European Network of
Transmission System Operators
for Electricity

INCIDENT CLASSIFICATION SCALE
2013 ANNUAL REPORT

SYSTEM OPERATIONS COMMITTEE

09.12.2014

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1 INTRODUCTION

The Annual Report 2013 of the Incident Classification Scale (ICS) covers all 41 ENTSO-E members, across 34 countries and is prepared according to the Incident Classification Scale [1] (ICS) developed by ENTSO-E pursuant to the Article 8(3)(a) of the Regulation (EC) 714/2009. The ICS is submitted to ACER for opinion pursuant to Article 9(2) of the Regulation (EC) 714/2009.

The Network Codes are still in the process of being approved so the ICS may need further improvements in order to be compliant with the approved versions of the NCs. The ICS has been approved by SOC, Assembly and ACER.

The objective is to achieve full harmonization between the ICS and the EAS for the reporting of System States. This will take into account performance indicators from the NCs and will be available after full implementation of the EAS (which is expected in 2014) and the adoption of the NCs on System Operation, currently expected in late 2014, subject to comitology and formal legal steps.

This Annual Report is a collation of the reports prepared by each TSO, classified according to the Incident Classification Scale Methodology and appraised at a Synchronous Area level. It will be prepared in the second quarter of the year following the year covered by the report. To facilitate the production of the Annual Report it is proposed that a process will be set up through which TSOs will collectively analyse the relevance of the incidents during the year. The report provides a detailed analysis of the incidents on Scale 1 to 3 at a Synchronous Area level and a high level summary of scale 0 incidents

The recording of the incidents according to the common classification enables:

- monitoring of the number of incidents, system performance during the year and comparisons between years;
- identifying occurrences of high risk to a breach of system security;
- incident investigations to be organized;
- analysis of incidents and the potential to improve grid codes.

The report is organized to provide three types of information:

- statistical data per synchronous area;
- analysis from the working group and other ENTSO-E bodies and recommendations to improve security of the system;
- recommendations to improve the methodology.

The incidents from the different synchronous areas are analysed by the TSOs concerned and classified according to the ICS [1]. Therefore, this report is not a compilation of all the incidents which occurred in 2013; only those incidents which meet the criteria of the Incident Classification Scale are included.

2 INCIDENT CLASSIFICATION SCALE: DESCRIPTION AND DEFINITION

Criteria have been defined by using definitions (from ENTSO-E network codes and IEC standards). Each criterion describes “factually” an incident or a situation which is observable. Only significant incidents are recorded and classified according to a scale based on severity.

Thus this report does not describe or analyse all the incidents which affected the pan European network, but only those significant enough to be classified according to the ICS.

The Incident Classification Scale has 4 levels increasing in severity up to a general Europe wide incident. It is compliant with the “System States” definitions in the Operational Security network code ([5], chapter 2, article 8):

- **Scale 0** (normal state) for anomaly.
- **Scale 1** for noteworthy disturbances.
- **Scale 2** for extensive incidents.
- **Scale 3** for widespread incidents or Major incidents on one Transmission System Operator.

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TABLE 1 : SUMMARY OF THE INCIDENT CLASSIFICATION SCALE

Scale 0	Scale 1	Scale 2	Scale 3
Events on load (L0)	Events on load (L1)	Events on load (L2)	Blackout State (OB3)
Disturbance leading to frequency degradation (F0)	Disturbance leading to frequency degradation (F1)	Disturbance leading to frequency degradation (F2)	
Disturbance on Transmission Network equipment (T0)	Disturbance on Transmission Network equipment (T1)	Disturbance on Transmission Network equipment (T2)	
Disturbances on generation facilities (G0)	Disturbances on generation facilities (G1)	Disturbances on generation facilities (G2)	
Violation of standards on voltage (OV0)	N-1 violation (ON1)	Separation from the grid (RS2)	
	Violation of standards on voltage (OV1)	Emergency State (OE2)	
	Lack of Reserve (OR1)		
	Alert State (OA1)		

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3 ENTSO-E GLOBAL OVERVIEW

3.1 SYSTEM OPERATION REVIEW

The Winter Review 2012/2013 [3] shows that no extraordinary weather conditions affected a wide area of Europe simultaneously, as occurred during Winter 2011/12. While in the southern part of Europe the winter was mild, in the northern part the winter was marginally colder than average. In central Europe the time period January – March was slightly colder than average. In many countries a high amount of rainfall was observed which has a positive effect on hydro generation.

During the second half of January parts of the peak load reserve in Sweden were activated to maintain a sufficient margin between demand and generation, due to temperatures being colder than normal.

In Belgium two nuclear power plants were not in operation during the whole winter, which led to a structural dependency on imports of up to 3500 MW, taking into account additional planned outages. On Friday the 11th January, Elia faced a further forced outage of a third nuclear power plant Tihange3 (1000MW). The unit came back on Saturday, on time to contribute to meet the highest load that occurred in both Belgium and France on January 17th. Due to a cold spell in combination with a forced outage of multiple generating units right before and during the evening peak, this day was the most critical day of the past winter for Belgium.
In Spain the wind production was much higher than average, and several wind production records were met.

The German control area was massively oversupplied by up to 8 GW on the evening of December 24th (2012), resulting in strong negative prices for electricity. This also contributed to an unusually high upward frequency deviation (frequency reached a maximum value of 50.13 Hz). During this period of time the German demand for negative control reserve could not be satisfied by the procured reserves and emergency reserve had to be used. This unusually high demand for negative control reserve continued – to a lesser extent – until 5th January. Cross-border flows caused by this oversupply also affected Poland and the Czech Republic, where redispatching became necessary.

The summer of 2013 was slightly warmer than average in Europe. While June was colder than average and heavy rainfall occurred in most parts of Europe, the temperatures in July and August were higher than average and the whole period was relatively dry.
The heavy rainfall in June caused severe floods in parts of the Czech Republic, Austria, Southern Germany and Eastern Germany. In some regions provisional arrangements were set into operation.

With the exception of these floods no extreme weather conditions were observed and the load in Europe generally remained at normal levels and no critical or unexpected situations occurred in the energy system of Europe.

The experience of several European TSOs demonstrates the increased relevance of downward adequacy assessment at weekends and on public holidays, as they are generally characterised by low consumption on the one hand and a high in-feed of renewable generation on the other.

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The “Summer Outlook Report 2013 and Winter Review 2012/2013” [3] and the Winter Outlook Report 2013/2014 and Summer Review 2013” [4] give further information concerning an overview of system adequacy.

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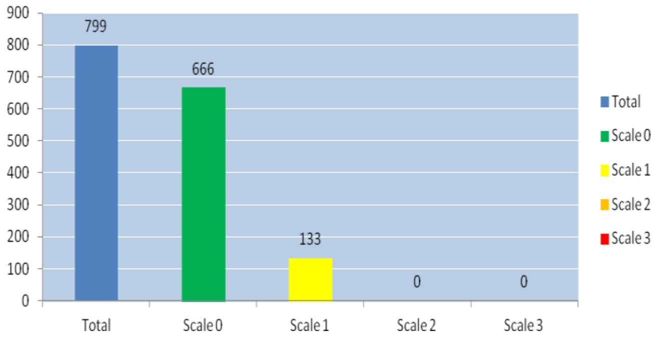
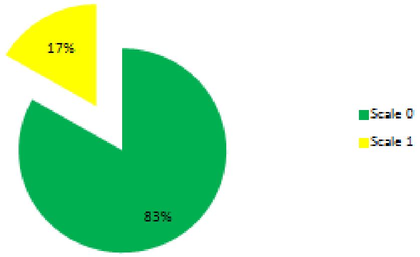
3.2 Number of Classified Incidents



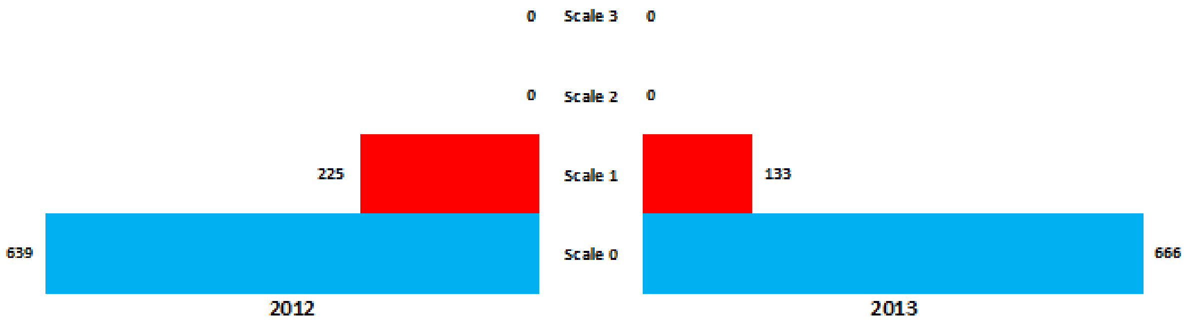


Graphic 1: Pan-European classified incidents

Graphic 2 : Percentage of pan-European incidents

799 classified incidents were recorded in 2013 by all TSOs.

83% of the incidents belong to scale 0 and 17% to scale 1. No scale 2 or scale 3 incidents have been reported during 2013.



Graphic 3 : Bird pyramid representation of the classified incidents

In 2013 the proportion is: Scale 0 = Scale 1 x 5

In 2012 the proportion was: Scale 0 = Scale 1 x 2.84

The proportion of scale 1 to scale 0 incidents in 2013 is almost half of that for 2012. This evolution is explained in chapter 6 (Analysis of scale 1 incidents).

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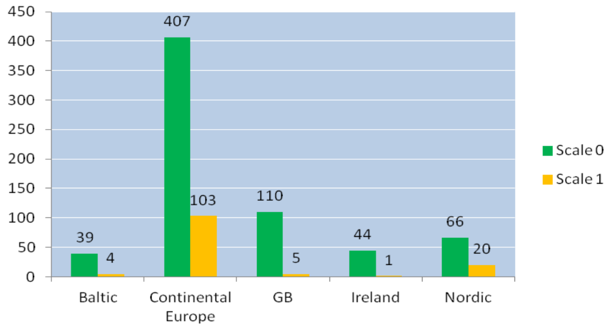
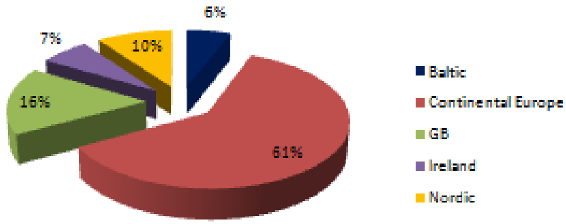
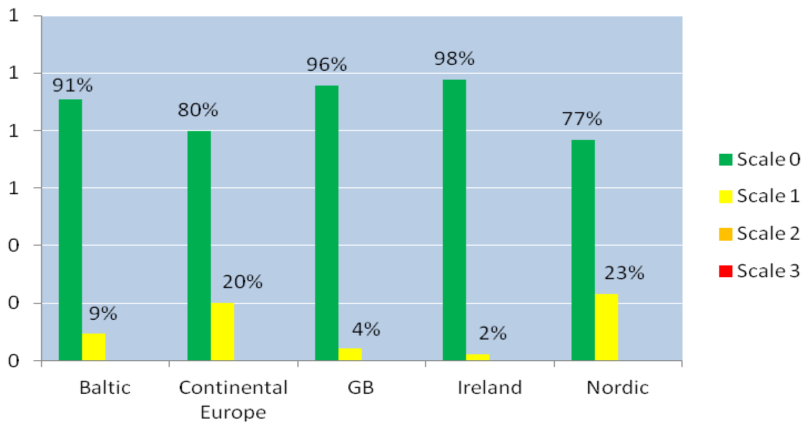




GRAPHIC 4 : NUMBER OF INCIDENTS PER SYNCHRONOUS AREA

Continental Europe Synchronous Area represents the largest part of the classified incidents. Graphics n°6 and 7 show the ratio between the number of incidents and the annual consumption and the ration between number of incidents and length of circuit.



GRAPHIC 5: PERCENTAGE OF INCIDENTS PER SYNCHRONOUS AREA

Baltic region, GB and Ireland Synchronous Area have similar repartition between scale 0 (between 91% and 98%) and scale1 (between 9% and 2%).

On the other hand, Continental Europe and Nordic, have a very homogeneous repartition of scale 0 (80% and 77%) and scale 1 incidents (20% and 23%).

