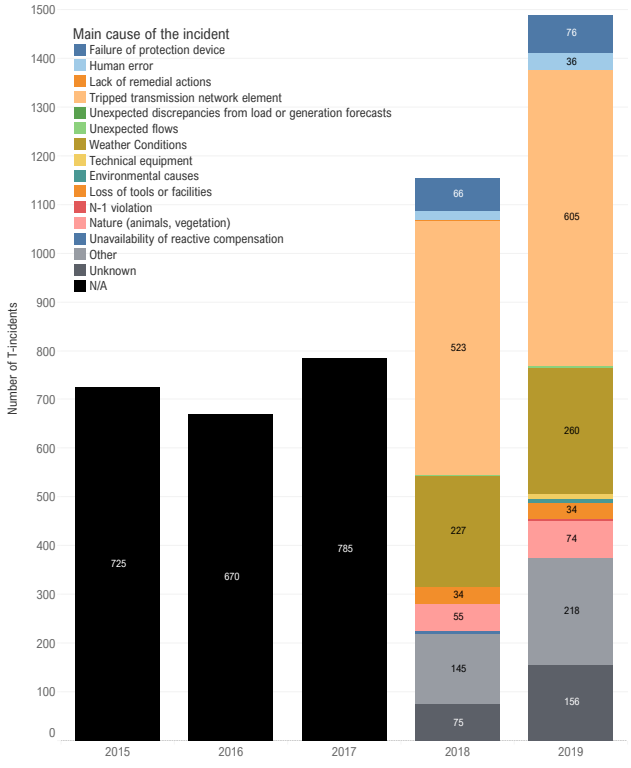

Figure 3.14: The annual number of T-incidents per cause from 2015–2019.

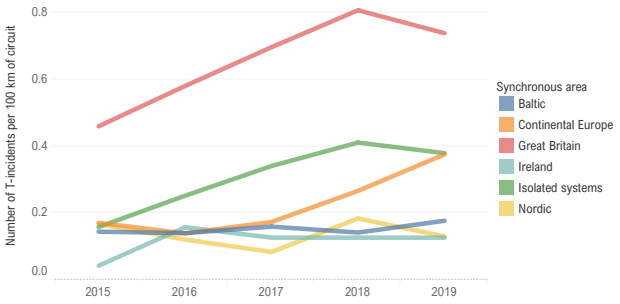

Figure 3.15: The annual number of T-incidents per 100 km installed circuit length in each synchronous area from 2015–2019.

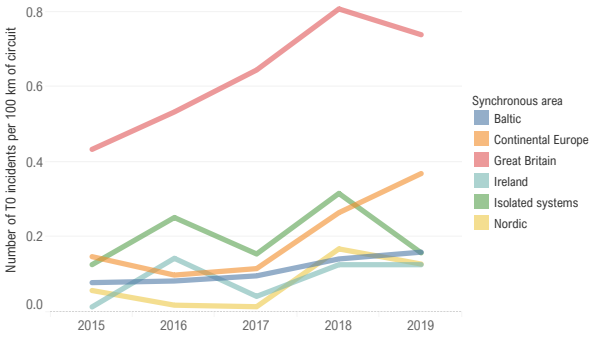

Figure 3.16: The annual number of T0-incidents per 100 km of circuit length from 2015–2019.

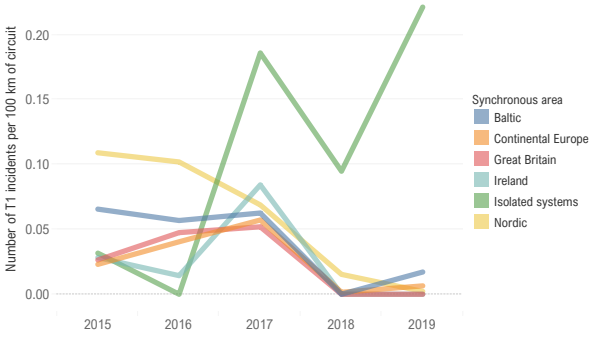

Figure 3.17: The annual number of T1-incidents per 100 km of circuit length from 2015–2019.

3.3.4 Detailed view of incidents involving loss of tools or facilities

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

Table 3.13 presents the annual number of loss of tools and facilities incidents for each synchronous area, and Table 3.14 and Figure 3.18 show the same distributed per cause. Figure 3.19 presents the annual number of LT-incidents normalised by the installed circuit length in each synchronous area.

The increase in LT-incidents between 2017 and 2018 is due to updates in the ICS methodology in 2018 [1]. The update introduced LT0-incidents to the report, that is, incidents that do not affect other TSOs but last for more than 30 minutes. Before, only incidents affecting multiple TSOs were reported (LT1 and LT2). The updates are summarised in Section 2.1.

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

Table 3.13: The annual number of LT-incidents from 2015–2019.

Synchronous area	2015	2016	2017	2018	2019
Baltic	0	4	0	1	0
Continental Europe	11	18	18	124	124
Great Britain	1	1	2	31	42
Ireland	0	0	2	0	0
Isolated systems	0	0	0	0	0
Nordic	0	0	2	2	1
Grand Total	12	23	24	158	167

Table 3.14: The annual number of LT-incidents per cause from 2015–2019.

Main cause of the incident	2015	2016	2017	2018	2019
Human error	0	0	0	1	0
Technical equipment	0	0	0	0	0
Loss of tools or facilities	0	0	0	146	134
Other	0	0	0	7	33
Unknown	0	0	0	4	0
N/A	12	23	24	0	0
Grand Total	12	23	24	158	167

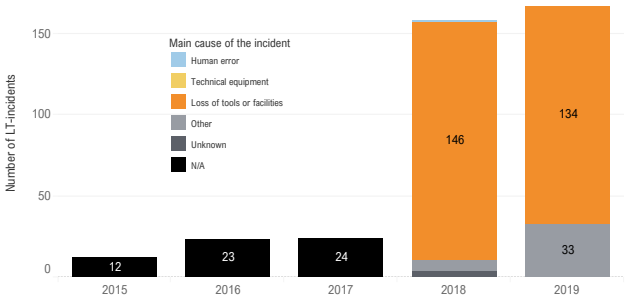

Figure 3.18: The annual number of LT-incidents per cause from 2015–2019.

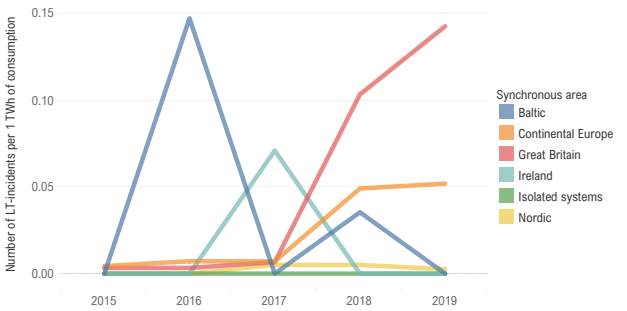

Figure 3.19: The annual number of LT-incidents per 1 TWh of consumption for each synchronous area from 2016–2019.

3.3.5 Detailed view of incidents involving a reduction of reserve capacity

This section presents a detailed view of incidents involving a reduction of reserve capacity, that is, RRC0, RRC1 and RRC2 events.

Table 3.15 presents the annual number of reduced reserve capacity events for each synchronous area, and Table 3.16 and Figure 3.20 show the same distributed per cause. Figure 3.21 presents the annual number of RRC-incidents normalised by the installed circuit length in each synchronous area.

The number of RRC-incidents increased in 2018 because MAVIR ZRt started to report RRC-incidents. There are more scale 1 than scale 0 RRC-incidents because most TSOs set 30 minutes as the minimum power generation scheduling resolution. Therefore, they exceed the 15–30 minute reduced reserve capacity threshold to begin with.

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

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Table 3.15: The annual number of RRC-incidents from 2015–2019.

Synchronous area	2015	2016	2017	2018	2019
Baltic	0	0	0	0	0
Continental Europe	3	3	13	118	162
Great Britain	0	0	0	0	0
Ireland	0	0	0	0	0
Isolated systems	0	0	0	0	0
Nordic	0	0	0	0	0
Grand Total	3	3	13	118	162

Table 3.16: The annual number of RRC-incidents per cause from 2015–2019.

Main cause of the incident	2015	2016	2017	2018	2019
Unexpected discrepancies from load or generation forecasts	0	0	0	0	2
Weather conditions	0	0	0	0	0
Loss of generation	0	0	0	1	1
Not enough/exhausted FRR	0	0	0	114	158
Not enough/exhausted RR	0	0	0	3	0
Reduction of reserve capacity (RRC1)	0	0	0	0	1
Technical equipment	0	0	0	0	0
Other	0	0	0	0	0
Unknown	0	0	0	0	0
N/A	3	3	13	0	0
Grand Total	3	3	13	118	162

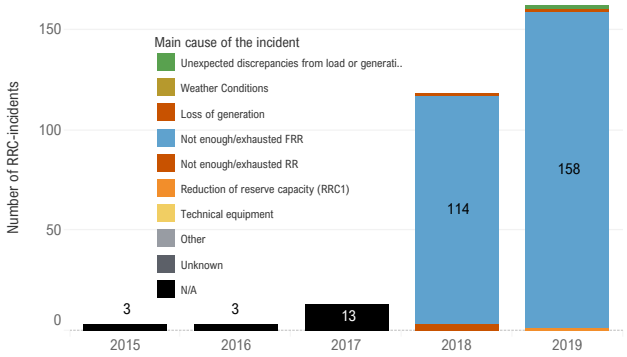

Figure 3.20: The annual number of RRC-incidents per cause from 2015–2019.

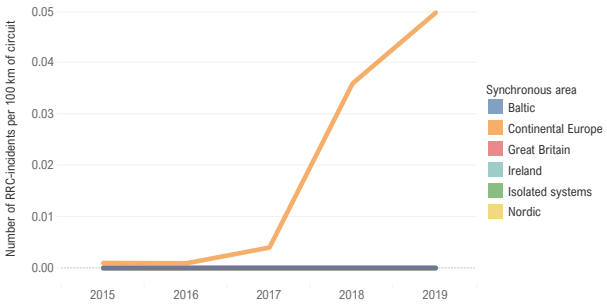

Figure 3.21: The annual number of RRC-incidents per 100 km of installed circuit length in each synchronous area from 2015–2019.

3.3.6 Detailed view of violations of standards on voltage

This section presents a detailed view of 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 and Figure 3.22 show the same distributed by cause. Figure 3.23 presents the annual number of OV-incidents normalised by the installed circuit length in each synchronous area.

As can be seen from Figure 3.22, TSOs could decrease the number of voltage standard violations by more than half, if they would add more reactive power to their power reserves. It should be noted, however, that most of these incidents are of scale 0 and do not endanger normal operating conditions, as shown in Table 3.6.

From 2018 to 2019, the number of OV-incidents decreased while the unavailability of reactive compensation increased. Furthermore, the cause categories other and unknown decreased. This decreasing trend should be followed up in the future.

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

Table 3.17: The annual number of OV-incidents from 2015–2019.

Synchronous area	2015	2016	2017	2018	2019
Baltic	0	0	0	0	0
Continental Europe	34	34	48	386	295
Great Britain	0	0	0	0	0
Ireland	0	1	0	0	0
Isolated systems	0	0	0	0	0
Nordic	0	0	0	5	0
Grand Total	34	35	48	391	295

Table 3.18: The annual number of OV-incidents per cause from 2015–2019.

Main cause of the incident	2015	2016	2017	2018	2019
Unavailability of reactive compensation	0	0	0	167	221
Unexpected flows	0	0	0	4	1
Weather conditions	0	0	0	1	0
Other	0	0	0	132	30
Unknown	0	0	0	87	43
N/A	34	35	48	0	0
Grand Total	34	35	48	391	295

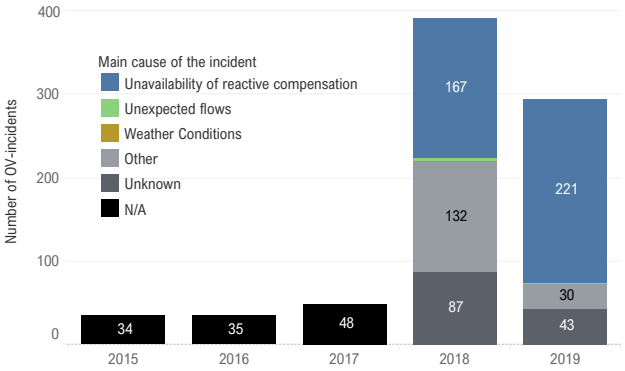

Figure 3.22: The annual number of OV-incidents per cause from 2015–2019.

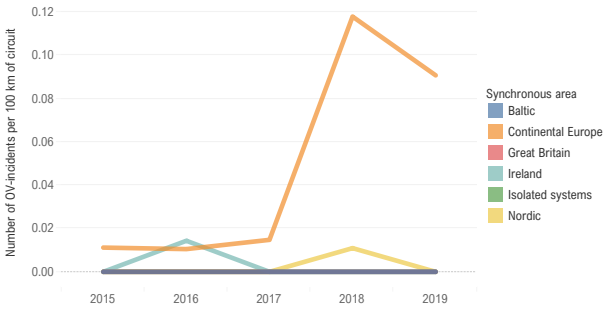

Figure 3.23: The annual number of OV-incidents per 100 km of installed circuit length in each synchronous area from 2015–2019.

3.3.7 Detailed view of N- and N-1 violations

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

Table 3.19 presents the annual number of ON1 and ON2 incidents for each synchronous area. Table 3.20 and Figure 3.24 show the same distributed by cause. Figure 3.25 presents the annual number of ON-incidents normalised by the installed circuit length in each synchronous area.

As most ON-incidents are caused by unexpected flows, improving load flow forecasts could drastically reduce the number of ON-incidents. This improvement is of critical importance as every ON-incident degrades the TSO's operating state to alert or emergency.

Great Britain has reported a high number of incidents on transmission system elements (T) compared to other synchronous areas. However, Great Britain's number of N and N-1 violation (ON) incidents per 100 km of circuit length is very similar to other synchronous areas indicating that Great Britain is operating within its operational security limits.

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

Table 3.19: The annual number of ON-incidents from 2015–2019.

Synchronous area	2015	2016	2017	2018	2019
Baltic	0	0	0	0	0
Continental Europe	92	67	66	34	26
Great Britain	0	0	0	2	0
Ireland	0	0	0	0	0
Isolated systems	0	0	0	0	0
Nordic	10	9	0	2	0
Grand Total	102	76	66	38	26

Table 3.20: The annual number of ON-incidents per cause from 2015–2019.

Main cause of the incident	2015	2016	2017	2018	2019
Failure of protection device	0	0	0	1	0
Human error	0	0	0	1	0
Lack of remedial actions	0	0	0	0	0
Tripped transmission network element	0	0	0	3	0
Unexpected discrepancies from load or generation forecasts	0	0	0	2	0
Unexpected flows	0	0	0	26	23
Weather conditions	0	0	0	2	0
Unknown	0	0	0	0	0
Other	0	0	0	3	3
N/A	102	76	66	0	0
Grand Total	102	76	66	38	26

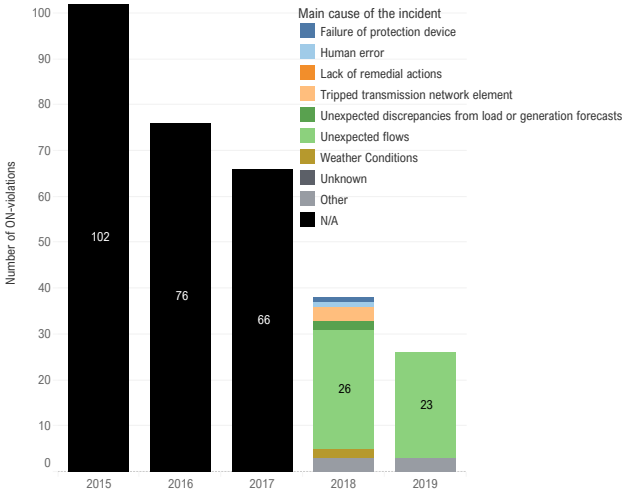

Figure 3.24: The annual number of ON-incidents per cause from 2015–2019.

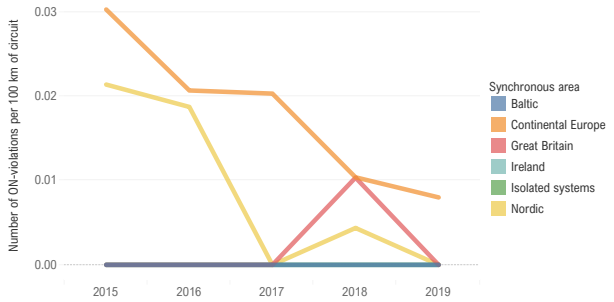

Figure 3.25: The annual number of ON-incidents per 100 km of installed circuit length in each synchronous area from 2015–2019.

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 during 2019. There were 2 scale 2 incidents in continental Europe and 1 scale 2 incident in Great Britain. No scale 3 incidents were recorded in 2019.

4.1 The scale 2 incidents in continental Europe

4.1.1 Swissgrid incident on 15 November 2019

Prevailing load flow patterns with transit flows through the central and western parts of the Swiss transmission grid in the days leading up to 15 November 2019 made it necessary to apply both counter-trading and topological changes in several substations to address predicted contingencies. These topological changes reduced the connectivity between the western and eastern parts of the Swiss transmission grid so that only four connecting paths remained. One of the four connections affected by the load flow patterns was a 125 kV distribution grid in western Switzerland. To avoid overloading lines and potential loss of service to consumers, the DSO had to separate its grid. This separation further reduced the connections between the western and eastern parts of the Swiss transmission grid and caused an increase in the remaining load flows in the transmission grid and a cascade of effects: due to a faulty protection setting, a 220 kV line in the Lake Geneva region tripped; two additional transmission system elements in Switzerland tripped as well; and one 400 kV line in France was overloaded and switched off. 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. The subsequent investigation determined the following main contributing factors for this event:

- general load flow patterns requiring topological changes (non-costly remedial actions) in the Swiss transmission grid negatively impacted the connectivity of the transmission grid;
- feedback effects between topology changes in the transmission and distribution grid that were not observed in Day Ahead Congestion Forecast (DACF) and Intraday Congestion Forecast (IDCF) processes, which occurred too quickly in real-time to allow for coordination between Swissgrid and the affected DSO;
- faulty protection settings on a Swiss 220 kV line;
- the DACF and IDCF models in AMICA (a load flow calculation tool) as well as in Swissgrid's Energy Management System (EMS) were incorrect regarding a special protection scheme on a Swiss 400/220 kV transformer.

4.1.2 ELES incident on 16 November 2019

The partial separation in the Swiss transmission system at 22.39 on 15 November 2019 led to an approximately 31 MW increase in physical flow from Slovenia to Italy of (see Swissgrid scale 2 incident above). At 22.30, the flows were approximately 1 024 MW and after the event approximately 1 055 MW.

At 2.17 on 16 November 2019, with a flow of almost 1 700 MW, the lines were very close to being overloaded. Due to N-violations on tie lines to Italy, ELES set the EAS state to "emergency". The grid situation did not permit a return to normal operating state until 8.12 on 16 November.

This incident is directly linked to the Swissgrid incident which ended with the resumption of a normal operation state at 7.40.

