

LOAD-FREQUENCY CONTROL

Annual Report

2018



Executive Summary

According to Article 16 of the Commission Regulation (EU) 2017/1485 of 2 August 2017, establishing a guideline on electricity transmission system operation, transmission system operators [hereinafter TSOs] of each European Union Member State are obligated to provide ENTSO-E with the necessary data and information for the preparation and creation of the annual report on LFC [hereinafter: ALFC Report]. ENTSO-E is obligated to publish the annual report and the ALFC report for 2018 is the first publication of its kind.

All ENTSO-E member TSOs agreed to provide their data and information for the preparation of the ALFC Report and its publication. The objectives of the ALFC report are to present:

- (a) information (identification, graphical representation and associated monitors) for each synchronous area, LFC block and TSO of the five synchronous areas (Ireland/Northern Ireland; Great Britain; Nordic, Continental Europe and Baltic). Details are presented in Chapter 2, “Synchronous Areas, LFC Blocks and TSO Identification”;
- (b) results of the frequency quality evaluation criteria for each synchronous area and each LFC block. Details are presented in Chapter 3, “Frequency Quality Evaluation Criteria”;
- (c) description and date of implementation of any mitigation measures and ramping requirements to alleviate deterministic frequency deviations in which TSOs were involved during the preceding year. Details are presented in Chapter 3, “Frequency Quality Evaluation Criteria”; and
- (d) FCR obligation and the initial FCR obligation of each TSO covering each month of the preceding two years. Details are presented in Chapter 4, “FCR Data”.

The main conclusion is that for all reported data the synchronous areas frequency quality was within the defined levels. All LFC blocks and TSOs provided their data and have explained mitigation measures where applied.

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1. Introduction

Load-frequency control [hereinafter LFC] Annual Report is a requirement of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation [hereinafter SO GL].

Article 16 of SO GL sets the obligation on transmission system operators [hereinafter TSOs] of each European Union Member State to provide ENTSO-E with the necessary data and information for the preparation and creation of the annual report on LFC, and on ENTSO-E to publish the annual report.

All ENTSO-E member TSOs agreed to provide the necessary data and information for the preparation of annual LFC report and its publication. Each annual report is approved separately by System Operations Committee for publication.

The objectives of the LFC report are to represent results of the frequency quality evaluation criteria for each synchronous area and each LFC block and the FCR obligation and the initial FCR obligation of each TSO covering each month of preceding two years, as well as a description and date of implementation of any mitigation measures and ramping requirements to alleviate deterministic frequency deviations in which TSOs were involved during the last preceding year.

The annual report on load-frequency control includes the information listed in SO GL Article 16 (2) for each synchronous area, LFC block and TSO of ENTSO-E.

2. Synchronous Areas, LFC Blocks and TSO Identification

In this paragraph, the SO GL Article 16. 2. (a), (b) and (c) requirements are reported with the goal of identifying the LFC blocks, LFC areas and monitoring areas in the ENTSO-E. The location of each member state in relation to the European synchronous areas and LFC blocks is also reported.

The five synchronous areas included in this document are Continental Europe, Nordic, Great Britain, Ireland and Northern Ireland and Baltic as shown in Tables 1-5 and graphically in Figure 1 below. Each LFC block and LFC block monitor are reported in Tables 1-5. TSOs acronyms are explained in Appendix A. For the Baltic synchronous area data collection process is not performed. The Baltic States power system is currently asynchronously connected to Continental Europe through LitPol Link between Lithuania and Poland and to the Nordic Synchronous Area through NordBalt between Lithuania and Sweden and Estlink 1 and 2 between Estonia and Finland. The Baltic synchronisation with Continental Europe is part of the EU Energy Union strategy and will provide for the Baltic TSOs to operate their systems under the frequency of the Continental European System and under the EU rules.

European Synchronous Areas and LFC Blocks

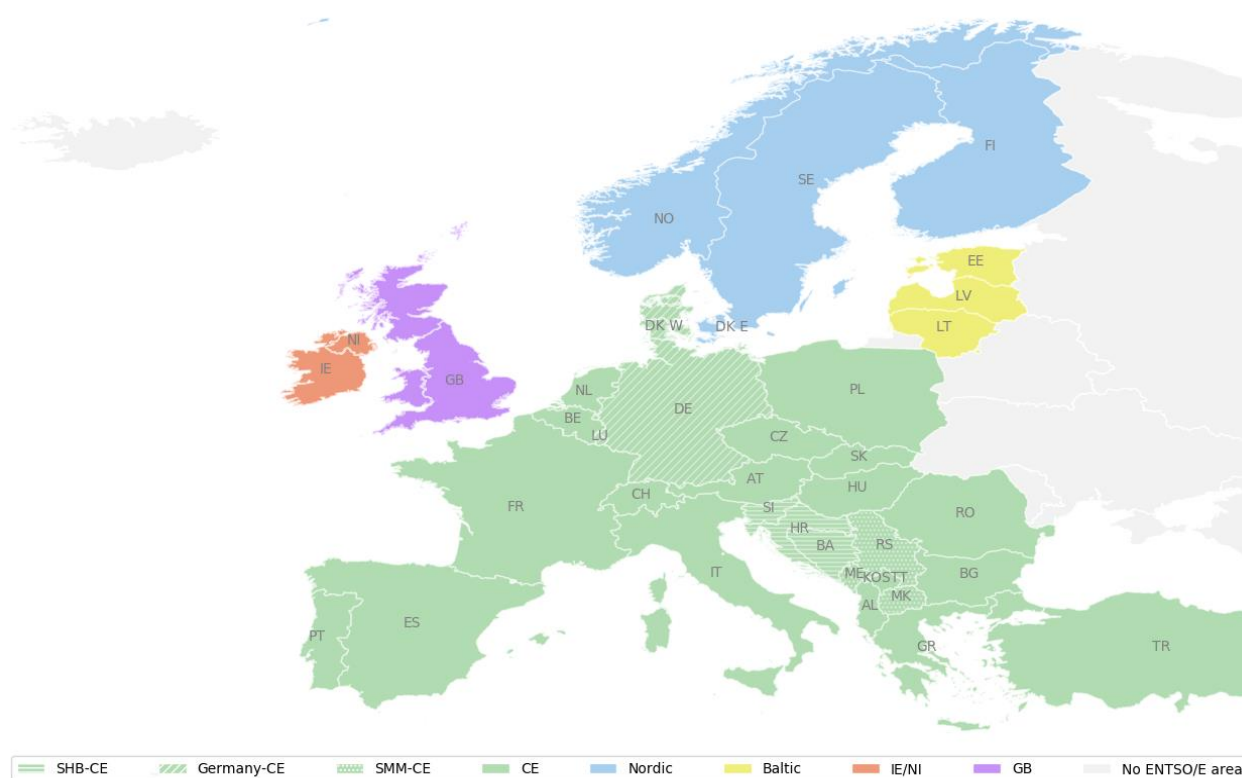


Figure 1 European Synchronous Areas and LFC Blocks

According to Article 133 of SO GL, all TSOs of a synchronous area shall appoint one TSO of that synchronous area in the synchronous area operational agreement as the synchronous area monitor. The synchronous area monitor shall implement the data collection and delivery process of the synchronous area referred to in Article 132 of SO GL, and implement the criteria application process referred to in Article 129 of SO GL.

Furthermore, the synchronous area monitor shall collect the frequency quality evaluation data of its synchronous area and perform the criteria application process, including the calculation of the frequency quality evaluation criteria, once every 3 months and within 3 months after the end of the analyzed period.

According to Article 118 of SO GL, the following synchronous areas and associated monitors are:

- Swissgrid (south CE), Amprion (north CE),
- Statnett SF-SN (Nordic),
- National Grid ESO - NGENSO (Great Britain),
- EirGrid (Ireland and Northern Ireland).

Table 1 Continental Europe SA identification of LFC blocks

LFC Block	LFC Area	LFC Block Monitor	Country
OST	OST	OST	Albania
APG	APG	APG	Austria
SHB	NOS BIH, HOPS, ELES	ELES	Bosnia and Herzegovina, Croatia, Slovenia
ELIA	ELIA	ELIA	Belgium
ESO	ESO	ESO	Bulgaria
SG	SG	SG	Switzerland
CEPS	CEPS	CEPS	Czech Republic
Germany	TNG+TTG+AMP+50HZT+EN+CREOS	Amprion	Germany, Denmark-West(EN), Luxembourg(CREOS)
REE	REE	REE	Spain
RTE	RTE	RTE	France
IPTO	IPTO	IPTO	Greece
MAVIR	MAVIR	MAVIR	Hungary
TERNA	TERNA	TERNA	Italy
SMM	CGES, MEPSO, EMS	EMS	Montenegro, North Macedonia, Serbia
TTB	TTB	TTB	The Netherlands
PSE	PSE, Western WPS	PSE	Poland
REN	REN	REN	Portugal
TEL	TEL	TEL	Romania
SEPS	SEPS	SEPS	Slovak Republic
TEIAS	TEIAS	TEIAS	Turkey

Table 2 GB SA identification of LFC blocks

LFC Block	LFC Area	LFC Block Monitor	Country
GB	NGESO	NGESO	Great Britain

Table 3 IE/NI SA identification of LFC blocks

LFC Block	LFC Area	LFC Block Monitor	Country
EirGrid+SONI	EirGrid+SONI	EirGrid	Ireland and Northern Ireland

Table 4 Nordic identification of LFC blocks

LFC Block	LFC Area	LFC Block Monitor	Country
Nordic	NO1, NO2, NO3, NO4, NO5, SE1, SE2, SE3, SE4, EN, FG	SN	Norway, Sweden, Finland, Denmark-East

Table 5 Baltic identification of LFC blocks

LFC Block	LFC Area	LFC Block Monitor	Country
Baltic	Baltic	Baltic	Estonia, Latvia, Lithuania

3. Frequency Quality Evaluation Criteria

A. Introduction and target parameters

For keeping the power system frequency within secure limits, TSOs shall maintain the balance between load and generation on a short-term basis. The first step of balancing actions is application of Frequency Containment Reserves [hereinafter FCR]. These reserves are activated fast (typically within 30s), and they stabilize the power system frequency and make sure that the frequency deviation will not further increase. The Frequency Containment Process [hereinafter FCP] will stabilize the frequency with an offset from 50 Hz, but in reality, it is the change of speed of the rotating masses, inertia, that ensures the frequency change is damped so FCR is able to contain and stabilize the frequency at a value close to 50 Hz. The second step is assigned to Frequency Restoration Reserves [hereinafter FRR] which replace FCR and restore the frequency to the target frequency. SO GL defines two type of FRR: automatic (aFRR) and manual (mFRR). FRR is activated by an automatic control device and/or by manual activation which reduces the Frequency Restoration Control Error [hereinafter FRCE] to zero value. Usually, this control device for aFRR is called Load-Frequency Controller [hereinafter LF-Controller]. The LF-Controller is physically a process computer that is implemented in the TSOs' control center systems (SCADA/EMS/AGC) and collects FRCE measurements every 4-10s and provides - in the same time cycle – automated instructions to balancing service providers that are connected by data communication links. The Frequency Restoration Process [hereinafter FRP], aFRR and/or mFRR, will restore frequency by replacing the power from the FCR. This principle is applicable for normal imbalances like the switching on of a light bulb, the start of a train or the sudden outage of a large power plant. Market behavior like the stop and start of production units at hour shift will also create a power imbalance and result in frequency deviations.

All frequency deviations are recorded carefully for further analyses. SO GL defines processes for the calculation and the evaluation of frequency data and the required parameters for each synchronous area and each LFC block (defined in SO GL in Articles 127 – 131, and in Annex III-V) are presented below in Tables 6 and 7 below.

Table 6 Frequency quality defining parameters of synchronous areas

Data item	CE	GB	IE/NI	Nordic
Standard frequency range	± 50 mHz	± 200 mHz	± 200 mHz	± 100 mHz
Maximum instantaneous frequency deviation	800 mHz	800 mHz	1000 mHz	1000 mHz
Maximum steady-state frequency deviation	200 mHz	500 mHz	500 mHz	500 mHz
Time to recover frequency	Not used	1 minute	1 minute	Not used
Frequency recovery range	Not used	± 500 mHz	± 500 mHz	Not used
Time to restore frequency	15 minutes	15 minutes	15 minutes	15 minutes
Frequency restoration range	Not used	± 200 mHz	± 200 mHz	± 100 mHz
Alert state trigger time	5 minutes	10 minutes	10 minutes	5 minutes

Table 7 Frequency quality target parameters of synchronous areas

Data item	CE	GB	IE/NI	Nordic
Maximum number of minutes outside the standard frequency range	15 000	15 000	15 000	15 000

Taking into account above mentioned for each synchronous area during operation in normal state or alert state, on a monthly basis, for the instantaneous frequency data following values are reported:

- (i) the mean value;
- (ii) the standard deviation;
- (iii) the 1-,5-,10-, 90-,95- and 99-percentile;
- (iv) the total time in which the absolute value of the instantaneous frequency deviation was larger than the standard frequency deviation, distinguishing between negative and positive instantaneous frequency deviations;
- (v) the total time in which the absolute value of the instantaneous frequency deviation was larger than the maximum instantaneous frequency deviation, distinguishing between negative and positive instantaneous frequency deviations;
- (vi) the number of events in which the absolute value of the instantaneous frequency deviation of the synchronous area exceeded 200 % of the standard frequency deviation and the instantaneous frequency deviation was not returned to 50 % of the standard frequency deviation for the CE synchronous area and to the frequency restoration range for the GB, IE/NI and Nordic synchronous areas, within the time to restore frequency. The data are distinguished between negative and positive frequency deviations;
- (vii) for the GB and IE/NI synchronous areas, the number of events for which the absolute value of the instantaneous frequency deviation was outside of the frequency recovery range and was not returned to the frequency recovery range within the time to recover frequency, distinguishing between negative and positive frequency deviations;

For LFC blocks from CE and Nordic following data are reported:

(i) for a data-set containing the average values of the FRCE of the LFC block over time intervals equal to the time to restore frequency:

- the mean value,
- the standard deviation,
- the 1-,5-,10-, 90-,95- and 99-percentile,
- the number of time intervals in which the average value of the FRCE was outside the Level 1 FRCE range, distinguishing between negative and positive FRCE, and — the number of time intervals in which the average value of the FRCE was outside the Level 2 FRCE range, distinguishing between negative and positive FRCE;

(ii) for a data-set containing the average values of the FRCE of the LFC block over time intervals with a length of one minute: the number of events on a monthly basis for which the FRCE exceeded 60 % of the reserve capacity on FRR and was not returned to 15 % of the reserve capacity on FRR within the time to restore frequency, distinguishing between negative and positive FRCE (the calculation procedures of these target parameters are set in both the Nordic and the Continental Europe Synchronous Area Operational Agreements). The objective behind the Level 1 and Level 2 parameters is to provide quality targets for the individual FRCE quality of each LFC block. Since it is the responsibility of each TSO in its LFC block to keep FRCE as low as possible, the level 1 and level 2 parameters must not be exploited in order to reduce reserves or reserves activation. These parameters should rather be interpreted as an absolute warning limit that shows that quality of ACE is below the required standard and that respective countermeasures have been reported and will be implemented urgently.

For the LFC blocks of the GB and IE/NI synchronous area, during operation in normal state or alert state in accordance with Article 18(1) and (2), following data are presented; on a monthly basis and for a data-set containing the average values of the FRCE of the LFC block over time intervals with a length of one minute: the number of events for which the absolute value of the FRCE exceeded the maximum steady-state frequency deviation and the FRCE was not returned to 10 % of the maximum steady-state frequency deviation within the time to restore frequency, distinguishing between negative and positive FRCE.

B. Performance – IE/NI

a. Ireland/Northern Ireland Synchronous Area Performance

In the following tables and figures data for 2017 & 2018 for IE/NI synchronous area are presented. Input values for frequency are based on an instantaneous frequency values. Based on input values; mean value, standard deviation and percentiles were calculated. Moreover, time periods and events when system frequency was outside of predefined ranges were also notified. For data when frequency was outside 200/1000 mHz time is measured in minutes time scale.