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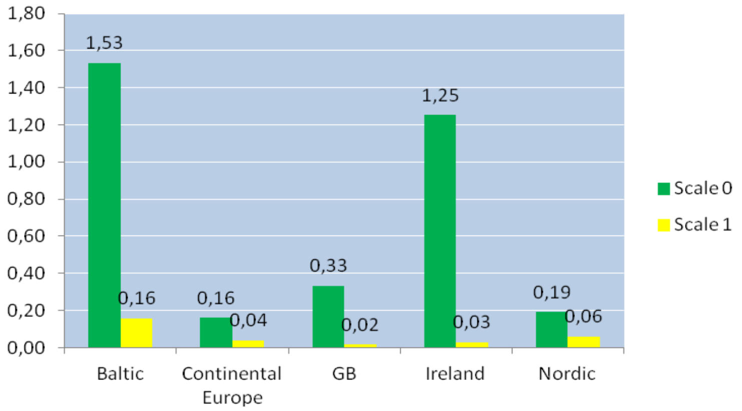
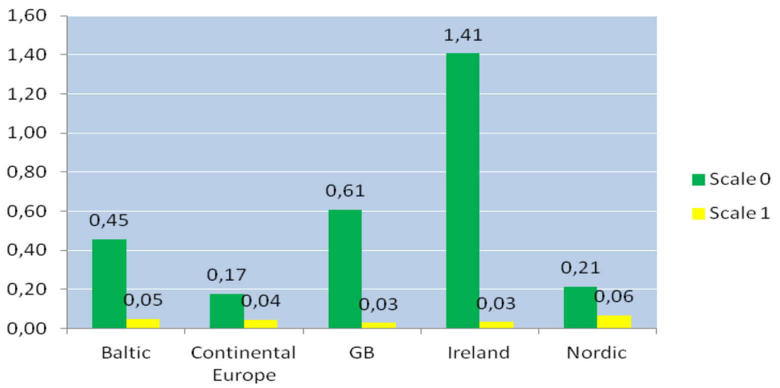
3.3 Classified incidents per length of circuit and energy consumption



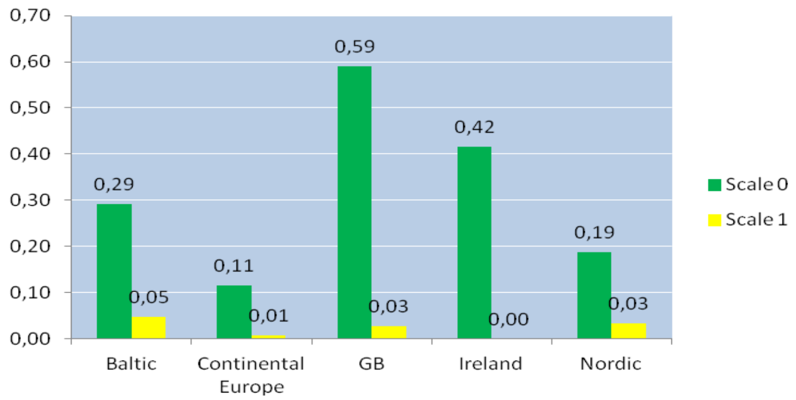
Graphic 6 : Number of incidents per 1000 GWh

The reference for the energy consumption is the Statistical Yearbook 2011 [2].



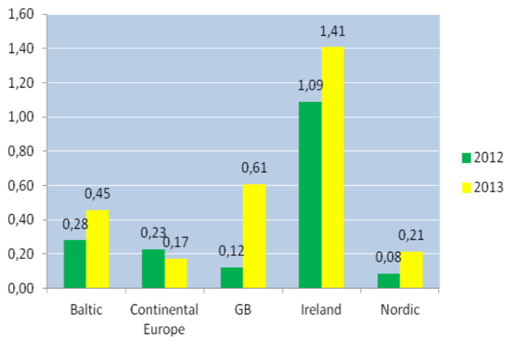
Graphic 7 : Number of incidents per 100km of circuit

The reference for the length of circuit is the Statistical Yearbook 2011 [2].

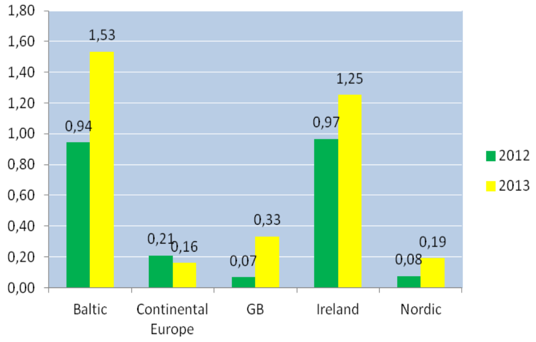


Graphic 8 : Final tripping of equipment (scale 0 and 1) per length of circuit: number of incidents per 100km of circuit

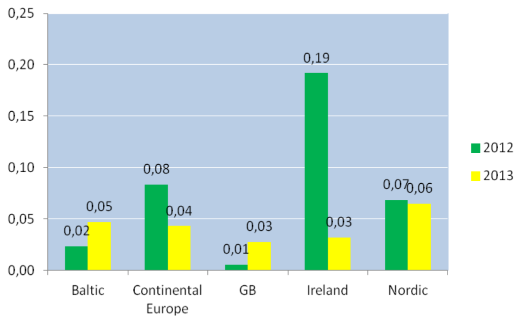
3.4 EVOLUTION BETWEEN 2012 AND 2013



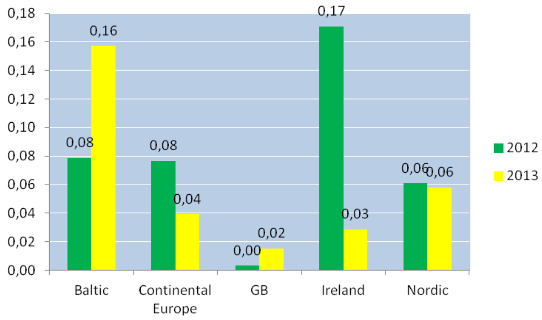
GRAPHIC 9: NUMBER OF SCALE 0 INCIDENTS PER 100KM OF CIRCUIT



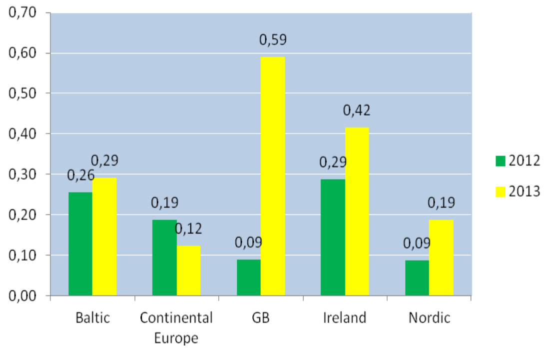
GRAPHIC 10: NUMBER OF SCALE 0 INCIDENTS PER 1000GWH



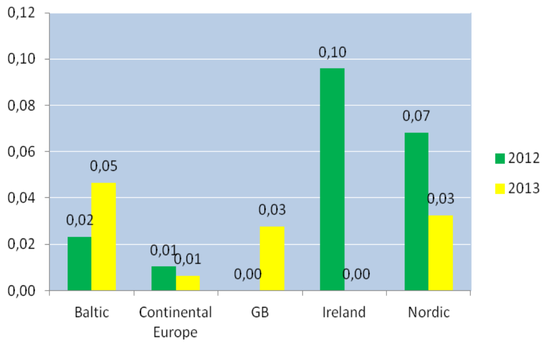
GRAPHIC 11: NUMBER OF SCALE 1 INCIDENTS PER 100KM OF CIRCUIT



GRAPHIC 12: NUMBER OF SCALE 1 INCIDENTS PER 1000GWH



Graphic 13: Number of scale 0 Incidents on transmission network per 100km of circuit



Graphic 14: Number of scale 1 Incidents on transmission network per 100km of circuit

3.5 Conclusion

As the number of scale 0 incidents are similar between 2012 and 2013, (639 in 2012 and 666 in 2013), the indicators per 100km of circuit and per 1000GWh are also close.

Due to a large decrease of the scale 1 incidents (almost -50%) between 2012 and 2013, the indicators per 100km of circuit and per 1000GWh improved significantly.

Comparison between Synchronous Areas is not relevant. Indeed, the network designs (adapted to the specificity of the countries), the energy mix, the operational conditions (wind, temperature…) are very different from a Synchronous Area to another. Moreover the methodology is not designed to compare Synchronous Areas.

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The Table 2 contains a global overview of the pan European number and type of incidents which occurred in 2013.

Criteria scale 0	Number of classified incidents in scale 0	Criteria scale 1	Number of classified incidents in scale 1
Number of classified incidents in level 0	**666**	**Number of classified incidents in level 1**	**133**
Disturbance on transmission network equipment. Final tripping of equipment without impact in other TSO ***OR*** Final tripping of HVDC link between synchronous areas	492	**Disturbance on transmission network equipment**	37
Disturbance on generation facilities. Loss of generation in time period of 30 minutes	129	**Disturbance on generation facilities.** Loss of generation in time period of 30	0
Events on load. Disconnection of load on 1 TSO < 5% peak load before incident if reasons are in the transmission grid	24	**ALERT state** (endangered state precision) - real time alert transmitted by “ENTSO-E wide awareness system” (EAS or traffic light system)	15
Disturbance leading to frequency degradation	9	**Lack of reserve**. Lack of more than 20% of reserve (secondary and tertiary reserve are considered combined)	5
Violation on standard of voltage	12	**Violation on standard of voltage**	1
		N-1 violation situation	73
		Disturbance leading to frequency degradation	1
		Events on load. Disconnection of load from 5% to 10% of load at the time of incident.	1

TABLE 2 : SUMMARY OF INCIDENTS (SCALE 0-1-2-3)

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	Criteria	Continental Europe	Nordic	GB	Baltic	Ireland
1	**Disturbance on transmission network equipment**	18	10	5	4	0
2	**Disturbance on generation facilities**	0	0	0	0	0
3	**ALERT state**	15	0	0	0	0
4	**Lack of reserve**	5	0	0	0	0
5	**Violation on standard of voltage**	0	1	0	0	0
6	**N-1 violation situation**	64	9	0	0	0
7	**Disturbance leading to frequency degradation**	1	0	0	0	0
8	**Events on load**	0	0	0	0	1

TABLE 3 : SUMMARY OF INCIDENTS ON SCALE 1

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4 PERFORMANCE INDICATORS

4.1 OPERATIONAL SECURITY NETWORK CODE

Article 32(2) of the Operational Security Network Code states that each TSO shall contribute to the yearly report of the Incident Classification Scale. According to the text of the article, up to 11 Operational Security Performance Indicators can be defined. Those Performance Indicators and their calculation according to the Incident Classification Scales methodology are as follows:

- OS-A: number of tripped Transmission System elements per year;

  It is calculated adding up all Transmission Network Elements tripped in any incident in scale 1, 2 or 3.

- OS-B: Number of Tripped Power Generation Facilities per year;

  It is calculated adding up all Power Generation Facilities tripped in any incident in scale 1, 2 or 3 with dominating or subsidiary criteria G1 or G2.

- OS-C: Energy of disconnected Demand Facilities per year;

  It is calculated adding up all “Energy not Supplied” in any incident in scale 1, 2 or 3 with dominating or subsidiary criteria L1 or L2.

- OS-D: Time duration of being in Operational States other than Normal State;

  It is calculated adding up all minutes that a TSO has been in Alert, Emergency, Blackout or Restoration State. If two TSOs have been in an Operational State different to Normal state at the same time, the time is considered twice, once per TSO.

- OS-E: Time duration within which there was a lack of reserves identified;

  It is calculated adding up all minutes with lack of reserves identified in any incident in scale 1, 2 or 3 with dominating or subsidiary criteria OR1.

- OS-F: Number of voltage deviation exceeding the voltage thresholds for Emergency State;

  It is calculated adding up all the incidents in scale 1, 2 or 3 with dominating or subsidiary criteria OV1.

- OS-G1: Number of events within which there was a frequency deviation per Synchronous Area;

  It is calculated adding up all the incidents in scale 1, 2 or 3 with dominating or subsidiary criteria F1 or F2. The incidents are calculated once per Synchronous Area. In cases where two TSOs have reported frequency deviation at the same time, it is counted once.

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- OS-G2: Time duration within which there was a frequency deviation per Synchronous Area;

  it is calculated by adding up all the time durations of frequency deviation incidents classified as scale 1, 2 or 3 with dominating or subsidiary criteria F1 or F2. The incidents are calculated once per Synchronous Area. In cases where two TSOs have reported the same frequency deviation at the same time, it is only counted once.

- OS-H: number of system-split, separations or local blackouts;

  It is calculated by adding up all the incidents in scale 2 or 3 with dominating or subsidiary criteria RS2.

- OS-I: number of blackouts involving two or more TSOs.

  It is calculated by adding up all the incidents with criteria OB3.

According to this methodology for calculating the operational security performance indicators, the values for each synchronous area for the year 2013 are as follows:

Indicator	Baltic	Continental Europe	Great Britain	Ireland	Nordic
OS-A [Tripped Elements]	4	19	6	7	10
OS-B [Tripped PGF]	0	0	0	0	0
OS-C [Energy not Supplied]	0	0	0	103,1MWh	0
OS-D [minutes]	0	28600	4	14	540
OS-E [minutes]	0	705	0	0	0
OS-F [Incidents]	0	0	0	0	1
OS-G1 [Incidents]	0	1	0	1	0
OS-G2 [minutes]	0	36	0	14	0
OS-H [Incidents]	0	0	0	0	0
OS-I [Blackouts]	0	0	0	0	0

TABLE 4 : OPERATIONAL SECURITY PERFORMANCE INDICATORS FOR 2013

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4.2 OPERATIONAL PLANNING AND SCHEDULING NETWORK CODE

Articles 60(1) and 60(2) of the Operational Planning and Scheduling Network Code state that each TSO shall contribute to the yearly report of the Incident Classification Scale. According to the text of article 60(2), 5 Operational Planning and Scheduling Performance Indicators are defined. Those Performance Indicators and their calculation according to the Incident Classification Scales methodology are as follows:

- OPS-1A: an indicator of the number of events in which an incident contained in the Contingency list led to a degradation of System Operation conditions;

  It is calculated by adding up all incidents in scale 1, 2 or 3, with any dominating or subsidiary criteria, with loss of one Transmission System element.

- OPS-1B: an indicator of the number of events counted by indicator OPS-1A in which a degradation of System Operation conditions occurred as a result of unexpected discrepancies of demand or Generation forecast;

  It is calculated by adding up all incidents in scale 1, 2 or 3 with dominating or subsidiary criteria OR1 and loss of one Transmission System element.

- OPS-2A: an indicator of the number of events in which there was a degradation in System Operation conditions due to an Out-of-Range Contingency;

  It is calculated by adding up all incidents in scale 1, 2 or 3, with any dominating or subsidiary criteria, with loss of more than one Transmission System element.

- OPS-2B: an indicator of the number of events counted by indicator OPS-2A in which a degradation of system Operation conditions occurred as a result of unexpected discrepancies of demand or Generation forecast;

  It is calculated by adding up all incidents in scale 1, 2 or 3 with dominating or subsidiary criteria OR1 and loss of more than one Transmission System element.

- OPS-3: an indicator of the number of events leading to a degradation in System Operation conditions due to lack of Active Power Reserves;

  It is calculated by adding up all incidents with lack of reserves identified in any incident in scale 1, 2 or 3 with dominating or subsidiary criteria OR1.