4.2 The scale 2 incident in Great Britain

At 16.52.33 on Friday 9 August 2019 there was a lightning strike on a 400 kV circuit. This was one of several lightning strikes that hit the transmission system on the day, but this was the only one to have had a significant impact. The protection systems on the transmission system operated correctly to clear the lightning strike and the associated voltage disturbance was expected. Vector Shift protection relays correctly initiated following the lightning strike resulting in the tripping of approximately 150 MW of embedded generation in the DNO network. Furthermore, there were two almost simultaneous unexpected generation losses at an offshore windfarm (737 MW) and a steam turbine at a gas-fired power station (244 MW) – these occurred independently of one another, but coincident with the lightning strike. Generation trip or de-load is usually not expected in response to a lightning strike which makes this event extremely rare and unexpected.

The above events resulted in a cumulative power loss greater than the level required to be secured by the Security Standards (1 000 MW based on the largest infeed at the time), and a large frequency drop outside the statutory range. The frequency drop caused further tripping of approximately 350 MW of embedded generation on Rate of Change of Frequency (RoCoF) protection relays.

The total loss of generation at this point was 1 481 MW, and the frequency fall was arrested at 49.1 Hz and began to recover with the deployment of all available response and reserve on the system. However, one of the gas turbines at the same gas-fired power station with the previously tripped steam turbine, then unexpectedly tripped while generating 210 MW bringing the cumulative loss of generation to 1 691 MW. There were no further reserves left on the system, and the frequency fell to 48.8 Hz.

The Low Frequency Demand Disconnection (LFDD) scheme has correctly triggered at 48.8 Hz and automatically disconnected approximately 1.1 million customers, which is around 1 GW of load.

Soon after the initiation of LFDD, another 187 MW gas turbine tripped bringing the total generation lost to 1 878 MW. The effect of the gas turbine trip was absorbed by the LFDD and the additional plant dispatched by the GB Electricity National Control Centre (ENCC).

The disconnection of demand, coupled with the response and reserve in place along with further dispatch of a fast-acting plant by the GB Electricity National Control Centre (ENCC), enabled the frequency return to 50 Hz within 5 minutes. The Distribution Network Operators quickly restored supplies within 40 minutes once the system was in a stable and secure position.

5 Operational Security Indicators

This chapter presents the operational security indicators relevant to operational security, planning and scheduling.

5.1 Operational security indicators relevant to operational security

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

Table 5.2 shows the calculated values for each security indicator for the year 2019.

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.	Total number of tripped transmission system elements reported for scale 0–3 incidents.
OS-B	Number of tripped power generation facilities per year per TSO.	Total number of tripped power generation facilities reported for scale 0–3 incidents.
OS-C	Energy not supplied due to unscheduled disconnection of demand facilities per year per TSO.	Sum the reported energy not supplied due to unscheduled disconnection of demand facilities for scale 0–3 incidents.
OS-D1	Duration of time in alert and emergency states per year per TSO.	Sum the time duration (in minutes) spent in alert and emergency states for all reported scale 0–3 incidents.
OS-D2	Number of reported alert and emergency state incidents per year per TSO.	Total number of scale 0–3 incidents in which an alert or emergency state was reported.
OS-E1	Duration of time where a lack of reserve was identified per year per TSO	Sum the duration of incidents reported under the RRC0, RRC1 and RRC2 criteria and the duration of all other incidents on scale 0–3 where reduction of reserve capacity is reported.
OS-E2	Number of events within which there was a lack of reserve identified per year per TSO.	Sum the number of incidents reported under the RRC0, RRC1 and RRC2 criteria and the number of all other incidents on scale 0–3 where reduction of reserve capacity is reported.
OS-F1	Duration of time voltage deviations exceed the ranges set forth in Tables 1 and 2 of SO GL [2] Annex II per year per TSO.	Sum the duration of incidents reported under the OV0, OV1 and OV2 criteria and the duration of all other incidents on scale 0–3 where voltage deviations exceeding the ranges from SO GL Annex II [2] are reported.
OS-F2	Number of voltage deviations exceeding the ranges from tables 1 and 2 of SO GL [2] Annex II per year per TSO.	Sum the number of violation of standards of voltage incidents (OV0, OV1 and OV2) and the number of all other scale 0–3 incidents in which the voltage standards are violated.
OS-G1	Number of minutes outside the standard frequency range per year per synchronous area.	Sum the number of minutes outside the standard frequency range for all scale 0–3 incidents.
OS-G2	Number of minutes outside the 50 % of maximum steady-state frequency range per year per synchronous area.	Sum the number of minutes outside the 50 % of maximum steady-state frequency deviation for all scale 0–3 incidents.
OS-H	Number of system-split separations or local blackout states per year.	Total number of separation of grid incidents (RS1 and RS2).
OS-I	Number of blackouts involving two or more TSOs per year.	Total number of blackout incidents (OB3) in which two or more TSOs were involved.

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

	Synchronous area						
	Baltic	Continental Europe	Great Britain	Ireland	Isolated systems	Nordic	ENTSO-E average
OS-A [tripped elements/TSO]	19.3	60.1	218.0	4.5	9.0	21.8	51.4
OS-B [tripped PGF/TSO]	5.0	4.4	25.0	7.0	4.5	1.3	4.8
OS-C [MWh/TSO]	0.0	9.5	353.0	0.0	3.8	57.7	22.1
OS-D1 [minutes/TSO]	24.3	1 000.3	2.4	0.0	188.5	163.6	713.5
OS-D2 [incidents/TSO]	2.0	9.7	1.0	0.0	2.0	26.5	9.7
OS-E1 [minutes/TSO]	1 141.0	271.0	0.0	0.0	250.0	0.0	288.7
OS-E2 [incidents/TSO]	1.0	6.2	0.0	0.0	2.5	0.0	4.5
OS-F1 [minutes/TSO]	0.0	2 034.3	0.0	0.0	0.0	0.0	1 391.9
OS-F2 [incidents/TSO]	0.0	11.2	0.0	0.0	0.0	0.0	7.6
OS-G1 [minutes]	25.0	1 913.6	139.7	0.0	0.0	6.8	2 085.1
OS-G2 [minutes]	17.0	90.4	70.0	0.0	0.3	0.0	177.7
OS-H [incidents]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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 for operational security, 2015–2019

Figure 5.1 to Figure 5.12 show the annual calculated values from 2015 to 2019 for operational security indicators OS-A to OS-H, respectively.

The substantial increases in the operational security indicators for 2018 are a result of the updated Incident Classification Scale Methodology [1], that was introduced for the Annual Report of 2018. The updates are summarised in Section 2.1.

Furthermore, some security indicators changed in the methodology update:

- 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; and
- OS-F became OS-F2, and OS-F1 was created to calculate the time duration of all OS-F2 occurrences per TSO.

Finally, the operational security indicator OS-I has been omitted from this section because, from 2015–2019, there were no scale 3 events in the ENTSO-E area.

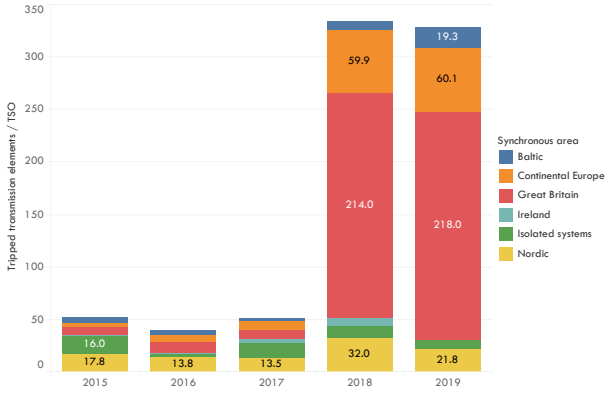

Figure 5.1: Operational security indicator OS-A from 2015–2019. It is calculated by summing the number of tripped transmission system elements reported for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area.

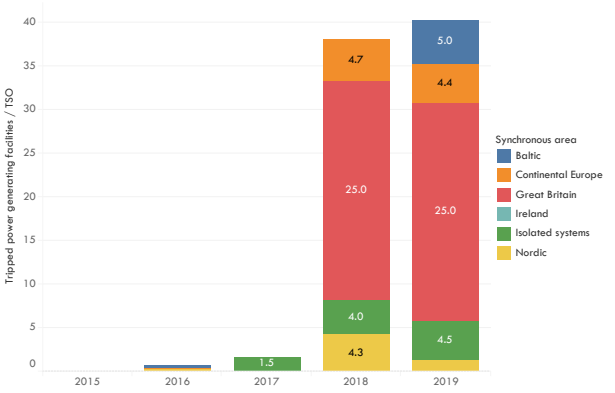

Figure 5.2: Operational security indicator OS-B from 2015–2019. It is calculated by summing the number of tripped power generation facilities reported for scale 0–3 incidents and dividing by the number of TSOs in the synchronous area.

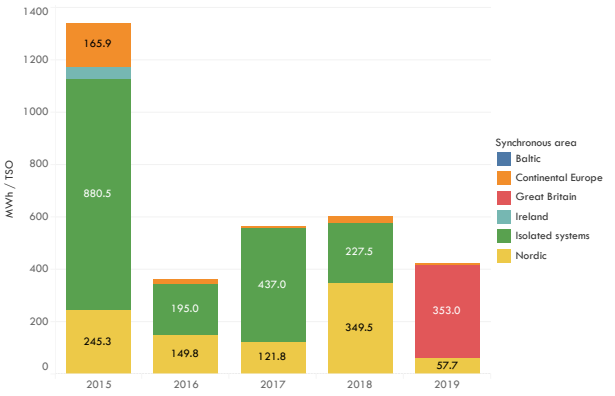

Figure 5.3: Operational security indicator OS-C from 2015–2019. It is calculated by summing the reported energy not supplied due to unscheduled disconnection of demand facilities for all scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area. As can be seen, there was less energy not supplied due to unscheduled disconnection of demand facilities in 2019 than the previous two years.

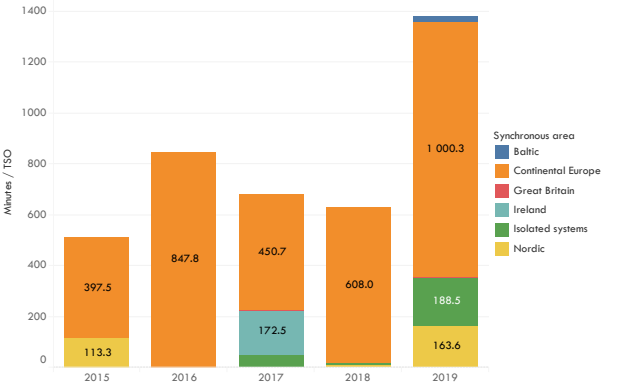

Figure 5.4: Operational security indicator OS-D1 from 2015–2019. It is calculated by summing the number of minutes in alert and emergency states of all reported scale 0–3 incidents, and dividing by the number of TSOs in the synchronous area. The increase in OS-D1 in 2019 is linked to using the duration of the whole scale 1 or scale 2 incident where alert or emergency state has not been reported. Previously, only reported alert and emergency state minutes were counted. The effect of this improvement should be followed in the future.

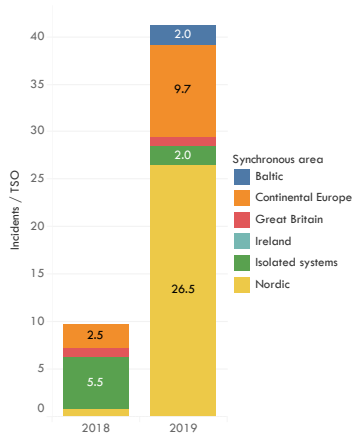

Figure 5.5: Operational security indicator OS-D2 from 2018–2019. It is calculated by counting the number of scale 0–3 incidents in which an alert or emergency state was reported, and dividing by the number of TSOs in the synchronous area. The security indicator OS-D2 was created in 2018. Comparing OS-D1 and OS-D2 shows that the number of incidents has increased while the combined duration has decreased.

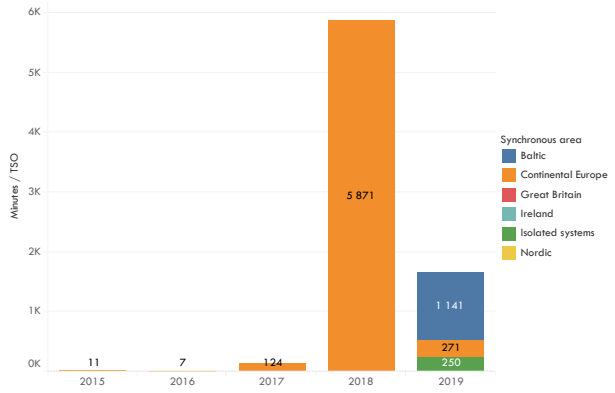

Figure 5.6: Operational security indicator OS-E1 from 2015–2019. It is calculated by summing the duration of RRC0-, RRC1- and RRC2-incidents and the duration of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area.

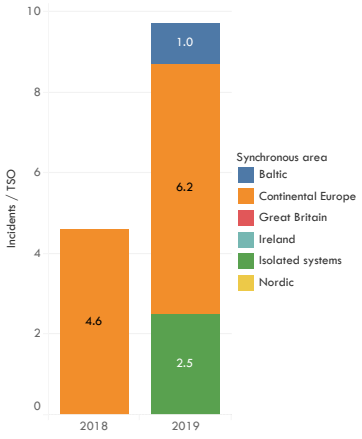

Figure 5.7: Operational security indicator OS-E2 from 2015–2019. It is calculated by counting the number RRC0-, RRC1- and RRC2-incidents and the number of all other scale 0–3 incidents if a reduction of reserve capacity is reported, and dividing by the number of TSOs in the synchronous area. The security indicator OS-E2 was created in 2018.

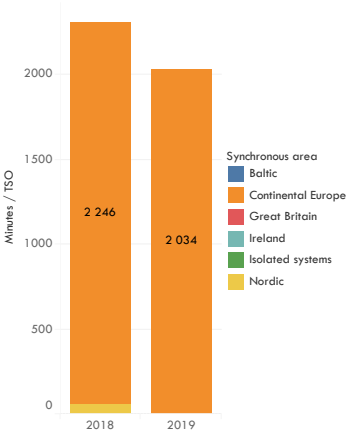

Figure 5.8: Operational security indicator OS-F1 from 2015–2019. It is calculated by summing the duration of OV0-, OV1- and OV2-incidents and the duration of all other incidents on scale 0–3 where voltage deviations exceed the ranges from SO GL Annex II [2] are reported, and dividing by the number of TSOs in the synchronous area. The security indicator OS-F1 was created in 2018.

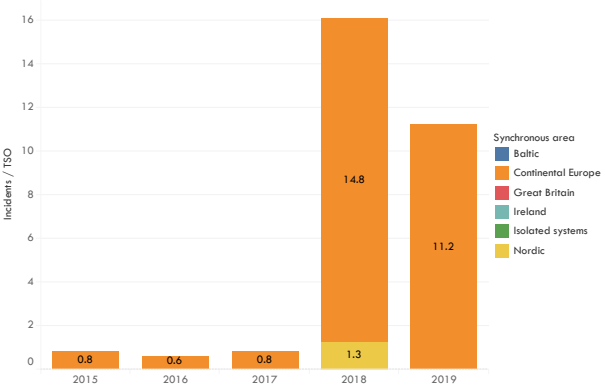

Figure 5.9: Operational security indicator OS-F2 from 2015–2019. It is calculated by counting the number of violation of standards of voltage incidents (OV0, OV1 and OV2) and the number of all other scale 0–3 incidents in which the voltage standards are violated, and dividing by the number of TSOs in the synchronous area.

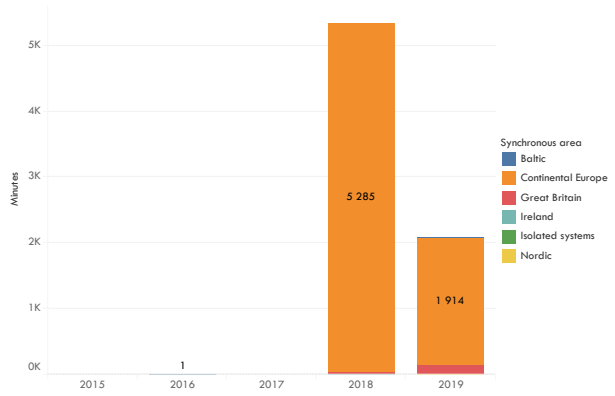

Figure 5.10: Operational security indicator OS-G1 from 2015–2019. It is calculated by summing the number of minutes outside the standard frequency range for all scale 0–3 incidents.

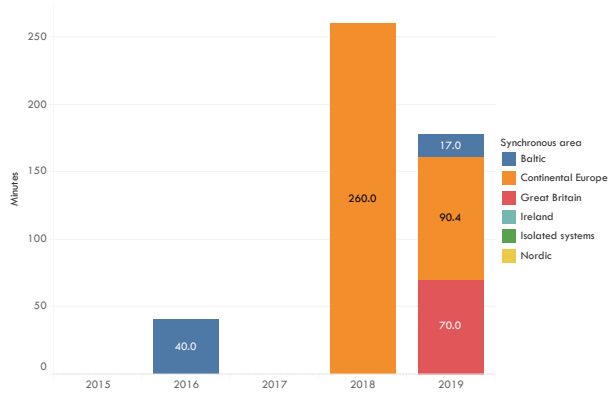

Figure 5.11: Operational security indicator OS-G2 from 2015–2019. It is calculated by summing the number of minutes outside the 50 % of maximum steady-state frequency deviation for all scale 0–3 incidents.

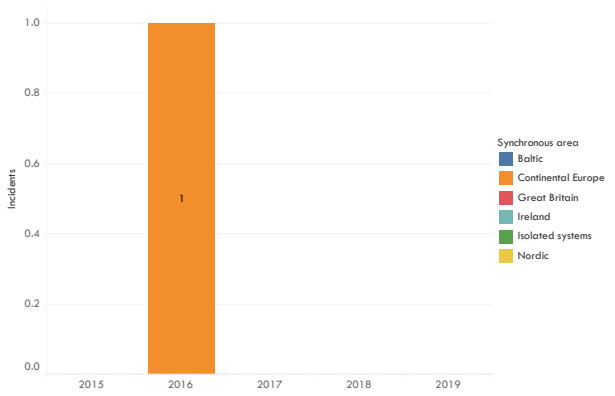

Figure 5.12: Operational security indicator OS-H from 2015–2019. It is calculated by counting the number of grid separation incidents (RS1 and RS2). As it can be seen, RS1- and RS2-incidents were only reported in 2016.

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5.2 Operational security indicators relevant to operational planning and scheduling

The operational security indicators relevant to operational planning and scheduling are presented in Table 5.3. Table 5.4 presents the calculated value of each operational security indicators relevant to operational planning and scheduling for the year 2019.

As Table 5.4 shows, among the operational security indicators that are relevant to operational planning and scheduling, OPS-A has the highest values in the Baltic and isolated system synchronous areas. However, these values are less concerning when compared to continental Europe. OPS-E indicators are found only in continental Europe, and OPS-B and OPS-D indicators are non-existing for all synchronous areas.

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

Abbr.	Description of the operational security indicator	Calculation method
OPS-A	Number of events where an incident contained in the contingency list led to degradation of the system operation state.	Total number of scale 0–3 incidents where a contingency from the contingency list degraded the system operation state.
OPS-B	Number of the OPS-A indicator events where degradation of system operation conditions occurred as a result of unexpected discrepancies from load or generation forecasts.	Total number of OPS-A indicators caused by unexpected discrepancies from load and generation forecasts.
OPS-C	Number of events where there was degradation in system operation conditions due to an exceptional contingency.	Total number of scale 0–3 incidents where an exceptional contingency degraded the system operation state.
OPS-D	Number of OPS-C indicator events where degradation of system operation conditions occurred as a result of unexpected discrepancies from load or generation forecasts.	Total number of OPS-C indicators caused by unexpected discrepancies from load and generation forecasts.
OPS-E	Number of events leading to degradation in system operation conditions due to lack of active power reserves.	Total number of scale 0–3 incidents caused by lack of active power reserves.