Table 8 IE/NI SA Performance for Year 2017

2017												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	50,0002	49,9999	49,9999	49,9998	50,0007	49,9998	50,0004	50,0001	50,0001	49,9999	50,0002	49,9998
The standard deviation	0,0377	0,041	0,0403	0,0354	0,0341	0,0371	0,035	0,0357	0,0391	0,0399	0,038	0,0382
1-percentile	49,917	49,908	49,914	49,92	49,923	49,917	49,923	49,92	49,914	49,914	49,916	49,912
5-percentile	49,939	49,933	49,935	49,942	49,946	49,938	49,943	49,943	49,938	49,936	49,938	49,937
10-percentile	49,952	49,947	49,947	49,955	49,957	49,952	49,955	49,955	49,951	49,949	49,95	49,95
90-percentile	50,047	50,052	50,051	50,043	50,042	50,046	50,045	50,045	50,049	50,051	50,047	50,047
95-percentile	50,06	50,065	50,064	50,056	50,055	50,059	50,055	50,058	50,063	50,065	50,06	50,061
99-percentile	50,085	50,09	50,087	50,083	50,081	50,083	50,076	50,081	50,087	50,091	50,085	50,086
Time > 200 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < -200 mHz	0	3	0	1	0	1	0	6	9	2	1	0
Time > 1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < -1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev > 400 and > 200 mHz within 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev < -400 and < -200 mHz within 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev > 500 mHz and > 1 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev < -500 mHz and > 1 min	0	0	0	0	0	0	0	0	1	0	0	0

Table 9 IE/NI SA Performance for Year 2018

2018												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	50,0003	50,0004	49,9995	50,0005	49,9997	50,0005	50,0002	49,9998	50,0007	49,9996	50,0001	50,0003
The standard deviation	0,0396	0,0411	0,0351	0,037	0,0354	0,0346	0,0355	0,0388	0,0402	0,0423	0,0422	0,0419
1-percentile	49,916	49,907	49,924	49,918	49,92	49,919	49,921	49,914	49,911	49,91	49,91	49,909
5-percentile	49,938	49,933	49,943	49,941	49,943	49,943	49,941	49,937	49,936	49,933	49,934	49,935
10-percentile	49,95	49,947	49,955	49,953	49,955	49,956	49,953	49,95	49,949	49,947	49,947	49,948
90-percentile	50,051	50,052	50,045	50,049	50,044	50,044	50,045	50,05	50,052	50,056	50,056	50,055
95-percentile	50,066	50,066	50,057	50,062	50,057	50,055	50,055	50,063	50,066	50,071	50,071	50,07
99-percentile	50,093	50,093	50,081	50,086	50,083	50,077	50,077	50,088	50,091	50,096	50,097	50,097
Time > 200 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < -200 mHz	3	0	0	0	0	0	0	2	1	0	3	5
Time > 1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < -1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev > 400 and > 200 mHz within 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev < -400 and < -200 mHz within 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev > 500 mHz and > 1 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev < -500 mHz and > 1 min	0	0	0	0	0	0	0	0	0	0	0	0

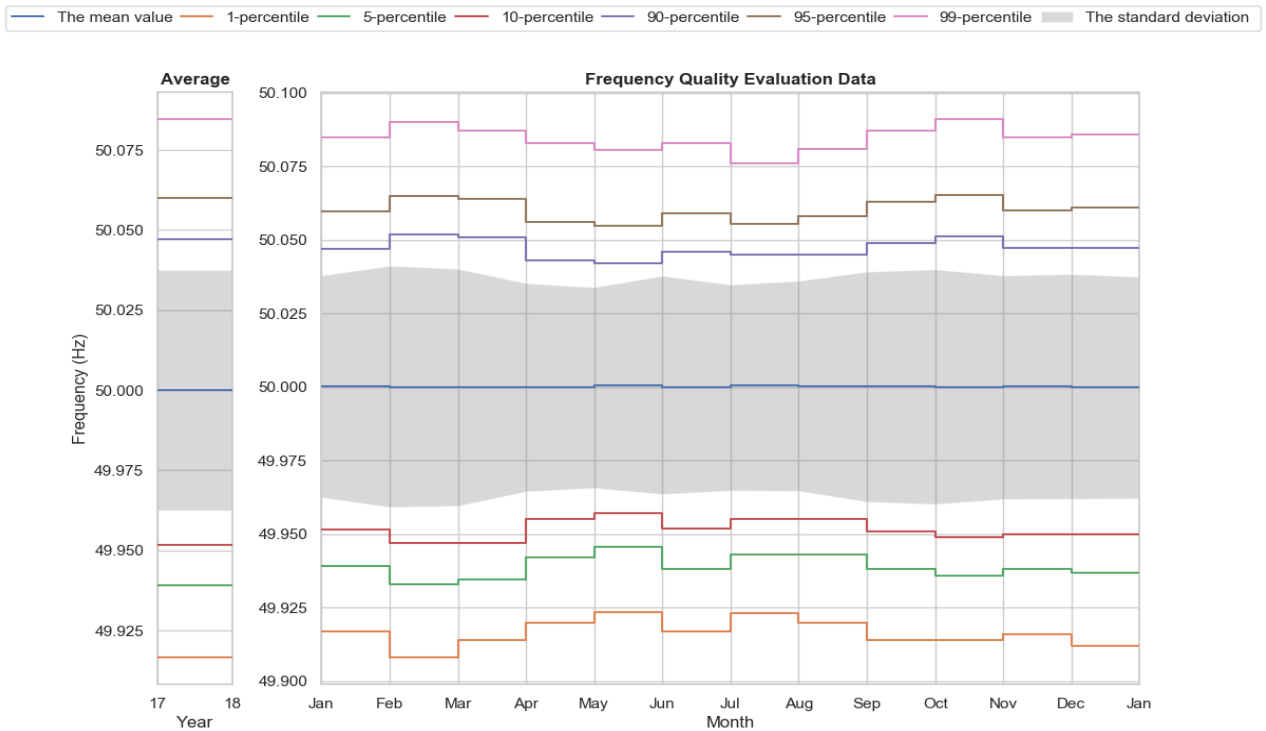


Figure 2 IE-NI SA 2017 frequency quality

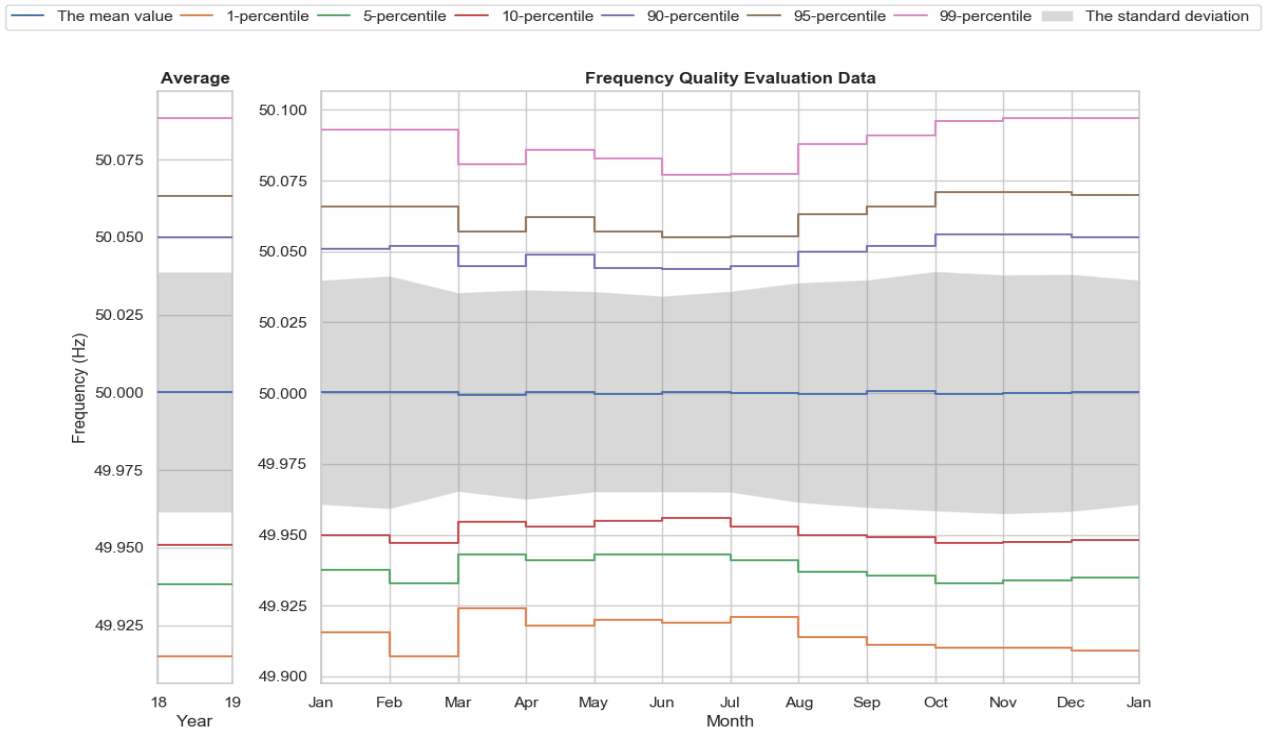


Figure 3 IE-NI SA 2018 frequency quality

In Figures 4-5 accumulated minutes outside standard ranges are presented for the Years 2017 and 2018.

Red line shows theoretical line in case of linear distribution (1/12 per month) of minutes outside standard range taking into account standard range from SO GL (15 000 minutes).

Black line shows accumulated minutes outside standard ranges per month for synchronous area. In case that black line is higher than red line at the end of the Year this indicate that synchronous area did not meet Frequency Quality Parameters.

Graph below shows that, for Synchronous Area Ireland/ Northern Ireland Frequency Quality target parameters from SO GL were fulfilled for respective years.

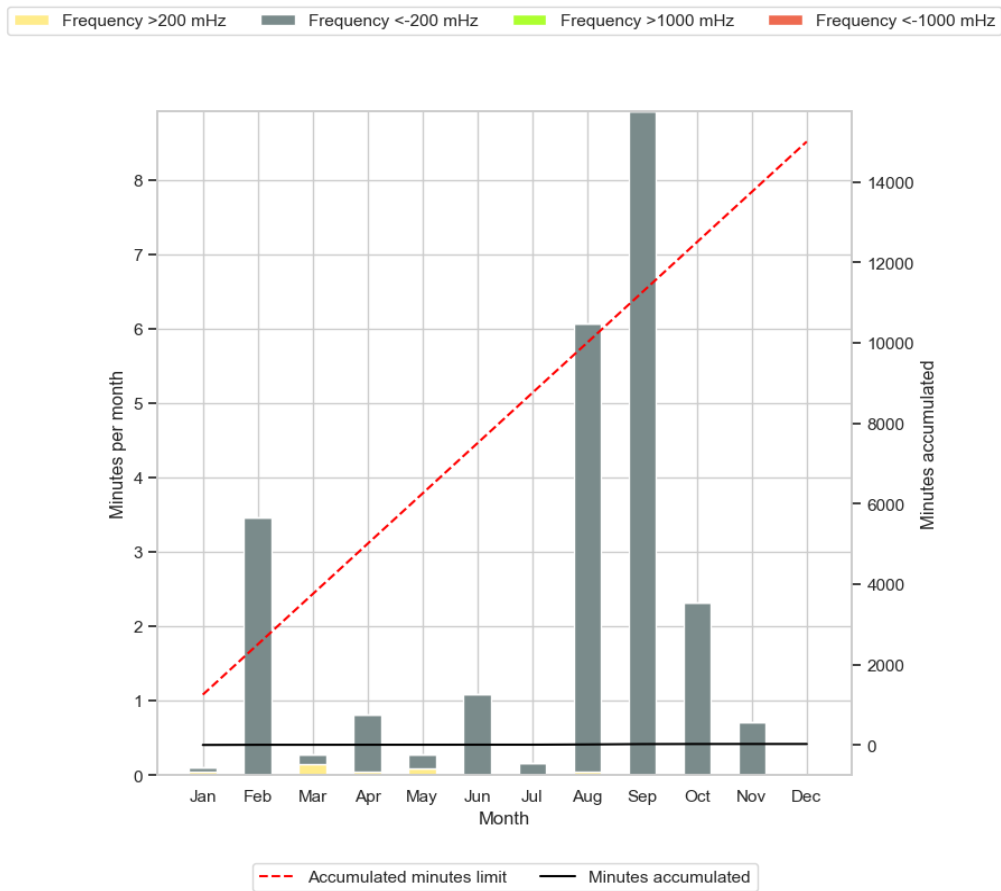


Figure 4 IE-NI SA 2017 frequency deviation

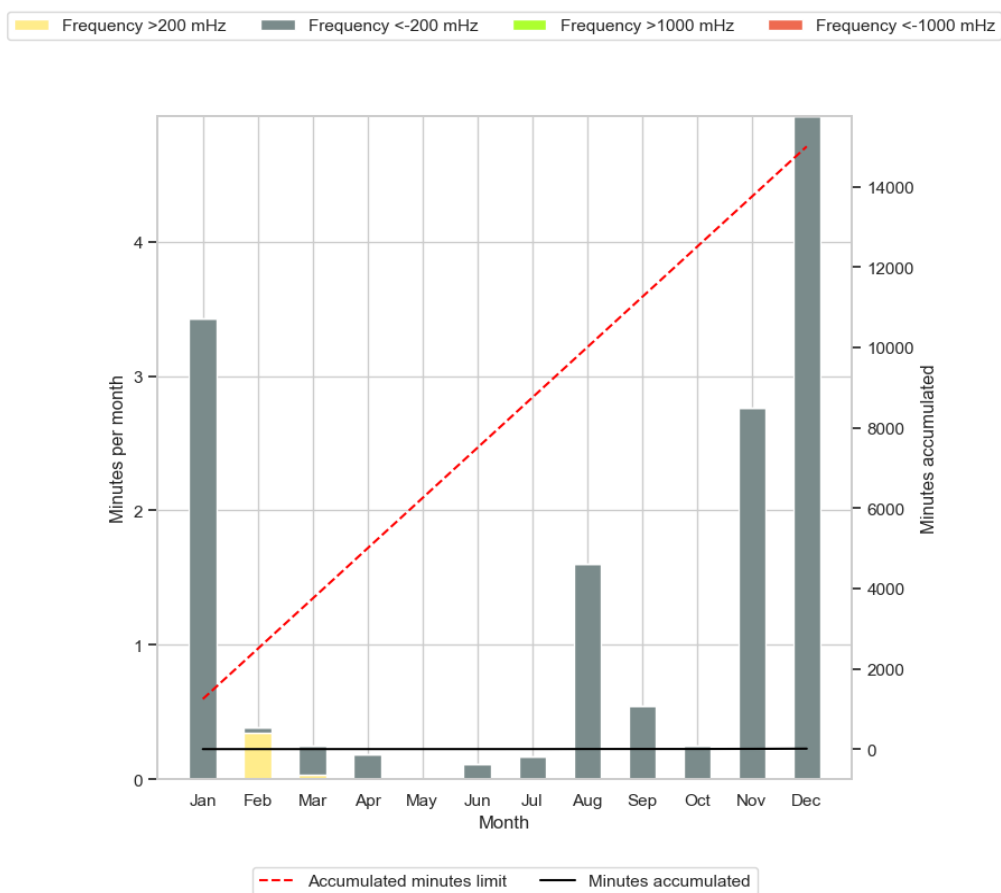


Figure 5 IE-NI SA 2018 frequency deviation

b. IE/NI Synchronous Area LFC Block Performance

Tables 10 and 11 show that there were not events when FRCE values were higher than 500 mHz or lower than -500 mHz and FRCE values were not returned to 50 mHz, or -50 mHz, respectively during time to restore frequency which corresponds to 15 minutes.