According to this methodology for calculating the Operational Planning and Scheduling Performance Indicators, the values for each Synchronous Area for the year 2013 are as follows:

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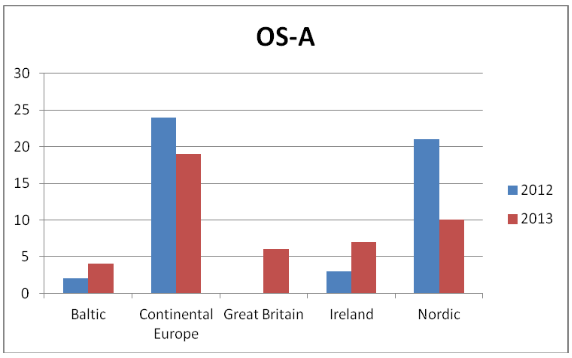
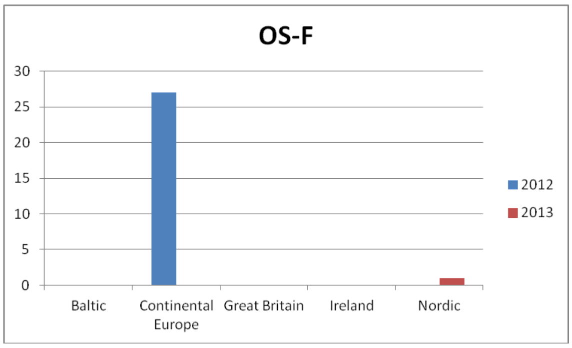
Indicator	Baltic	Continental Europe	Great Britain	Ireland	Nordic
OPS-1A [Incidents]	4	16	4	0	2
OPS-1B [Incidents]	0	0	0	0	0
OPS-2A [Incidents]	0	1	1	1	4
OPS-2B [Incidents]	0	0	0	0	0
OPS-3 [Incidents]	0	5	0	0	0

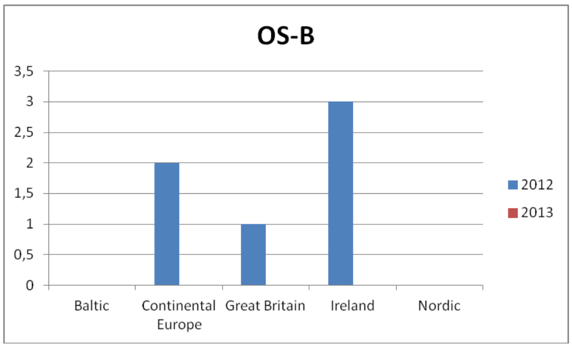
TABLE 5: OPERATIONAL PLANNING AND SCHEDULING PERFORMANCE INDICATORS FOR 2013



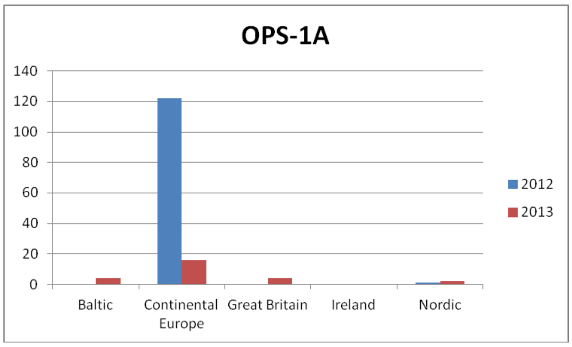
GRAPHIC 15: PERFORMANCE INDICATOR OS-A- 2012-2013



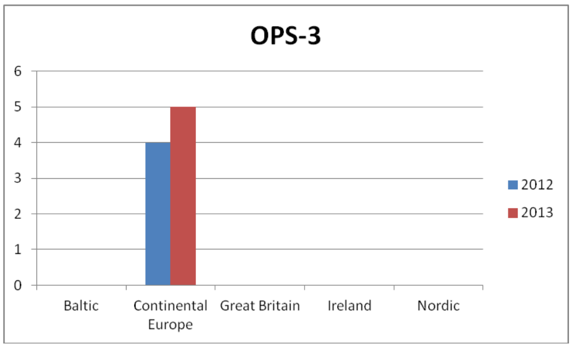
GRAPHIC 17: PERFORMANCE INDICATOR OS-F- 2012-2013



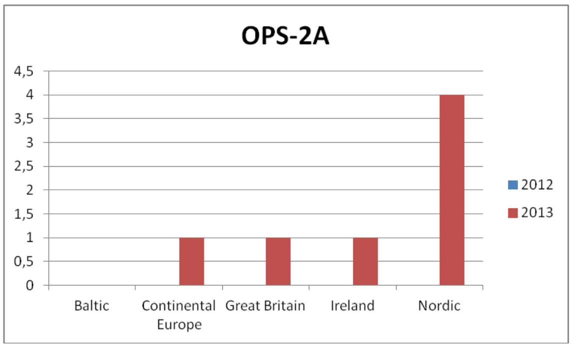
GRAPHIC 16: PERFORMANCE INDICATOR OS-B- 2012-2013



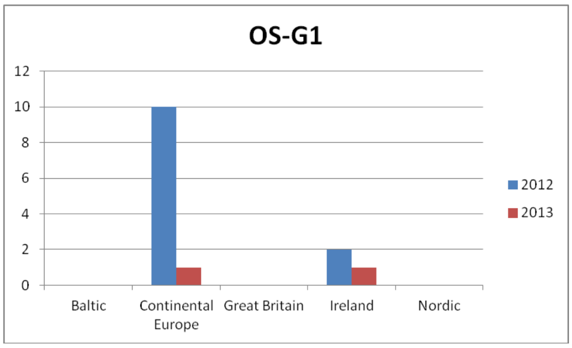
GRAPHIC 18: PERFORMANCE INDICATOR OPS-1A- 2012-2013



GRAPHIC 19: PERFORMANCE INDICATOR OPS-3- 2012-2013



GRAPHIC 21: PERFORMANCE INDICATOR OPS-2A- 2012-2013



GRAPHIC 20: PERFORMANCE INDICATOR OS-G1- 2012-2013

The values for indicators OS-1, OS-B, OS-G1, OPS-1A, OPS-2A and OPS-3, were calculated in similar ways for 2012 and 2013, so the values can be compared. Indicators OS-H and OS-I were calculated also similarly and their values were 0 for both years. The rest of indicators cannot be compared because they were not calculated in 2012 or they were measured in a different way.

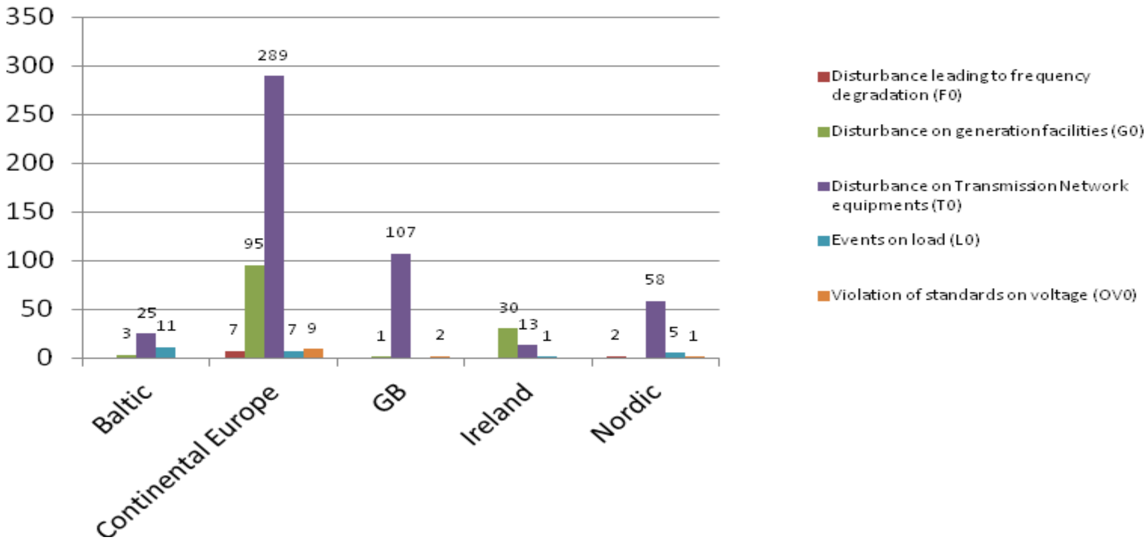
4.3 CONCLUSION

ENTSO-E's proposal for the Network Codes on Operational Security and on Operational Planning and Scheduling were submitted to ACER in September 2013. In November ACER gave positive opinion. The text of these "stable" codes is the reference for the definition of the Performance Indicators (as requested in the Framework Guidelines on System Operation) used for the 2013 Report.

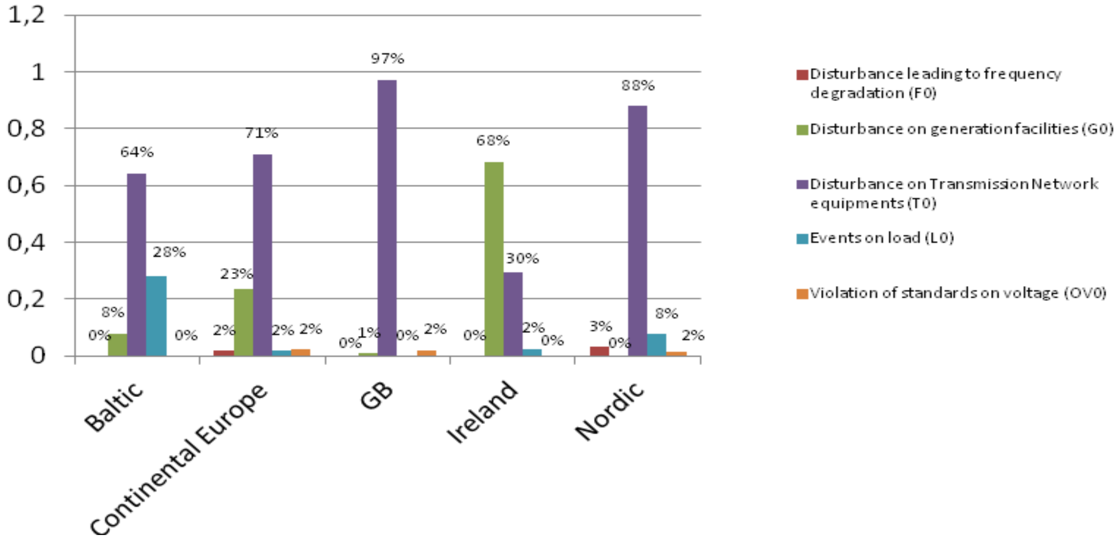
The Performance Indicators for 2012 were based on earlier versions of the Network Codes; consequently there are some differences between the Performance Indicators for 2012 and for 2013. The above graphics show, as far as possible, the comparison between the values calculated for 2012 and 2013. The values for 2013 can be considered as the starting point to analyse trends in following years.

5 SCALE 0 INCIDENTS

5.1 GLOBAL OVERVIEW



GRAPHIC 22: SCALE 0 INCIDENTS



GRAPHIC 23: SCALE 0 INCIDENTS IN PERCENTAGE

93% of the scale 0 incidents are:

- Final tripping of equipment.
- Loss of generation.

The situation of the scale 0 incidents in 2013 and 2012 is close. In 2012 80% of the scale 0 incidents were consecutive to a final tripping of equipment and 20% consecutive to a loss of generation.

5.2 CONCLUSION

”Disturbance on transmission network equipment” is the largest part of the incidents (74% in average). The proportion of final tripping of equipment and loss of generation is homogeneous among synchronous areas.

Ireland Synchronous Area is not directly comparable with others Synchronous Areas. The Irish system (comprising Ireland and Northern Ireland) has a relatively small number of generators, the ratings of which are large in terms of the overall system demand. Thus most generator trips on the Irish system qualify as level 0 events, whereas this would not be the case in larger power systems with more interconnection. For this reason the number of scale 0 events / 1000 GWh and per 100 km of circuit for the Irish system are not directly comparable with those of other systems.

According to scale 0 definition (see chapter 2 of this report) the disturbance on transmission equipment recorded in scale 0 has no consequences on operational security.

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6 ANALYSIS OF SCALE 1 INCIDENTS

6.1 GLOBAL OVERVIEW AND REMARKS

In 2013 133 scale 1 incidents were reported by 14 TSOs, this compares with 225 incidents reported in 2012. The disparity in the number of events is primarily due to developments of the ICS methodology and clarifications of what constitutes a scale 1 incident versus a scale 0 incident. Thus direct comparison of 2012 and 2013 is not particularly meaningful. As the ICS methodology is now more fully defined, meaningful annual comparisons should be possible from the 2015 annual report onwards.

As mentioned in the Table 2 of Chapter 3 of this report, incidents can be classified in scale 1 by virtue of the cause or the consequences. For example when an N-1 violation results in an Alert State they are treated in the same incident but described with 2 criteria.

The following paragraphs below lists all the criteria which define the scale 1 incidents per synchronous area.