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	Grand total
OPS-A [incidents]	4	43	0	0	7	2	56
OPS-B [incidents]	0	0	0	0	0	0	0
OPS-C [incidents]	1	3	0	0	5	0	9
OPS-D [incidents]	0	0	0	0	0	0	0
OPS-E [incidents]	0	158	0	0	0	0	158

5.2.1 Evolution of operational security indicators relevant for operational planning and scheduling, 2015–2019

Figures 5.13 through 5.16 show the annual calculated values from 2015–2019 for operational security indicators OPS-A, OPS-B, OPS-C and OPS-E, respectively. No value for OPS-D is shown because it has been zero since 2015.

The substantial increase in operational security indicator OPS-E, as seen in Figure 5.16, is connected to the increase in RRC-incidents reported by MAVIR ZRt in Hungary. Section 12.1.13 presents detailed values from MAVIR ZRt.

Finally, the operational security indicator OPS-D is omitted from this section because no OPS-C incidents have been caused by unexpected discrepancies from load and generation forecasts.

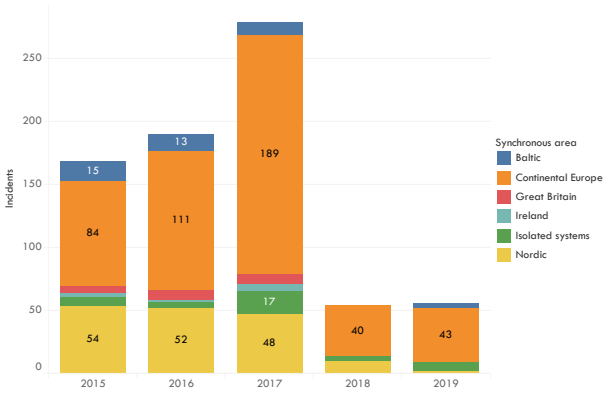

Figure 5.13: Operational security indicator OPS-A annually from 2015–2019. It is calculated by counting the number of scale 0–3 incidents where a contingency from the contingency list degraded the system operation state. The decreased values in 2018 and 2019 are due to a better definition of a contingency in the methodology [1]. The methodology updates are summarised in Section 2.1.

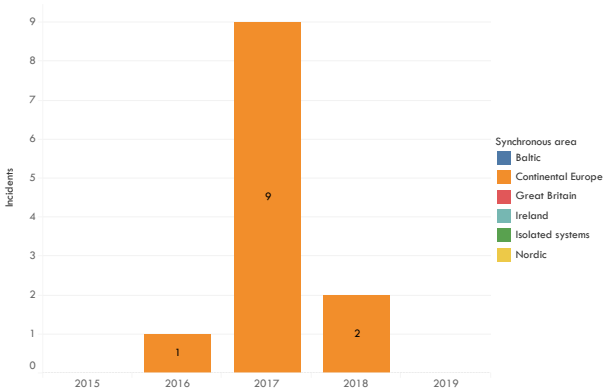

Figure 5.14: Operational security indicator OPS-B annually from 2015–2019. It is calculated by counting the number of OPS-A indicators where the cause was unexpected discrepancies from load and generation forecasts.

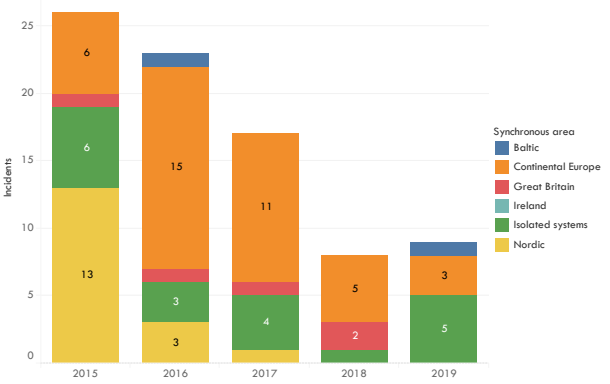

Figure 5.15: Operational security indicator OPS-C annually from 2015–2019. It is calculated by counting the number of scale 0–3 incidents where an exceptional contingency degraded the system operation state.

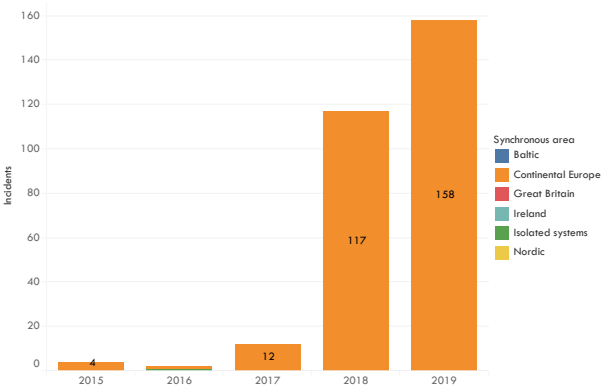

Figure 5.16: Operational security indicator OPS-E annually from 2015–2019. It is calculated by counting the number of scale 0–3 incidents caused by lack of active power reserves.

6 Incidents in continental Europe

6.1 Overview of 2019

This section presents an overview of incidents in continental Europe in 2019. The incidents are organised by dominating criterion and further grouped by month and duration in Table 6.1 and Table 6.2, respectively.

As Table 6.1 shows, in 2019 a total of 2 687 incidents that meet the ICS criteria were reported by TSOs in continental Europe. Scale 0 incidents comprised 90.96 % of the incidents; scale 1 and scale 2 incidents followed with 8.97 % and 0.07 %. No scale 3 incidents were reported. The incidents on transmission network elements (T0) and frequency degradations (F0), combined, account for 75.5 % of all incidents.

Table 6.1 shows the distribution of then umber of incidents recorded in 2019. The number of T0-incidents was high from June to August and November to December, and the number of F0-incidents was high from January to April and from September to December. The number of OV0-incidents was high from March to July.

As shown in Table 6.2, more than half of all incidents were solved within less than an hour, and all frequency deviations were cleared in less than an hour. However, T- and G-incidents were particularly prone to take more than 24 hours to be resolved. The duration of T- and G-incidents depended mainly on the underlying cause of the trip. LT-, OV- and RRC-incidents have a more diverse duration distribution, and more than 60 % are resolved within less than two hours.

For most TSOs, 30 minutes is the minimum scheduling resolution of power generation, and in the 2018 ICS methodology [1], RRC-incidents that last for more than 30 minutes are automatically classified as scale 1 events.

Table 6.1: Number of incidents by dominant criteria distributed per month in 2019 in continental Europe.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	99	81	84	49	42	42	46	43	62	69	66	76	759
	Incidents on power generating facilities (G0)	6	2	7	7	6	5	9	12	5	10	12	12	93
	Incidents on transmission network elements (T0)	92	62	79	94	78	127	137	142	89	78	106	115	1 199
	Loss of tools and facilities (LT0)	10	5	6	6	23	5	6	7	11	11	8	8	106
	Reduction of reserve capacity (RRC0)	0	0	0	0	1	0	0	0	0	0	0	0	1
	Violation of standards on voltage (OV0)	14	14	38	27	37	32	32	21	17	17	22	15	286
	Total	221	164	214	183	187	211	230	225	184	185	214	226	2 444
Scale 1	Incidents leading to frequency degradation (F1)	1	0	0	0	1	2	0	0	0	1	2	0	7
	Incidents on load (L1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	1	2	0	2	4	4	1	3	0	1	3	21
	Loss of tools and facilities (LT1)	2	0	0	0	2	1	1	1	1	2	6	2	18
	N-1 violation (ON1)	1	0	2	3	2	1	3	3	2	5	2	1	25
	Reduction of reserve capacity (RRC1)	12	2	11	27	27	12	3	21	13	6	18	9	161
	Separation from the grid (RS1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	1	2	2	0	1	0	1	1	0	1	0	9
	Total	16	4	17	32	34	21	11	27	20	14	30	15	241
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Loss of tools and facilities (LT2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	2	0	2
Scale 3	Blackout (OB3)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total		237	168	231	215	221	232	241	252	204	199	246	241	2 687

Table 6.2: Cumulative number of incidents by dominant criteria and duration in 2019 in continental Europe.

		2019					
Scale	Dominating criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents leading to frequency degradation (F0)	759	759	759	759	759	759
	Incidents on power generating facilities (G0)	12	22	35	45	54	93
	Incidents on transmission network elements (T0)	349	497	737	872	997	1 199
	Loss of tools and facilities (LT0)	49	73	91	99	105	106
	Reduction of reserve capacity (RRC0)	0	0	1	1	1	1
	Violation of standards on voltage (OV0)	83	166	236	282	286	286
	Total	1 252	1 517	1 859	2 058	2 202	2 444
Scale 1	Incidents leading to frequency degradation (F1)	7	7	7	7	7	7
	Incidents on load (L1)	0	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	8	9	14	17	19	21
	Loss of tools and facilities (LT1)	7	12	15	17	18	18
	N-1 violation (ON1)	2	8	21	24	25	25
	Reduction of reserve capacity (RRC1)	149	157	160	161	161	161
	Separation from the grid (RS1)	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	3	5	7	8	8	9
	Total	176	198	224	234	238	241
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	1	1	1
	Loss of tools and facilities (LT2)	0	0	0	0	0	0
	N violation (ON2)	0	0	0	1	1	1
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0
	Total	0	0	0	2	2	2
Scale 3	Blackout (OB3)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Grand Total		1 428	1 715	2 083	2 294	2 442	2 687

6.2 Evolution 2015–2019

This section presents the annual number of incidents in continental Europe from 2015–2019, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in Table 2.1.

As shown in Table 6.3, Scale 0 incidents in 2019 increased by 361, or close to 66 %, over 2018. Whether that increase is substantial is not certain; it may simply be a result of the updated Incident Classification Scale Methodology [1] that was introduced for the Annual Report of 2018. The updates are summarised in Section 2.1.

The increases in the number of reported incidents since 2018 is mainly due to the new methodology. This evolving trend needs to be followed up when the use of the methodology has stabilised.

Between TSOs in continental Europe, the number of reported incidents between 2018 and 2019 are quite similar. The number of scale 1 incidents remained the same. This may be the result of an increase in scale 1 incidents caused by reduction of reserve capacity (RRC1) being offset by the decrease in reported voltage standards violations (OV1).

In 2019, 2 scale 2 incidents (an ON2 and a T2) in continental Europe, and no scale 3 incidents were reported in 2019.

Table 6.3: The annual number of incidents by dominating criterion from 2015–2019.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	25	15	11	953	759
	Incidents on power generating facilities (G0)	131	85	84	113	93
	Incidents on transmission network elements (T0)	449	320	377	867	1 199
	Loss of tools and facilities (LT0)	0	0	0	99	106
	Reduction of reserve capacity (RRC0)	0	2	1	0	1
	Violation of standards on voltage (OV0)	13	19	27	336	286
	Total	618	441	500	2 368	2 444
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	10	7
	Incidents on load (L1)	5	2	1	3	0
	Incidents on power generating facilities (G1)	0	1	0	0	0
	Incidents on transmission network elements (T1)	70	131	186	5	21
	Loss of tools and facilities (LT1)	11	18	18	25	18
	N-1 violation (ON1)	92	67	66	31	25
	Reduction of reserve capacity (RRC1)	3	1	12	118	161
	Separation from the grid (RS1)	0	0	0	0	0
	Violation of standards on voltage (OV1)	21	15	21	50	9
	Total	202	235	304	242	241
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	1
	Loss of tools and facilities (LT2)	0	0	0	0	0
	N violation (ON2)	0	0	0	3	1
	Reduction of reserve capacity (RRC2)	0	0	0	0	0
	Separation from the grid (RS2)	0	1	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0
	Total	0	1	0	3	2
Scale 3	Blackout (OB3)	0	0	0	0	0
	Total	0	0	0	0	0
Grand Total		820	677	804	2 613	2 687

6.3 Analysis of significant changes in trends

In 2019, 2 972 incidents were reported in continental Europe; an increase of 13 % over 2018. This increase appears to be significant and was mainly driven by F0- and T0-incidents. In 2019, G0- and OV0-incidents slightly decreased from 2018. For scale 1 incidents, reduction of reserve capacity was the primary cause of increased incident reports.

The trend of scale 1 incidents shifting to scale 0 incidents observed in 2018 continued in 2019. This shift is due to clarifications and better alignment of the methodology with the SO GL [2]. The updates are summarised in Section 2.1. The number of scale 2 incidents is similar to previous years, and no scale 3 incidents were reported in continental Europe.

7 Incidents in the Nordic synchronous area

7.1 Overview of 2019

This section presents an overview of incidents in the Nordic synchronous area in 2019. The incidents are presented by dominating criterion and further grouped by month and duration in Table 7.1 and Table 7.2, respectively.

In 2019, 170 incidents were reported in the Nordic synchronous area, including 61 scale 0 incidents and 109 scale 1 incidents. There were no scale 2 or scale 3 incidents.

As shown in Table 7.1, incidents leading to frequency degradation (F1) were the most common type with 106 incidents. The Nordic synchronous area did not register any F0-incidents due to a lack of reported numbers. Therefore, the number of F0-incidents in the Nordic synchronous area must be estimated, and it is assumed to be several hundred. The frequency data for the Nordics are extracted from a frequency report provided by Svenska kraftnät and Statnett. That report doesn't contain the F0-incidents. The Nordics are aware of this and will gather the data for the coming years.

With 59 reported incidents, the next largest type of incidents were on transmission network elements (T0). These incidents on transmission network elements were mainly due to tripped HVDC-links and AC-lines as a result of faults in technical equipment or weather conditions.

Table 7.1 also shows that nearly half of the incidents recorded in 2019 occurred during the summer season and were caused by incidents on transmission network elements (T0).

As shown in Table 7.2, 72 % of the incidents are resolved in less than an hour. 91 % of the incidents were resolved in less than 24 hours. The majority of the reported incidents that lasted less than an hour were incidents leading to frequency degradation (F1) and incidents on transmission network elements (T0).

Table 7.1: Number of incidents by dominant criteria distributed per month in 2019 in the Nordic synchronous area.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G0)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Incidents on transmission network elements (T0)	7	9	1	6	6	4	4	5	3	5	4	5	59
	Loss of tools and facilities (LT0)	0	0	0	0	1	0	0	0	0	0	0	0	1
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	7	9	1	6	7	4	4	5	3	5	5	5	61
Scale 1	Incidents leading to frequency degradation (F1)	5	8	10	4	9	14	3	9	13	11	7	13	106
	Incidents on load (L1)	0	0	0	0	0	0	1	0	1	0	0	0	2
	Incidents on power generating facilities (G1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	0	0	0	0	0	0	0	0	1	0	0	1
	Loss of tools and facilities (LT1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	5	8	10	4	9	14	4	9	14	12	7	13	109
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total		12	17	11	10	16	18	8	14	17	17	12	18	170

Table 7.2: Cumulative number of incidents by dominating criteria and duration in 2019 in the Nordic synchronous area.

		2019					
Scale	Dominating criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	0	0
	Incidents on power generating facilities (G0)	1	1	1	1	1	1
	Incidents on transmission network elements (T0)	14	23	32	40	45	59
	Loss of tools and facilities (LT0)	1	1	1	1	1	1
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0
	Total	16	25	34	42	47	61
Scale 1	Incidents leading to frequency degradation (F1)	105	105	105	105	105	106
	Incidents on load (L1)	1	2	2	2	2	2
	Incidents on power generating facilities (G1)	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	1	1	1	1	1
	Loss of tools and facilities (LT1)	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0
	Total	106	108	108	108	108	109
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Grand Total		122	133	142	150	155	170

7.2 Evolution 2015–2019

This section presents the annual number of incidents in the Nordic synchronous area from 2015–2019, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in 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 SO GL [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.

Scale 0 incidents in the Nordic synchronous area reported in 2019 decreased by 24 compared to 2018, as shown in Table 7.3. Scale 1 incidents increased by 95, largely due to frequency incidents; there were 18 incidents fewer on transmission network elements (T0) and 6 fewer T1-incidents compared to 2018. There has never been a scale 2 or scale 3 incident in the Nordic synchronous area.

Table 7.3: The annual number of incidents by dominating criterion from 2015–2019.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	1	0	0	2	0
	Incidents on power generating facilities (G0)	0	0	0	1	1
	Incidents on transmission network elements (T0)	27	9	7	77	59
	Loss of tools and facilities (LT0)	0	0	0	0	1
	Reduction of reserve capacity (RRC0)	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	5	0
	Total	28	9	7	85	61
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	106
	Incidents on load (L1)	3	2	2	3	2
	Incidents on power generating facilities (G1)	0	1	0	0	0
	Incidents on transmission network elements (T1)	51	49	33	7	1
	Loss of tools and facilities (LT1)	0	0	2	2	0
	N-1 violation (ON1)	10	9	0	2	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0
	Total	64	61	37	14	109
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0
	Total	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0
	Total	0	0	0	0	0
Grand Total		92	70	44	99	170

7.3 Analysis of significant changes in trends

In 2019, 170 incidents were reported in the Nordic synchronous area, representing an increase of 71 incidents compared to 2018. In 2018, incidents on transmission network elements (T0) comprised 78 % of incidents; in 2019, 62 % incidents were incidents leading to frequency degradation (F1). The Nordic synchronous area did not register any F0-incidents due to a lack of reported numbers. Therefore, the number of F0-incidents in the Nordic synchronous area must be estimated, and it is assumed to be several hundred. The frequency data for the Nordics are extracted from a frequency report provided by Svenska kraftnät and Statnett. That report does not contain the F0-incidents. The Nordics are aware of this and will gather the data for the coming years.

In 2019, the number of scale 0 incidents decreased by 24 over the previous year, but the number of scale 1 incidents increased by 95.

8 Incidents in Great Britain

8.1 Overview of 2019

This section presents an overview of incidents in Great Britain in 2019. The incidents are presented by dominating criteria 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 276 incidents in 2019, of which 275 incidents were scale 0 and one was scale 2.

Out of the 275 scale 0 incidents, 155 incidents were incidents on transmission system elements (T0), 78 incidents resulted in frequency degradation (F0), and 42 incidents resulted in loss of tools and facilities (LT0). No incidents on power generating facilities (G0) were recorded. All transmission incidents were secured following the application of curative remedial actions within appropriate timescales.

Disturbances on transmission network elements (T0), frequency degradation (F0) and loss of tools and facilities (LT0) were significant portion of the reported incidents, as seen in Table 8.2. One incident leading to frequency degradation (F2) was reported, and no incidents on power generating facilities (G0) were reported.

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

In 2019, 78 incidents led to scale 0 frequency degradation (F0), and one incident reached a scale 2 frequency degradation (F2). There were 42 incidents that resulted in loss of tools and facilities (LT0), and more than half (79) of the incidents 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 the incidents.

As shown in Table 8.2, 50 % of the reported incidents were resolved in under an hour. 24 % of the reported incidents 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.

All 78 incidents leading to frequency degradation (F0) were of relatively short duration, with each lasting for less than 5 minutes. Nearly 40 % (59 incidents) of the incidents on transmission network elements (T0) lasted more than 24 hours.

Table 8.1: Number of incidents by dominant criteria distributed per month in 2019 in Great Britain.