Table 10 IE/NI LFC FRCE Statistic for Year 2017

2017												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of events: FRCE > 500 mHz and > 50 mHz after 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events: FRCE < -500 mHz and < -50 mHz after 15 min	0	0	0	0	0	0	0	0	0	0	0	0

Table 11 IE/NI LFC FRCE Statistic for Year 2018

2018												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of events: FRCE > 500 mHz and > 50 mHz after 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events: FRCE < -500 mHz and < -50 mHz after 15 min	0	0	0	0	0	0	0	0	0	0	0	0

Additionally, the synchronous areas of GB and IE/NI are each required to report the number of time intervals outside Level 1 and Level 2 FRCE ranges over the course of one year which is presented in Table 12. The time intervals are aligned with SO GL, Annex III, Table 1. The number of time intervals are calculated using the following procedure:

1. Where frequency deviation is ≥ 200 mHz over a 15 minutes period or ≤ -200 mHz over a 15 minutes period; this qualifies as a Level 1 event.
2. Where frequency deviation is ≥ 500 mHz over a 1 minute period or ≤ -500 mHz over a 1 minute period; this qualifies as a Level 2 event.
3. The Level 1 FRCE target parameter = 3%, which is 35 040 (periods) \times 0.03 = 1 051 periods.
4. The Level 2 FRCE target parameter = 1%, which is 525 600 (periods) \times 0.01 = 5 256 periods.
5. The number of Level 1 periods calculated in step 1 must be less than or equal to 1 051.
6. The number of Level 2 periods calculated in step 3 must be less than or equal to 5 256.

Table 12 IE/NI LFC Number of Time Intervals Outside Range for Years 2017 and 2018

Data item	2017	2018
Number of time intervals outside Level 1 FRCE	0	0
Number of time intervals outside Level 2 FRCE	1	0

C. Performance – GB

a. Great Britain Synchronous Area Performance

In the following tables and figures data for 2017 and 2018 for Great Britain synchronous area are presented. Input values for frequency are based on an instantaneous frequency values. Based on input values; mean value, standard deviation and percentiles were calculated. Moreover, time periods and events when system frequency was outside of predefined ranges were also notified. For data when frequency was outside 200 and 800 mHz time is measured in minutes time scale.

Table 13 GB SA Performance for Year 2017

2017												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	49,99979	49,99969	49,99969	49,99954	49,99944	49,99973	49,99984	49,9997	49,99991	49,99985	49,99991	49,99979
The standard deviation	0,0573	0,063	0,0615	0,0576	0,0572	0,0586	0,0584	0,0596	0,0606	0,065	0,0622	0,0605
1-percentile	49,874	49,866	49,867	49,873	49,877	49,877	49,874	49,869	49,873	49,861	49,862	49,87
5-percentile	49,909	49,901	49,903	49,908	49,91	49,91	49,909	49,906	49,907	49,899	49,9	49,905
10-percentile	49,928	49,92	49,922	49,928	49,928	49,928	49,927	49,926	49,925	49,919	49,921	49,922
90-percentile	50,075	50,083	50,081	50,075	50,075	50,079	50,077	50,079	50,081	50,086	50,082	50,08
95-percentile	50,096	50,106	50,104	50,096	50,095	50,101	50,098	50,101	50,104	50,11	50,103	50,102
99-percentile	50,136	50,151	50,145	50,137	50,136	50,141	50,139	50,142	50,144	50,158	50,145	50,14
Time > 200 mHz	24	31	29	11	11	9	17	21	24	78	21	18
Time < -200 mHz	7	7	6	3	5	0	3	4	5	19	7	8
Time > 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < -800 mHz	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev > 400 and > 200 mHz within 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev < -400 and < -200 mHz within 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev > 500 mHz and > 1 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev < -500 mHz and > 1 min	0	0	0	0	0	0	0	0	0	0	0	0

Table 14 GB SA Performance for Year 2018

2018												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	49,99828	49,99904	49,99841	50,00067	49,99877	50,00058	49,99939	49,99989	49,99936	50,00064	49,99939	50,00008
The standard deviation	0,0631	0,0666	0,0666	0,0655	0,0611	0,0651	0,0662	0,0666	0,0685	0,0692	0,0701	0,0655
1-percentile	49,867	49,86	49,86	49,862	49,875	49,87	49,86	49,86	49,855	49,852	49,85	49,86
5-percentile	49,9	49,897	49,897	49,9	49,907	49,902	49,897	49,895	49,892	49,89	49,887	49,895
10-percentile	49,92	49,917	49,917	49,92	49,925	49,92	49,917	49,915	49,912	49,912	49,91	49,915
90-percentile	50,082	50,09	50,087	50,087	50,082	50,087	50,087	50,085	50,09	50,09	50,092	50,085
95-percentile	50,105	50,112	50,112	50,11	50,105	50,11	50,11	50,107	50,112	50,112	50,115	50,105
99-percentile	50,145	50,155	50,157	50,152	50,145	50,152	50,15	50,15	50,155	50,152	50,152	50,145
Time > 200 mHz	29	47	62	37	17	25	28	32	34	35	45	26
Time < -200 mHz	6	11	6	5	5	7	14	12	9	19	22	14
Time > 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < -800 mHz	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev > 400 and > 200 mHz within 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev < -400 and < -200 mHz within 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev > 500 mHz and > 1 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. dev < -500 mHz and > 1 min	0	0	0	0	0	0	0	0	0	0	0	0

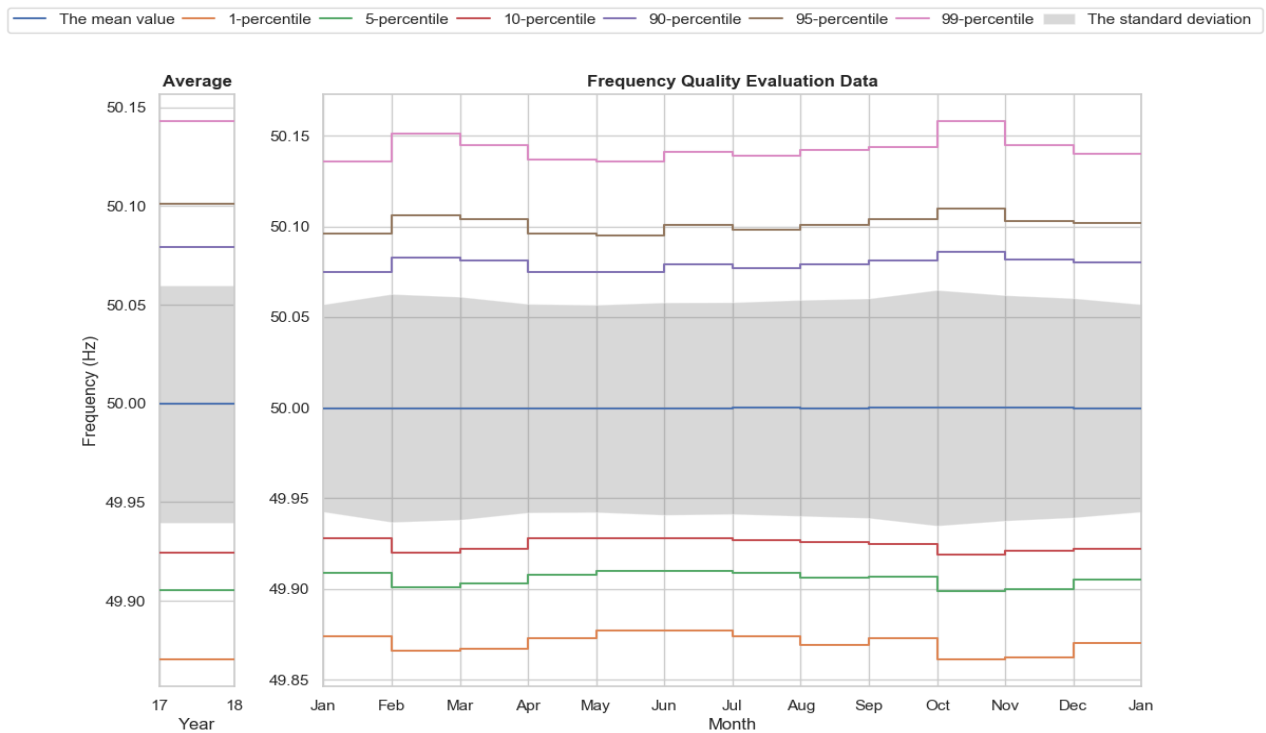


Figure 6 GB SA 2017 frequency quality

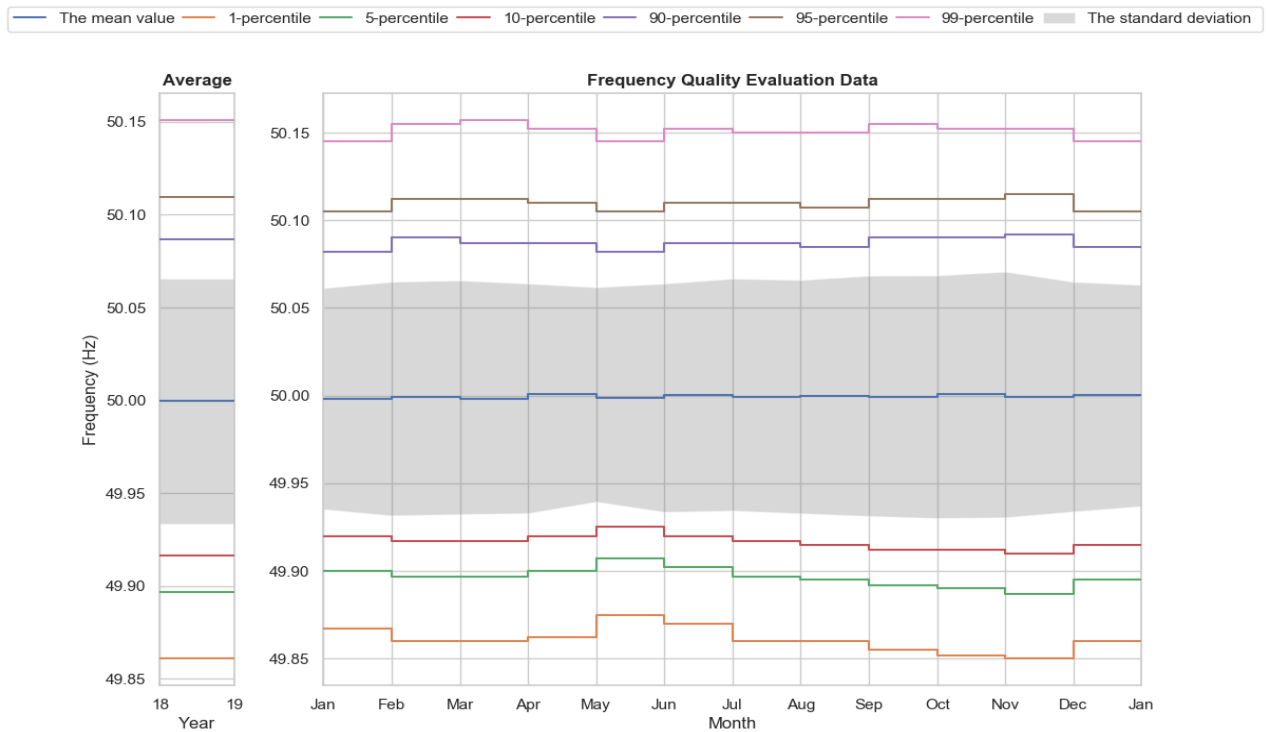


Figure 7 GB SA 2018 frequency quality

In Figures 8 and 9 accumulated minutes outside standard ranges are presented for the Years 2017 and 2018.

Red line shows theoretical line in case of linear distribution (1/12 per month) of minutes outside standard range taking into account standard range from SO GL (15 000 minutes).

Black line shows accumulated minutes outside standard ranges per month for synchronous area. In case that black line is higher than red line at the end of the Year this indicates that synchronous area does not meet Frequency Quality Parameters.

Graphs below show that, for Synchronous Area Great Britain, Frequency Quality target parameters from SO GL were fulfilled for respective years.

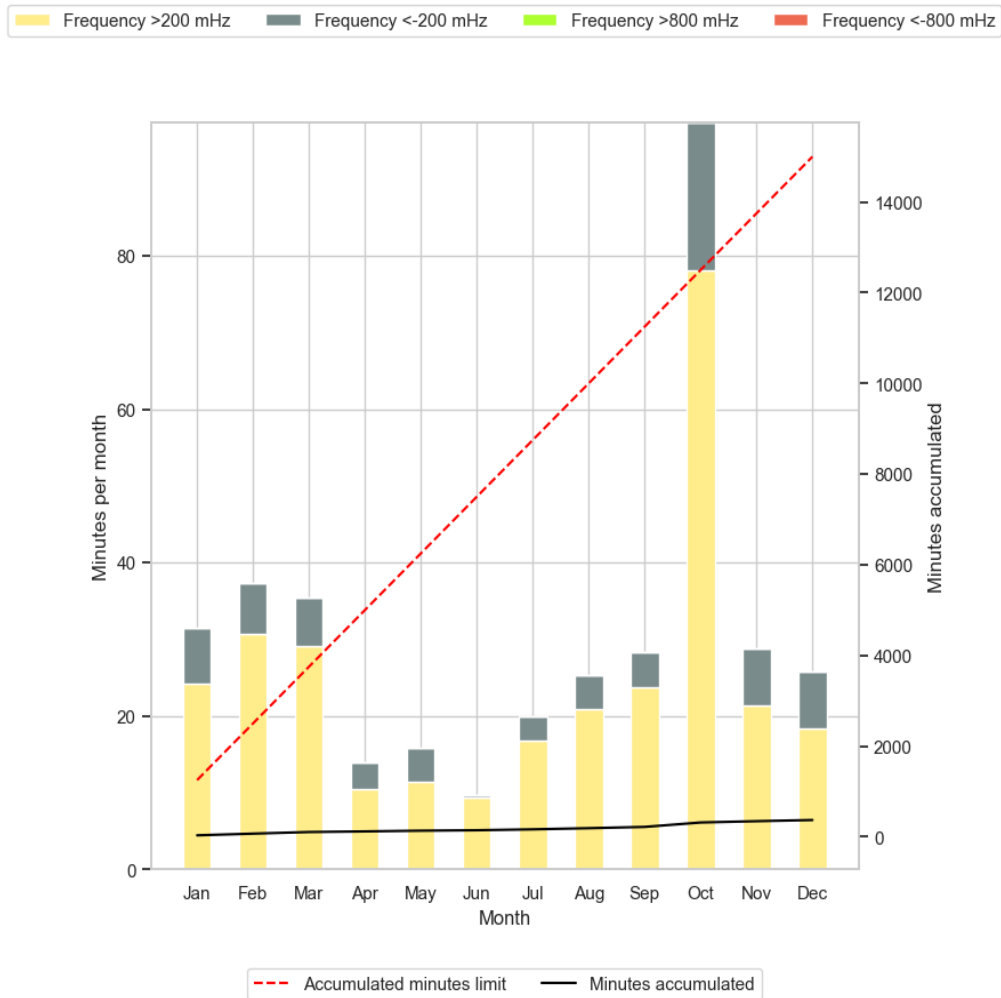


Figure 8 GB SA 2017 frequency deviation

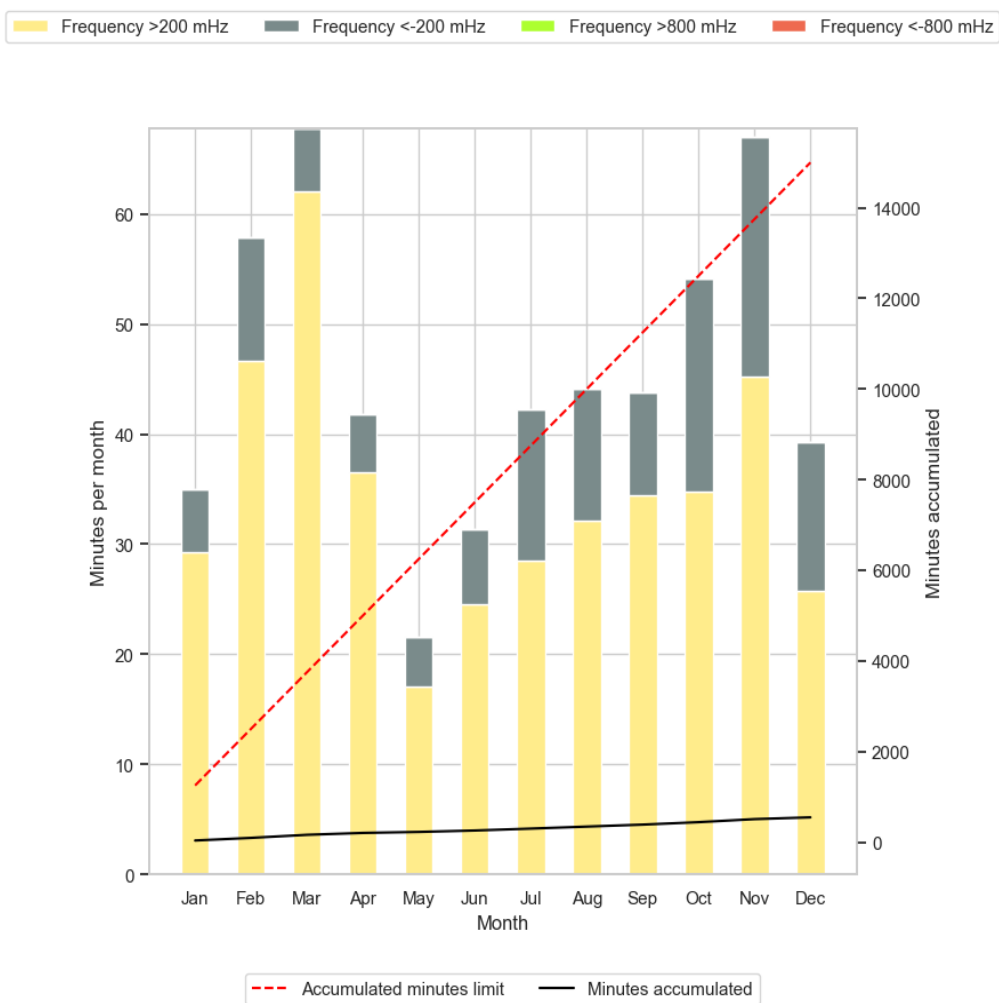


Figure 9 GB SA 2018 frequency deviation

b. GB Synchronous Area LFC Block Performance

In Tables 15 and 16 number of events for GB LFC block are presented. Table shows that there were not events when FRCE values were higher than 500 mHz or lower than -500 mHz and FRCE value were not returned to 50 mHz, or -50 mHz, respectively during time to restore frequency which corresponds to 15 minutes.