		2013 Classification of Scale 1 Incidents
1	Transmission Disturbance T1	37
2	Loss of Generation G1	0
3	Alert State OA1	15
4	Lack of Reserve OR1	5
5	Voltage Outside Range OV1	1
6	N-1 Violation ON1	73
7	Frequency Degradation F1	1
8	Load Disconnection L1	1

TABLE 6: CLASSIFICATION OF SCALE 1 INCIDENTS REPORTED IN 2013

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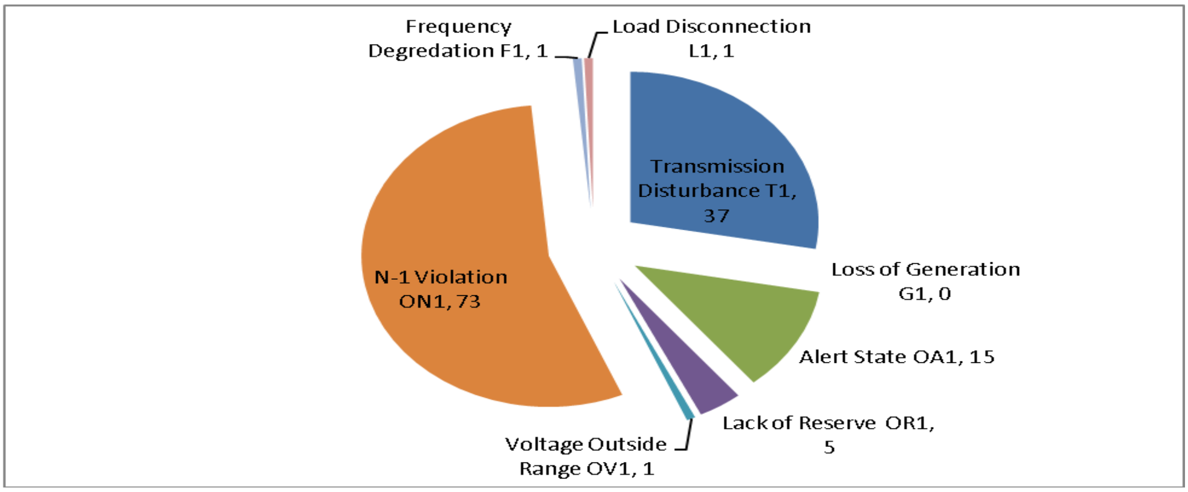


GRAPHIC 24 : NUMBER AND CLASSIFICATION OF SCALE 1 INCIDENTS

The **N-1 violation** incidents represent 55**%** of the incidents classified in scale 1.

The **Alert State** incidents represent 11**%** of the incidents classified in scale 1.

Transmission Disturbance T1 incidents represent 28**%** of the incidents classified in scale 1.

Lack of Reserve incidents represent 3**%** of the incidents classified in scale 1.

Voltage violation and Loss of Load incidents each represent 1% of the incidents classified in scale 1.

Frequency Degradation incidents represent 1**%** of the incidents classified in scale 1.

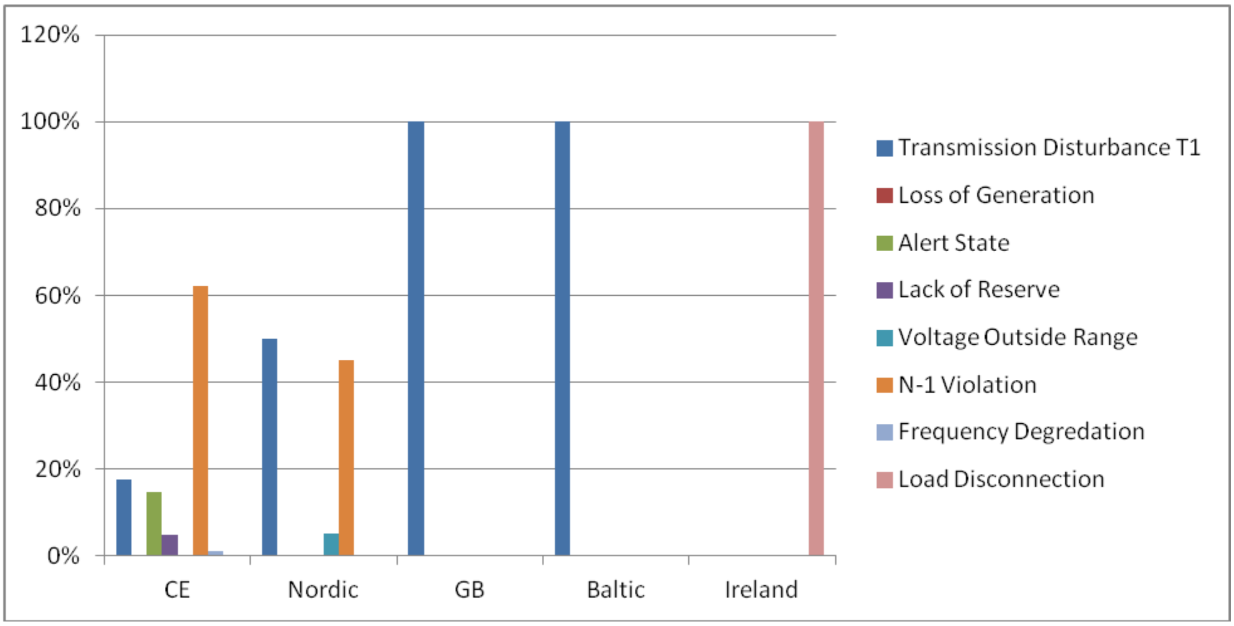
		CE	Nordic	GB	Baltic	Ireland
1	Transmission Disturbance T1	18	10	5	4	0
2	Loss of Generation	0	0	0	0	0
3	Alert State	15	0	0	0	0
4	Lack of Reserve	5	0	0	0	0
5	Voltage Outside Range	0	1	0	0	0
6	N-1 Violation	64	9	0	0	0
7	Frequency Degradation	1	0	0	0	0
8	Load Disconnection	0	0	0	0	1

TABLE 7 : CLASSIFIED INCIDENTS IN SCALE 1 BY SYNCHRONOUS AREA

	Region	Percentage of total scale 1 Incidents %
1	CE	77
2	Nordic	15
3	GB	4
4	Baltic	3
5	Ireland	1

TABLE 8: Percentage responsibility of regions for incidents

Graphic 25 (below), gives a global overview of the percentage of the various scale 1 recorded incidents by Synchronous Area.



GRAPHIC 25: SCALE 1 GLOBAL OVERVIEW

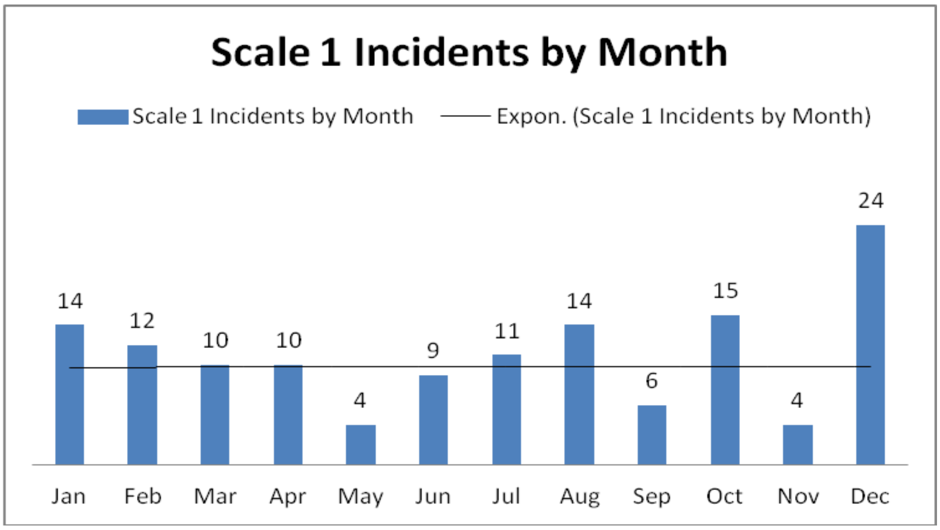
The majority 123 of 133 of the reported Scale 1 incidents occurred in the CE and Nordic Control Areas. The remaining incidents were reported by the GB (5), Baltic (4) and Ireland (1).

For Baltic Synchronous Area, all four scale 1 classified incidents were a consequence of Disturbance on Transmission Network Equipment (T1).

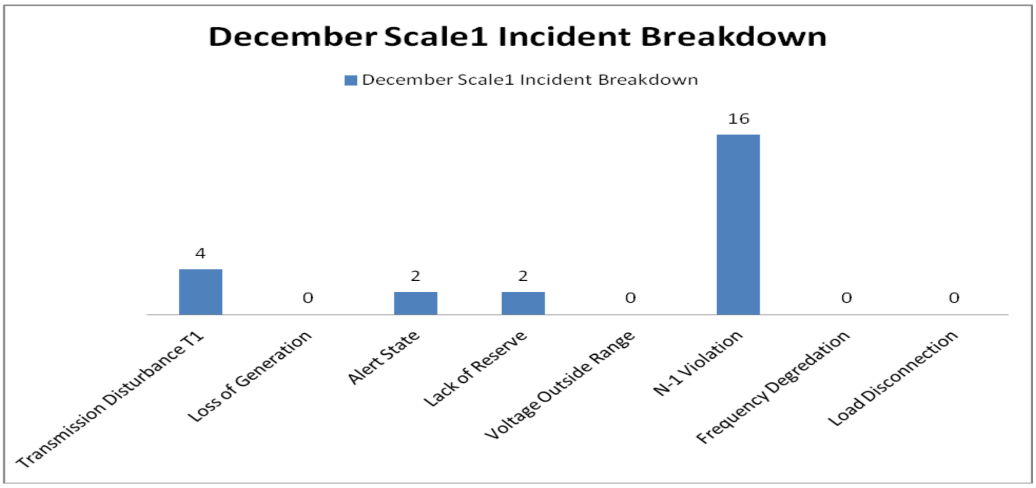
For the Ireland Synchronous Area, the scale 1 classified incident was due to load disconnection.

6.2 Monthly Distribution of Reported Scale 1 Incidents

The Graphic below shows the number of Scale 1 Incidents recorded for each month of 2013. The majority (55%) of incidents were due to N-1 Violations. The largest number of incidents (24) occurred in December. Of the 24 Incidents in December, sixteen were N-1 Violations thirteen of which were due to unexpected flows. On average there were eleven incidents per month.



Graphic 26: Scale 1 Incidents Monthly Variation



Graphic 27: Breakdown of Scale 1 Incidents Recorded in December

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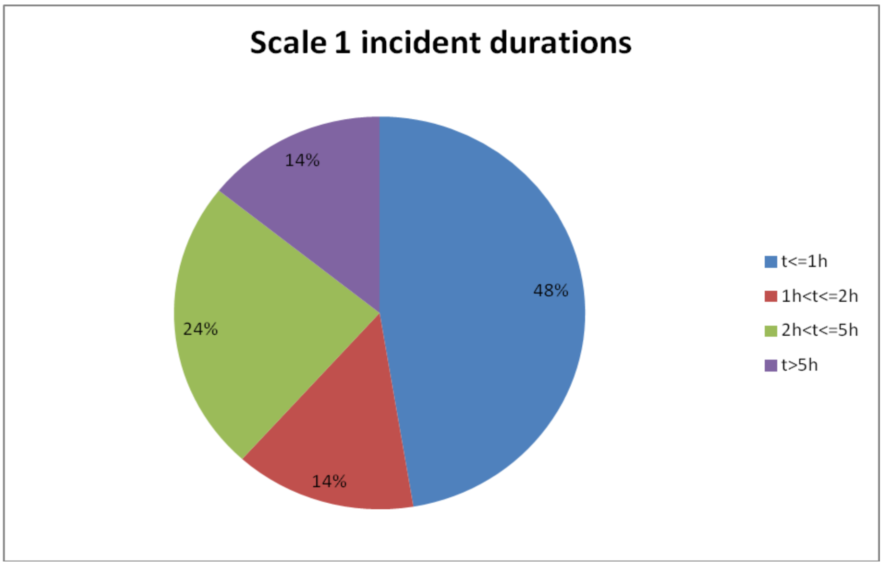
6.3 Scale 1 Incident Duration

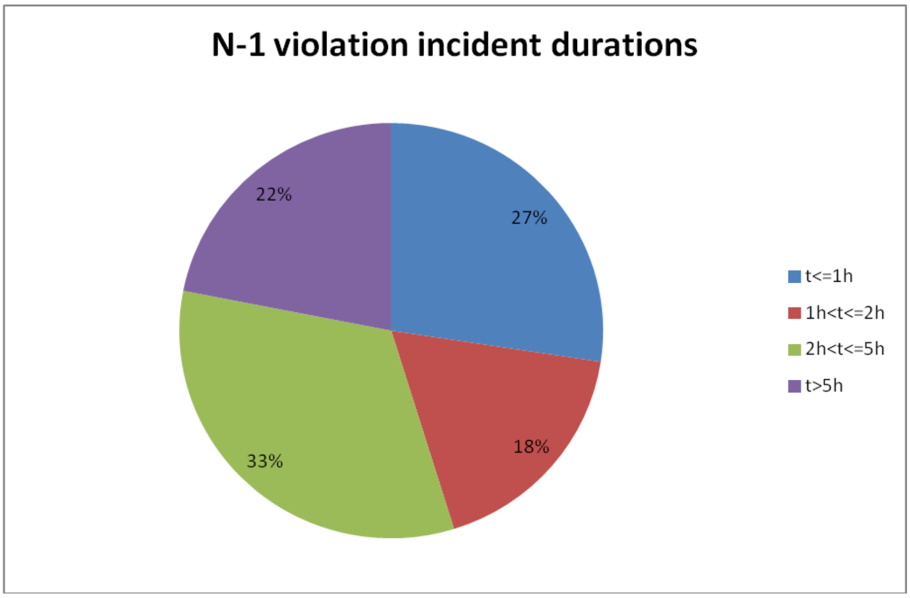
In 2013 scale 1 incident durations ranged from 5 minutes to 41h. 62% of Incident durations were less than 2 hours. 14% of incidents had duration longer than 5 hours.



Graphic 28: Scale 1 Incident Durations

Scale 1, N-1 Violation Duration

N-1 Violation durations ranged from 30 minutes to 41h. 78% of Violations were less than 5 hours in duration. 22% of Incident durations were longer than 5 hours. The average duration of the N-1 violation is 4h.