Scale	Dominating criterion	2019 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	9	8	6	4	6	5	12	7	1	7	5	8	78
	Incidents on power generating facilities (G0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T0)	20	12	13	12	7	15	22	11	3	11	10	19	155
	Loss of tools and facilities (LT0)	3	4	4	5	4	4	8	2	1	1	3	3	42
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	32	24	23	21	17	24	42	20	5	19	18	30	275
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on load (L1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Loss of tools and facilities (LT1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0	0	1	0	0	0	0	1
	Incidents on load (L2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	1	0	0	0	0	1
Scale 3	Blackout (OB3)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total		32	24	23	21	17	24	42	21	5	19	18	30	276

Table 8.2: Cumulative number of incidents by dominating criteria and duration in 2019 in Great Britain.

		2019					
Scale	Dominating criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents leading to frequency degradation (F0)	78	78	78	78	78	78
	Incidents on power generating facilities (G0)	0	0	0	0	0	0
	Incidents on transmission network elements (T0)	42	52	71	80	96	155
	Loss of tools and facilities (LT0)	16	23	31	35	36	42
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0
	Total	136	153	180	193	210	275
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0	0
	Incidents on load (L1)	0	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	0	0	0	0	0
	Loss of tools and facilities (LT1)	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Scale 2	Incidents leading to frequency degradation (F2)	1	1	1	1	1	1
	Incidents on load (L2)	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0
	Total	1	1	1	1	1	1
Scale 3	Blackout (OB3)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Grand Total		137	154	181	194	211	276

8.2 Evolution 2015–2019

This section presents the annual number of incidents in Great Britain from 2015–2019, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in Table 2.1.

National Grid Electricity System Operator (NGESO) of Great Britain (GB) recorded 276 incidents in 2019 in compared to 250 in 2018, and the reporting numbers are showing a steady increase in incidents since 2015. In 2019, there were 275 scale 0 incidents, no scale 1 incidents, and 1 scale 2 incident.

Table 8.3 shows that the incidents in 2018 and 2019 are quite similar. The large number of scale 0 incidents emerging in 2018 and 2019 are attributed to the recent change in the methodology [1]. The sizeable number was due to the reporting scale change for the 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 2015 and 2017. The methodology updates are summarised in Section 2.1.

In 2019, Great Britain recorded no scale 1 incidents in compared to 2 in 2018 and 12 in 2017. The first scale 2 incident in Great Britain was recorded in 2019, and it was an incident leading to frequency degradation (F2). Incident report-

ing history shows that the number of scale 1 incidents have never been this low.

The details of the scale 2 incident are presented in Section 4.2.

Table 8.3: The annual number of incidents by dominating criterion from 2015–2019.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	58	78
	Incidents on power generating facilities (G0)	0	1	2	3	0
	Incidents on transmission network elements (T0)	82	101	124	156	155
	Loss of tools and facilities (LT0)	0	0	0	31	42
	Reduction of reserve capacity (RRC0)	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0
	Total	82	102	126	248	275
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0
	Incidents on load (L1)	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0
	Incidents on transmission network elements (T1)	5	9	10	0	0
	Loss of tools and facilities (LT1)	1	1	2	0	0
	N-1 violation (ON1)	0	0	0	2	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0
	Total	6	10	12	2	0
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	1
	Incidents on load (L2)	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0
	Total	0	0	0	0	1
Scale 3	Blackout (OB3)	0	0	0	0	0
	Total	0	0	0	0	0
Grand Total		88	112	138	250	276

8.3 Analysis of significant changes in trends

In 2019, 276 incidents were reported in Great Britain synchronous area, which is similar to the reported number of incidents in 2018. Dominant criteria in 2019 were incidents on transmission system elements (T0), incidents leading to frequency degradation (F0) and loss of tools and facilities (LT0).

The number of scale 0 incidents in 2019 increased slightly compared to 2018, while scale 1 incidents decreased from 2 in 2018 to none in 2019. The number of reported scale 1 incidents have never been this low.

The first scale 2 incident in Great Britain was recorded in 2019, and it was an incident leading to frequency degradation (F2). The details of the scale 2 incident are presented in Section 4.2.

The increased reporting of incidents is primarily attributed to the methodology update in 2018 [1]. This evolving trend needs to be followed up when the methodology has stabilised.

9 Incidents in the Baltic Area

9.1 Overview of 2019

This section presents an overview of incidents in the Baltic area in 2019. The incidents are presented by dominating criterion and further grouped by month and duration in Table 9.1 and Table 9.2, respectively.

In 2019, 45 incidents were reported in the Baltic area. 39 of them were scale 0 and 6 were scale 1. No scale 2 or scale 3 incidents were reported in 2019.

Incidents on transmission network elements (T0) were the most frequent type of incident, as shown in Table 9.1. 58 % of the incidents were caused by tripped network elements and 19 % by weather conditions. Table 9.1 also portrays that the number of incidents recorded in 2019 has a uniform distribution during the year, with a slight concentration of incidents during the summer.

In 2019, there were 11 incidents on power generating facilities (G0) compared with 2 in 2018. This increasing trend should be followed up in the future.

The distribution of incidents by duration shown in Table 9.2 portrays that a significant share of 2019 incidents lasted less than an hour, and the number of incidents lasting more than 24 hours is the same in 2019 as in 2018.

Table 9.1: Number of incidents by dominant criteria distributed per month in 2019 in the Baltic area.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G0)	2	1	0	3	2	1	1	0	0	0	0	1	11
	Incidents on transmission network elements (T0)	1	0	3	1	3	5	2	7	1	1	2	2	28
	Loss of tools and facilities (LT0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	3	1	3	4	5	6	3	7	1	1	2	3	39
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0	0	1	0	0	0	0	0	1
	Incidents on load (L1)	0	0	0	0	0	0	0	0	1	1	0	0	2
	Incidents on power generating facilities (G1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	0	1	0	0	0	1	0	1	0	0	0	3
	Loss of tools and facilities (LT1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	1	0	0	0	2	0	2	1	0	0	6
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total		3	1	4	4	5	6	5	7	3	2	2	3	45

Table 9.2: Cumulative number of incidents by dominating criteria and duration in 2019 in the Baltic area.

		2019					
Scale	Dominating criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	0	0
	Incidents on power generating facilities (G0)	0	0	3	3	3	11
	Incidents on transmission network elements (T0)	11	14	17	22	25	28
	Loss of tools and facilities (LT0)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0
	Total	11	14	20	25	28	39
Scale 1	Incidents leading to frequency degradation (F1)	1	1	1	1	1	1
	Incidents on load (L1)	0	0	1	2	2	2
	Incidents on power generating facilities (G1)	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	1	2	3	3	3	3
	Loss of tools and facilities (LT1)	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0
	Total	2	3	5	6	6	6
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Grand Total		13	17	25	31	34	45

9.2 Evolution 2015–2019

This section presents the annual number of incidents in the Baltic area power system from 2015–2019, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in Table 2.1.

The number of reported incidents is similar to previous years for all incident types except incidents on power generating facilities (G0) and incidents leading to transmission network elements (T1), as seen in Table 9.3.

The number of G0-incidents increased from 2 incidents in 2018 to 11 in 2019. Ten of the eleven G0-incidents occurred in Elering AS's power grid. This increase should be followed up in the future. In contrast, the decrease in T1-incidents is a result of the updated Incident Classification Scale Methodology [1], that was introduced for the Annual Report of 2018. The updates are summarised in Section 2.1.

There is not much to be seen due to the methodology change in 2018. However, the number of scale 1 incidents is significantly higher in 2019 than in 2018.

Table 9.3: The annual number of incidents by dominating criterion from 2015–2019.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	0
	Incidents on power generating facilities (G0)	3	3	0	2	11
	Incidents on transmission network elements (T0)	18	19	17	25	28
	Loss of tools and facilities (LT0)	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0
	Total	21	22	17	27	39
Scale 1	Incidents leading to frequency degradation (F1)	0	1	0	0	1
	Incidents on load (L1)	0	0	0	0	2
	Incidents on power generating facilities (G1)	0	1	0	0	0
	Incidents on transmission network elements (T1)	15	13	11	0	3
	Loss of tools and facilities (LT1)	0	4	0	1	0
	N-1 violation (ON1)	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0
	Total	15	19	11	1	6
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0
	Total	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0
	Total	0	0	0	0	0
Grand Total		36	41	28	28	45

9.3 Analysis of significant changes in trends

In 2019, a total of 45 incidents 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-incidents increased slightly, the number of G0-incidents was exceptionally high. The higher number of incidents in 2019 compared to 2018 can be linked to the increased number of incidents reported by Elering AS. This increase should be followed up in the future.

The number of reported scale 1 incidents was higher in 2019 compared to 2018, but not higher than during previous years. However, all incidents on HVDC links were reported as scale 1 before the methodology update in 2018 [1]. All methodology updates are summarised in Section 2.1. All except 1 scale 1 incident occurred in Litgrid AB's transmission network.

In general, most of the incidents are incidents on transmission system elements (T). Small differences in other criteria are more connected to the size of the Baltic area and probability of uncommon incidents.

10 Incidents in Ireland

10.1 Overview of 2019

This section presents an overview of incidents in Ireland in 2019. The incidents are presented by dominating criteria and further grouped by month and duration in Table 10.1 and Table 10.2, respectively.

In 2019, 23 incidents were reported in Ireland, and they were all of scale 0. No incidents at the scales 1, 2 or 3 were reported.

Incidents on power generating facilities (G0) caused of 43 % of all incidents, and incidents transmission network elements (T0) 39 % of all incidents in Ireland in 2019, as can be seen in Table 10.1. The rest of the events were incidents leading to frequency degradation (F0). The incidents did not show any particular monthly distribution during the year.

Furthermore, 10 incidents at power generating facilities (G0) were reported with an average generation disconnection of 318 MW. 9 incidents on transmission network elements (T0) were reported. Tripping of elements was considered as ordinary trips due to different reasons, such as vegetation and failure equipment.

65 % of all incidents were cleared in under 24 hours, as seen in Table 10.2. The rest of the incidents, 8 in number, lasted for more than 24 hours.

Table 10.1: Number of incidents by dominant criteria distributed per month in 2019 in Ireland.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	1	0	2	0	0	1	0	0	0	0	4
	Incidents on power generating facilities (G0)	1	0	1	1	0	1	1	1	0	2	2	0	10
	Incidents on transmission network elements (T0)	0	0	0	0	2	2	0	3	1	1	0	0	9
	Loss of tools and facilities (LT0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1	0	2	1	4	3	1	5	1	3	2	0	23
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on load (L1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Loss of tools and facilities (LT1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total		1	0	2	1	4	3	1	5	1	3	2	0	23

Table 10.2: Cumulative number of incidents by dominating criteria and duration in 2019 in Ireland.

		2019					
Scale	Dominating criterion	<1h	<2h	<5h	<10h	<24h	Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	2	4
	Incidents on power generating facilities (G0)	2	3	6	7	7	10
	Incidents on transmission network elements (T0)	3	4	5	6	6	9
	Loss of tools and facilities (LT0)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0
	Total	5	7	11	13	15	23
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0	0
	Incidents on load (L1)	0	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	0	0	0	0	0
	Loss of tools and facilities (LT1)	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Grand Total		5	7	11	13	15	23

10.2 Evolution 2015–2019

This section presents the annual number of incidents in Ireland from 2015–2019, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in Table 2.1.

The number of scale 0 incidents reported in 2019 is comparable to 2018, as seen in Table 10.3. No scale 1 incidents were reported in 2019 nor 2018. However, there has been 11 scale 1 incidents from 2015–2017. A slight decreasing trend of reported incidents can be seen over the years.

In 2018, when 8 incidents leading to frequency degradation (F0) were reported, 7 were due to a power generation loss and 1 due to a loss of transmission system element (HVDC tie line). The number of incidents in 2019 is comparable to previous years.

No scale 2 or scale 3 incidents were reported in Ireland in 2019. 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 incidents by dominating criterion from 2015–2019.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	8	4
	Incidents on power generating facilities (G0)	27	21	24	7	10
	Incidents on transmission network elements (T0)	1	10	3	9	9
	Loss of tools and facilities (LT0)	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	1	0	0	0
	Total	28	32	27	24	23
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0
	Incidents on load (L1)	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0
	Incidents on transmission network elements (T1)	2	1	6	0	0
	Loss of tools and facilities (LT1)	0	0	2	0	0
	N-1 violation (ON1)	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0
	Total	2	1	8	0	0
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	1	0
	Incidents on load (L2)	1	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0
	Total	1	0	0	1	0
Scale 3	Blackout (OB3)	0	0	0	0	0
	Total	0	0	0	0	0
Grand Total		31	33	35	25	23

10.3 Analysis of significant changes in trends

In 2019, a total of 23 incidents were reported on Ireland, which is comparable to 2018, when 25 incidents were reported. The dominant criteria in 2019 were incidents on power generating facilities (G0) and incidents involving transmission network elements (T0), and the rest of the incidents were incidents leading to frequency degradation (F0). The continuing trend of only G0-, T0- and F0-incidents can still be seen in Ireland. The number of scale 1 incidents has been zero since 2018, when the ICS methodology was updated [1]. The methodology updates are summarised in Section 2.1. No scale 1 nor scale 2 incidents were reported in 2019, which means that the reported incidents were of low impact and did not affect normal operating conditions.

11 Incidents in isolated systems

11.1 Overview of 2019

This section presents an overview of incidents in isolated systems in 2019. The incidents are presented by dominating criterion and further grouped by month and duration in Table 11.1 and Table 11.2, respectively.

In 2019, a total of 16 incidents were reported for the isolated systems Iceland and Cyprus. All of the incidents occurred in Iceland, and they were all of either scale 0 or scale 1. No scale 2 or scale 3 incidents were recorded.

The only types of reported events were incidents on transmission network elements (T0 and T1) and incidents on power generating facilities (G0), as shown in Table 11.1. Incidents on transmission network elements (T0 and T1) were mainly due to tripped transmission network element.

The analysis of the distribution of incidents per duration shows uniform distribution over the categories for scale 0 incidents. Due to the low number of scale 1 and scale 2 incidents, no conclusions can be drawn.

Almost a third of the reported incidents lasted less than 1 hour. Only 2 of the reported 16 scale 2 incidents were resolved within 24 hours; however, the number of scale 1 and scale 2 incidents are not significant enough to make a relevant comparison with previous years' incident criteria for F0, LT0, RRC0 and OV0.

Table 11.1: Number of incidents by dominant criteria distributed per month in 2019 in isolated systems.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G0)	0	0	0	0	1	1	0	0	1	0	1	0	4
	Incidents on transmission network elements (T0)	1	0	1	0	0	0	1	0	0	0	0	2	5
	Loss of tools and facilities (LT0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1	0	1	0	1	1	1	0	1	0	1	2	9
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on load (L1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T1)	0	1	1	0	1	0	0	0	0	1	0	3	7
	Loss of tools and facilities (LT1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	1	1	0	1	0	0	0	0	1	0	3	7
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total		1	1	2	0	2	1	1	0	1	1	1	5	16

Table 11.2: Cumulative number of incidents by dominating criteria and duration in 2019 in isolated systems.

		2019				
Scale	Dominating criterion	<1h	<2h	<5h	<24h	Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	0
	Incidents on power generating facilities (G0)	2	3	4	4	4
	Incidents on transmission network elements (T0)	1	2	3	4	5
	Loss of tools and facilities (LT0)	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0
	Total	3	5	7	8	9
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0
	Incidents on load (L1)	0	0	0	0	0
	Incidents on power generating facilities (G1)	0	0	0	0	0
	Incidents on transmission network elements (T1)	2	5	6	6	7
	Loss of tools and facilities (LT1)	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0
	Total	2	5	6	6	7
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0
	Incidents on load (L2)	0	0	0	0	0
	Incidents on power generating facilities (G2)	0	0	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	0	0
	N violation (ON2)	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0
	Total	0	0	0	0	0
Scale 3	Blackout (OB3)	0	0	0	0	0
	Total	0	0	0	0	0
Grand Total		5	10	13	14	16

11.2 Evolution 2015–2019

This section presents the annual number of incidents in the isolated systems 2015–2019, distributed by scale and dominating criterion. The dominating criteria used in this report are presented in Table 2.1.

The number of scale 0 incidents reported in 2019 is comparable to the number of scale 0 incidents reported in 2018, as seen in Table 11.3. The number of reported incidents is quite similar over the years (only some small shifts occur between the different criteria).

Scale 1 incidents, which contains incidents on transmission network elements (T1) reported in 2019, increased by 4 incidents. Nevertheless, the number of incidents in 2019 is still lower than the number of incidents that were reported in 2017.

There were no scale 2 incidents in isolated systems in 2019, and the trend of them seems to be decreasing. Finally, no scale 3 incidents have been reported from 2015–2019.

Table 11.3: The annual number of incidents by dominating criterion from 2015–2019.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	0
	Incidents on power generating facilities (G0)	0	0	1	0	4
	Incidents on transmission network elements (T0)	4	8	5	10	5
	Loss of tools and facilities (LT0)	0	0	0	0	0
	Reduction of reserve capacity (RRC0)	0	0	0	0	0
	Violation of standards on voltage (OV0)	0	0	0	0	0
	Total	4	8	6	10	9
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0
	Incidents on load (L1)	3	2	7	0	0
	Incidents on power generating facilities (G1)	0	0	2	0	0
	Incidents on transmission network elements (T1)	1	0	6	3	7
	Loss of tools and facilities (LT1)	0	0	0	0	0
	N-1 violation (ON1)	0	0	0	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	0	0
	Separation from the grid (RS1)	0	0	0	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	0
	Total	4	2	15	3	7
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0
	Incidents on load (L2)	3	1	2	1	0
	Incidents on power generating facilities (G2)	0	1	0	0	0
	Incidents on transmission network elements (T2)	0	0	0	0	0
	Loss of tools and facilities (LT2)	0	0	0	1	0
	N violation (ON2)	0	0	0	0	0
	Reduction of reserve capacity (RRC2)	0	0	0	0	0
	Separation from the grid (RS2)	0	0	0	0	0
	Violation of standards on voltage (OV2)	0	0	0	0	0
	Total	3	2	2	2	0
Scale 3	Blackout (OB3)	0	0	0	0	0
	Total	0	0	0	0	0
Grand Total		11	12	23	15	16

11.3 Analysis of significant changes in trends

In 2019, a total of 16 incidents were reported on isolated systems. There is no clear visible trend over the last years. Nevertheless, the data must be interpreted cautiously because the overall number of incidents is low, and the isolated systems comprise only two TSOs. The two TSOs, Landsnet in Iceland and Cyprus TSO in Cyprus, also have very different operating environments.

The number of scale 0, Scale 1 and scale 2 incidents are not significant enough to make a relevant comparison with previous years. Most of the incidents in the isolated systems occur in Landsnet's transmission network, and the only finding that can be made is that overall, the number of scale 2 incidents are sporadic and that the year 2019 was a good year without any scale 2 incidents.

12 Overview of incidents per TSO

This chapter presents detailed information about each TSO that has reported data according to the Incident Classification Scale Methodology [1]. In total, 38 TSOs have delivered data to the 2019 ICS report. The TSOs in each synchronous area is listed below.

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

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

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

Great Britain

- National Grid ESO

Baltic

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

Ireland

- EirGrid
- SONI

Isolated Systems

- Cyprus TSO
- Landsnet

12.1 Overview of incidents per TSOs in continental Europe

12.1.1 Incidents reported by 50Hertz

This section presents incidents for 50Hertz, one of the TSOs in Germany. Table 12.1 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.2 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.1 presents the number of incidents grouped by duration in 2019.