Table 15 GB LFC FRCE Statistic for Year 2017

2017												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of events: FRCE > 500 mHz and < 50 mHz after 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events: FRCE < -500 mHz and < -50 mHz after 15 min	0	0	0	0	0	0	0	0	0	0	0	0

Table 16 GB LFC FRCE Statistic for Year 2018

2018												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of events: FRCE > 500 mHz and < 50 mHz after 15 min	0	0	0	0	0	0	0	0	0	0	0	0
No. of events: FRCE < -500 mHz and < -50 mHz after 15 min	0	0	0	0	0	0	0	0	0	0	0	0

Additionally, the synchronous areas of GB and IE/NI are each required to report the number of time intervals outside Level 1 and Level 2 FRCE ranges over the course of one year which is presented in Table 17. The time intervals are aligned with SO GL, Annex III, Table 1. The number of time intervals is calculated using the following procedure:

1. Where frequency deviation is ≥ 200 mHz over a 15 minutes period or ≤ -200 mHz over a 15 minutes period; this qualifies as a Level 1 event.
2. Where frequency deviation is ≥ 500 mHz over a 1 minute period or ≤ -500 mHz over a 1 minute period; this qualifies as a Level 2 event.
3. The Level 1 FRCE target parameter = 3%, which is 35 040 (periods) x 0.03 = 1 051 periods.
4. The Level 2 FRCE target parameter = 1%, which is 525 600 (periods) x 0.01 = 5 256 periods.

Table 17 GB LFC Number of Time Intervals Outside Range for Years 2017 and 2018

Data item	2017	2018
Number of time intervals outside Level 1 FRCE	0	0
Number of time intervals outside Level 2 FRCE	0	0

D. Performance – Nordic

a. Nordic Synchronous Area Performance

In the following tables and figures data for 2017 and 2018 for Nordic synchronous area are presented. Input values for frequency are based on an instantaneous frequency values. Based on input values; mean value, standard deviation and percentiles were calculated. Moreover, time periods and events when system frequency was outside of predefined ranges were also notified. For data when frequency was outside 100 and 1000 mHz time is measured in minutes time scale.

Table 18 Nordic SA Block Performance for Year 2017

2017												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	49,99955	49,99967	49,99937	49,99932	49,99934	49,99913	49,99974	49,99983	49,99948	49,99969	49,99913	49,9994
The standard deviation	0,0396	0,0395	0,0433	0,0406	0,0416	0,0414	0,041	0,0417	0,0404	0,044	0,0409	0,0393
1-percentile	49,91	49,909	49,9	49,906	49,9	49,903	49,906	49,903	49,908	49,898	49,902	49,912
5-percentile	49,936	49,935	49,93	49,933	49,932	49,931	49,932	49,933	49,936	49,93	49,932	49,936
10-percentile	49,949	49,949	49,944	49,947	49,947	49,947	49,947	49,947	49,949	49,945	49,947	49,949
90-percentile	50,05	50,051	50,055	50,051	50,052	50,053	50,052	50,055	50,052	50,056	50,051	50,049
95-percentile	50,064	50,064	50,071	50,065	50,066	50,067	50,067	50,069	50,067	50,072	50,065	50,064
99-percentile	50,09	50,088	50,101	50,093	50,095	50,093	50,096	50,095	50,096	50,107	50,092	50,092
Time > 100 mHz	365	216	738	457	521	418	499	483	514	964	398	435
Time < -100 mHz	369	354	664	443	684	533	464	574	447	743	586	249
Time > 1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < -1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. deviation > 200 mHz and > 100 mHz within 15 minutes	0	0	0	1	2	0	0	0	0	2	0	0
No. of events freq. deviation < -200 mHz and < -100 mHz within 15 minutes	0	0	0	0	1	0	0	0	0	0	0	0

Table 19 Nordic SA Block Performance for Year 2018

2018												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	50,00006	49,99955	49,99909	49,99955	49,99936	49,99863	49,99967	49,99946	49,99994	49,99904	49,99985	50,00041
The standard deviation	0,0386	0,0384	0,0397	0,0398	0,0411	0,0389	0,0385	0,0402	0,0415	0,0429	0,0412	0,0415
1-percentile	49,909	49,912	49,907	49,905	49,901	49,911	49,911	49,906	49,903	49,899	49,908	49,904
5-percentile	49,938	49,936	49,935	49,935	49,932	49,936	49,937	49,934	49,933	49,928	49,933	49,934
10-percentile	49,952	49,95	49,949	49,95	49,947	49,95	49,951	49,949	49,948	49,944	49,948	49,948
90-percentile	50,051	50,049	50,05	50,05	50,051	50,048	50,048	50,05	50,052	50,054	50,053	50,055
95-percentile	50,065	50,063	50,064	50,066	50,066	50,063	50,062	50,066	50,068	50,07	50,068	50,069
99-percentile	50,092	50,088	50,094	50,095	50,097	50,093	50,093	50,096	50,097	50,099	50,098	50,097
Time > 100 mHz	400	241	474	483	571	474	520	553	541	630	591	546
Time < -100 mHz	411	305	481	508	684	342	363	485	595	763	400	608
Time > 1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < -1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. deviation > 200 mHz and > 100 mHz within 15 minutes	0	0	0	1	1	1	2	0	0	0	1	0
No. of events freq. deviation < -200 mHz and < -100 mHz within 15 minutes	0	0	0	0	0	0	0	0	2	0	0	1

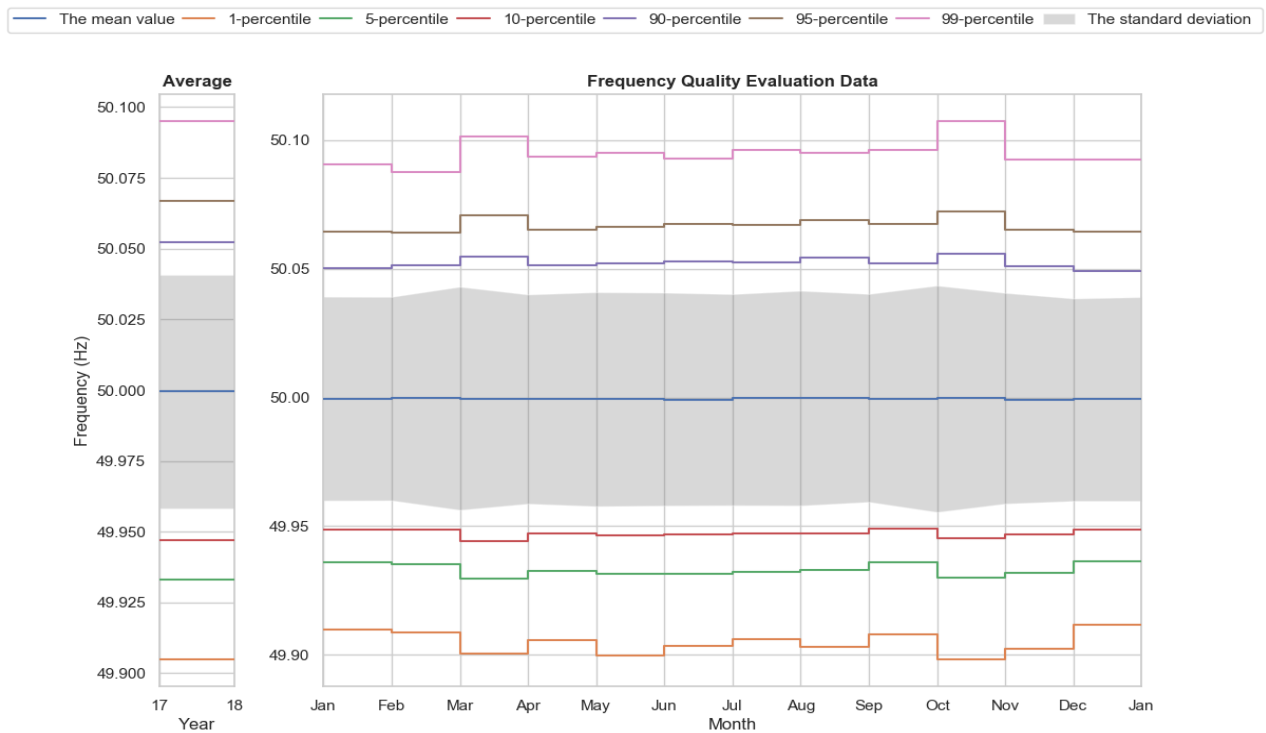


Figure 10 Nordic SA 2017 frequency quality

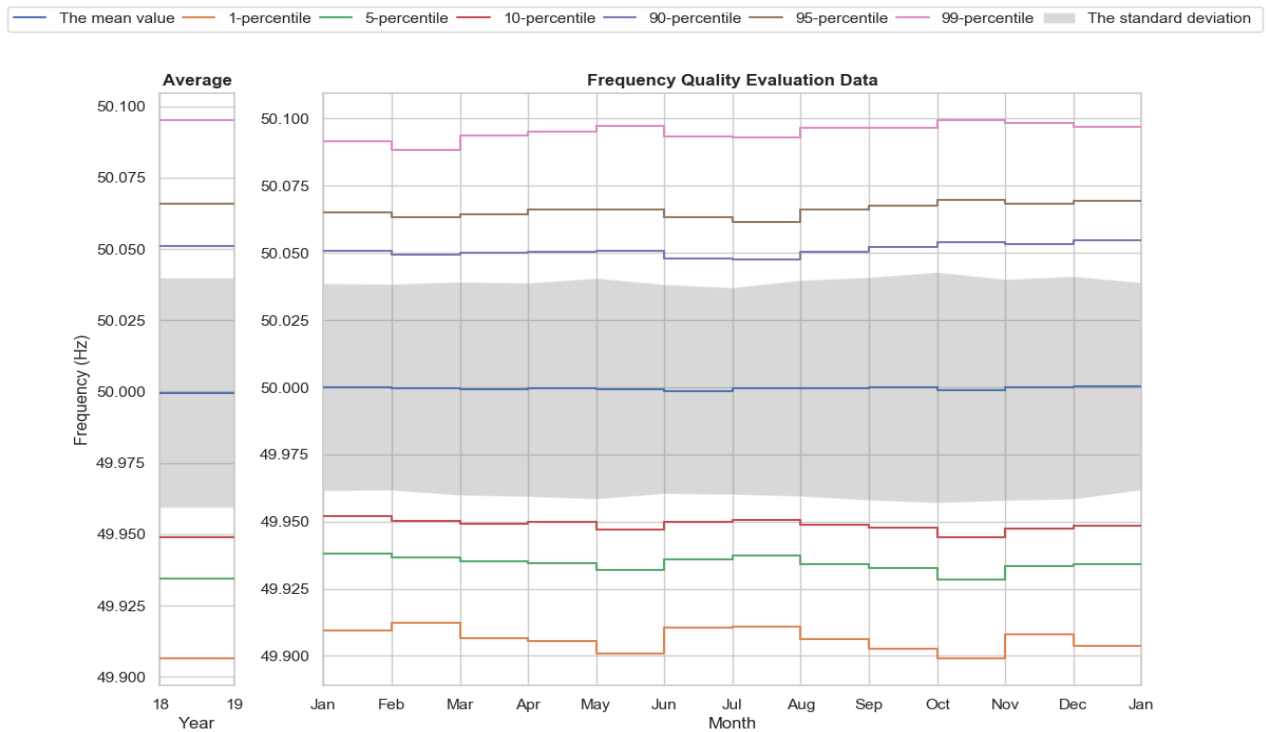


Figure 11 Nordic SA 2018 frequency quality

In Figures 12 and 13 accumulated minutes outside standard ranges are presented for the Years 2017 and 2018.

Red line shows theoretical line in case of linear distribution (1/12 per month) of minutes outside standard range taking into account standard range from SO GL (15 000 minutes).

Black line shows accumulated minutes outside standard ranges per month for synchronous area. In case that black line is higher than red line at the end of the Year this indicates that synchronous area does not meet Frequency Quality Parameters. Graph below shows that, for Synchronous Area Nordic, Frequency Quality target parameters from SO GL were fulfilled for respective years.