Graphic 29: Scale 1 N-1 Incident Durations

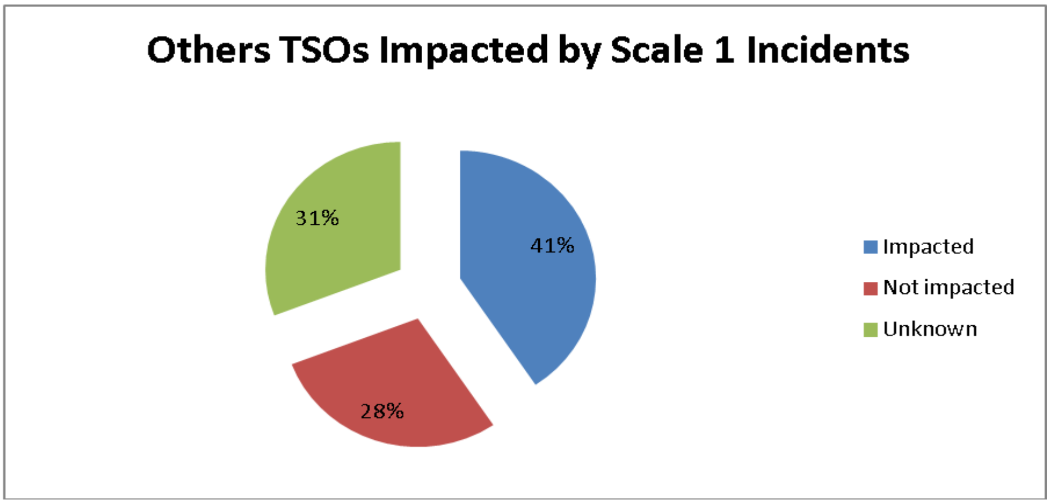
An assessment of the circumstances surrounding the N-1 violations with a duration equal to or in excess of 5 hours was undertaken with the objective of understanding the causes and identifying ways of reducing the number of occurrences in the future. A limit of 5 hours was chosen on the assumption that the factors identified as contributing to the delay in restoring the system to the normal state for these events would also apply to events of shorter duration. This does not imply that N-1 violations with a duration of less than 5 hours are acceptable.

In all cases the events which caused the N-1 violations were identified as credible risks by D-1. However the circumstances surrounding the events turned out to be more severe than anticipated and consequently there were insufficient remedial actions available for the TSOs to use to return the system to the normal state within a reasonable timescale. Without exception all available remedial actions (including counter trading and redispatching) were used to try and return the system to normal.

The main cause of the prolonged N-1 violations was insufficient remedial actions available for initiation by the TSO immediately after the event. With the growth of intermittent generation capacity (e.g. wind powered generation) and the increasing volatility of the market (intraday market trade) it is becoming more difficult for TSOs to predict the condition of the power system. Consequently there is often a high degree of uncertainty until very close to real time. This gives rise to situations where system conditions rapidly change and time is required for TSOs to put in place the remedial actions necessary to resolve N-1 violations. The occurrence of N-1 violations can be reduced by better prediction of system conditions giving TSOs more time to identify and apply remedial actions. This may be achieved by improving the forecasting tools and if the market participants provide more accurate schedules.

6.4 Impact of Scale 1 Incident on Other TSOs

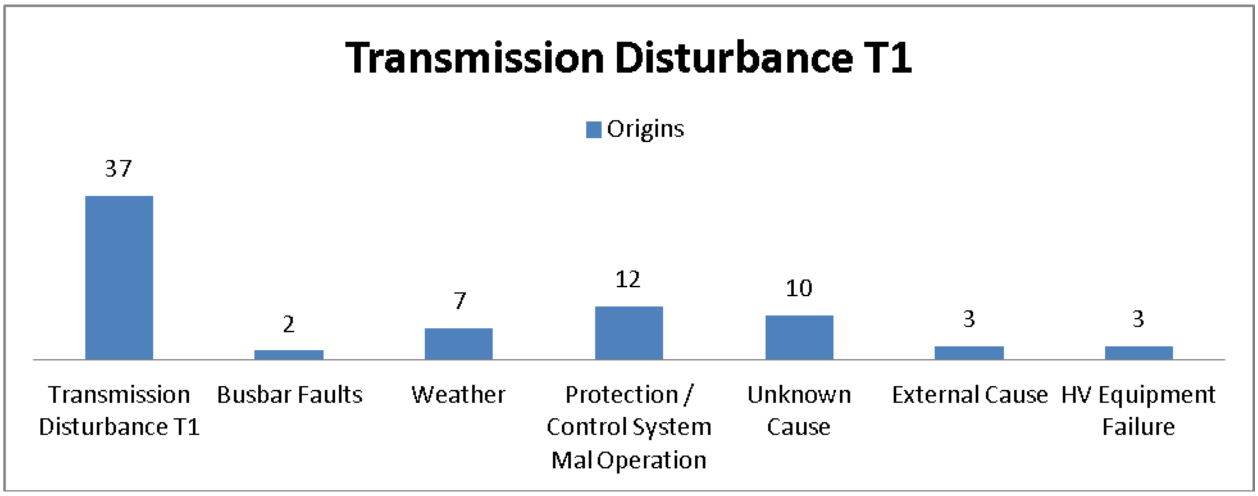
41% of Incidents originating in one TSO's Responsibility Area impacted one or more TSOs in other Responsibility Areas. In 28% of incidents there was no impact outside the TSO in which the incident occurred. In 31% of incidents it was not known if the incident impacted on another TSO.



Graphic 30: Scale 1 Incidents Impact on Other TSOs

6.5 Origins of Scale 1 transmission disturbances T1

There were 37 Scale 1 Transmission Disturbances, the major cause of 32 % of such incidents was Protection / Control System Mal-operation. Weather is the reported cause of 7 incidents corresponding 19%. The cause of 10 incidents corresponding 27% is unknown. Most of the Transmission Disturbance T1 incidents are the result of internal system technical issues rather than external causes such as weather.



Graphic 31: Scale 1 Origins of Transmission Disturbances T1

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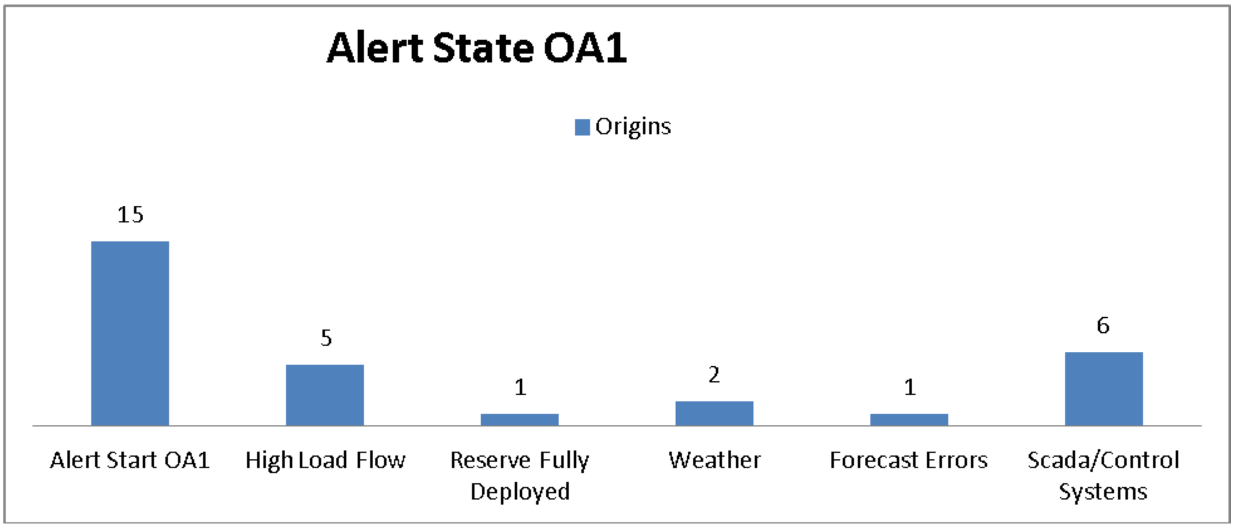
6.6 ORIGINS OF SCALE 1 ALERT STATES OA1

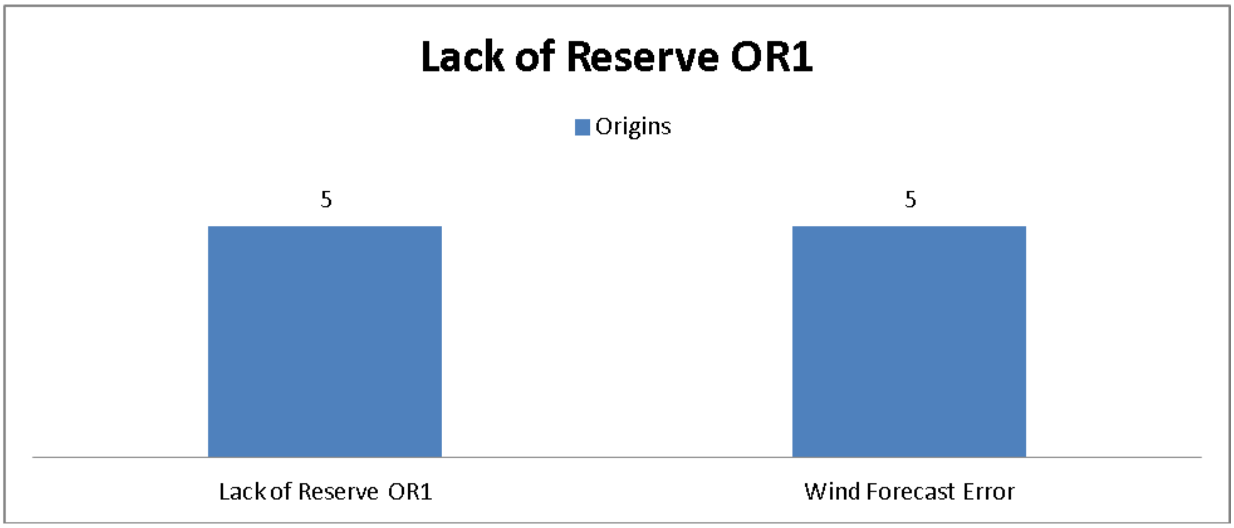
15 Alert States were recorded. The major cause (40 %) of such incidents was SCADA / Control System Mal-operation. 33% of incidents were due to high load flows. Similar to Disturbances on transmission equipment, most of the Alert State incidents are the result of technical issues rather than external issues.



GRAPHIC 32: ORIGINS OF SCALE 1 ALERT STATES OA1

6.7 ORIGINS OF SCALE 1 LACK OF RESERVE INCIDENTS OR1

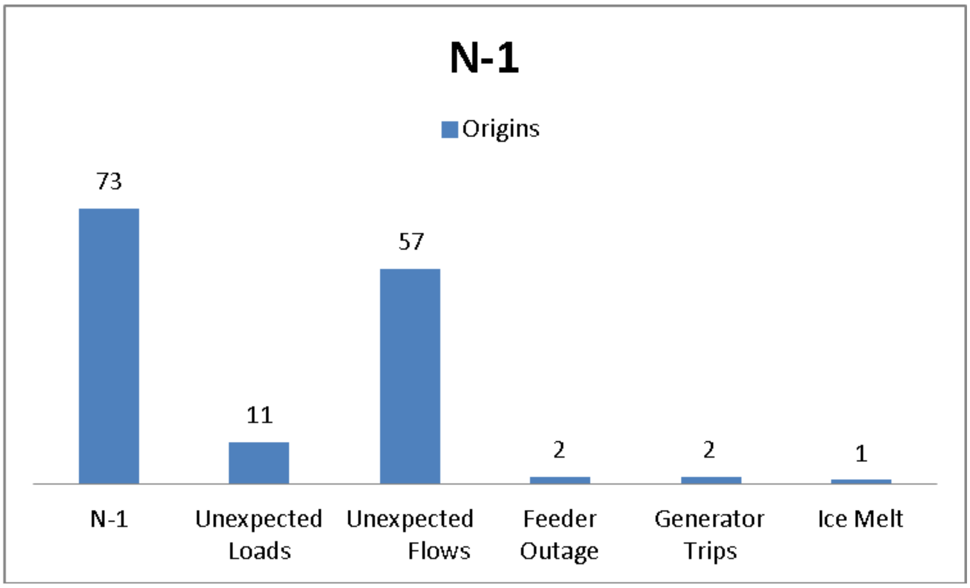
5 Lack of Reserve Incidents were recorded. All were due to wind forecasting difficulties.



GRAPHIC 33: ORIGINS OF SCALE 1 LACK OF RESERVE INCIDENTS OR1

6.8 ORIGINS OF SCALE 1 N-1 INCIDENTS ON1

73 Scale 1 N-1 Incidents were recorded. The major cause (78 %) of such incidents was unexpected flows. The next most significant cause (15%) was unexpectedly high loads.