Table 12.1: Monthly distribution of incidents by dominating criterion in 2019 for 50Hertz.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	0	0	0	1	0	0	0	0	0	0	0	1	2
	Incidents on transmission network elements (T0)	2	0	2	0	1	2	6	5	1	3	1	1	24
	Loss of tools and facilities (LT0)	1	0	1	0	1	0	1	0	0	0	1	1	6
	Total	3	0	3	1	2	2	7	5	1	3	2	3	32
Scale 1	Loss of tools and facilities (LT1)	0	0	0	0	1	0	0	0	0	1	1	0	3
	N-1 violation (ON1)	0	0	0	1	0	0	0	0	1	0	1	0	3
	Total	0	0	0	1	1	0	0	0	1	1	2	0	6
Grand Total		3	0	3	2	3	2	7	5	2	4	4	3	38

Table 12.2: The annual number of incidents by dominating criterion from 2015–2019 for 50Hertz.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	0	1	0	2
	Incidents on transmission network elements (T0)	17	12	17	30	24
	Loss of tools and facilities (LT0)	0	0	0	0	6
	Total	17	12	18	30	32
Scale 1	Incidents on transmission network elements (T1)	7	3	1	0	0
	Loss of tools and facilities (LT1)	0	0	1	0	3
	N-1 violation (ON1)	11	15	16	5	3
	Total	18	18	18	5	6
Grand Total		35	30	36	35	38

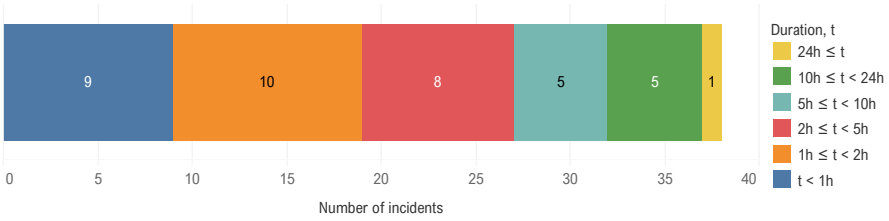

Figure 12.1: Number of incidents grouped by duration in 2019 for 50Hertz.

12.1.2 Incidents reported by Amprion GmbH

This section presents incidents for Amprion GmbH, one of the TSOs in Germany. Table 12.3 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.4 presents the annual number of incidents by dominating criterion from 2015–2019.

The number of T0-incidents in 2019 has not deviated from typical values, nor had any extraordinary occurrences. One possible reason for the decrease in G0-incidents may be due to the significant decrease in conventional power plants over the past years. Another reason could be the increased infeed of renewable energies, which reduces the available operating time of the remaining conventional power plants and fewer incidents.

LT0-incidents were introduced to the ICS methodology in spring 2018 [1], so there is little history to draw upon. The updates are summarised in Section 2.1.

Table 12.3: Monthly distribution of incidents by dominating criterion in 2019 for Amprion GmbH.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	1	0	1	0	0	0	0	2	0	1	1	1	7
	Incidents on transmission network elements (T0)	4	1	8	2	1	2	1	7	0	3	2	0	31
	Loss of tools and facilities (LT0)	1	0	1	0	0	0	0	2	0	0	1	1	6
	Total	6	1	10	2	1	2	1	11	0	4	4	2	44
Scale 1	N-1 violation (ON1)	1	0	0	1	0	1	0	0	0	0	0	0	3
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	1	0	0	0	0	1
	Total	1	0	0	1	0	1	0	1	0	0	0	0	4
Grand Total		7	1	10	3	1	3	1	12	0	4	4	2	48

Table 12.4: The annual number of incidents by dominating criterion from 2015–2019 for Amprion GmbH.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	35	20	19	13	7
	Incidents on transmission network elements (T0)	14	12	25	47	31
	Loss of tools and facilities (LT0)	0	0	0	0	6
	Total	49	32	44	60	44
Scale 1	Incidents on transmission network elements (T1)	0	1	4	1	0
	Loss of tools and facilities (LT1)	0	0	4	6	0
	N-1 violation (ON1)	0	3	9	7	3
	Reduction of reserve capacity (RRC1)	0	0	0	0	1
	Total	0	4	17	14	4
Grand Total		49	36	61	74	48

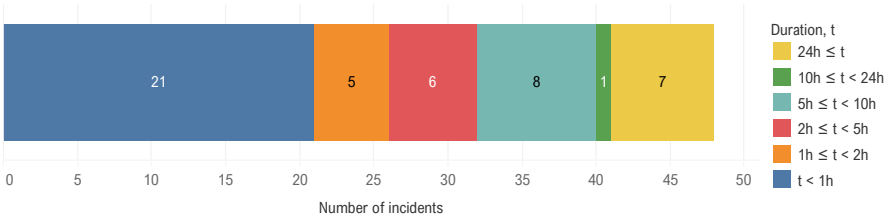

Figure 12.2: Number of incidents grouped by duration in 2019 for Amprion GmbH.

12.1.3 Incidents reported by Austrian Power Grid AG (APG)

This section presents incidents for Austrian Power Grid AG (APG), the TSO in Austria. Table 12.5 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.6 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.3 presents the number of incidents grouped by duration in 2019.

The number of incidents in 2019 was average when compared to previous years.

Table 12.5: Monthly distribution of incidents by dominating criterion in 2019 for Austrian Power Grid AG.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	6	1	0	3	3	1	1	1	1	2	5	0	24
	Total	6	1	0	3	3	1	1	1	1	2	5	0	24
Scale 1	Loss of tools and facilities (LT1)	0	0	0	0	0	0	0	0	0	1	1	0	2
	N-1 violation (ON1)	0	0	0	0	0	0	0	1	0	0	0	0	1
	Total	0	0	0	0	0	0	0	1	0	1	1	0	3
Grand Total		6	1	0	3	3	1	1	2	1	3	6	0	27

Table 12.6: The annual number of incidents by dominating criterion from 2015–2019 for Austrian Power Grid AG.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	26	27	24	10	24
	Total	26	27	24	10	24
Scale 1	Incidents on transmission network elements (T1)	3	5	3	0	0
	Loss of tools and facilities (LT1)	0	0	0	0	2
	N-1 violation (ON1)	3	0	0	0	1
	Total	6	5	3	0	3
Grand Total		32	32	27	10	27

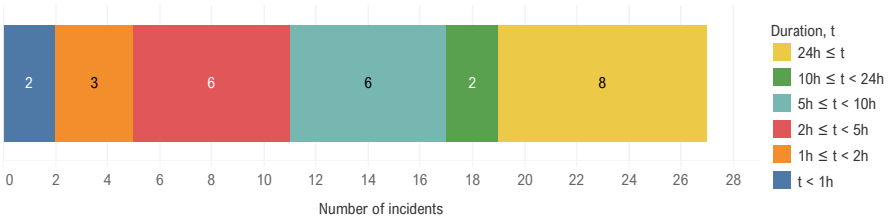

Figure 12.3: Number of incidents grouped by duration in 2019 for Austrian Power Grid AG.

12.1.4 Incidents reported by CEPS

This section presents incidents for CEPS, the TSO in the Czech Republic. Table 12.7 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.8 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.4 presents the number of incidents grouped by duration in 2019.

Table 12.7: Monthly distribution of incidents by dominating criterion in 2019 for CEPS.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	0	0	1	2	1	0	0	0	0	0	1	1	6
	Incidents on transmission network elements (T0)	1	2	0	0	1	3	1	0	1	1	1	0	11
	Loss of tools and facilities (LT0)	1	0	1	0	0	0	0	2	0	0	1	0	5
	Violation of standards on voltage (OV0)	1	0	0	0	5	2	1	4	1	0	5	0	19
	Total	3	2	2	2	7	5	2	6	2	1	8	1	41
Scale 1	Incidents on transmission network elements (T1)	0	0	0	0	0	1	1	0	0	0	0	0	2
	Loss of tools and facilities (LT1)	1	0	0	0	0	0	0	0	0	0	0	0	1
	Violation of standards on voltage (OV1)	0	0	0	2	0	1	0	0	0	0	0	0	3
	Total	1	0	0	2	0	2	1	0	0	0	0	0	6
Grand Total		4	2	2	4	7	7	3	6	2	1	8	1	47

Table 12.8: The annual number of incidents by dominating criterion from 2015–2019 for CEPS.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	4	4	0	2	6
	Incidents on transmission network elements (T0)	14	6	12	2	11
	Loss of tools and facilities (LT0)	0	0	0	0	5
	Violation of standards on voltage (OV0)	0	0	0	31	19
	Total	18	10	12	35	41
Scale 1	Incidents on load (L1)	0	1	0	0	0
	Incidents on transmission network elements (T1)	0	4	3	0	2
	Loss of tools and facilities (LT1)	0	2	3	1	1
	N-1 violation (ON1)	56	26	3	6	0
	Reduction of reserve capacity (RRC1)	0	1	2	0	0
	Violation of standards on voltage (OV1)	0	0	0	7	3
	Total	56	34	11	14	6
Grand Total		74	44	23	49	47

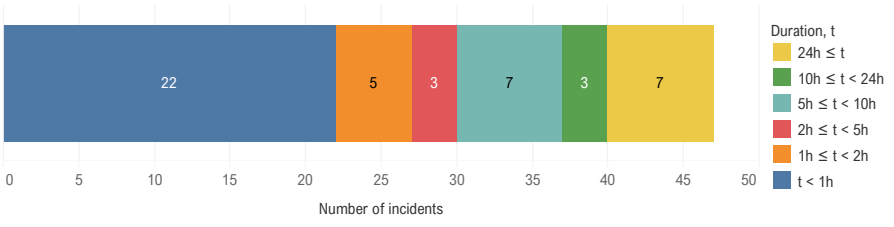

Figure 12.4: Number of incidents grouped by duration in 2019 for CEPS.

12.1.5 Incidents reported by CGES

This section presents incidents for CGES, the TSO in Montenegro. Table 12.9 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.10 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.5 presents the number of incidents grouped by duration in 2019.

Table 12.9: Monthly distribution of incidents by dominating criterion in 2019 for CGES.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	8	2	4	5	7	11	8	4	5	11	6	71
	Total	0	8	2	4	5	7	11	8	4	5	11	6	71
Grand Total		0	8	2	4	5	7	11	8	4	5	11	6	71

Table 12.10: The annual number of incidents by dominating criterion from 2015–2019 for CGES.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	2	0	0	0	0
	Incidents on transmission network elements (T0)	49	26	22	84	71
	Total	51	26	22	84	71
Scale 1	Incidents on transmission network elements (T1)	0	26	52	0	0
	Total	0	26	52	0	0
Grand Total		51	52	74	84	71

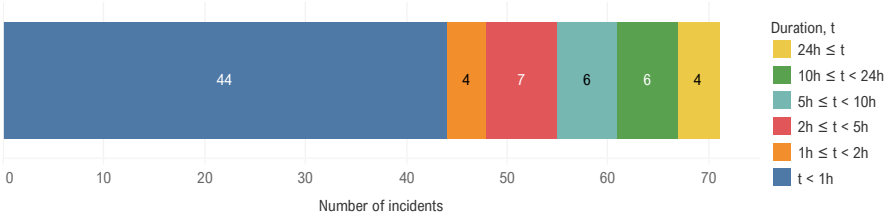

Figure 12.5: Number of incidents grouped by duration in 2019 for CGES.

12.1.6 Incidents reported by ELES

This section presents incidents for ELES, the TSO in Slovenia. Table 12.11 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.12 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.6 presents the number of incidents grouped by duration in 2019.

Table 12.11: Monthly distribution of incidents by dominating criterion in 2019 for ELES.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	0	1	2	0	0	1	0	0	0	0	0	4
	Total	0	0	1	2	0	0	1	0	0	0	0	0	4
Scale 1	Violation of standards on voltage (OV1)	0	0	0	0	0	0	0	1	0	0	0	0	1
	Total	0	0	0	0	0	0	0	1	0	0	0	0	1
Scale 2	N violation (ON2)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Total	0	0	0	0	0	0	0	0	0	0	1	0	1
Grand Total		0	0	1	2	0	0	1	1	0	0	1	0	6

Table 12.12: The annual number of incidents by dominating criterion from 2015–2019 for ELES.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	13	2	5	4	4
	Total	13	2	5	4	4
Scale 1	Incidents on transmission network elements (T1)	0	0	2	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	1
	Total	0	0	2	0	1
Scale 2	N violation (ON2)	0	0	0	0	1
	Total	0	0	0	0	1
Grand Total		13	2	7	4	6

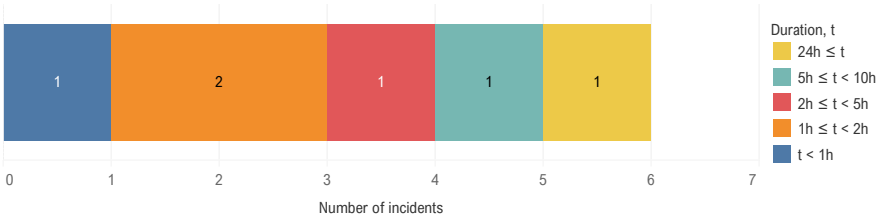

Figure 12.6: Number of incidents grouped by duration in 2019 for ELES.

12.1.7 Incidents reported by Elia

This section presents incidents for Elia, the TSO in Belgium. Table 12.13 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.14 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.7 presents the number of incidents grouped by duration in 2019.

Table 12.13: Monthly distribution of incidents by dominating criterion in 2019 for Elia.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	0	0	0	0	0	0	0	0	0	0	0	2	2
	Incidents on transmission network elements (T0)	1	0	0	3	1	0	0	0	1	0	0	0	6
	Loss of tools and facilities (LT0)	0	0	0	1	0	1	0	0	0	0	2	0	4
	Violation of standards on voltage (OV0)	1	0	0	0	0	0	0	0	0	0	0	0	1
	Total	2	0	0	4	1	1	0	0	1	0	2	2	13
Scale 1	N-1 violation (ON1)	0	0	1	1	1	0	0	2	0	3	0	0	8
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	0	0	0	0	1	1
	Total	0	0	1	1	1	0	0	2	0	3	0	1	9
Grand Total		2	0	1	5	2	1	0	2	1	3	2	3	22

Table 12.14: The annual number of incidents by dominating criterion from 2015–2019 for Elia.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	5	6	6	1	2
	Incidents on transmission network elements (T0)	4	2	1	5	6
	Loss of tools and facilities (LT0)	0	0	0	0	4
	Violation of standards on voltage (OV0)	1	1	0	1	1
	Total	10	9	7	7	13
Scale 1	Incidents on transmission network elements (T1)	0	0	1	0	0
	Loss of tools and facilities (LT1)	4	1	3	4	0
	N-1 violation (ON1)	1	0	3	1	8
	Reduction of reserve capacity (RRC1)	0	0	3	0	1
	Total	5	1	10	5	9
Grand Total		15	10	17	12	22

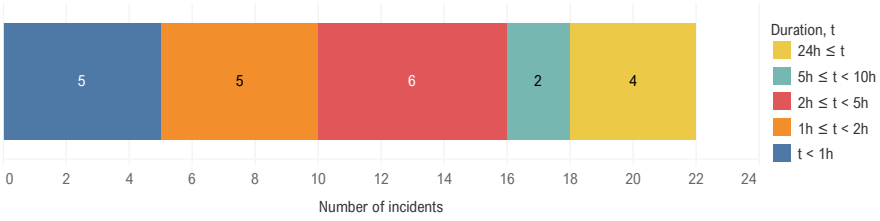

Figure 12.7: Number of incidents grouped by duration in 2019 for Elia.

12.1.8 Incidents reported by EMS JSC

This section presents incidents for EMS JSC, the TSO of Serbia. Table 12.15 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.16 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.8 presents the number of incidents grouped by duration in 2019.

Table 12.15: Monthly distribution of incidents by dominating criterion in 2019 for EMS JSC.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	0	0	2	0	2	1	1	1	0	0	1	8
	Loss of tools and facilities (LT0)	0	0	0	0	0	0	0	0	0	0	0	1	1
	Total	0	0	0	2	0	2	1	1	1	0	0	2	9
Scale 1	Incidents on transmission network elements (T1)	0	0	0	0	1	1	0	0	1	0	0	0	3
	Total	0	0	0	0	1	1	0	0	1	0	0	0	3
Grand Total		0	0	0	2	1	3	1	1	2	0	0	2	12

Table 12.16: The annual number of incidents by dominating criterion from 2015–2019 for EMS JSC.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	46	2	0	28	0
	Incidents on transmission network elements (T0)	14	2	4	4	8
	Loss of tools and facilities (LT0)	0	0	0	0	1
	Violation of standards on voltage (OV0)	5	10	12	0	0
	Total	65	14	16	32	9
Scale 1	Incidents on load (L1)	1	1	1	0	0
	Incidents on transmission network elements (T1)	0	0	3	0	3
	Reduction of reserve capacity (RRC1)	0	0	1	0	0
	Total	1	1	5	0	3
Grand Total		66	15	21	32	12

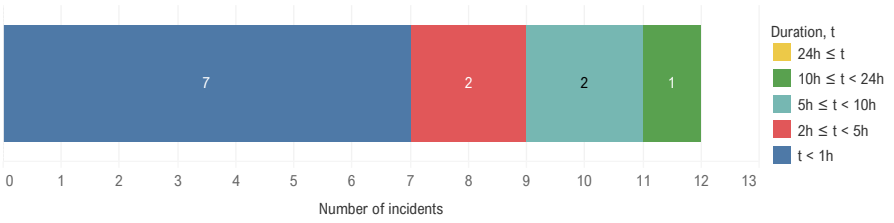

Figure 12.8: Number of incidents grouped by duration in 2019 for EMS JSC.

12.1.9 Incidents reported by Energinet (CE)

This section presents incidents for Energinet (CE), the TSO in Denmark. Table 12.17 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.18 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.9 presents the number of incidents grouped by duration in 2019.

Table 12.17: Monthly distribution of incidents by dominating criterion in 2019 for Energinet (CE).

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	1	0	0	2	2	1	0	1	5	2	1	15
	Loss of tools and facilities (LT0)	0	1	0	0	0	0	0	0	3	0	0	0	4
	Total	0	2	0	0	2	2	1	0	4	5	2	1	19
Scale 1	Loss of tools and facilities (LT1)	0	0	0	0	0	1	0	0	0	0	0	0	1
	Total	0	0	0	0	0	1	0	0	0	0	0	0	1
Grand Total		0	2	0	0	2	3	1	0	4	5	2	1	20

Table 12.18: The annual number of incidents by dominating criterion from 2015–2019 for Energinet (CE).

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	2	1	1	6	15
	Loss of tools and facilities (LT0)	0	0	0	0	4
	Total	2	1	1	6	19
Scale 1	Incidents on transmission network elements (T1)	3	6	6	0	0
	Loss of tools and facilities (LT1)	0	3	0	0	1
	Total	3	9	6	0	1
Grand Total		5	10	7	6	20

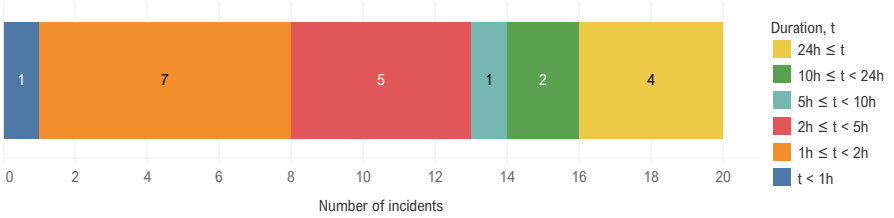

Figure 12.9: Number of incidents grouped by duration in 2019 for Energinet (CE).

12.1.10 Incidents reported by ESO EAD

This section presents incidents for ESO EAD, the TSO in Bulgaria. Table 12.19 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.20 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.10 presents the number of incidents grouped by duration in 2019.