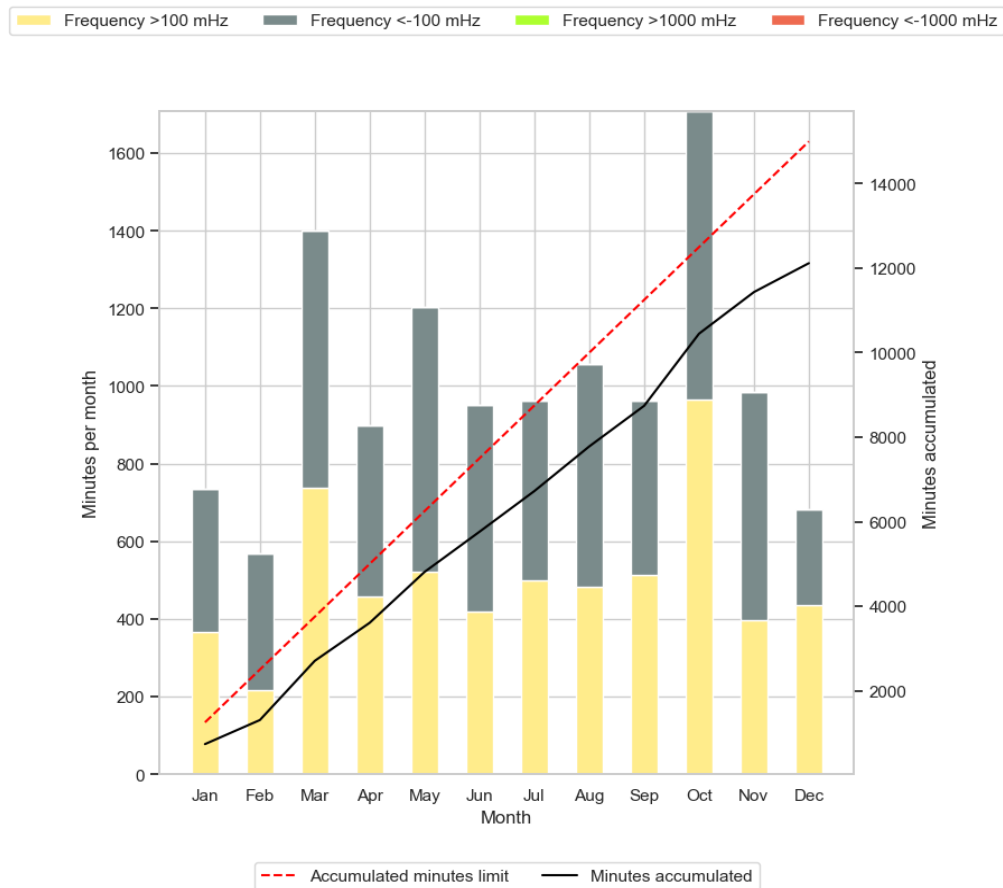


Figure 12 Nordic SA 2017 frequency deviation

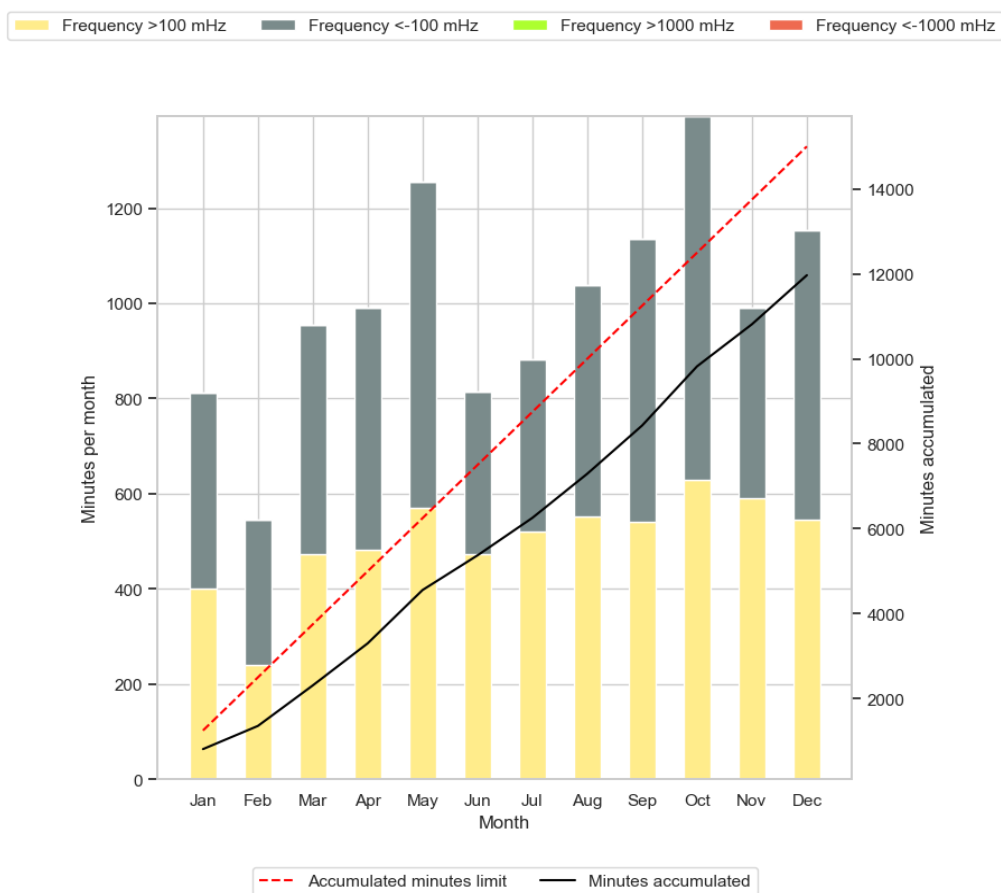


Figure 13 Nordic SA 2018 frequency deviation

b. Nordic Synchronous Area LFC Block Performance

In the following table Nordic LFC block performance is presented. Level 1 and Level 2 limits are calculated according to the Methodology defined in Synchronous Area Framework Agreement. The level 1 and level 2 Frequency Restoration Control Error Target Parameters for the Nordic LFC block are presented in Table 20.

Table 20 Level 1 FRCE range and the level 2 FRCE range for the Nordic Area and targets for the number of 15 minutes time intervals per year outside the level 1 and level 2 FRCE range

FRCE target parameters	Level 1	Level 2
FRCE range	40 mHz	76 mHz
Target for the maximum number of 15 minutes time intervals per year outside the level 1 and level 2 FRCE range	30 %	5%

The methodology for calculation of these target parameters is as defined in the Nordic Synchronous Area Operational Agreement. FRCE values are calculated on a basis of 15 minutes frequency data. The percentages in Table 20 refer to 30% or 5% of the time intervals of the year. Additionally, events which indicate where FRCE exceeds 60 % of FRR used and not returned to 15 % of FRR during 15 minutes time period are reported.

Table 21 Nordic LFC Block Performance

2017												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	49,99955	49,99967	49,99937	49,99932	49,99934	49,99913	49,99974	49,99983	49,99948	49,99969	49,99913	49,9994
The standard deviation	0,0396	0,0395	0,0433	0,0406	0,0416	0,0414	0,041	0,0417	0,0404	0,044	0,0409	0,0393
1-percentile	49,91	49,909	49,9	49,906	49,9	49,903	49,906	49,903	49,908	49,898	49,902	49,912
5-percentile	49,936	49,935	49,93	49,933	49,932	49,931	49,932	49,933	49,936	49,93	49,932	49,936
10-percentile	49,949	49,949	49,944	49,947	49,947	49,947	49,947	49,947	49,949	49,945	49,947	49,949
90-percentile	50,05	50,051	50,055	50,051	50,052	50,053	50,052	50,055	50,052	50,056	50,051	50,049
95-percentile	50,064	50,064	50,071	50,065	50,066	50,067	50,067	50,069	50,067	50,072	50,065	50,064
99-percentile	50,09	50,088	50,101	50,093	50,095	50,093	50,096	50,095	50,096	50,107	50,092	50,092
No. of time intervals: average FRCE > Level 1 positive	395	381	454	397	406	420	455	470	401	478	391	387
No. of time intervals: avg FRCE < Level 1 negative	434	368	490	432	450	424	450	444	404	482	419	438
No. of time intervals: avg FRCE > Level 2 positive	47	30	79	41	52	47	63	58	59	88	49	55
No. of time intervals: avg FRCE < Level 2 negative	44	45	72	55	58	59	61	53	42	78	72	36
No. of time intervals: FRCE > 60% FRR capacity+ and < 15% FRR capacity+ after 15 min	0	0	0	0	3	0	0	0	0	0	0	0
No. of time intervals: FRCE < -60% FRR capacity+ and < 15% FRR capacity+ after 15 min	0	0	0	0	0	0	0	0	0	0	0	0

Table 22 Nordic LFC Block Performance

2018												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	50,00006	49,99955	49,99909	49,99955	49,99936	49,99863	49,99967	49,99946	49,99994	49,99904	49,99985	50,00041
The standard deviation	0,0386	0,0384	0,0397	0,0398	0,0411	0,0389	0,0385	0,0402	0,0415	0,0429	0,0412	0,0415
1-percentile	49,909	49,912	49,907	49,905	49,901	49,911	49,911	49,906	49,903	49,899	49,908	49,904
5-percentile	49,938	49,936	49,935	49,935	49,932	49,936	49,937	49,934	49,933	49,928	49,933	49,934
10-percentile	49,952	49,95	49,949	49,95	49,947	49,95	49,951	49,949	49,948	49,944	49,948	49,948
90-percentile	50,051	50,049	50,05	50,05	50,051	50,048	50,048	50,05	50,052	50,054	50,053	50,055
95-percentile	50,065	50,063	50,064	50,066	50,066	50,063	50,062	50,066	50,068	50,07	50,068	50,069
99-percentile	50,092	50,088	50,094	50,095	50,097	50,093	50,093	50,096	50,097	50,099	50,098	50,097
No. of time intervals: average FRCE > Level 1 positive	401	351	390	352	375	319	348	390	415	440	424	459
No. of time intervals: avg FRCE < Level 1 negative	353	343	397	361	429	376	404	430	404	478	416	400
No. of time intervals: avg FRCE > Level 2 positive	47	45	51	57	63	51	50	54	54	72	55	72
No. of time intervals: avg FRCE < Level 2 negative	42	38	48	45	56	30	31	41	53	80	44	59
No. of time intervals: FRCE > 60 % FRR capacity+ and < 15 % FRR capacity+ after 15 min	0	0	0	2	7	2	1	0	0	0	0	1
No. of time intervals: FRCE < -60 % FRR capacity+ and < -15 % FRR capacity+ after 15 min	0	1	0	0	0	0	0	0	0	0	0	0

I. Level 1/Level 2 statistics

In following Figures 14-17 monthly distribution of FRCE time intervals outside Level 1 range and Level 2 range for positive and negative time intervals per month and Year is presented. If the maximum numbers of intervals exceed 10512 for Level 1 or 1752 for level 2 then mitigation measures have to be proposed and taken.