GRAPHIC 34: ORIGINS OF SCALE 1 N-1 INCIDENTS

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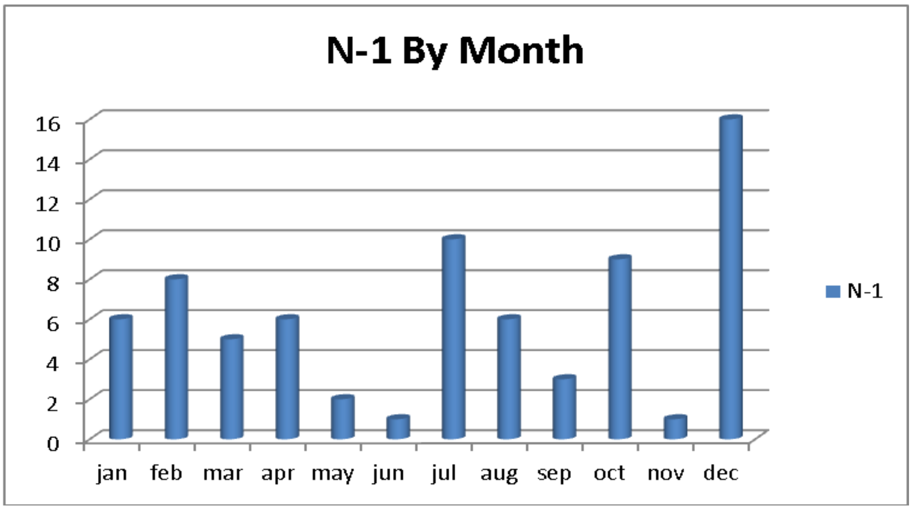
Monthly Distribution of Reported Scale 1 N-1 Incidents

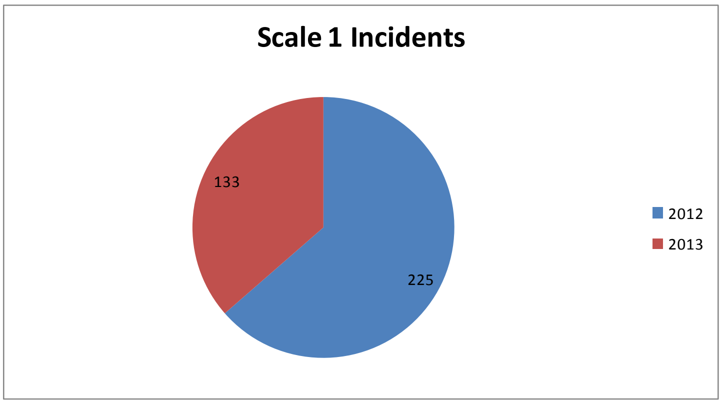
The graphic below shows the number of scale 1 N-1 incidents recorded for each month of 2013. The largest number of incidents occurred in December whilst July was the month with the next largest number of incidents.



GRAPHIC 35: SCALE 1 N-1 INCIDENTS BY MONTH

6.9 COMPARISON WITH 2012

In 2013 there were 133 Scale 1 Incidents this represents a 40% reduction on 2012's 225 Incidents. Similar to 2012 the majority (55%) of 2013 scale 1 incidents were due to N-1 violations, however the numbers of N-1 incidents recorded in 2013 represents a 40% reduction on the 2012 incidents. This is primarily due to closer cooperation between TSOs in reducing unexpected flows and to a lesser extent to revisions in the ICS Methodology.



GRAPHIC 36: EUROPEAN SCALE 1 INCIDENTS COMPARISON 2012-2013

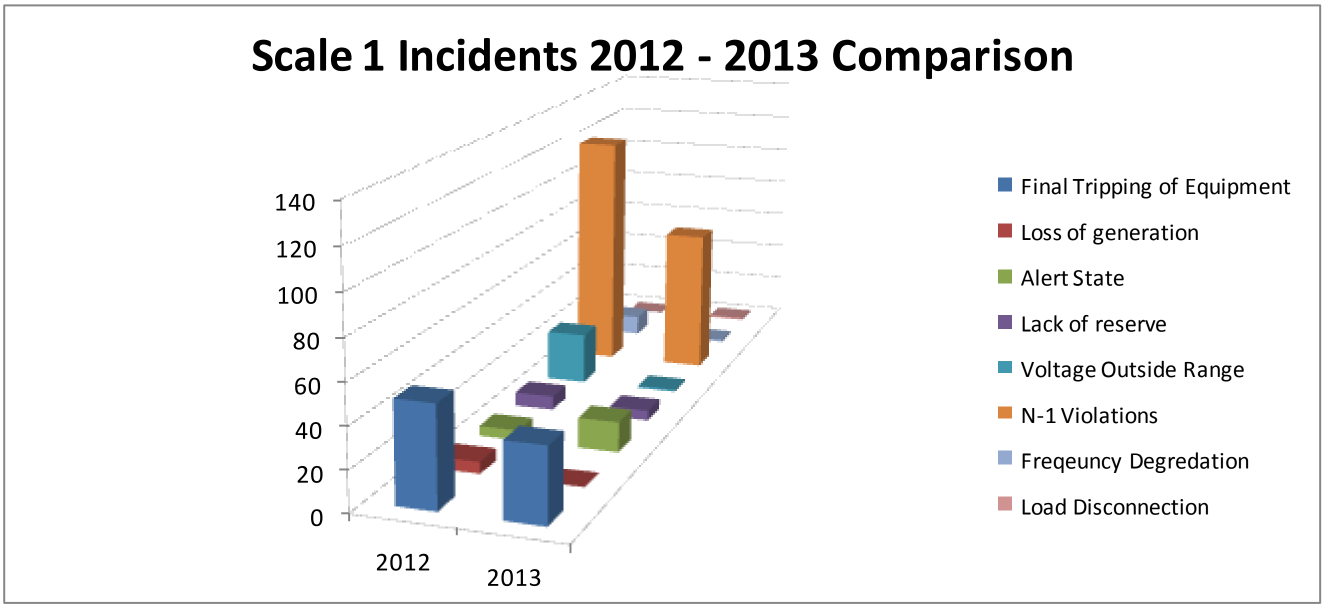
2013 saw an increase in the occurrence of two categories of incidents.

- Alert states, which trebled from 5 incidents to 15
- Load disconnections which rose from zero incidents to one.

In all other categories the number of incidents fell significantly. The changes for all categories are recorded in the following table.

N.O	Incident	Percentage change from 2012 to 2013 %
1	Final Tripping of Equipment	-26
2	Loss of Generation	-100
3	Alert State	+200
4	Lack of Reserve	-28
5	Voltage Outside Range	-96
6	N-1 Violation	-40
7	Frequency Degradation	-90
8	Load Disconnection	+100

TABLE 9: PERCENTAGE CHANGE IN SCALE 1 INCIDENTS



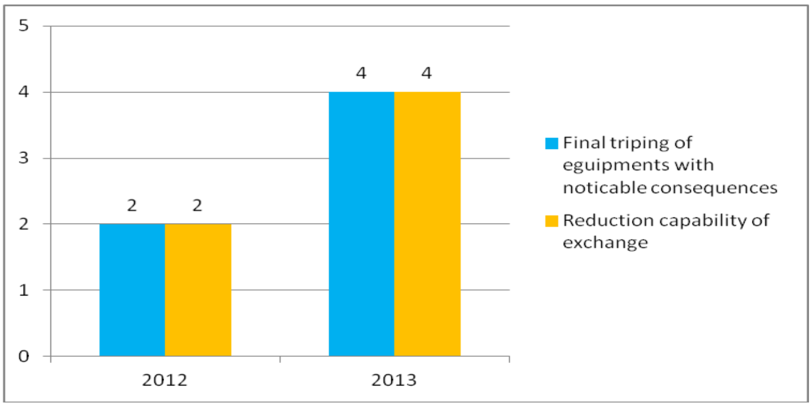
GRAPHIC 37: TOTAL SCALE 1 INCIDENTS COMPARISON 2012-2013

The **N-1 violation** incidents represent **54%** of the incidents classified in scale 1.

The **final tripping of equipment** incidents represent **24%** of the incidents classified in scale 1.

The **network node operated at voltage exceeding voltage** ±10% incidents represents **11%** of the incidents classified in scale 1.

6.10 INCIDENTS FROM BALTIC



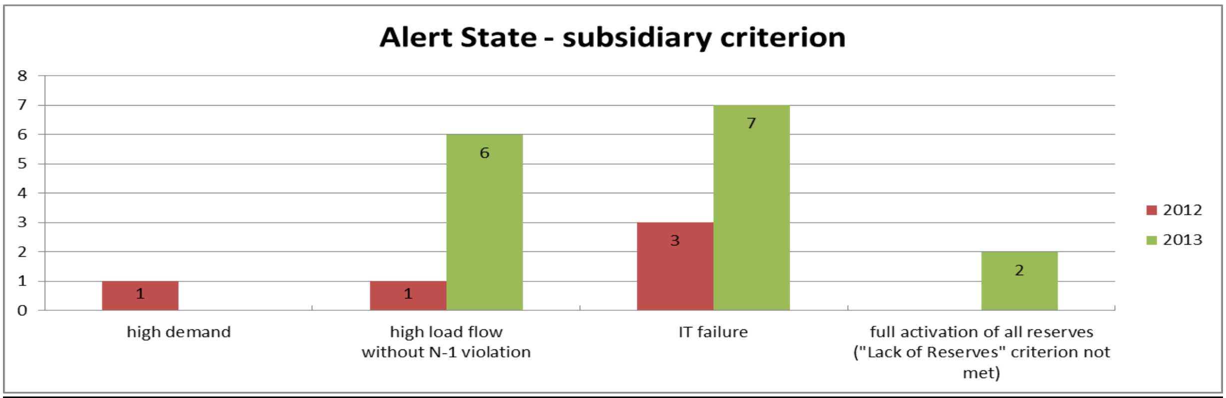
GRAPHIC 38: BALTIC - FINAL TRIPPING OF EQUIPMENT INCIDENTS

Four incidents have been reported on scale 1 by Baltic Synchronous Area in 2013. Those four incidents led to a reduction of exchange.
Compared to 2012 this is an increase of 50%. In all cases final tripping of equipment led to a reduction of exchange.

6.11 INCIDENTS FROM CONTINENTAL EUROPE

Alert State criterion

GRAPHIC 39: CONTINENTAL EUROPE - ALERT STATE CRITERION



GRAPHIC 40: CONTINENTAL EUROPE - ALERT STATE CRITERION – SUBSIDIARY CRITERIONS

The NC OS [5] defines the Alert State:

i. voltage and power flows are within their Operational Security Limits defined according to Articles 10 and 12 in accordance with Article 8(5); and

ii. at least one of the following conditions is fulfilled:

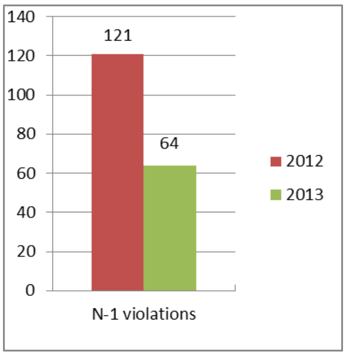
   a. Active Power Reserve requirements are not fulfilled with lack of more than 20% of the required amount of any of the following: FCR, FRR and RR according to the dimensioning in the [NC LFCR[7]], for more than 30 minutes and with no means to replace them;

   b. frequency is within the frequency limits for the Alert State as defined in [NC LFCR];

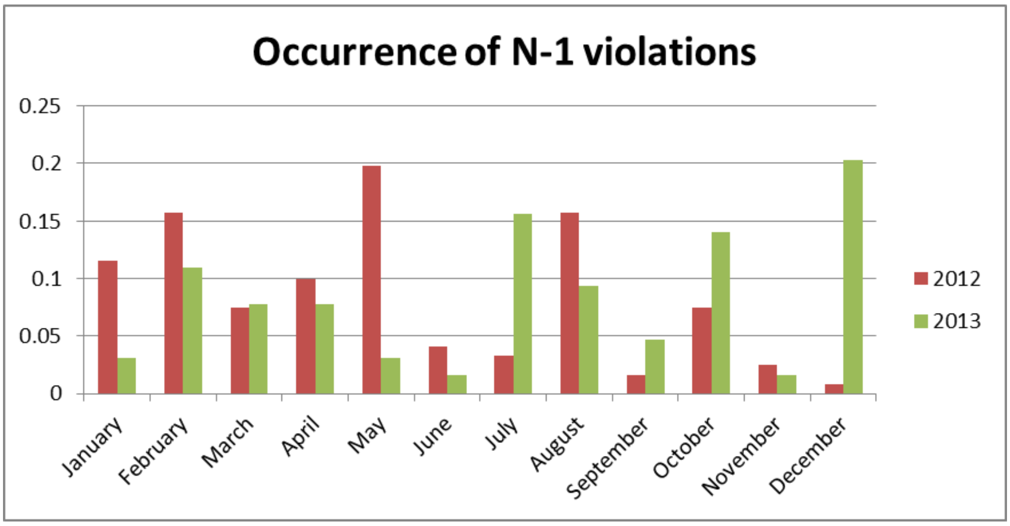
   c. at least one Contingency from the Contingency List defined according to Article 13 can lead to deviations from Operational Security Limits, even after effects of Remedial Actions;

In 2013 there were 15 declarations of "Alert State" as dominating criterion. Compared to 2012 the rate has tripled.
The main reasons in 2013 for declaring "Alert State" as dominating criterion were high load flows (without violating the N-1 criterion) and various IT-failures.
The Alert State in this report was based on operator judgment that Operational Security Limits were close to being breached. Going forward Alert States will only be reported when defined criterion have been breached.

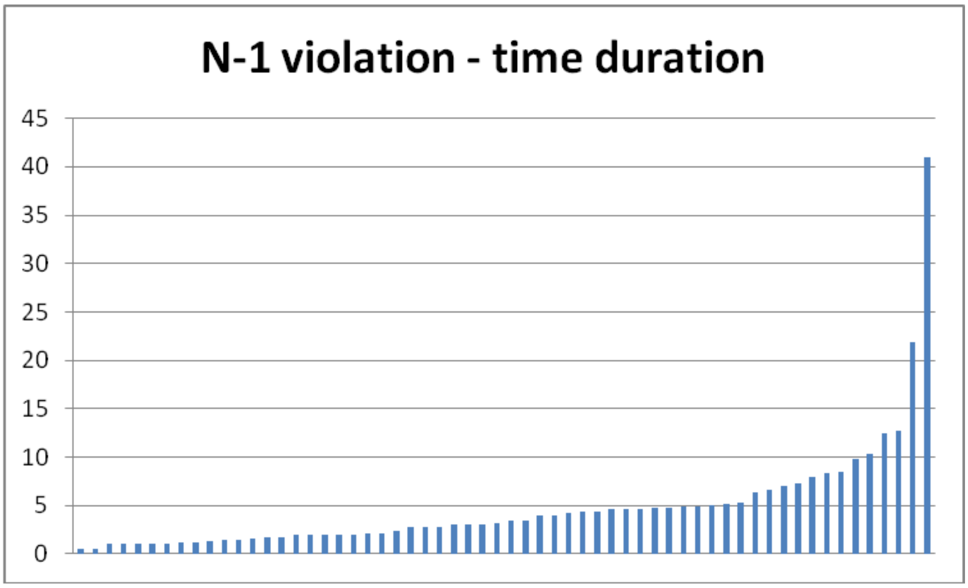
N-1 violation criterion



GRAPHIC 41: CONTINENTAL EUROPE - N-1 VIOLATION CRITERION



GRAPHIC 42: CONTINENTAL EUROPE - N-1 VIOLATION CRITERION – MONTH OF OCCURRENCE NORMALIZED WITH VIOLATIONS PER YEAR



GRAPHIC 43: CONTINENTAL EUROPE - N-1 VIOLATION CRITERION – TIME DURATION OF VIOLATIONS [h]

In 2013, 70% of the time N-1 violations occurred, an "Alert State" on the ENTSO-E Awareness System (EAS) was declared. Compared to 2012 this is an increase of 19%.