Table 12.19: Monthly distribution of incidents by dominating criterion in 2019 for ESO EAD.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	0	0	0	0	0	0	1	0	0	0	1	0	2
	Incidents on transmission network elements (T0)	1	1	2	6	0	2	5	13	5	1	0	2	38
	Total	1	1	2	6	0	2	6	13	5	1	1	2	40
Grand Total		1	1	2	6	0	2	6	13	5	1	1	2	40

Table 12.20: The annual number of incidents by dominating criterion from 2015–2019 for ESO EAD.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	0	0	0	2
	Incidents on transmission network elements (T0)	33	16	25	29	38
	Total	33	16	25	29	40
Scale 1	Incidents on transmission network elements (T1)	1	10	11	0	0
	Total	1	10	11	0	0
Grand Total		34	26	36	29	40

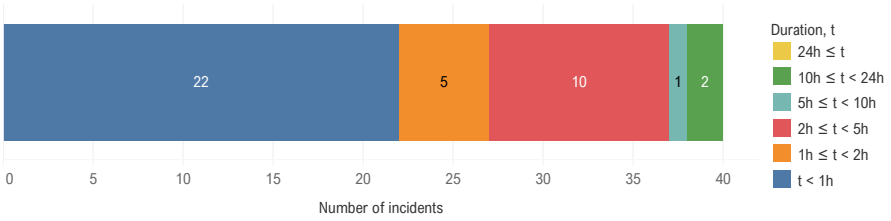

Figure 12.10: Number of incidents grouped by duration in 2019 for ESO EAD.

12.1.11 Incidents reported by HOPS

This section presents incidents for HOPS, the TSO in Croatia. Table 12.21 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.22 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.11 presents the number of incidents grouped by duration in 2019.

Table 12.21: Monthly distribution of incidents by dominating criterion in 2019 for HOPS.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	2	3	2	4	4	3	1	4	0	6	2	31
	Total	0	2	3	2	4	4	3	1	4	0	6	2	31
Grand Total		0	2	3	2	4	4	3	1	4	0	6	2	31

Table 12.22: The annual number of incidents by dominating criterion from 2015–2019 for HOPS. HOPS did not have any incidents from 2015–2016.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	0	0	0	6	31
	Total	0	0	0	6	31
Scale 1	N-1 violation (ON1)	0	0	11	0	0
	Total	0	0	11	0	0
Grand Total		0	0	11	6	31

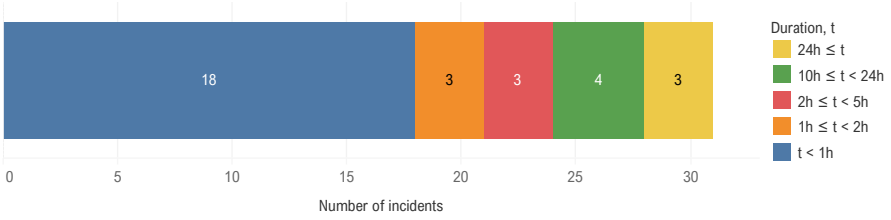

Figure 12.11: Number of incidents grouped by duration in 2019 for HOPS.

12.1.12 Incidents reported by IPTO

This section presents incidents for IPTO, the TSO in Greece. Table 12.23 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.24 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.12 presents the number of incidents grouped by duration in 2019.

Table 12.23: Monthly distribution of incidents by dominating criterion in 2019 for IPTO.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	1	2	0	0	0	5	1	5	1	0	2	17
	Violation of standards on voltage (OV0)	1	1	0	0	0	0	0	0	0	0	0	0	2
	Total	1	2	2	0	0	0	5	1	5	1	0	2	19
Scale 1	Incidents on transmission network elements (T1)	0	1	0	0	0	0	0	1	0	0	0	1	3
	Violation of standards on voltage (OV1)	0	1	0	0	0	0	0	0	0	0	0	0	1
	Total	0	2	0	0	0	0	0	1	0	0	0	1	4
Grand Total		1	4	2	0	0	0	5	2	5	1	0	3	23

Table 12.24: The annual number of incidents by dominating criterion from 2015–2019 for IPTO.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	0	16	8	22	17
	Violation of standards on voltage (OV0)	0	0	0	2	2
	Total	0	16	8	24	19
Scale 1	Incidents on load (L1)	0	0	0	1	0
	Incidents on transmission network elements (T1)	20	8	17	0	3
	Violation of standards on voltage (OV1)	15	4	0	1	1
	Total	35	12	17	2	4
Grand Total		35	28	25	26	23

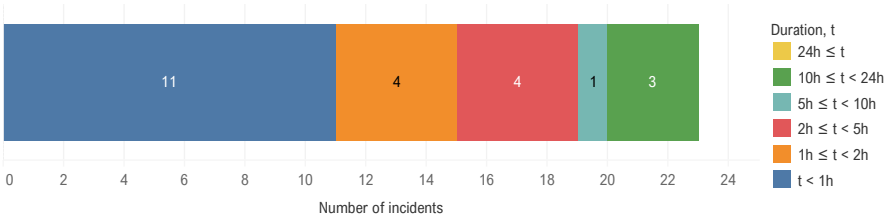

Figure 12.12: Number of incidents grouped by duration in 2019 for IPTO.

12.1.13 Incidents reported by MAVIR ZRt

This section presents incidents for MAVIR ZRt, the TSO in Hungary. Table 12.25 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.26 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.13 presents the number of incidents grouped by duration in 2019.

The number of scale 1 reduction of reserve capacity (RRC1) incidents in 2018 and 2019 is explained with the understanding that MAVIR ZRt did not register them prior to 2018.

Table 12.25: Monthly distribution of incidents by dominating criterion in 2019 for MAVIR ZRt.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	6	1	0	2	9	10	2	3	3	3	5	8	52
	Reduction of reserve capacity (RRC0)	0	0	0	0	1	0	0	0	0	0	0	0	1
	Violation of standards on voltage (OV0)	4	1	8	1	5	0	6	1	2	0	10	5	43
	Total	10	2	8	3	15	10	8	4	5	3	15	13	96
Scale 1	Loss of tools and facilities (LT1)	1	0	0	0	0	0	0	0	0	0	0	0	1
	Reduction of reserve capacity (RRC1)	12	2	11	26	27	12	3	19	13	6	17	7	155
	Total	13	2	11	26	27	12	3	19	13	6	17	7	156
Grand Total		23	4	19	29	42	22	11	23	18	9	32	20	252

Table 12.26: The annual number of incidents by dominating criterion from 2015–2019 for MAVIR ZRt.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	10	0	0	72	52
	Reduction of reserve capacity (RRC0)	0	0	0	0	1
	Violation of standards on voltage (OV0)	0	0	0	77	43
	Total	10	0	0	149	96
Scale 1	Incidents on transmission network elements (T1)	1	0	0	0	0
	Loss of tools and facilities (LT1)	0	1	0	0	1
	N-1 violation (ON1)	3	0	0	1	0
	Reduction of reserve capacity (RRC1)	0	0	3	112	155
	Total	4	1	3	113	156
Scale 2	Separation from the grid (RS2)	0	1	0	0	0
	Total	0	1	0	0	0
Grand Total		14	2	3	262	252

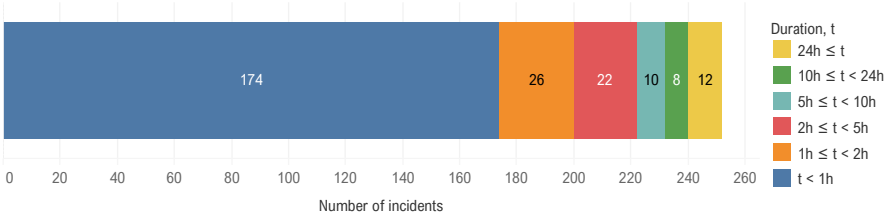

Figure 12.13: Number of incidents grouped by duration in 2019 for MAVIR ZRt.

12.1.14 Incidents reported by MEPSO

This section presents incidents for MEPSO, the TSO in Macedonia. Table 12.27 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.28 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.14 presents the number of incidents grouped by duration in 2019.

Table 12.27: Monthly distribution of incidents by dominating criterion in 2019 for MEPSO.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 1	Incidents on transmission network elements (T1)	0	0	0	0	0	1	3	0	1	0	0	0	5
	Total	0	0	0	0	0	1	3	0	1	0	0	0	5
Grand Total		0	0	0	0	0	1	3	0	1	0	0	0	5

Table 12.28: The annual number of incidents by dominating criterion from 2015–2019 for MEPSO.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	4	1	0	4	0
	Total	4	1	0	4	0
Scale 1	Incidents on transmission network elements (T1)	1	3	4	0	5
	Total	1	3	4	0	5
Grand Total		5	4	4	4	5

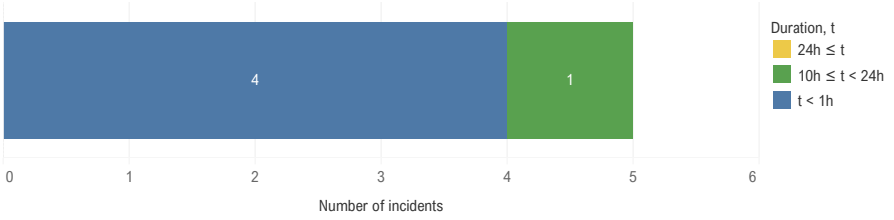

Figure 12.14: Number of incidents grouped by duration in 2019 for MEPSO.

12.1.15 Incidents reported by NOS BiH

This section presents incidents for NOS BiH, the TSO in Bosnia and Herzegovina. Table 12.29 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.30 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.15 presents the number of incidents grouped by duration in 2019.

Table 12.29: Monthly distribution of incidents by dominating criterion in 2019 for NOS BiH.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	1	2	3	0	1	3	6	1	0	0	3	0	20
	Total	1	2	3	0	1	3	6	1	0	0	3	0	20
Grand Total		1	2	3	0	1	3	6	1	0	0	3	0	20

Table 12.30: The annual number of incidents by dominating criterion from 2015–2019 for NOS BiH.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	0	0	5	80	20
	Violation of standards on voltage (OV0)	1	0	0	0	0
	Total	1	0	5	80	20
Grand Total		1	0	5	80	20

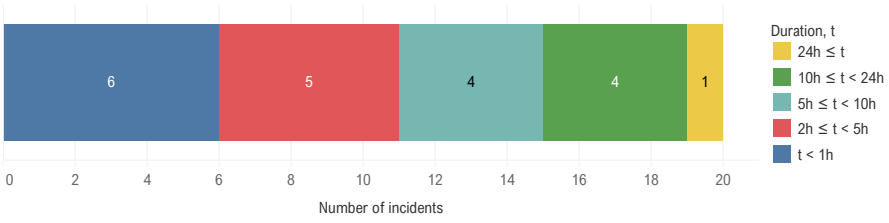

Figure 12.15: Number of incidents grouped by duration in 2019 for NOS BiH.

12.1.16 Incidents reported by PSE

This section presents incidents for PSE, the TSO in Poland. Table 12.31 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.32 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.16 presents the number of incidents grouped by duration in 2019.

The decrease in T1-incidents after 2018, as seen in Table 12.32, is due to the ICS methodology update [1] in 2018. Prior to 2018, incidents on tie-lines were always categorised as scale 1 incidents. The methodology updates are summarised in Section 2.1.

Table 12.31: Monthly distribution of incidents by dominating criterion in 2019 for PSE.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	1	0	0	0	2	0	0	3	1	2	0	1	10
	Incidents on transmission network elements (T0)	9	3	8	6	11	12	8	9	12	2	6	3	89
	Loss of tools and facilities (LT0)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Total	10	3	8	6	13	12	8	12	13	4	7	4	100
Scale 1	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	1	0	0	0	0	1
	Total	0	0	0	0	0	0	0	1	0	0	0	0	1
Grand Total		10	3	8	6	13	12	8	13	13	4	7	4	101

Table 12.32: The annual number of incidents by dominating criterion from 2015–2019 for PSE.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	1	1	0	14	10
	Incidents on transmission network elements (T0)	110	69	40	86	89
	Loss of tools and facilities (LT0)	0	0	0	0	1
	Total	111	70	40	100	100
Scale 1	Incidents on load (L1)	3	0	0	0	0
	Incidents on transmission network elements (T1)	13	14	5	0	0
	N-1 violation (ON1)	3	1	0	0	0
	Reduction of reserve capacity (RRC1)	1	0	0	0	1
	Total	20	15	5	0	1
Grand Total		131	85	45	100	101

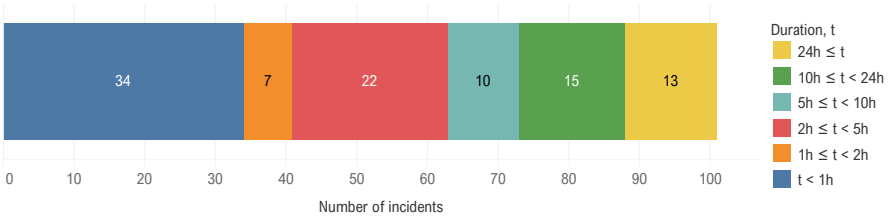

Figure 12.16: Number of incidents grouped by duration in 2019 for PSE.

12.1.17 Incidents reported by REE

This section presents incidents for REE, the TSO in Spain. Table 12.33 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.34 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.17 presents the number of incidents grouped by duration in 2019.

Even though the number of scale 0 incidents increased as a result of the ICS methodology update in 2018, no scale 1 incidents were reported in 2019. In February, August, November and December, REE registered unusually frequent incidents due to weather conditions; the number of incidents was exceptionally high in November and December due to six high-impact squalls in Spain (including the storms "Elsa" and "Fabien"), which caused gusts that tripped multiple network elements.

2 LT0-incidents were reported in 2019. This type of incident was introduced to the ICS methodology in spring 2018 [1], as mentioned in Section 2.1.

Table 12.33: Monthly distribution of incidents by dominating criterion in 2019 for REE.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	13	24	16	18	6	19	12	29	14	12	28	44	235
	Loss of tools and facilities (LT0)	0	0	0	1	0	0	0	0	1	0	0	0	2
	Total	13	24	16	19	6	19	12	29	15	12	28	44	237
Grand Total		13	24	16	19	6	19	12	29	15	12	28	44	237

Table 12.34: The annual number of incidents by dominating criterion from 2015–2019 for REE.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	0	2	0	0
	Incidents on transmission network elements (T0)	0	0	0	90	235
	Loss of tools and facilities (LT0)	0	0	0	1	2
	Total	0	0	2	91	237
Scale 1	Incidents on load (L1)	0	0	0	1	0
	Incidents on transmission network elements (T1)	0	0	14	0	0
	Loss of tools and facilities (LT1)	0	0	1	1	0
	Total	0	0	15	2	0
Grand Total		0	0	17	93	237

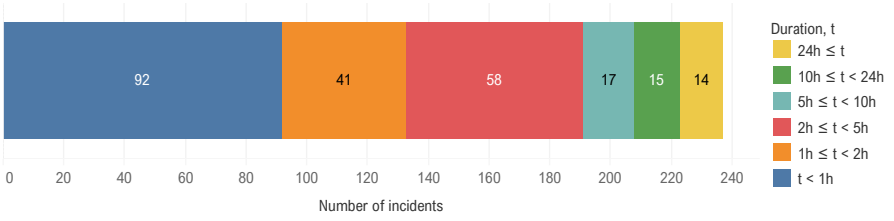

Figure 12.17: Number of incidents grouped by duration in 2019 for REE.

12.1.18 Incidents reported by REN

This section presents incidents for REN, the TSO in Portugal. Table 12.35 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.36 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.18 presents the number of incidents grouped by duration in 2019.

The low number of incidents is explained by the natural evolution behind the causes of the incidents. In 2019,the number of incidents caused by lightning was similar to that observed in previous years, and almost no incidents were caused by forest fires nor the storms "Elsa" and "Fabien". The highest number of incidents was reported in 2017, while 2019 had a record-low number of incidents. In fact, 2019 resembled the low rate occurrence of incidents not seen since 2015.

The low number of incidents cannot be attributed to either the change of maintenance programs nor to better anticipation, because these programs are unchanged since 2015 and 2016.

Table 12.35: Monthly distribution of incidents by dominating criterion in 2019 for REN.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	0	1	1	1	0	0	2	1	1	0	3	10
	Loss of tools and facilities (LT0)	0	0	1	0	0	0	0	0	0	0	0	0	1
	Total	0	0	2	1	1	0	0	2	1	1	0	3	11
Grand Total		0	0	2	1	1	0	0	2	1	1	0	3	11

Table 12.36: The annual number of incidents by dominating criterion from 2015–2019 for REN.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	1	0	1	0
	Incidents on transmission network elements (T0)	16	23	38	15	10
	Loss of tools and facilities (LT0)	0	0	0	1	1
	Total	16	24	38	17	11
Scale 1	Incidents on transmission network elements (T1)	0	8	2	0	0
	Total	0	8	2	0	0
Grand Total		16	32	40	17	11

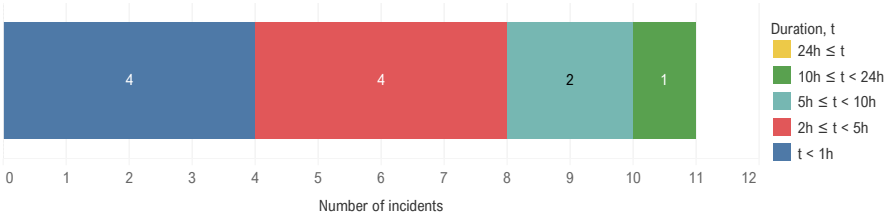

Figure 12.18: Number of incidents grouped by duration in 2019 for REN.

12.1.19 Incidents reported by RTE

This section presents incidents for RTE, the TSO in France. Table 12.37 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.38 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.19 presents the number of incidents grouped by duration in 2019.

Incidents 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 implementation of a new tool to improve market operations during May caused an increase of LT0-events. Furthermore, the number of incidents appears to have increased since 2018 only because incidents on 220 kV lines were not registered before.

Table 12.37: Monthly distribution of incidents by dominating criterion in 2019 for RTE.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	1	0	2	2	0	4	0	4	0	0	4	2	19
	Incidents on transmission network elements (T0)	24	7	19	25	14	22	42	26	29	19	17	26	270
	Loss of tools and facilities (LT0)	0	0	1	2	14	2	4	0	2	4	0	0	29
	Violation of standards on voltage (OV0)	1	0	0	2	0	1	0	1	0	2	2	1	10
	Total	26	7	22	31	28	29	46	31	31	25	23	29	328
Scale 1	Incidents on transmission network elements (T1)	0	0	1	0	1	0	0	0	0	0	0	1	3
	Loss of tools and facilities (LT1)	0	0	0	0	0	0	0	1	0	0	4	2	7
	Reduction of reserve capacity (RRC1)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Violation of standards on voltage (OV1)	0	0	0	0	0	0	0	0	1	0	1	0	2
	Total	0	0	1	0	1	0	0	1	1	0	6	3	13
Grand Total		26	7	23	31	29	29	46	32	32	25	29	32	341

Table 12.38: The annual number of incidents by dominating criterion from 2015–2019 for RTE.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	4	15	11	0	0
	Incidents on power generating facilities (G0)	0	27	32	30	19
	Incidents on transmission network elements (T0)	5	16	38	75	270
	Loss of tools and facilities (LT0)	0	0	0	14	29
	Violation of standards on voltage (OV0)	0	0	3	68	10
	Total	9	58	84	187	328
Scale 1	Incidents on transmission network elements (T1)	12	11	21	4	3
	Loss of tools and facilities (LT1)	1	3	0	8	7
	N-1 violation (ON1)	0	1	0	4	0
	Reduction of reserve capacity (RRC1)	2	0	1	5	1
	Violation of standards on voltage (OV1)	0	0	1	38	2
	Total	15	15	23	59	13
Grand Total		24	73	107	246	341

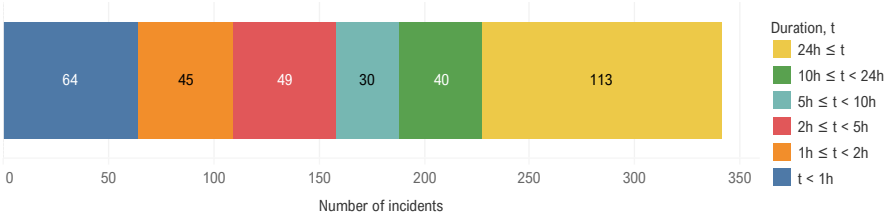

Figure 12.19: Number of incidents grouped by duration in 2019 for RTE.