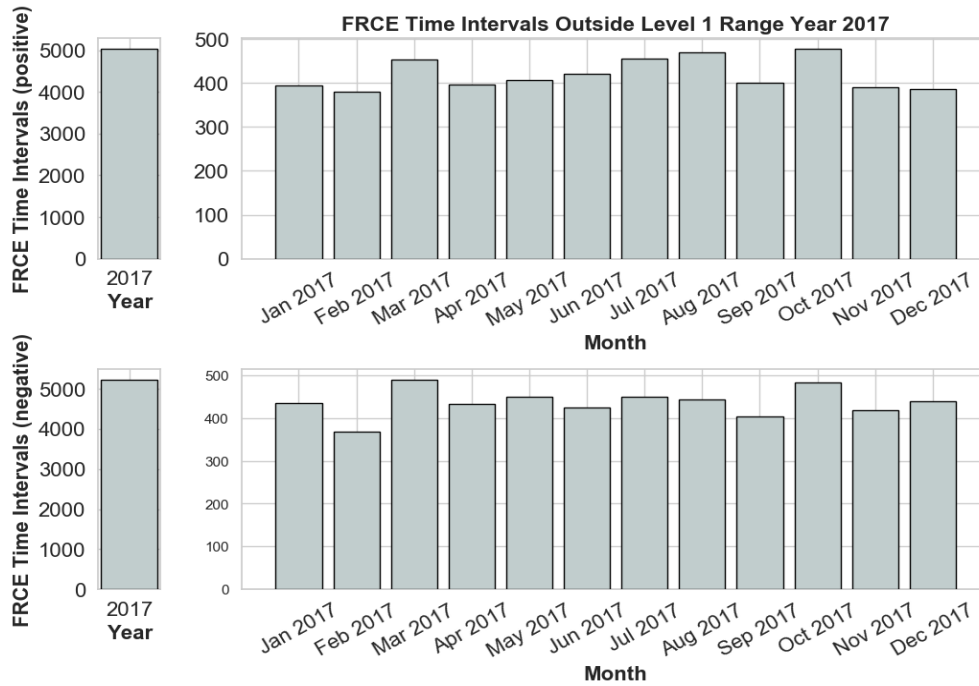


Figure 14 Nordic LFC 2017 FRCE Time Intervals Outside Level 1 Range

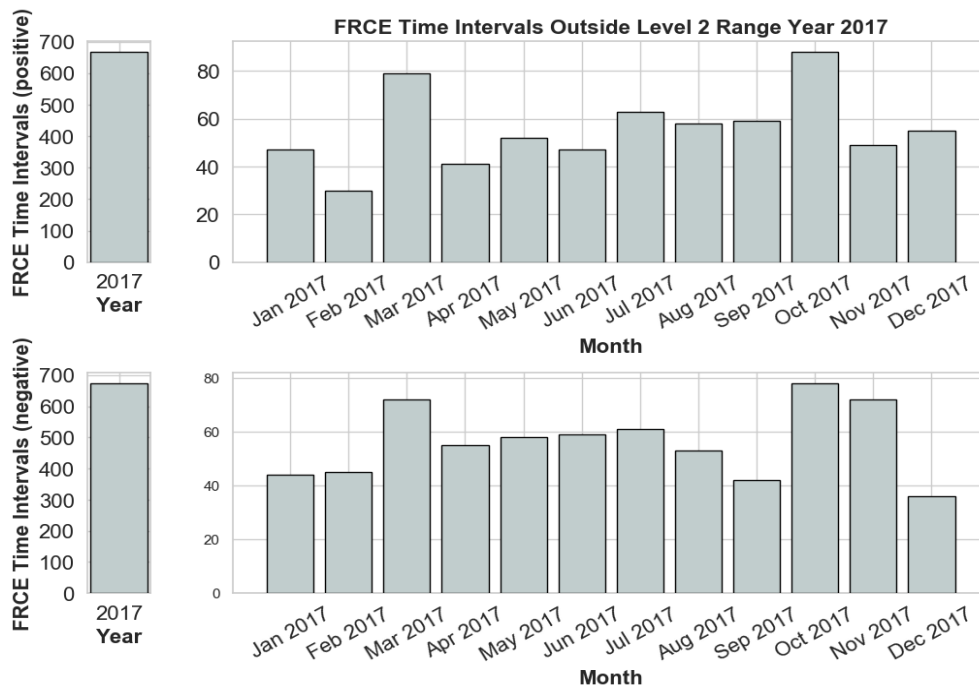


Figure 15 Nordic LFC 2017 FRCE Time Intervals Outside Level 2 Range

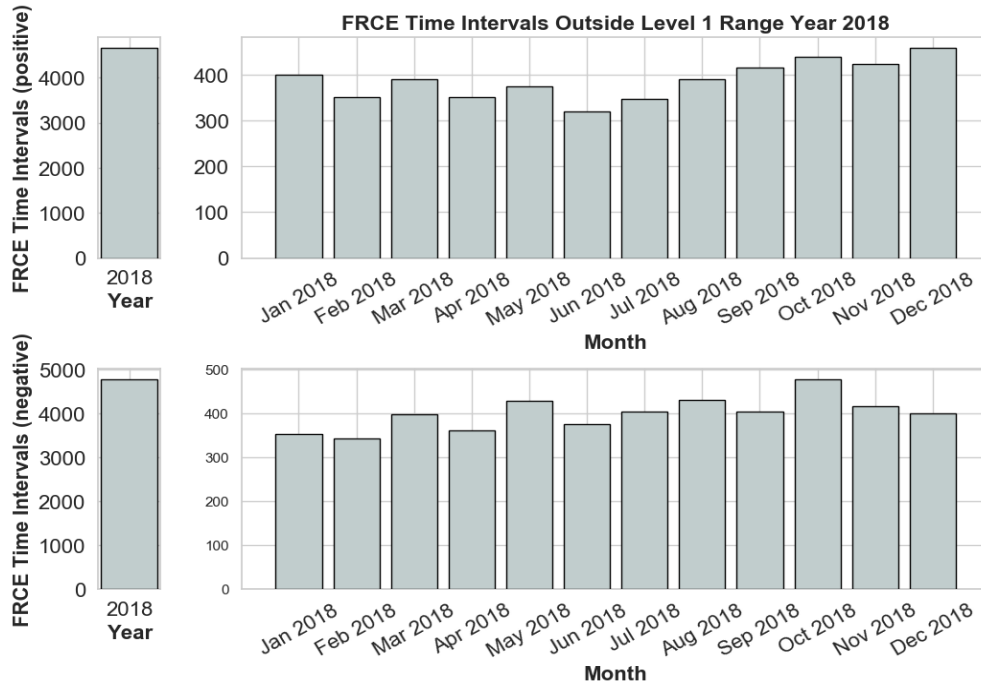


Figure 16 Nordic LFC 2018 FRCE Time Intervals Outside Level 1 Range

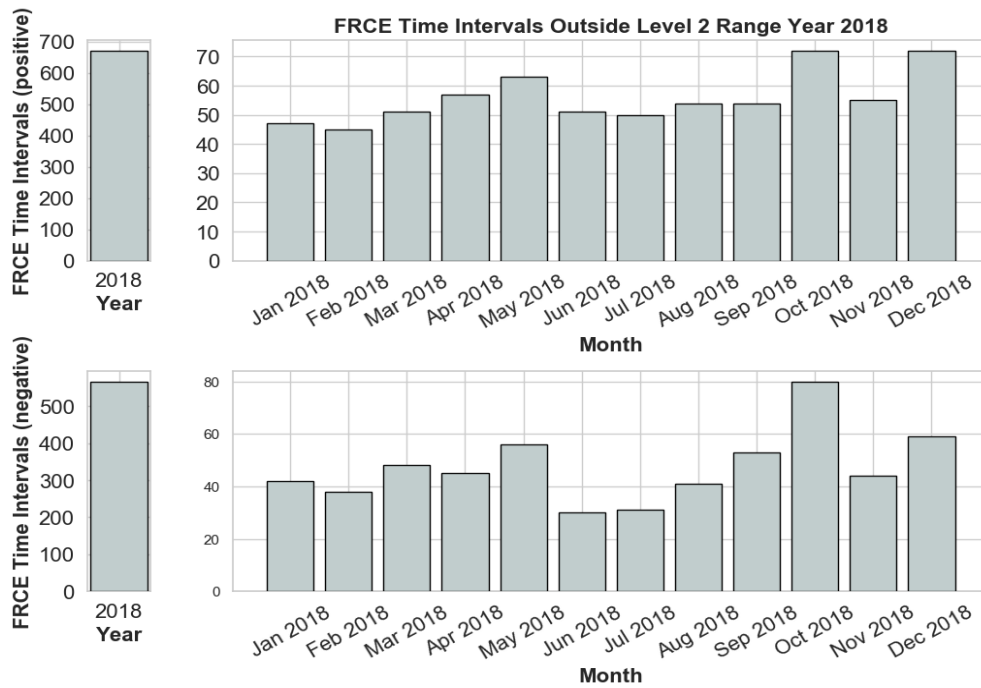


Figure 17 Nordic LFC 2018 FRCE Time Intervals Outside Level 2 Range

II. FRCE vs. FRR

Ability of LFC block to regulate its own FRCE is presented by comparing reserve capacity on FRR and FRCE value according to SO GL. Reserve capacity on FRR is defined as FRR capacity from the dimensioning process (SO GL, Art. 157). If a TSO in dedicated time interval had more FRR (e.g. from free energy bids) this can also be included in the calculation. FRR is considered separately, this means a positive FRR (referred as FRR+ in this document) for negative FRCE, and a negative FRR (referred as FRR- in this document) for positive FRCE. FRCE values includes all correction signals, for TSOs part of an Imbalance Netting Initiative, and is the value after the adjustment process for TSOs part of an FRR activation process. The values taken into account are the one minute average values. The granularity of FRCE instantaneous values (used to calculate the 1 minute average) is 10 seconds or lower.

Reported number of events indicate occurrence of large imbalances in LFC blocks (60 % of FRR) and an insufficient capability of LFC blocks to solve them during time to restore frequency.

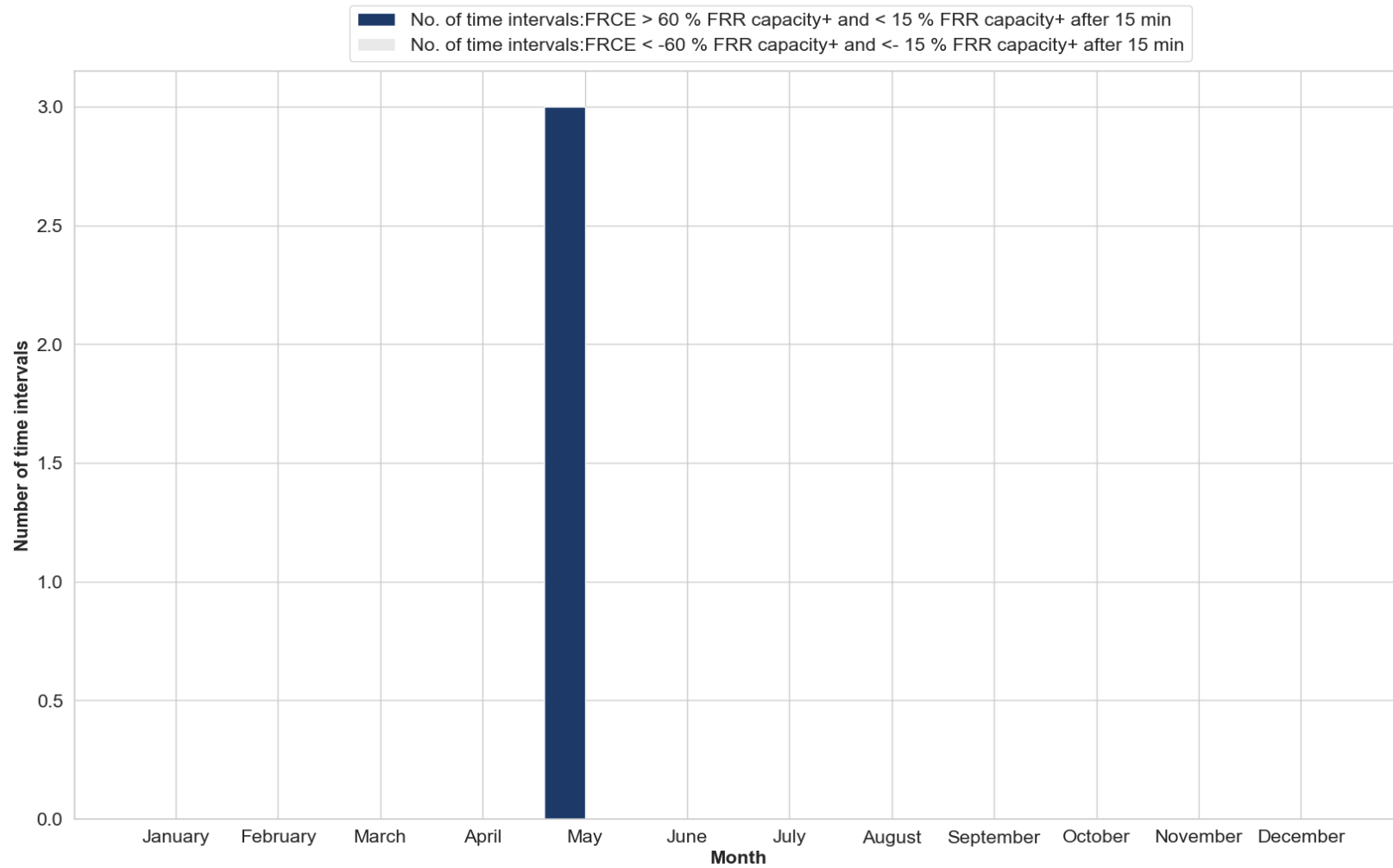


Figure 18 Nordic LFC 2017 FRCE Outside FRR Capacity within 15 minutes

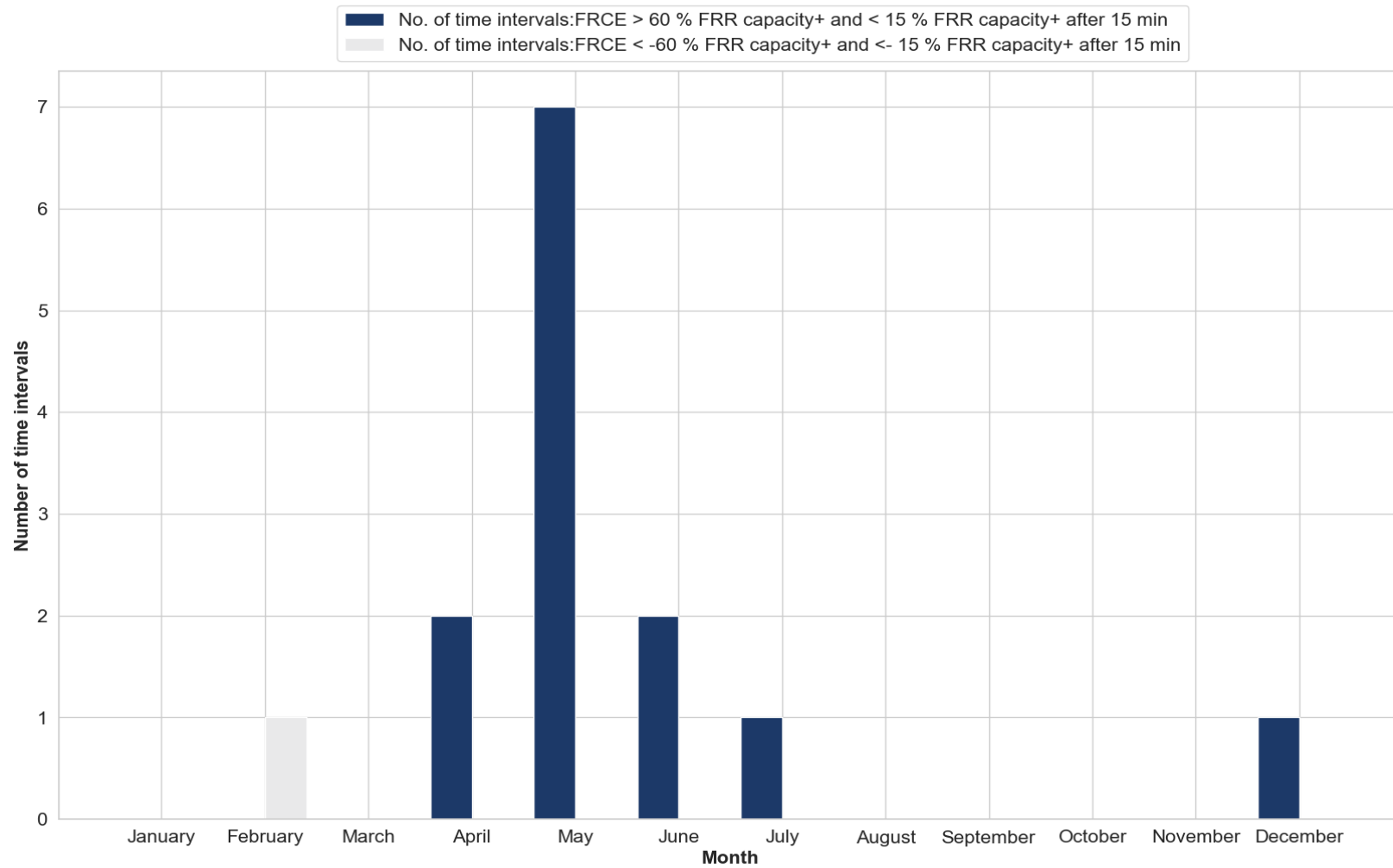


Figure 19 Nordic LFC 2018 FRCE Outside FRR Capacity within 15 minutes

c. Frequency quality evaluation

I. Mitigation Measures Analysis

Annual report on load-frequency control provides a description and date of implementation of any mitigation measures and ramping requirements to alleviate deterministic frequency deviations taken in the previous calendar year in accordance with SO GL Articles 137 and 138, in which TSOs were involved.

In accordance to Article 138., when the values calculated for the period of one calendar year concerning the frequency quality target parameters are outside the targets set for the synchronous area, all TSOs of the relevant synchronous area should provide analysis and mitigation measures.

In accordance to Article 138., when the values calculated for the period of one calendar year concerning FRCE target parameters are outside the targets set for the LFC block, all TSOs of the relevant LFC block should provide analysis and mitigation measures.

According to SO GL Article 138, information contains:

(a) analysis whether the frequency quality target parameters or the FRCE target parameters will remain outside the targets set for the synchronous area or for the LFC block and in case of a justified risk that this may happen, analyse the causes and develop recommendations; and

(b) description of developed mitigation measures to ensure that the targets for the synchronous area or for the LFC block can be met in the future.

For the reporting period, Year 2017 and Year 2018, in line with Figures 14-17 following analysis and mitigation measures were reported from Nordic LFC Block:

Mitigation measures for year 2017:

There were no mitigation measures applied.

Mitigation measures for year 2018:

There were no mitigation measures applied.

E. Performance – CE

a. Continental Europe Synchronous Area Performance

In the following tables and figures data for 2017 and 2018 for Continental Europe synchronous area are presented. Input values for frequency are based on an instantaneous frequency values. Based on input values; mean value, standard deviation and percentiles were calculated. Moreover, time periods and events when system frequency was outside of predefined ranges were also notified. For data when frequency was outside 50 and 800 mHz time is measured in minutes time scale.

Table 23 CE SA Performance for Year 2017

2017												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	50,00037	50,00061	50,00009	49,9993	50,00022	50,00118	50,0001	50,00004	49,99965	50,00094	49,99914	50,0007
The standard deviation	0,0224	0,0214	0,0225	0,0214	0,0204	0,0202	0,0194	0,0196	0,0215	0,0234	0,0229	0,022
1-percentile	49,942	49,946	49,944	49,946	49,953	49,953	49,954	49,954	49,948	49,942	49,94	49,945
5-percentile	49,964	49,967	49,965	49,966	49,969	49,971	49,971	49,97	49,967	49,964	49,963	49,967
10-percentile	49,973	49,975	49,973	49,974	49,975	49,977	49,977	49,977	49,974	49,973	49,972	49,975
90-percentile	50,026	50,026	50,027	50,025	50,026	50,025	50,024	50,024	50,026	50,028	50,026	50,027
95-percentile	50,034	50,034	50,035	50,033	50,033	50,035	50,031	50,032	50,034	50,037	50,034	50,035
99-percentile	50,056	50,054	50,056	50,054	50,051	50,05	50,052	50,051	50,056	50,06	50,058	50,058
Time > 50 mHz	658	543	689	551	488	425	485	471	649	892	698	734
Time < - 50 mHz	753	535	694	550	344	323	317	326	491	767	803	622
Time > 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < - 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. deviation > 100 mHz and not < 25 mHz	0	0	0	0	0	0	0	0	0	0	0	2
No. of events freq. deviation < - 100 mHz and not < -25 mHz	1	0	0	0	0	0	0	0	0	0	0	0

Table 24 CE SA Performance for Year 2018

2018												
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The mean value	49,99941	49,99478	50,00401	50,00194	49,99959	50,00038	50,00009	50,00072	50,00017	50,00018	49,99969	50,00051
The standard deviation	0,0208	0,0225	0,0241	0,0234	0,0199	0,0195	0,0189	0,019	0,0205	0,0222	0,0213	0,0202
1-percentile	49,947	49,936	49,943	49,95	49,953	49,954	49,953	49,956	49,949	49,943	49,945	49,95
5-percentile	49,967	49,96	49,965	49,967	49,97	49,971	49,971	49,972	49,968	49,966	49,967	49,969
10-percentile	49,975	49,969	49,974	49,974	49,976	49,977	49,977	49,978	49,976	49,974	49,975	49,977
90-percentile	50,024	50,021	50,033	50,031	50,024	50,023	50,023	50,023	50,025	50,026	50,025	50,025
95-percentile	50,032	50,029	50,042	50,041	50,031	50,031	50,029	50,03	50,032	50,035	50,033	50,032
99-percentile	50,053	50,052	50,062	50,063	50,049	50,05	50,046	50,049	50,05	50,056	50,053	50,051
Time > 50 mHz	525	450	1116	1062	396	414	285	398	414	699	526	470
Time < - 50 mHz	551	973	725	409	328	297	340	296	454	692	607	445
Time > 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0
Time < - 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0
No. of events freq. deviation > 100 mHz and not < 25 mHz	1	0	0	1	0	1	0	0	0	0	0	0
No. of events freq. deviation < - 100 mHz and not < -25 mHz	0	0	0	0	0	0	0	0	0	0	0	0