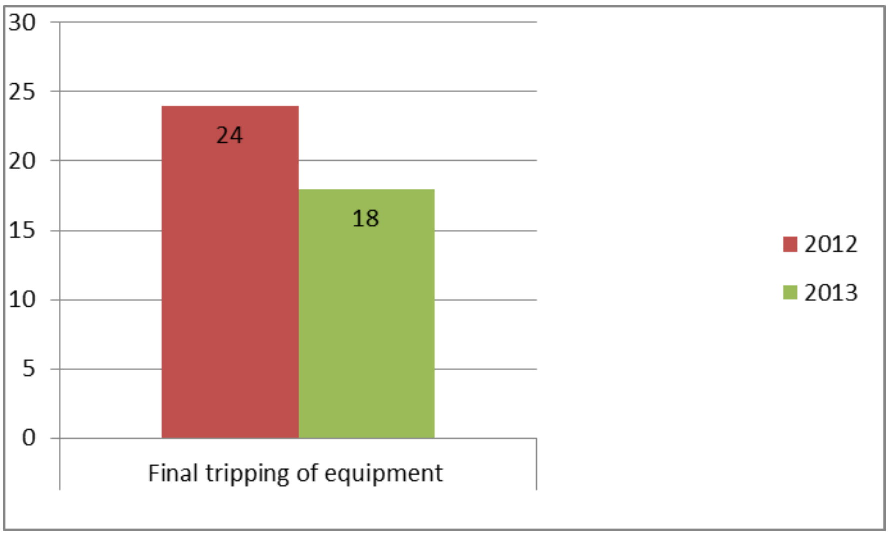
2013 unexpected load flows have been the main origin of N-1 violations (94%). On average the N-1 violations 2013 were resolved after 4 h and 51 min.

Comparison with 2012 shows a decrease of N-1 violations of about 47% (number of reports). One reason is the increased activation of redispatching both curative and preventative. Other reasons include the implementation of "virtual phase shifters" as well as the enhancements to TSO co-ordination and IDCF (Intraday Congestion Forecast) process. One approach to improving co-ordination is the development of RSCIs. The effect of increased co-ordination on reducing the number of incidents will be appraised year on year.

In 25 cases it was reported that redispatching was used to solve the N-1 violation.

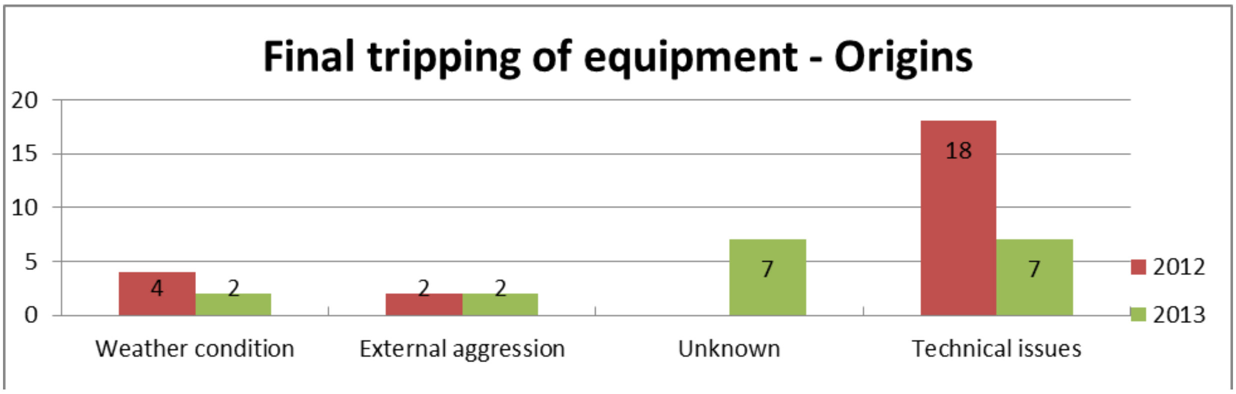
A detailed comparison between the years is not possible due to the big differences in the ICS – Methodology used in these years and connected with that the difference in the subsidiary criterion.

Final tripping of equipment criterion



Graphic 44: CONTINENTAL EUROPE - FINAL TRIPPING OF EQUIPMENT CRITERION

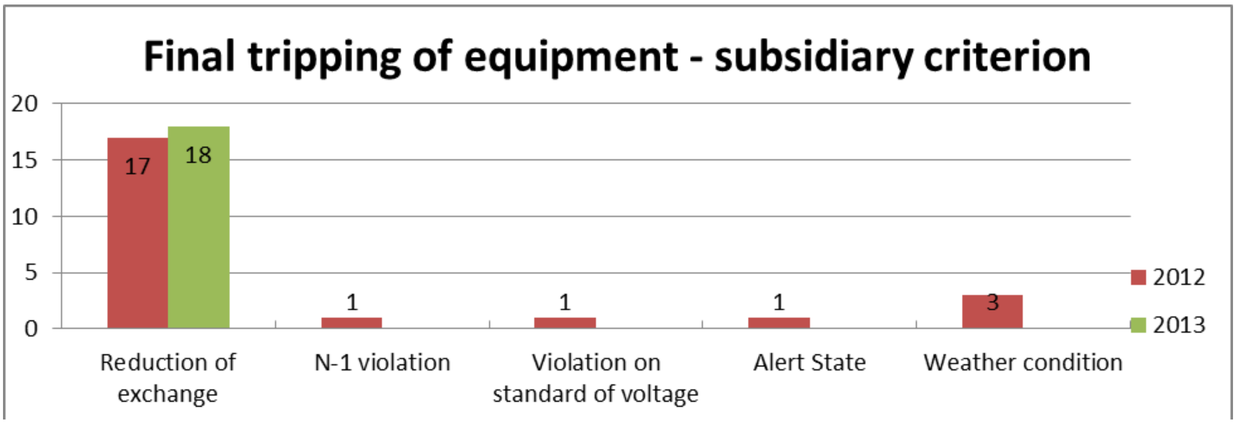
In 2013 there were 18 reported incidents with final tripping of equipment criterion, compared to the 24 incidents reported in 2012 there was a significant decrease in the number of incidents (25%) in 2013.



Graphic 45: CONTINENTAL EUROPE - FINAL TRIPPING OF EQUIPMENT CRITERION - ORIGINS

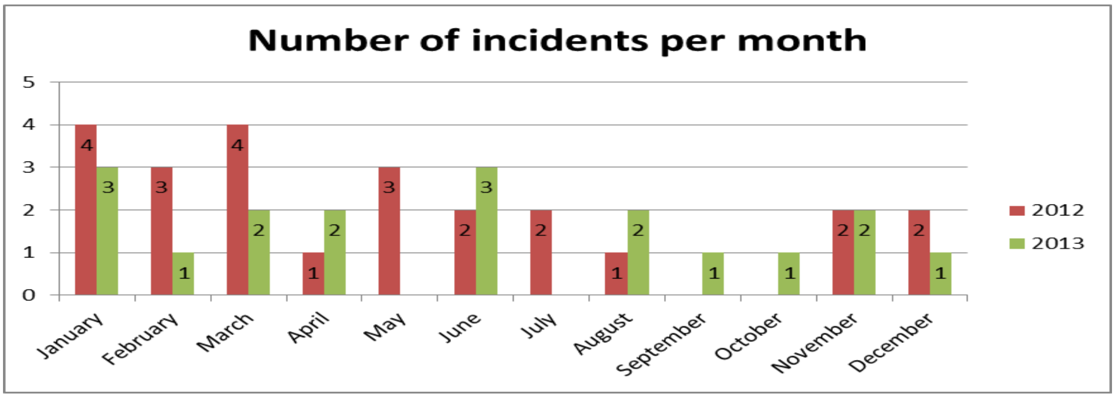
In 2012, 75% of the reported incidents are the consequence of technical issues, 17% are the consequence of weather condition and 8% are the consequence of external aggression.

In 2013, 38% of the reported incidents don't have the origin of fault and 62% of the reported incidents are consequence to weather conditions, external damages or technical issues.



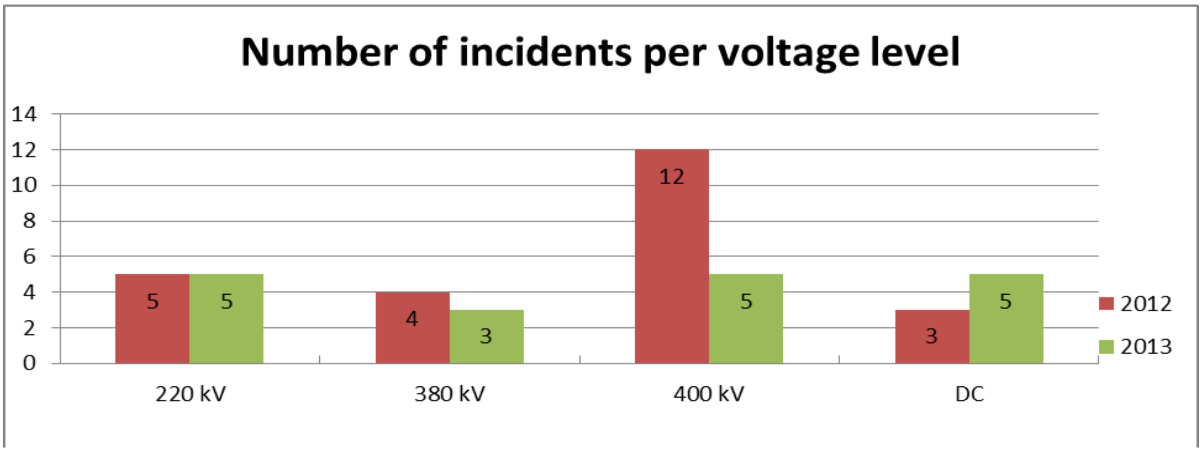
Graphic 46: CONTINENTAL EUROPE - FINAL TRIPPING OF EQUIPMENT CRITERION – SUBSIDIARY CRITERION

In 2013 there were 18 incidents that had, as a consequence, the reduction of the exchange capacity. Compared to 2012 we can observe a small increase, reported to the total number of incidents, 2013 didn't come with a progress, 100 % of incidents had, as an effect, the reduction of the exchange capacity.



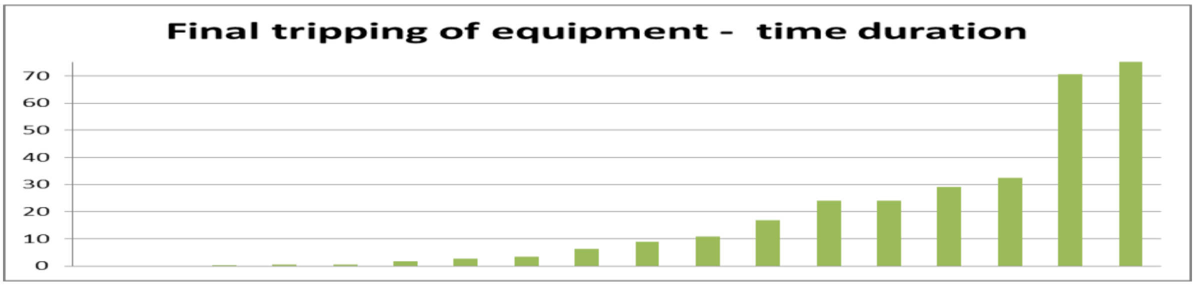
Graphic 47: CONTINENTAL EUROPE - FINAL TRIPPING OF EQUIPMENT CRITERION – OCCURRENCE PER MONTH

The graphic above shows the number of incidents recorded for each month of 2012 and 2013.



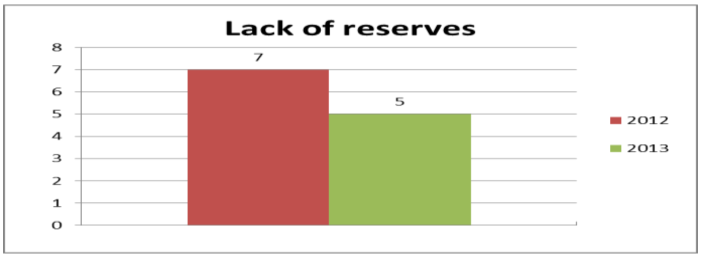
Graphic 48: CONTINENTAL EUROPE - FINAL TRIPPING OF EQUIPMENT CRITERION – OCCURRENCE PER VOLTAGE LEVEL

The graphic above shows the number of incidents recorded per voltage level for 2012 and 2013.



Graphic 49: **CONTINENTAL EUROPE - FINAL TRIPPING OF EQUIPMENT CRITERION 2013 – TIME DURATION [h]**

Lack of reserves



Graphic 50: Continental Europe - LACK OF RESERVES CRITERION

In 2013 there were 5 reported incidents with lack of reserves criterion, compared to 7 incidents reported in 2012. There was a decrease in the number of incidents (29%) in 2013. In 2013 all incidents were caused by wind forecasting inaccuracies.