12.1.20 Incidents reported by SEPS

This section presents incidents for SEPS, the TSO in Slovakia. Table 12.39 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.40 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.20 presents the number of incidents grouped by duration in 2019.

A new methodology for monitoring operating voltages was introduced at the beginning of 2019. The new methodology reflects all applicable legislative limits, such as contractual arrangements, technical specifics for measuring equipment and measuring points. The situation regarding voltage is improving, as several organisational and operational measures implemented into the real-time operations.

Table 12.39: Monthly distribution of incidents by dominating criterion in 2019 for SEPS.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	0	0	0	0	0	0	2	0	0	0	0	2
	Violation of standards on voltage (OV0)	1	0	13	0	1	0	0	0	0	0	0	0	15
	Total	1	0	13	0	1	0	0	2	0	0	0	0	17
Scale 1	Violation of standards on voltage (OV1)	0	0	2	0	0	0	0	0	0	0	0	0	2
	Total	0	0	2	0	0	0	0	0	0	0	0	0	2
Grand Total		1	0	15	0	1	0	0	2	0	0	0	0	19

Table 12.40: The annual number of incidents by dominating criterion from 2015–2019 for SEPS.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	1	0	0	6	2
	Violation of standards on voltage (OV0)	0	0	0	0	15
	Total	1	0	0	6	17
Scale 1	Incidents on transmission network elements (T1)	2	0	2	0	0
	N-1 violation (ON1)	3	4	2	0	0
	Reduction of reserve capacity (RRC1)	0	0	1	0	0
	Violation of standards on voltage (OV1)	0	0	0	0	2
	Total	5	4	5	0	2
Grand Total		6	4	5	6	19

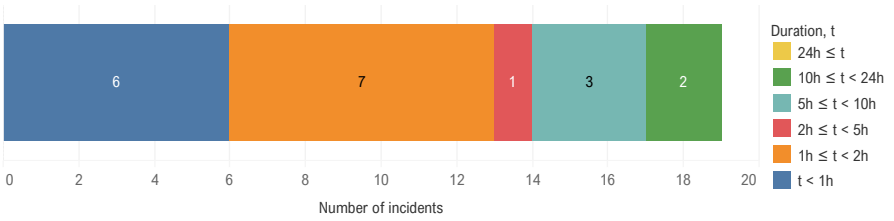

Figure 12.20: Number of incidents grouped by duration in 2019 for SEPS.

12.1.21 Incidents reported by Swissgrid

This section presents incidents for Swissgrid, the TSO in Switzerland. Table 12.41 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.42 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.21 presents the number of incidents grouped by duration in 2019.

Table 12.41: Monthly distribution of incidents by dominating criterion in 2019 for Swissgrid.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	1	0	0	0	0	0	0	0	0	0	1
	Incidents on power generating facilities (G0)	0	0	0	1	1	0	1	0	2	0	0	1	6
	Incidents on transmission network elements (T0)	8	0	2	1	3	3	1	8	0	0	3	2	31
	Loss of tools and facilities (LT0)	1	2	1	1	3	2	0	0	2	2	1	1	16
	Total	9	2	4	3	7	5	2	8	4	2	4	4	54
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0	1	0	0	0	0	1	0	2
	Incidents on transmission network elements (T1)	0	0	1	0	0	1	0	0	1	0	0	1	4
	N-1 violation (ON1)	0	0	0	0	1	0	0	0	0	0	1	0	2
	Reduction of reserve capacity (RRC1)	0	0	0	1	0	0	0	0	0	0	0	1	2
	Total	0	0	1	1	1	2	0	0	1	0	2	2	10
Scale 2	Incidents on transmission network elements (T2)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Total	0	0	0	0	0	0	0	0	0	0	1	0	1
Grand Total		9	2	5	4	8	7	2	8	5	2	7	6	65

Table 12.42: The annual number of incidents by dominating criterion from 2015–2019 for Swissgrid.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	0	1
	Incidents on power generating facilities (G0)	2	0	2	1	6
	Incidents on transmission network elements (T0)	12	14	7	12	31
	Loss of tools and facilities (LT0)	0	0	0	5	16
	Violation of standards on voltage (OV0)	0	1	1	0	0
	Total	14	15	10	18	54
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	2
	Incidents on load (L1)	0	0	0	1	0
	Incidents on power generating facilities (G1)	0	1	0	0	0
	Incidents on transmission network elements (T1)	0	4	2	0	4
	Loss of tools and facilities (LT1)	4	2	1	0	0
	N-1 violation (ON1)	0	1	3	1	2
	Reduction of reserve capacity (RRC1)	0	0	1	0	2
	Total	4	8	7	2	10
Scale 2	Incidents on transmission network elements (T2)	0	0	0	0	1
	N violation (ON2)	0	0	0	3	0
	Total	0	0	0	3	1
Grand Total		18	23	17	23	65

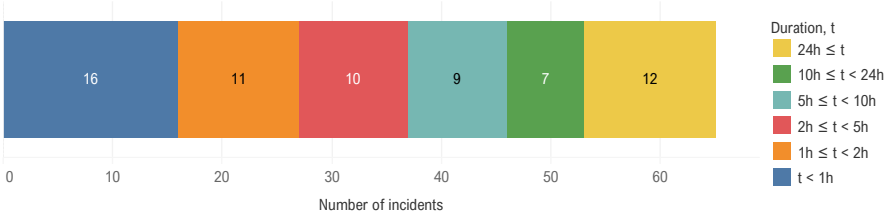

Figure 12.21: Number of incidents grouped by duration in 2019 for Swissgrid.

12.1.22 Incidents reported by TenneT TSO B.V.

This section presents incidents for TenneT TSO B.V, the TSO in the Netherlands. Table 12.43 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.44 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.22 presents the number of incidents grouped by duration in 2019.

Table 12.43: Monthly distribution of incidents by dominating criterion in 2019 for TenneT TSO B.V.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	1	1	1	0	1	0	1	0	0	2	3	2	12
	Incidents on transmission network elements (T0)	4	2	2	0	1	0	0	1	0	2	0	2	14
	Loss of tools and facilities (LT0)	4	0	0	0	3	0	1	3	3	4	1	4	23
	Total	9	3	3	0	5	0	2	4	3	8	4	8	49
Scale 1	Incidents on transmission network elements (T1)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Loss of tools and facilities (LT1)	0	0	0	0	0	0	0	0	1	0	0	0	1
	N-1 violation (ON1)	0	0	1	0	0	0	3	0	0	2	0	0	6
	Total	0	0	1	0	0	0	3	0	1	2	1	0	8
Grand Total		9	3	4	0	5	0	5	4	4	10	5	8	57

Table 12.44: The annual number of incidents by dominating criterion from 2015–2019 for TenneT TSO B.V.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	31	20	16	19	12
	Incidents on transmission network elements (T0)	5	10	4	13	14
	Loss of tools and facilities (LT0)	0	0	0	68	23
	Violation of standards on voltage (OV0)	6	3	11	0	0
	Total	42	33	31	100	49
Scale 1	Incidents on load (L1)	1	0	0	0	0
	Incidents on transmission network elements (T1)	0	8	4	0	1
	Loss of tools and facilities (LT1)	0	3	0	3	1
	N-1 violation (ON1)	0	3	1	3	6
	Violation of standards on voltage (OV1)	6	11	19	0	0
	Total	7	25	24	6	8
Grand Total		49	58	55	106	57

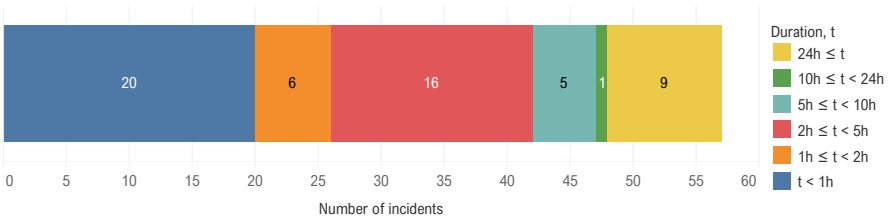

Figure 12.22: Number of incidents grouped by duration in 2019 for TenneT TSO B.V.

12.1.23 Incidents reported by TenneT TSO GmbH

This section presents incidents for TenneT TSO GmbH, one of the TSOs in Germany. Table 12.45 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.46 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.23 presents the number of incidents grouped by duration in 2019.

The changes in the yearly numbers stem mostly from changes to the methodology, and the variance during the year can be attributed to weather effects.

Table 12.45: Monthly distribution of incidents by dominating criterion in 2019 for TenneT TSO GmbH.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	3	3	5	8	1	10	4	9	1	4	4	1	53
	Loss of tools and facilities (LT0)	1	1	0	1	1	0	0	0	0	1	0	0	5
	Total	4	4	5	9	2	10	4	9	1	5	4	1	58
Scale 1	N-1 violation (ON1)	0	0	0	0	0	0	0	0	1	0	0	1	2
	Total	0	0	0	0	0	0	0	0	1	0	0	1	2
Grand Total		4	4	5	9	2	10	4	9	2	5	4	2	60

Table 12.46: The annual number of incidents by dominating criterion from 2015–2019 for TenneT TSO GmbH.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	3	3	2	0	0
	Incidents on transmission network elements (T0)	11	13	26	24	53
	Loss of tools and facilities (LT0)	0	0	0	10	5
	Violation of standards on voltage (OV0)	0	4	0	0	0
	Total	14	20	28	34	58
Scale 1	Incidents on transmission network elements (T1)	6	0	2	0	0
	Loss of tools and facilities (LT1)	2	3	3	0	0
	N-1 violation (ON1)	12	11	13	1	2
	Violation of standards on voltage (OV1)	0	0	1	4	0
	Total	20	14	19	5	2
Grand Total		34	34	47	39	60

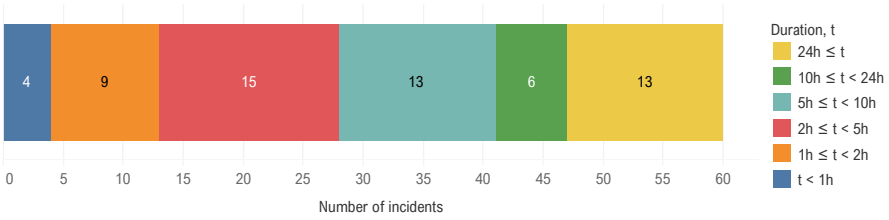

Figure 12.23: Number of incidents grouped by duration in 2019 for TenneT TSO GmbH.

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12.1.24 Incidents reported by TERNA

This section presents incidents for TERNA, the TSO in Italy. Table 12.47 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.48 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.24 presents the number of incidents grouped by duration in 2019.

Table 12.47: Monthly distribution of incidents by dominating criterion in 2019 for TERNA.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	7	3	2	8	5	4	10	8	5	10	12	9	83
	Loss of tools and facilities (LT0)	1	1	0	0	1	0	0	0	0	0	0	0	3
	Total	8	4	2	8	6	4	10	8	5	10	12	9	86
Grand Total		8	4	2	8	6	4	10	8	5	10	12	9	86

Table 12.48: The annual number of incidents by dominating criterion from 2015–2019 for TERNA.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	14	1	0	63	83
	Loss of tools and facilities (LT0)	0	0	0	0	3
	Total	14	1	0	63	86
Scale 1	Incidents on transmission network elements (T1)	1	19	17	0	0
	Total	1	19	17	0	0
Grand Total		15	20	17	63	86

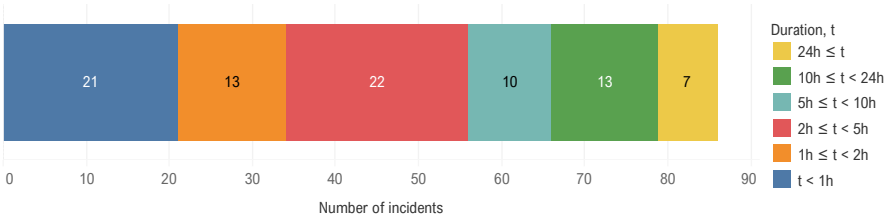

Figure 12.24: Number of incidents grouped by duration in 2019 for TERNA.

12.1.25 Incidents reported by Transelectrica

This section presents incidents for Transelectrica, the TSO in Romania. Table 12.49 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.50 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.25 presents the number of incidents grouped by duration in 2019.

The higher number of OV0-incidents in 2019 is due to the lack of reactive power compensation units. The lack is caused by either unavailability due to another incident, by replacement works for existing units or by delays in investment works.

Table 12.49: Monthly distribution of incidents by dominating criterion in 2019 for Transelectrica.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	2	0	0	1	6	17	11	6	0	0	0	1	44
	Violation of standards on voltage (OV0)	5	12	17	24	26	29	25	15	14	15	5	9	196
	Total	7	12	17	25	32	46	36	21	14	15	5	10	240
Grand Total		7	12	17	25	32	46	36	21	14	15	5	10	240

Table 12.50: The annual number of incidents by dominating criterion from 2015–2019 for Transelectrica.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	1	1	3	4	0
	Incidents on transmission network elements (T0)	47	22	47	64	44
	Reduction of reserve capacity (RRC0)	0	2	1	0	0
	Violation of standards on voltage (OV0)	0	0	0	157	196
	Total	48	25	51	225	240
Scale 1	Incidents on transmission network elements (T1)	0	0	6	0	0
	Reduction of reserve capacity (RRC1)	0	0	0	1	0
	Total	0	0	6	1	0
Grand Total		48	25	57	226	240

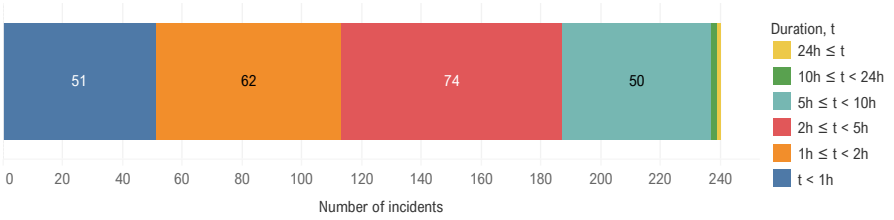

Figure 12.25: Number of incidents grouped by duration in 2019 for Transelectrica.

12.1.26 Incidents reported by TransnetBW GmbH

This section presents incidents for TransnetBW GmbH, one of the TSOs in Germany. Table 12.51 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.52 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.26 presents the number of incidents grouped by duration in 2019.

Table 12.51: Monthly distribution of incidents by dominating criterion in 2019 for TransnetBW GmbH.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	2	1	2	1	1	1	6	3	2	5	2	1	27
	Incidents on transmission network elements (T0)	0	0	1	0	2	2	5	1	0	4	0	1	16
	Total	2	1	3	1	3	3	11	4	2	9	2	2	43
Scale 1	Loss of tools and facilities (LT1)	0	0	0	0	1	0	1	0	0	0	0	0	2
	Total	0	0	0	0	1	0	1	0	0	0	0	0	2
Grand Total		2	1	3	1	4	3	12	4	2	9	2	2	45

Table 12.52: The annual number of incidents by dominating criterion from 2015–2019 for TransnetBW GmbH.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	1	0	1	0	27
	Incidents on transmission network elements (T0)	28	29	28	14	16
	Total	29	29	29	14	43
Scale 1	Incidents on transmission network elements (T1)	0	1	4	0	0
	Loss of tools and facilities (LT1)	0	0	2	2	2
	N-1 violation (ON1)	0	2	5	2	0
	Total	0	3	11	4	2
Grand Total		29	32	40	18	45

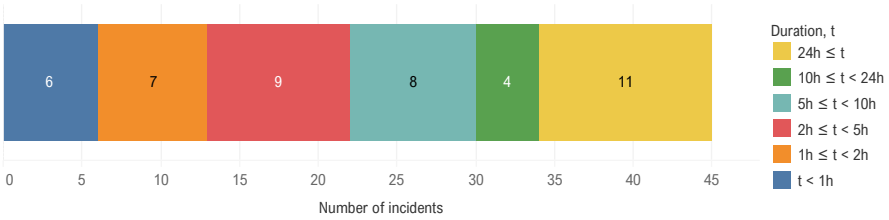

Figure 12.26: Number of incidents grouped by duration in 2019 for TransnetBW GmbH.

12.2 Overview of incidents per TSOs in the Nordic synchronous area

12.2.1 Incidents reported by Energinet (Nordic)

This section presents incidents for Energinet (Nordic), the TSO in Denmark. Table 12.53 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.54 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.27 presents the number of incidents grouped by duration in 2019.

Table 12.53: Monthly distribution of incidents by dominating criterion in 2019 for Energinet (Nordic).

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	0	1	0	0	0	0	2	0	0	2	0	0	5
	Total	0	1	0	0	0	0	2	0	0	2	0	0	5
Scale 1	Incidents on transmission network elements (T1)	0	0	0	0	0	0	0	0	0	1	0	0	1
	Total	0	0	0	0	0	0	0	0	0	1	0	0	1
Grand Total		0	1	0	0	0	0	2	0	0	3	0	0	6

Table 12.54: The annual number of incidents by dominating criterion from 2015–2019 for Energinet (Nordic).

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on transmission network elements (T0)	0	0	1	2	5
	Total	0	0	1	2	5
Scale 1	Incidents on transmission network elements (T1)	4	7	3	1	1
	Loss of tools and facilities (LT1)	0	0	0	2	0
	Total	4	7	3	3	1
Grand Total		4	7	4	5	6

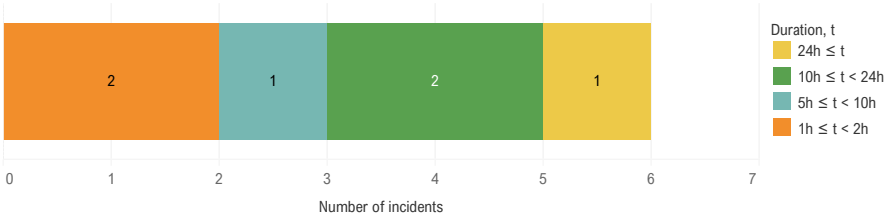

Figure 12.27: Number of incidents grouped by duration in 2019 for Energinet (Nordic).

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12.2.2 Incidents reported by Fingrid Oyj

This section presents incidents for Fingrid Oyj, the TSO in Finland. Table 12.55 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.56 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.28 presents the number of incidents grouped by duration in 2019.