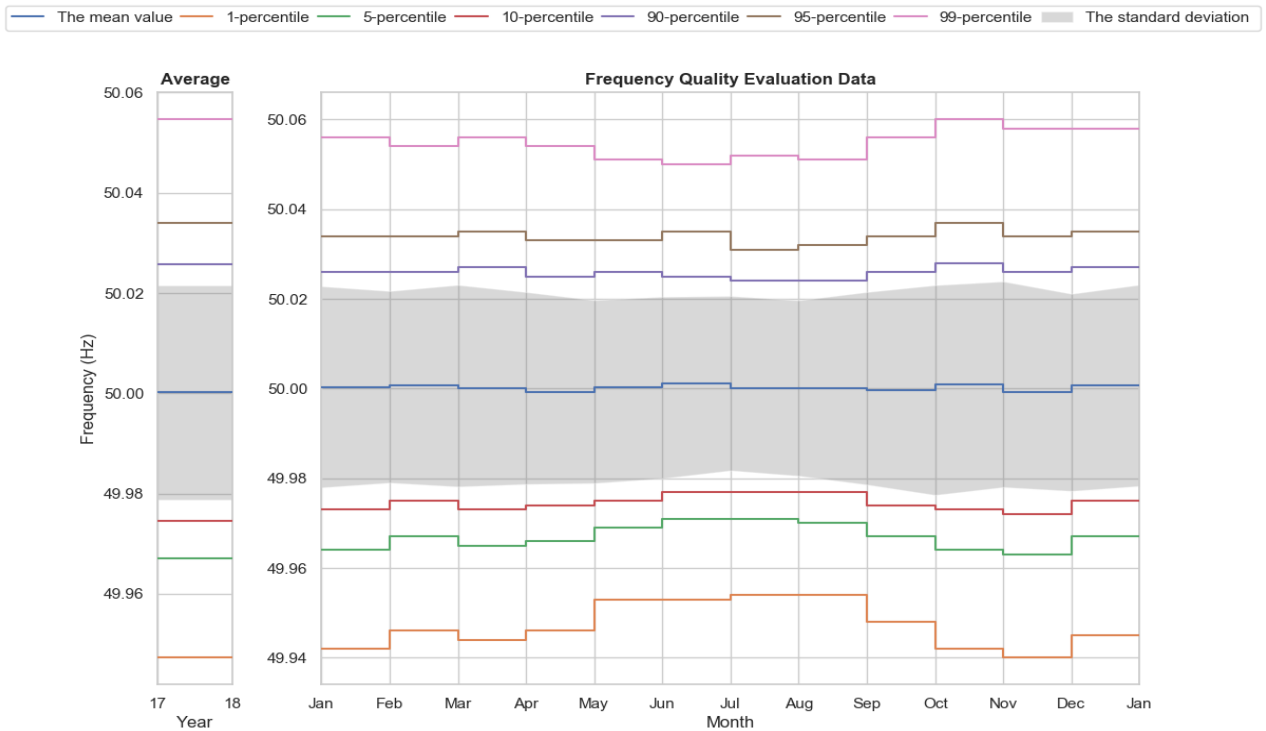


Figure 24 CE SA 2017 frequency quality

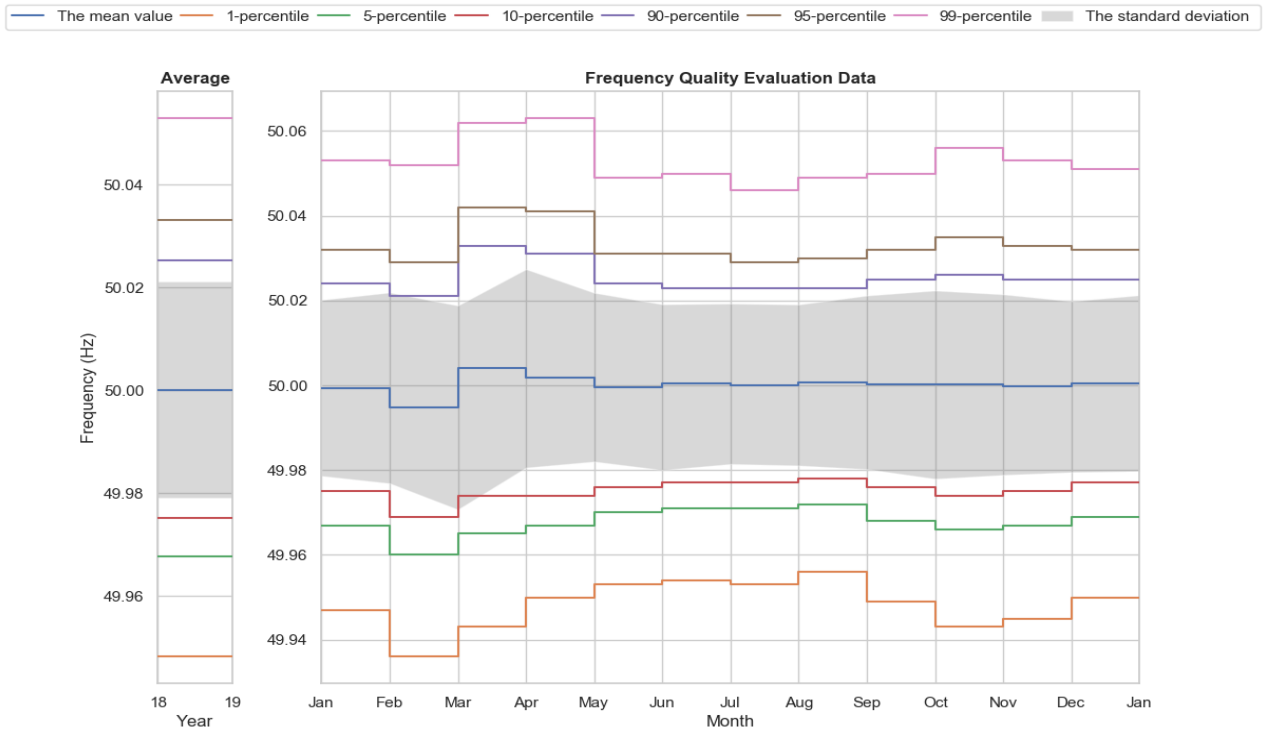


Figure 25 CE SA 2018 frequency quality

In Figures 27 and 28 accumulated minutes outside standard ranges are presented for the Years 2017 and 2018.

Red line shows theoretical line in case of linear distribution (1/12 per month) of minutes outside standard range taking into account standard range from SO GL (15 000 minutes).

Black line shows accumulated minutes outside standard ranges per month for synchronous area. In case that black line is higher than red line at the end of the Year this indicate that synchronous area does not meet Frequency Quality Parameters.

Graph below shows that, for Synchronous Area Continental Europe, Frequency Quality target parameters from SO GL were fulfilled for respective years.

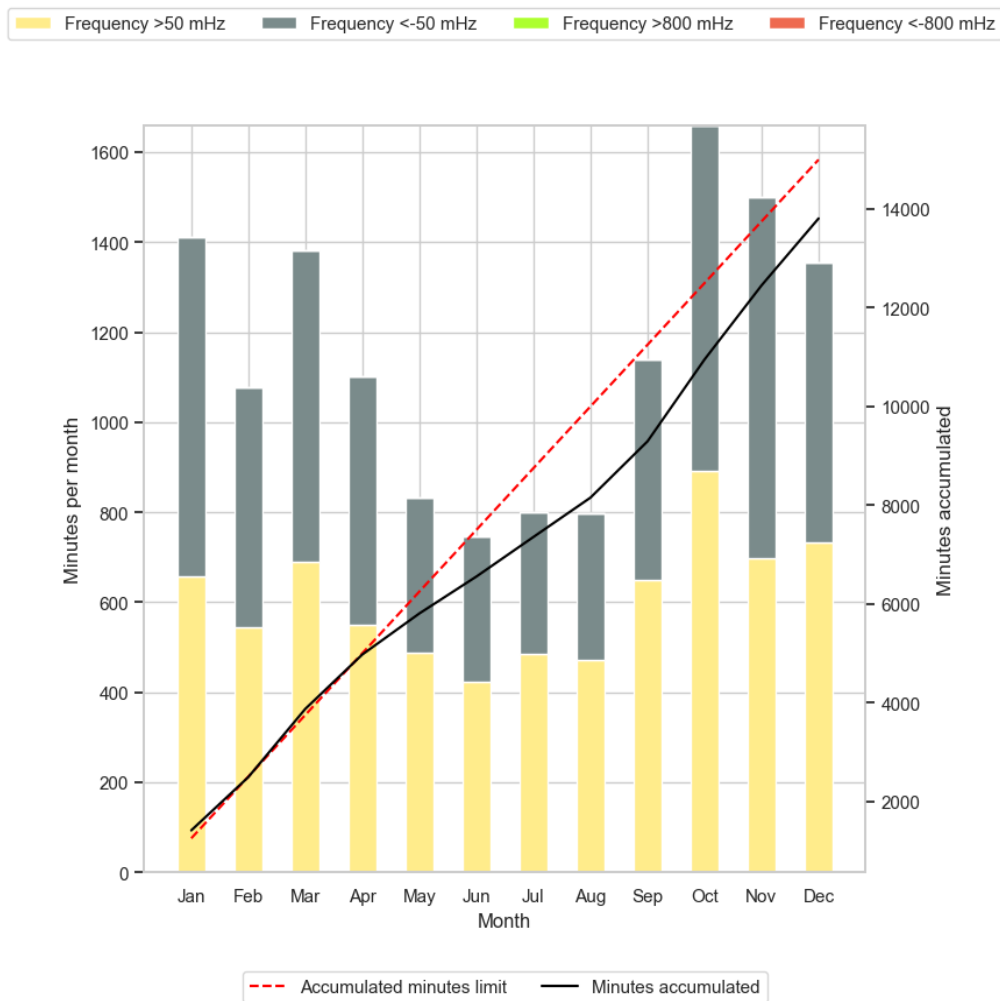


Figure 27 CE SA 2017 frequency deviation

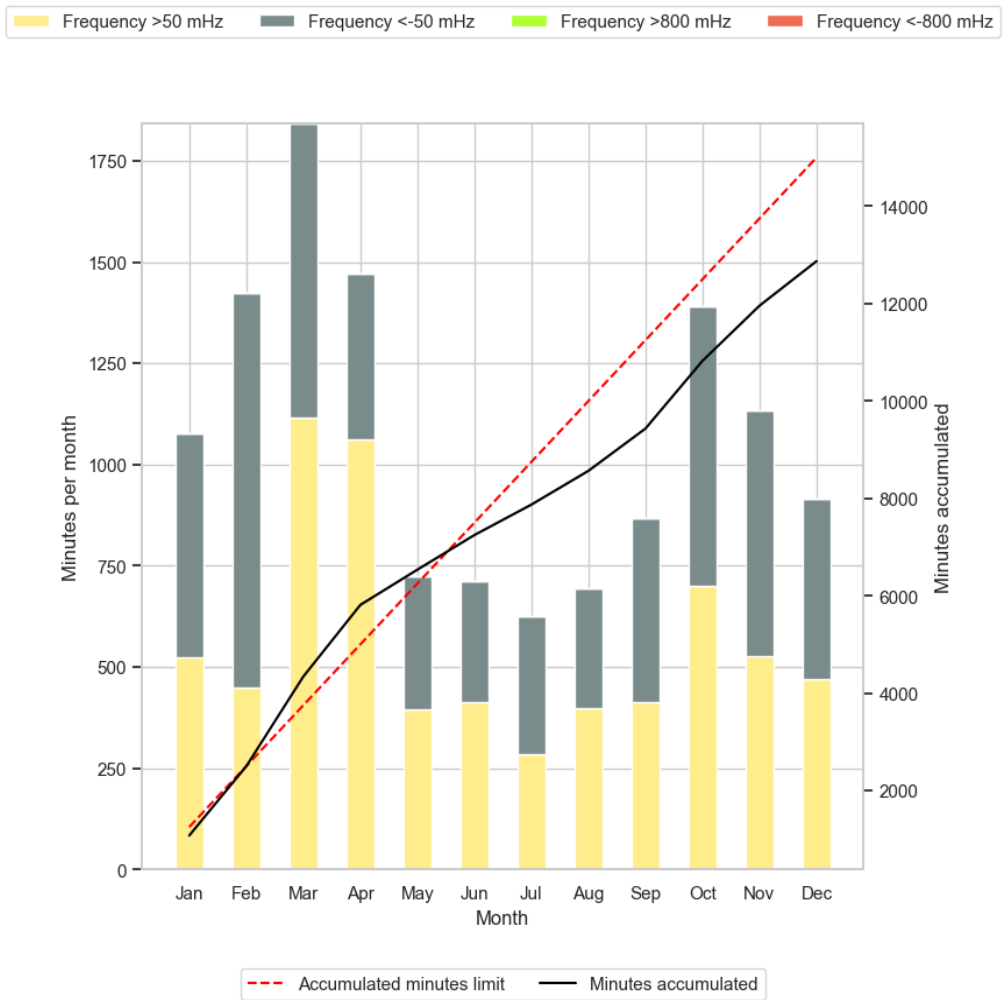


Figure 28 CE SA 2018 frequency deviation

b. Continental Europe Synchronous Area LFC Blocks Performance

In this chapter Continental Europe Frequency Quality Evaluation Criteria for LFC blocks is presented. Limits for Level 1 and Level 2 are calculated retroactively in line with Synchronous Area Framework Agreement for Continental Europe, whose entry into force was 14th of April 2019. FRCE values are calculated on a basis of 15 min Area Control Error (ACE) data. Additionally, events which indicate where FRCE exceeds 60 % of FRR used and not returned to 15 % of FRR during 15 minutes time period are reported. Complete list of data provided by LFC blocks is shown in Appendix B.

I. Level 1/Level 2 statistics

In the following graphs, monthly distribution of FRCE time intervals outside Level 1 and Level 2 ranges is presented, separately for positive and negative time intervals, for every month for reporting Years for each LFC block in Continental Europe Synchronous Area. Number of time intervals in which average FRCE was higher than Level 1 positive is shown with dots, while for the opposite direction with x. The level 1 and level 2 Frequency Restoration Control Error Target Parameters for the Continental Europe LFC blocks are presented in Tables 25 and 26 for respective years and measured in MW.

Table 25 Level 1 FRCE range and the level 2 FRCE range for the Continental Europe Synchronous Area and targets for the number of 15 minutes time intervals per year outside the level 1 and level 2 FRCE range for 2017

LFC Block	Level 1	Level 2
APG	76,985	145,591
CEPS	87,077	164,677
ELIA	80,337	151,93
ESO	65,995	124,808
Germany	242,928	459,416
IPTO	63,802	120,659
MAVIR	51,449	97,298
OST	23,191	43,858
PSE	125,772	237,855
REE	190,023	359,364
REN	68,581	129,698
RTE	231,001	436,86
SEPS	49,676	93,945
SG	80,337	151,93
SHB	60,667	114,731
SMM	69,194	130,857
TEIAS	159,322	301,304
TEL	77,667	146,881
TERNA	158,825	300,364
TTB	100,722	190,482
Target for the maximum number of 15 minutes time intervals per year outside the Level 1 and Level 2 FRCE range	10512	1752

Table 26 Level 1 FRCE range and the level 2 FRCE range for the Continental Europe Synchronous Area and targets for the number of 15 minutes time intervals per year outside the level 1 and level 2 FRCE range for 2018

LFC Block	Level 1	Level 2
APG	78,234	147,954
CEPS	86,08	162,79
ELIA	87,887	166,208
ESO	62,775	118,717
Germany	243,62	460,726
IPTO	63,851	120,752
MAVIR	52	98,34
OST	25,285	47,817
PSE	121,606	229,976
REE	187,236	354,093
REN	73,253	138,533
RTE	225,851	427,12
SEPS	38,305	72,441
SG	76,883	145,398
SHB	64,015	121,062
SMM	69,358	131,167
TEIAS	161,771	305,934
TEL	76,336	144,363
TERNA	158,993	300,682
TTB	102,579	193,993
Target for the maximum number of 15 minutes time intervals per year outside the Level 1 and Level 2 FRCE range	10512	1752

The methodology for calculation of these target parameters is as defined in the Continental Europe Synchronous Area Operational Agreement.