Violation of standards on voltage

In 2013 there were no incidents with violation of standards on voltage criterion, compared to 26 incidents reported in 2012 *(Comment from 2012: 26 incidents have been registered. The origins are not recorded, but each TSO declared for all those incidents an "Alert State" on the ENTSO-E Awareness System.).* The significant decrease was caused mainly by changing of the methodology used for the events reporting.

Events on load

There were no incidents with events on load criterion both in 2013 and 2012.

Loss of generation criterion

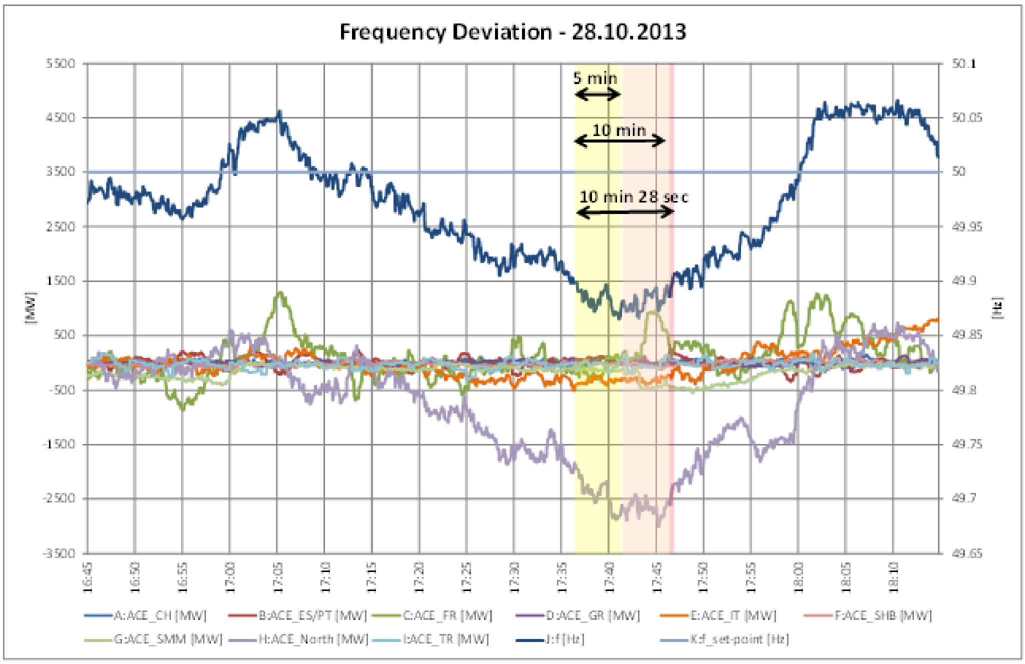
In 2013, no losses of generation above 1500 MW have been registered. This compared to 2 incidents in 2012.

Since no incidents of loss of generation occurred in 2013, it's not possible to assess the dimensioning of the Primary Reserve on this basis. However, after the 2 incidents of 2012 it was observed that the amount of Primary Reserve is sufficient to adequately prevent a large frequency drop.

Disturbance leading to frequency degradation

One scale 1 incident has been registered for 2013. In 2012, 10 frequency incidents were observed.

The incident occurred on 28th of October 2013 (see graphic 51) and had a minimum frequency of 49,864 Hz.



GRAPHIC 51: FREQUENCY INCIDENT 28/10/2013

Control Block Germany was the main contributor to the frequency deviation, with an ACE which decreased steadily from 17:18 approx., with a similar shape to the frequency deviation. It reached its minimum value of -3117 MW at 17:43. The calculated contribution of Germany to the frequency deviation is over 95% at the maximum frequency deviation time.

RTE stopped activation of 2000 MW of downward reserves at 17:45 in order to help support the frequency.

Reasons for the imbalance in Germany are low secondary reserves, long activation time for tertiary reserves due to grid congestions, and not enough power for the balancing of cross border redispatching measures. Besides, additional reported causes for the imbalance were a large amount of wind infeed (18-24 GW) with stormy weather, and the change from CEST to CET the day before, which caused unexpected imbalances from BRPs at the beginning of the twilight.

6.12 INCIDENTS FROM GREAT BRITAIN

Great Britain recorded five incidents on scale 1. All of these incidents involved loss of an HVDC interconnector between the Great Britain Synchronized Zone and the Continental Europe Synchronized Zone.

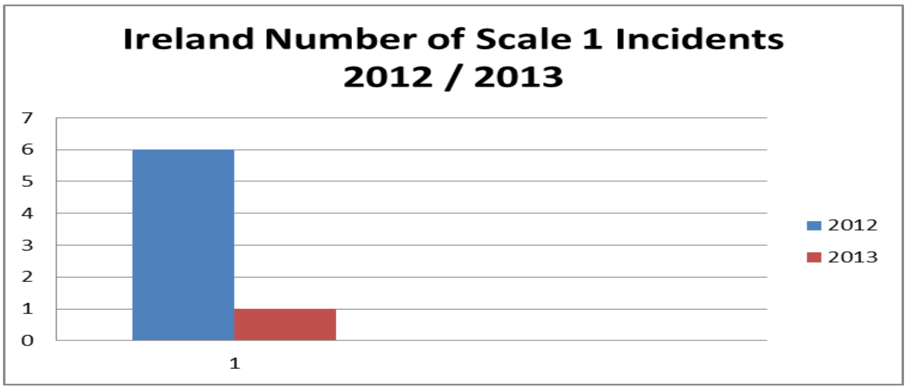
By design, a HVDC Interconnector facilitates inter-market power exchange between different Synchronized Zones. An unexpected loss of a HVDC Interconnector will have the consequence of impeding inter-market power exchange thus necessitating the loss to be reported as a Scale 1 incident. However, an isolated loss of a HV Interconnector would unlikely to cause an alert state within either Synchronized Zone.

HVDC Interconnectors are complex facilities connected to the extremities of a transmission network. This makes them prone to trip for a multitude of operational reasons. An example of this is where to protect the integrity of the transmission system many HVDC interconnectors are selectable to de-load or trip for the loss of transmission system elements. The TSOs at both ends of the HVDC Interconnector need to maintain operational security for all such incidents.

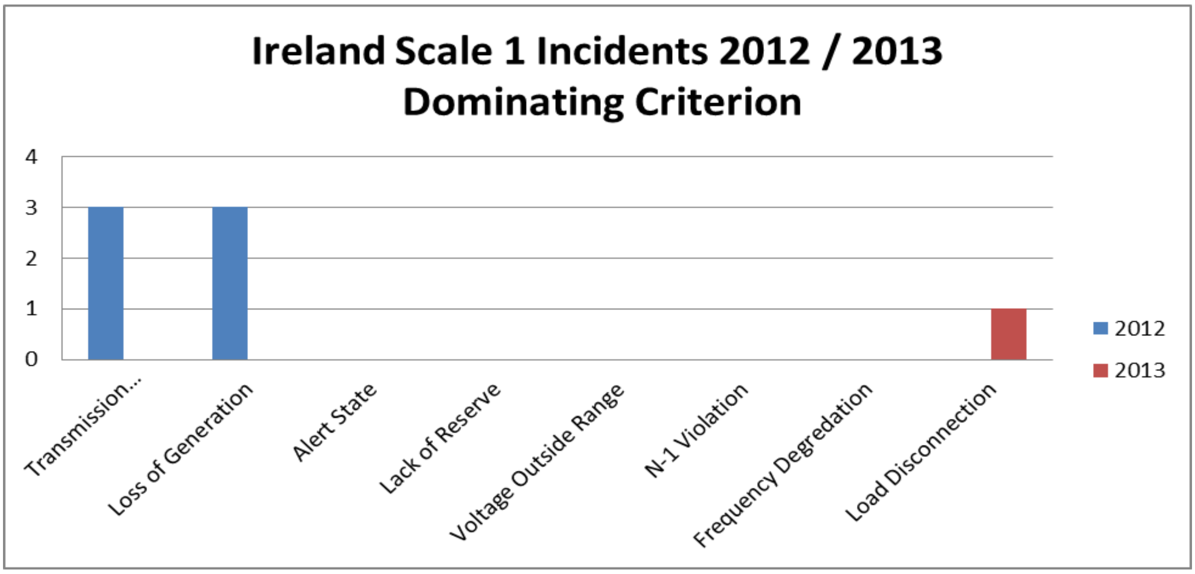
6.13 INCIDENTS FROM IRELAND

There was one recorded Scale 1 incident in Ireland in 2013. This compares with 6 such incidents in 2012.

The 2013 Scale 1 incident was a Load Disconnection (L1) in Northern Ireland. This occurred on the 23rd March 2013 and was due to final tripping of seven transmission lines caused by a combination of Snow & Ice Accretion and high winds. 442 MW of Load was disconnected for 14 minutes. The incident resulted in Energy Not Supplied (ENS) of 103 MWh and caused a maximum frequency deviation of 482 mHz.



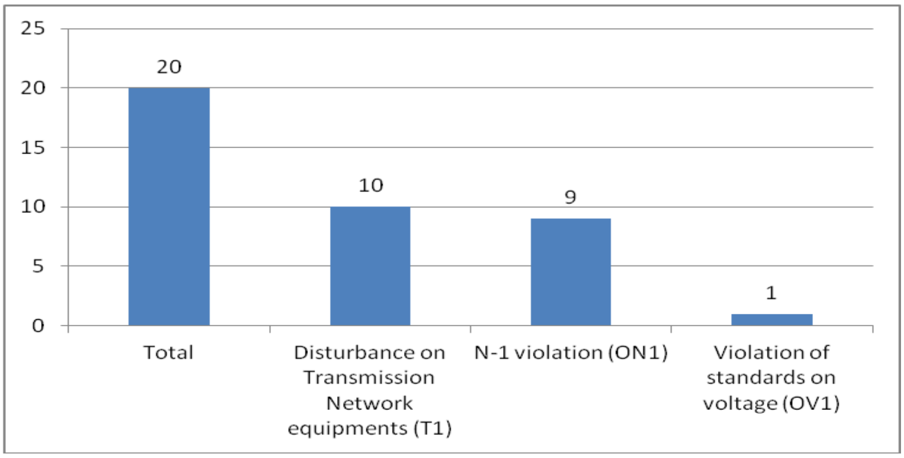
GRAPHIC 52: Ireland – 2012 / 2013 NUMBER OF SCALE 1 INCIDENTS



GRAPHIC 53: Ireland – 2012 / 2013 SCALE 1 INCIDENTS BY DOMINATING CRITERION

6.14 INCIDENTS FROM NORDIC

Nordic synchronous area recorded 20 incidents which belong to scale 1. 50% of the incidents are “final tripping of equipment”.



GRAPHIC 54: NORDIC – FINAL TRIPPING OF EQUIPMENT

All the “disturbance on transmission network equipment” incidents led to a reduction of exchange capacity.

The major part of the 10 events comes from problems with the HVDC-interconnection Fenno-Skan 1&2 (between Finland and Sweden) which existed through the whole winter period. This restricted import from Sweden to Finland, but did not endanger the system adequacy.

The N-1 violation situations are all due to unexpected load.

6.15 CONCLUSION

Synchronous Area Continental Europe concentrates 77% of the incidents (103 among 133 classified incidents).

Half of them are N-1 violation. The trend of 2012 is confirmed in 2013.

Continental Europe Synchronous Area had to face in 2013 (like in 2012) a large part of N-1 violation situation. Significant improvements to inter-TSO co-operation occurred in 2013 yet prevention of N-1 violation situations developing remains more challenging within synchronous areas containing multiple TSOs.

Nordic Synchronous Area had to face more N-1 violation situation in 2013 (9) compared to 2012 (only 1).

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7 CONCLUSION

TSOs reported 799 classified incidents in 2013, the second year of data collection and reporting.

The overall number of scale 0 incidents in 2013 (639) is broadly similar to the number in 2012 (666). When the proportion of each type is considered the numbers are again similar. Around 80% of the scale 0 incidents are due to a "disturbance on transmission network equipment" while the remaining (20%) incidents are due to "loss of generation".

For all Scale 0 incidents the system remained in the Normal State, (based of the system design criteria) during and after the incident. This was also the case in 2012.

In regard to the scale 1 incidents, the number decreased significantly between 2012 and 2013 (225 in 2012 and 133 in 2013). The proportion of N-1 violation is similar (around 55%), but in absolute terms the number decreased in 2013. One reason for this positive development is the increased activation of redispatching both curative and preventative. Other reasons include the implementation of phase shift transformers as well as the enhancements to TSO co-ordination and IDCF (Intraday Congestion Forecast) process. One example of improved co-ordination is the continuing development of RSCIs. The effect of increased co-ordination on reducing the number of N-1 violations will be appraised year by year.

For 2013, the time duration for which the system was outside the "normal state" is estimated to be 373 hours. This represents an average of 9 hours per year for each European TSO which is a small portion of the total year.
The system was outside the Normal State due to an N-1 violation estimated 300 hours (4h per N-1 incident in average at pan-European level). The trend of this indicator year by year will show the evolution of the system security in operation.

In 2013 there were indications of the effect of increased levels of renewable generation on reportable incidents. For the first time lack of reserve incidents caused by wind forecast errors were recorded.

The absence of incidents classified in scales 2 and 3 is an indication that overall the security of electricity supply was satisfactory throughout Europe. During this period, TSOs demonstrated high levels of co-ordination and co-operation enabling a highly stressed system with high cross-border flows and internal system constraints to be managed securely and efficiently. ENTSO-E recommends a continuation of the development of closer cooperation between the TSOs in order to improve transmission system operation and security.

Moreover, the occurrences of lack of reserve in 2013 due to errors in forecasting intermittent generation indicates the need for TSOs to continue improving forecasting tools.

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[2] ENTSO-E - Statistical Year Book 2011

[3] ENTSO-E - Summer Outlook Report 2013 and Winter Review 2012/2013

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[8] ENTSO-E – Load Frequency Control and Reserve Network Code

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