Table 12.55: Monthly distribution of incidents by dominating criterion in 2019 for Fingrid Oyj.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	1	0	0	1	1	1	0	1	0	0	0	1	6
	Loss of tools and facilities (LT0)	0	0	0	0	1	0	0	0	0	0	0	0	1
	Total	1	0	0	1	2	1	0	1	0	0	0	1	7
Grand Total		1	0	0	1	2	1	0	1	0	0	0	1	7

Table 12.56: The annual number of incidents by dominating criterion from 2015–2019 for Fingrid Oyj.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	0	0	1	0
	Incidents on transmission network elements (T0)	5	0	0	4	6
	Loss of tools and facilities (LT0)	0	0	0	0	1
	Violation of standards on voltage (OV0)	0	0	0	5	0
	Total	5	0	0	10	7
Scale 1	Incidents on transmission network elements (T1)	10	9	4	3	0
	N-1 violation (ON1)	10	8	0	0	0
	Total	20	17	4	3	0
Grand Total		25	17	4	13	7

Figure 12.28: Number of incidents grouped by duration in 2019 for Fingrid Oyj.

12.2.3 Incidents reported by Statnett

This section presents incidents for Statnett, the TSO in Norway. Table 12.57 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.58 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.29 presents the number of incidents grouped by duration in 2019.

Table 12.57: Monthly distribution of incidents by dominating criterion in 2019 for Statnett.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	0	0	0	0	0	0	0	0	0	0	1	0	1
	Incidents on transmission network elements (T0)	3	3	1	1	0	0	0	0	1	0	2	1	12
	Total	3	3	1	1	0	0	0	0	1	0	3	1	13
Scale 1	Incidents on load (L1)	0	0	0	0	0	0	1	0	1	0	0	0	2
	Total	0	0	0	0	0	0	1	0	1	0	0	0	2
Grand Total		3	3	1	1	0	0	1	0	2	0	3	1	15

Table 12.58: The annual number of incidents by dominating criterion from 2015–2019 for Statnett.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	0	0	0	1
	Incidents on transmission network elements (T0)	12	7	2	23	12
	Total	12	7	2	23	13
Scale 1	Incidents on load (L1)	3	2	2	3	2
	Incidents on power generating facilities (G1)	0	1	0	0	0
	Incidents on transmission network elements (T1)	13	6	9	2	0
	Loss of tools and facilities (LT1)	0	0	2	0	0
	N-1 violation (ON1)	0	1	0	2	0
	Total	16	10	13	7	2
Grand Total		28	17	15	30	15

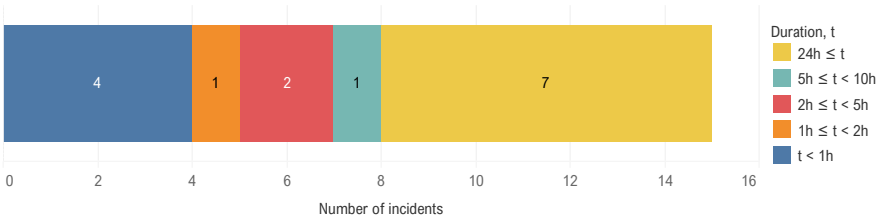

Figure 12.29: Number of incidents grouped by duration in 2019 for Statnett.

12.2.4 Incidents reported by Svenska Kraftnät

This section presents incidents for Svenska Kraftnät, the TSO in Sweden. Table 12.59 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.60 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.30 presents the number of incidents grouped by duration in 2019.

Table 12.59: Monthly distribution of incidents by dominating criterion in 2019 for Svenska Kraftnät.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	3	5	0	4	5	3	2	4	2	3	2	3	36
	Total	3	5	0	4	5	3	2	4	2	3	2	3	36
Grand Total		3	5	0	4	5	3	2	4	2	3	2	3	36

Table 12.60: The annual number of incidents by dominating criterion from 2015–2019 for Svenska Kraftnät.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	1	0	0	2	0
	Incidents on transmission network elements (T0)	10	2	4	48	36
	Total	11	2	4	50	36
Scale 1	Incidents on transmission network elements (T1)	24	27	17	1	0
	Total	24	27	17	1	0
Grand Total		35	29	21	51	36

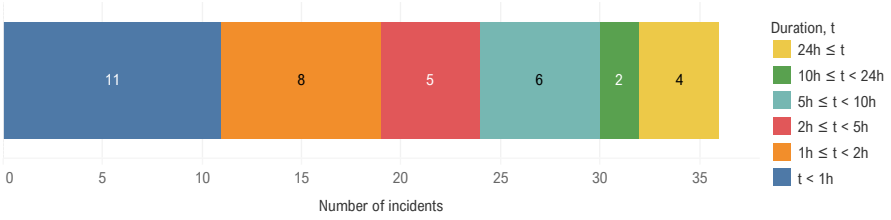

Figure 12.30: Number of incidents grouped by duration in 2019 for Svenska Kraftnät.

12.3 Overview of incidents per TSOs in Great Britain

12.3.1 Incidents reported by National Grid ESO

This section presents incidents for National Grid ESO, the TSO in Great Britain. Table 12.61 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.62 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.31 presents the number of incidents grouped by duration in 2019.

Table 12.61: Monthly distribution of incidents by dominating criterion in 2019 for National Grid ESO.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents leading to frequency degradation (F0)	9	8	6	4	6	5	12	7	1	7	5	8	78
	Incidents on transmission network elements (T0)	20	12	13	12	7	15	22	11	3	11	10	19	155
	Loss of tools and facilities (LT0)	3	4	4	5	4	4	8	2	1	1	3	3	42
	Total	32	24	23	21	17	24	42	20	5	19	18	30	275
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	0	0	0	1	0	0	0	0	1
	Total	0	0	0	0	0	0	0	1	0	0	0	0	1
Grand Total		32	24	23	21	17	24	42	21	5	19	18	30	276

Table 12.62: The annual number of incidents by dominating criterion from 2015–2019 for National Grid ESO.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	58	78
	Incidents on power generating facilities (G0)	0	1	2	3	0
	Incidents on transmission network elements (T0)	82	101	124	156	155
	Loss of tools and facilities (LT0)	0	0	0	31	42
	Total	82	102	126	248	275
Scale 1	Incidents on transmission network elements (T1)	5	9	10	0	0
	Loss of tools and facilities (LT1)	1	1	2	0	0
	N-1 violation (ON1)	0	0	0	2	0
	Total	6	10	12	2	0
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	0	1
	Total	0	0	0	0	1
Grand Total		88	112	138	250	276

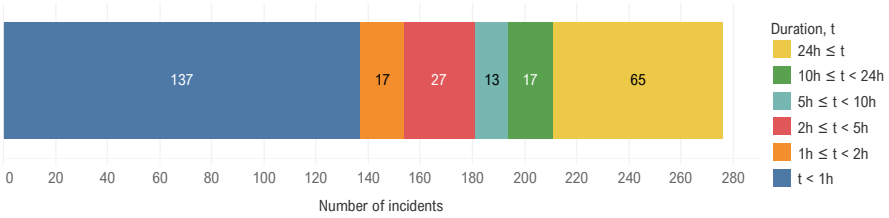

Figure 12.31: Number of incidents grouped by duration in 2019 for National Grid ESO.

12.4 Overview of incidents per TSOs in the Baltic area

12.4.1 Incidents reported by AS Augstsprieguma tīkls (AST)

This section presents incidents for AS Augstsprieguma tīkls (AST), the TSO in Latvia. Table 12.63 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.64 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.32 presents the number of incidents grouped by duration in 2019.

Table 12.63: Monthly distribution of incidents by dominating criterion in 2019 for AS Augstsprieguma tīkls.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	0	0	0	0	0	1	0	0	0	0	0	0	1
	Incidents on transmission network elements (T0)	0	0	0	0	0	2	0	1	0	1	1	1	6
	Total	0	0	0	0	0	3	0	1	0	1	1	1	7
Scale 1	Incidents leading to frequency degradation (F1)	0	0	0	0	0	0	1	0	0	0	0	0	1
	Total	0	0	0	0	0	0	1	0	0	0	0	0	1
Grand Total		0	0	0	0	0	3	1	1	0	1	1	1	8

Table 12.64: The annual number of incidents by dominating criterion from 2015–2019 for AS Augstsprieguma tīkls.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	0	0	0	1
	Incidents on transmission network elements (T0)	5	6	6	7	6
	Total	5	6	6	7	7
Scale 1	Incidents leading to frequency degradation (F1)	0	1	0	0	1
	Incidents on power generating facilities (G1)	0	1	0	0	0
	Loss of tools and facilities (LT1)	0	0	0	1	0
	Total	0	2	0	1	1
Grand Total		5	8	6	8	8

Figure 12.32: Number of incidents grouped by duration in 2019 for AS Augstsprieguma tīkls.

12.4.2 Incidents reported by Elering AS

This section presents incidents for Elering AS, the TSO in Estonia. Table 12.65 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.66 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.33 presents the number of incidents grouped by duration in 2019.

Table 12.65: Monthly distribution of incidents by dominating criterion in 2019 for Elering AS.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	2	1	0	3	2	0	1	0	0	0	0	1	10
	Incidents on transmission network elements (T0)	0	0	1	1	3	1	1	5	0	0	1	1	14
	Total	2	1	1	4	5	1	2	5	0	0	1	2	24
Grand Total		2	1	1	4	5	1	2	5	0	0	1	2	24

Table 12.66: The annual number of incidents by dominating criterion from 2015–2019 for Elering AS.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	0	0	1	10
	Incidents on transmission network elements (T0)	5	2	5	6	14
	Total	5	2	5	7	24
Scale 1	Incidents on transmission network elements (T1)	15	4	3	0	0
	Loss of tools and facilities (LT1)	0	1	0	0	0
	Total	15	5	3	0	0
Grand Total		20	7	8	7	24

Figure 12.33: Number of incidents grouped by duration in 2019 for Elering AS.

12.4.3 Incidents reported by Litgrid AB

This section presents incidents for Litgrid AB, the TSO in Lithuania. Table 12.67 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.68 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.34 presents the number of incidents grouped by duration in 2019.

Table 12.67: Monthly distribution of incidents by dominating criterion in 2019 for Litgrid AB.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on transmission network elements (T0)	1	0	2	0	0	2	1	1	1	0	0	0	8
	Total	1	0	2	0	0	2	1	1	1	0	0	0	8
Scale 1	Incidents on load (L1)	0	0	0	0	0	0	0	0	1	1	0	0	2
	Incidents on transmission network elements (T1)	0	0	1	0	0	0	1	0	1	0	0	0	3
	Total	0	0	1	0	0	0	1	0	2	1	0	0	5
Grand Total		1	0	3	0	0	2	2	1	3	1	0	0	13

Table 12.68: The annual number of incidents by dominating criterion from 2015–2019 for Litgrid AB.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	3	3	0	1	0
	Incidents on transmission network elements (T0)	8	11	6	12	8
	Total	11	14	6	13	8
Scale 1	Incidents on load (L1)	0	0	0	0	2
	Incidents on transmission network elements (T1)	0	9	8	0	3
	Loss of tools and facilities (LT1)	0	3	0	0	0
	Total	0	12	8	0	5
Grand Total		11	26	14	13	13

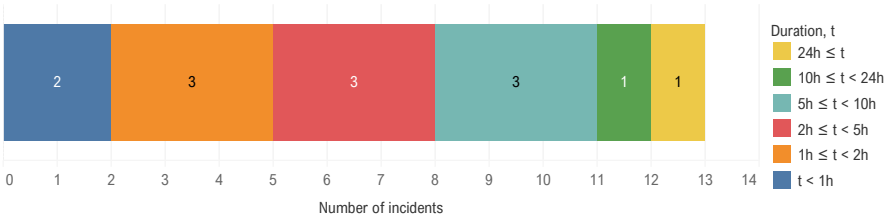

Figure 12.34: Number of incidents grouped by duration in 2019 for Litgrid AB.

12.5 Overview of incidents per TSOs in Ireland

12.5.1 Incidents reported by EirGrid

This section presents incidents for EirGrid, the TSO in Ireland. Table 12.69 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.70 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.35 presents the number of incidents grouped by duration in 2019.

Table 12.69: Monthly distribution of incidents by dominating criterion in 2019 for EirGrid.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents leading to frequency degradation (F0)	0	0	1	0	2	0	0	1	0	0	0	0	4
	Incidents on power generating facilities (G0)	0	0	0	1	0	1	1	1	0	2	2	0	8
	Incidents on transmission network elements (T0)	0	0	0	0	2	2	0	3	1	1	0	0	9
	Total	0	0	1	1	4	3	1	5	1	3	2	0	21
Grand Total		0	0	1	1	4	3	1	5	1	3	2	0	21

Table 12.70: The annual number of incidents by dominating criterion from 2015–2019 for EirGrid.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	7	4
	Incidents on power generating facilities (G0)	25	17	23	7	8
	Incidents on transmission network elements (T0)	1	7	3	8	9
	Violation of standards on voltage (OV0)	0	1	0	0	0
	Total	26	25	26	22	21
Scale 1	Incidents on transmission network elements (T1)	2	1	2	0	0
	Loss of tools and facilities (LT1)	0	0	2	0	0
	Total	2	1	4	0	0
Scale 2	Incidents leading to frequency degradation (F2)	0	0	0	1	0
	Total	0	0	0	1	0
Grand Total		28	26	30	23	21

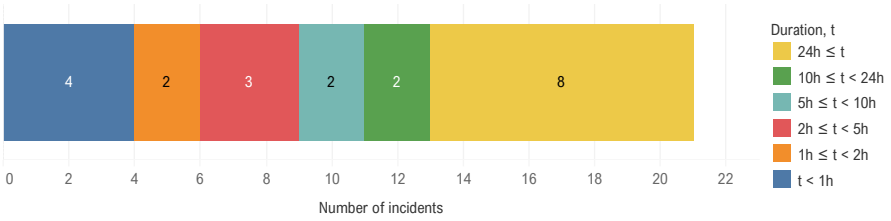

Figure 12.35: Number of incidents grouped by duration in 2019 for EirGrid.

12.5.2 Incidents reported by SONI

This section presents incidents for SONI, the TSO in Northern Ireland. Table 12.71 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.72 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.36 presents the number of incidents grouped by duration in 2019.

Table 12.71: Monthly distribution of incidents by dominating criterion in 2019 for SONI.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	1	0	1	0	0	0	0	0	0	0	0	0	2
	Total	1	0	1	0	0	0	0	0	0	0	0	0	2
Grand Total		1	0	1	0	0	0	0	0	0	0	0	0	2

Table 12.72: The annual number of incidents by dominating criterion from 2015–2019 for SONI.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents leading to frequency degradation (F0)	0	0	0	1	0
	Incidents on power generating facilities (G0)	2	4	1	0	2
	Incidents on transmission network elements (T0)	0	3	0	1	0
	Total	2	7	1	2	2
Scale 1	Incidents on transmission network elements (T1)	0	0	4	0	0
	Total	0	0	4	0	0
Scale 2	Incidents on load (L2)	1	0	0	0	0
	Total	1	0	0	0	0
Grand Total		3	7	5	2	2

Figure 12.36: Number of incidents grouped by duration in 2019 for SONI.

12.6 Overview of incidents per TSOs in isolated systems

12.6.1 Incidents reported by Cyprus TSO

This section presents incidents for Cyprus TSO, the TSO in Cyprus. Table 12.73 presents the annual number of incidents by dominating criterion from 2015–2019. Cyprus TSO had no incidents in 2018 or 2019.

Table 12.73: The annual number of incidents by dominating criterion from 2015–2019 for Cyprus TSO.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 1	Incidents on load (L1)	0	0	4	0	0
	Total	0	0	4	0	0
Scale 2	Incidents on load (L2)	0	0	1	0	0
	Incidents on power generating facilities (G2)	0	1	0	0	0
	Total	0	1	1	0	0
Grand Total		0	1	5	0	0

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12.6.2 Incidents reported by Landsnet

This section presents incidents for Landsnet, the TSO in Iceland. Table 12.74 presents the monthly distribution of incidents by dominating criterion in 2019, and Table 12.75 presents the annual number of incidents by dominating criterion from 2015–2019. Figure 12.37 presents the number of incidents grouped by duration in 2019.

Table 12.74: Monthly distribution of incidents by dominating criterion in 2019 for Landsnet.

		2019												
Scale	Dominating criterion	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Scale 0	Incidents on power generating facilities (G0)	0	0	0	0	1	1	0	0	1	0	1	0	4
	Incidents on transmission network elements (T0)	1	0	1	0	0	0	1	0	0	0	0	2	5
	Total	1	0	1	0	1	1	1	0	1	0	1	2	9
Scale 1	Incidents on transmission network elements (T1)	0	1	1	0	1	0	0	0	0	1	0	3	7
	Total	0	1	1	0	1	0	0	0	0	1	0	3	7
Grand Total		1	1	2	0	2	1	1	0	1	1	1	5	16

Table 12.75: The annual number of incidents by dominating criterion from 2015–2019 for Landsnet.

Scale	Dominating criterion	2015	2016	2017	2018	2019
Scale 0	Incidents on power generating facilities (G0)	0	0	1	0	4
	Incidents on transmission network elements (T0)	4	8	5	10	5
	Total	4	8	6	10	9
Scale 1	Incidents on load (L1)	3	2	3	0	0
	Incidents on power generating facilities (G1)	0	0	2	0	0
	Incidents on transmission network elements (T1)	1	0	6	3	7
	Total	4	2	11	3	7
Scale 2	Incidents on load (L2)	3	1	1	1	0
	Loss of tools and facilities (LT2)	0	0	0	1	0
	Total	3	1	1	2	0
Grand Total		11	11	18	15	16

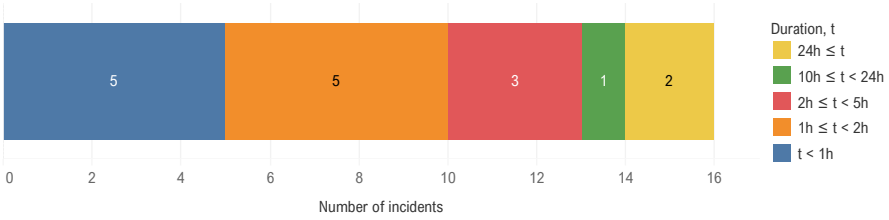

Figure 12.37: Number of incidents grouped by duration in 2019 for Landsnet.

13 Conclusion

For the 2019 Annual Report on the Incident Classification Scale, ENTSO-E members reported data on incidents to the ICS subgroup using the revised methodology from 2018 [1]. The subgroup analysed the data and prepared this report. Similar to 2018, the 2019 Annual Report provides a clear overview of the incidents that took place within each TSO.

A total of 3 217 incidents were reported for 2019, which represents a small increase compared to 2018. However, the distribution of incidents over the year is similar to that observed in 2018.

Between the 2018 and 2019 Reports, scale 0 incidents increased by 6 % from 2 782 to 2 851, and scale 1 incidents increased by 39 % from 262 to 363. There was a decrease in scale 2 incidents from 6 in 2018 to 3 in 2019, however, there were not enough scale 2 incidents to make a relevant comparison with previous years. One of the scale 2 incidents occurred in Great Britain, and the two other were in continental Europe.

Transmission network elements (T0) comprised 49 % of the scale 0 incidents. The next largest groups of scale 0 incidents, at 37 % and 9 %, respectively, involved incidents leading to frequency degradation (F0) and violations of standards on voltage (OV0).

At 62 % of the scale 1 incidents, reduction of reserve capacity (RRC1) constitutes the largest group, and these incidents have been reported throughout continental Europe.

The results and trends discussed herein are derived exclusively from the data reported by the individual TSOs. The increase in the total number of reported incidents in 2018 and 2019 was expected as a predictable side effect to updating the Incident Classification Scale Methodology [1], as summarised in Section 2.1. Because of the updated methodology, it is difficult to compare the reported incidents in 2019 with previous years. In addition, there are still doubts as to whether all TSOs have a harmonised understanding and application of all ICS categories. To address this, annual workshops have been organised to encourage consistent, high-quality reporting for all TSOs.

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.

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