Figure 29 CE LFCs 2017 FRCE Time Intervals outside Level 1 Range

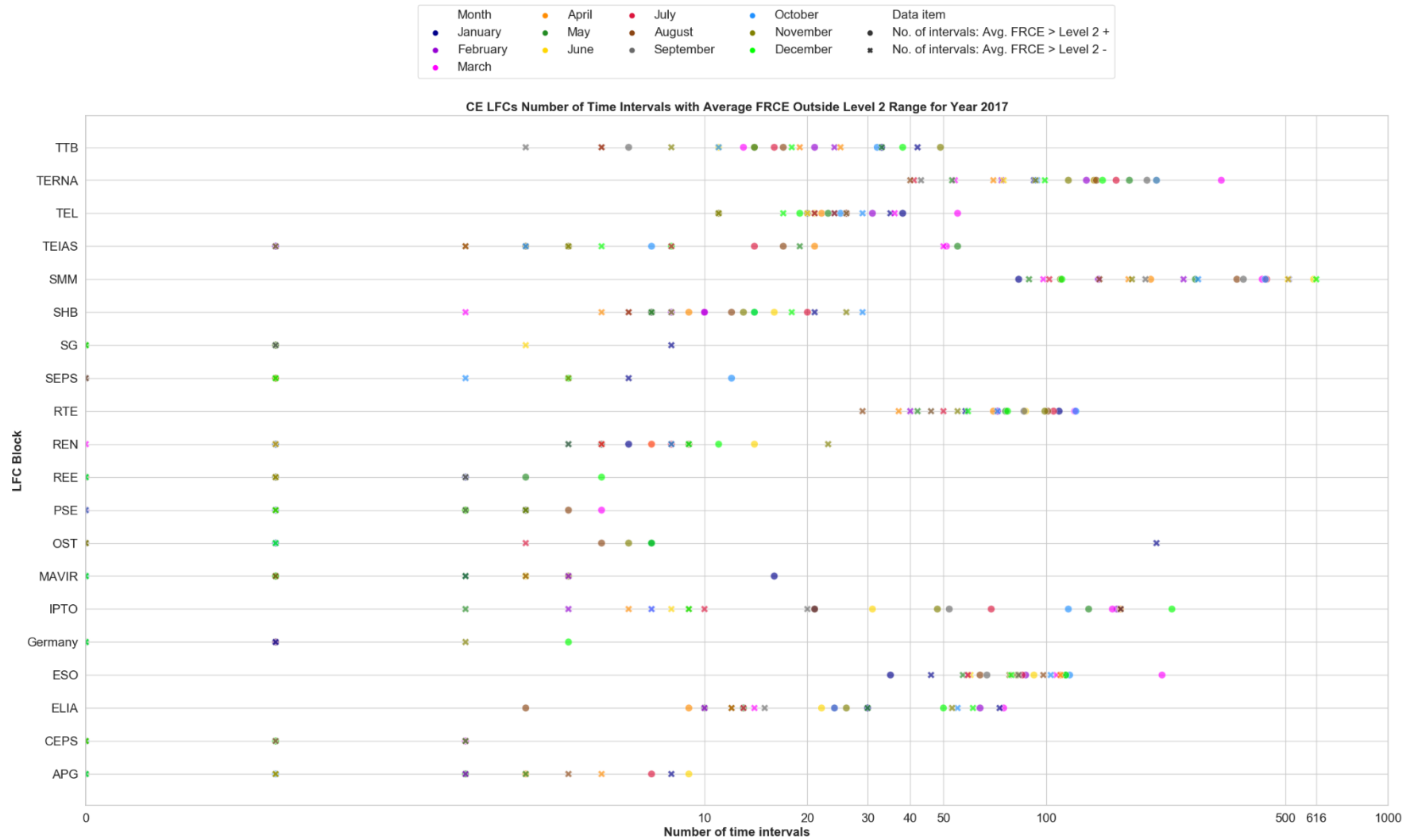


Figure 30 CE LFCs 2017 FRCE Time Intervals outside Level 2 Range



Figure 31 CE LFCs 2018 FRCE Time Intervals outside Level 1 Range

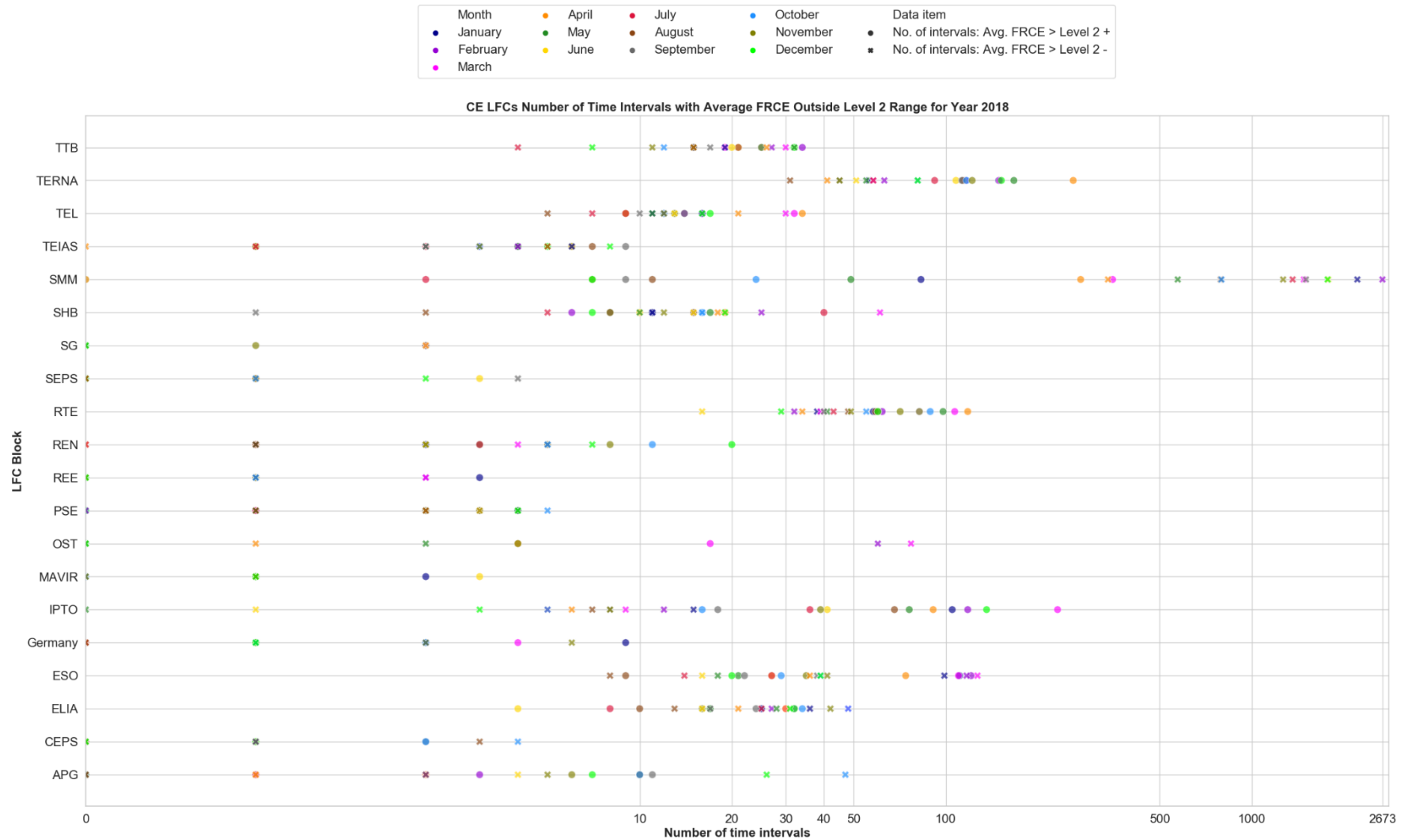


Figure 32 CE LFCs 2018 FRCE Time Intervals outside Level 2 Range

II. FRCE vs. FRR

Ability of LFC blocks to regulate its own FRCE is presented by comparing reserve capacity on FRR and FRCE value according to SO GL. Reserve capacity on FRR is defined as FRR capacity from the dimensioning process (SO GL, Art. 157). If a TSO in dedicated time interval had more FRR (e.g. from free energy bids) this can also be included in the calculation. FRR is considered separately, this means a positive FRR (referred as FRR+ in this document) for negative FRCE, and a negative FRR (referred as FRR- in this document) for positive FRCE. FRCE values includes all correction signals (e.g. for TSOs part of an Imbalance Netting Process), and is the value after the adjustment process for TSOs part of an FRR activation process. The values taken into account are the one minute average values. The granularity of FRCE instantaneous values (used to calculate the 1 minute average) is 10 seconds or lower.

Reported number of events indicate occurrence of large imbalances in LFC blocks (60 % of FRR) and an insufficient capability of LFC blocks to solve them during time to restore frequency.

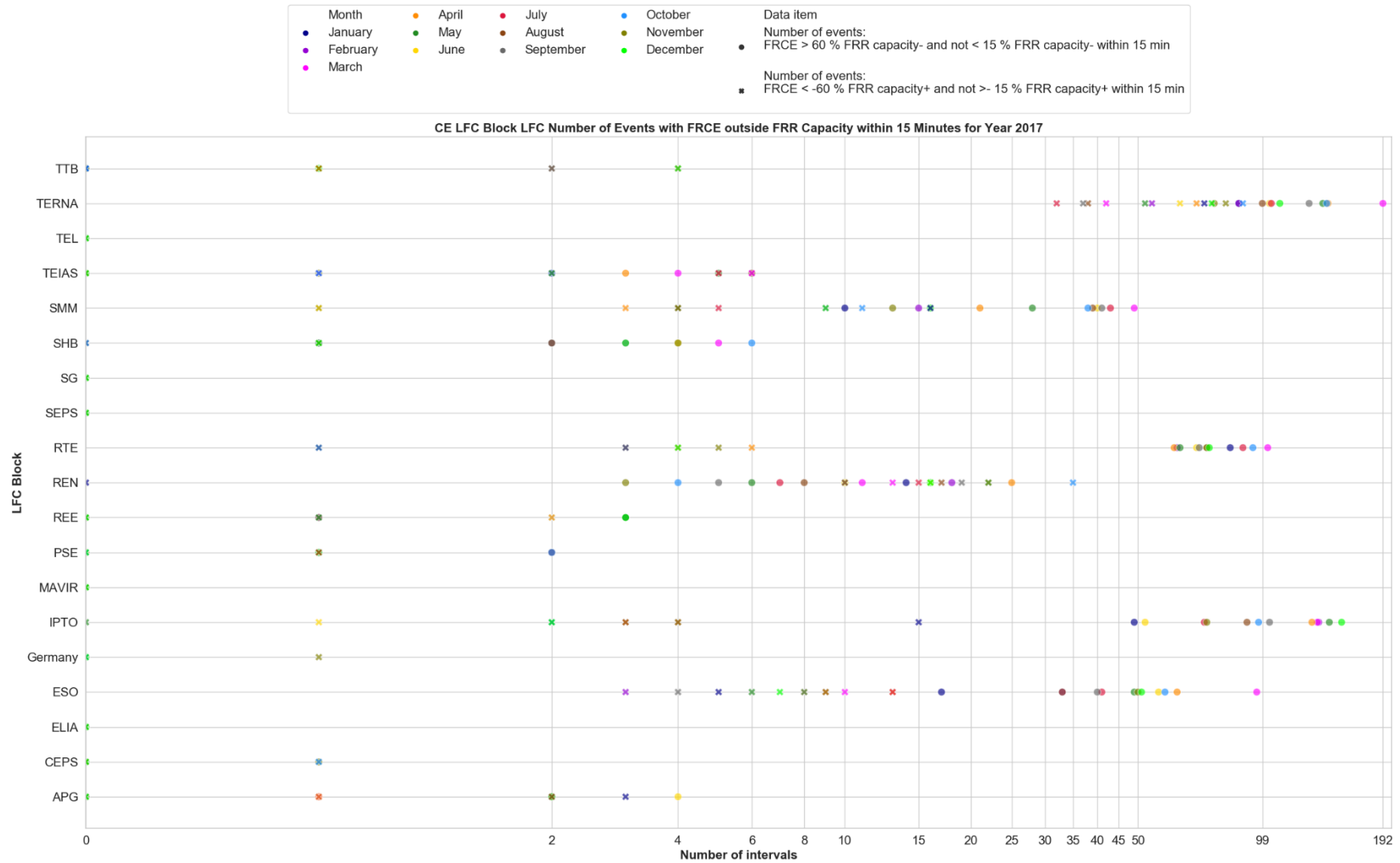


Figure 33 CE LFCs 2017 FRCE Outside FRR Capacity within 15 minutes

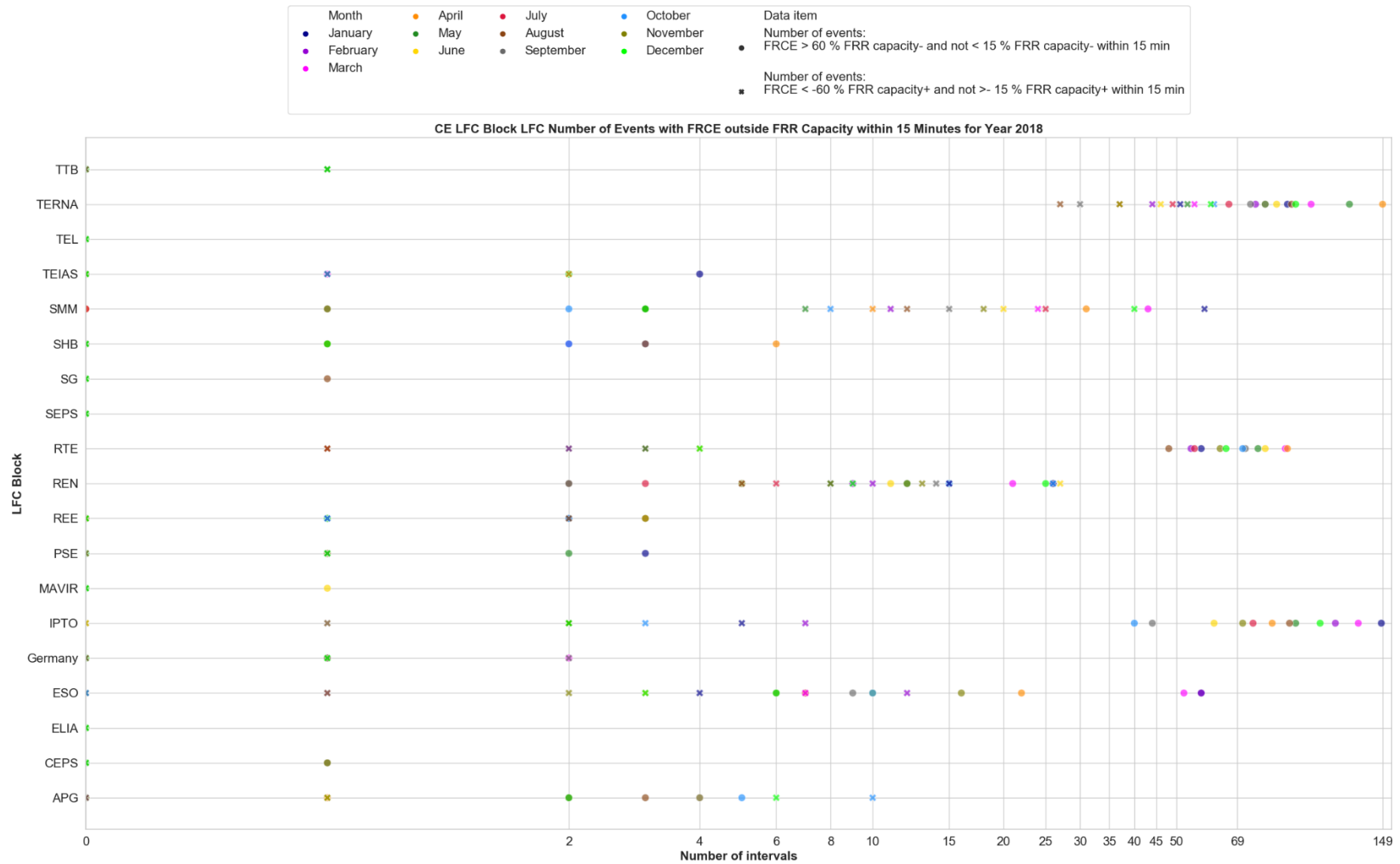


Figure 34 CE LFCs 2018 FRCE Outside FRR Capacity within 15 minutes

c. Frequency quality evaluation

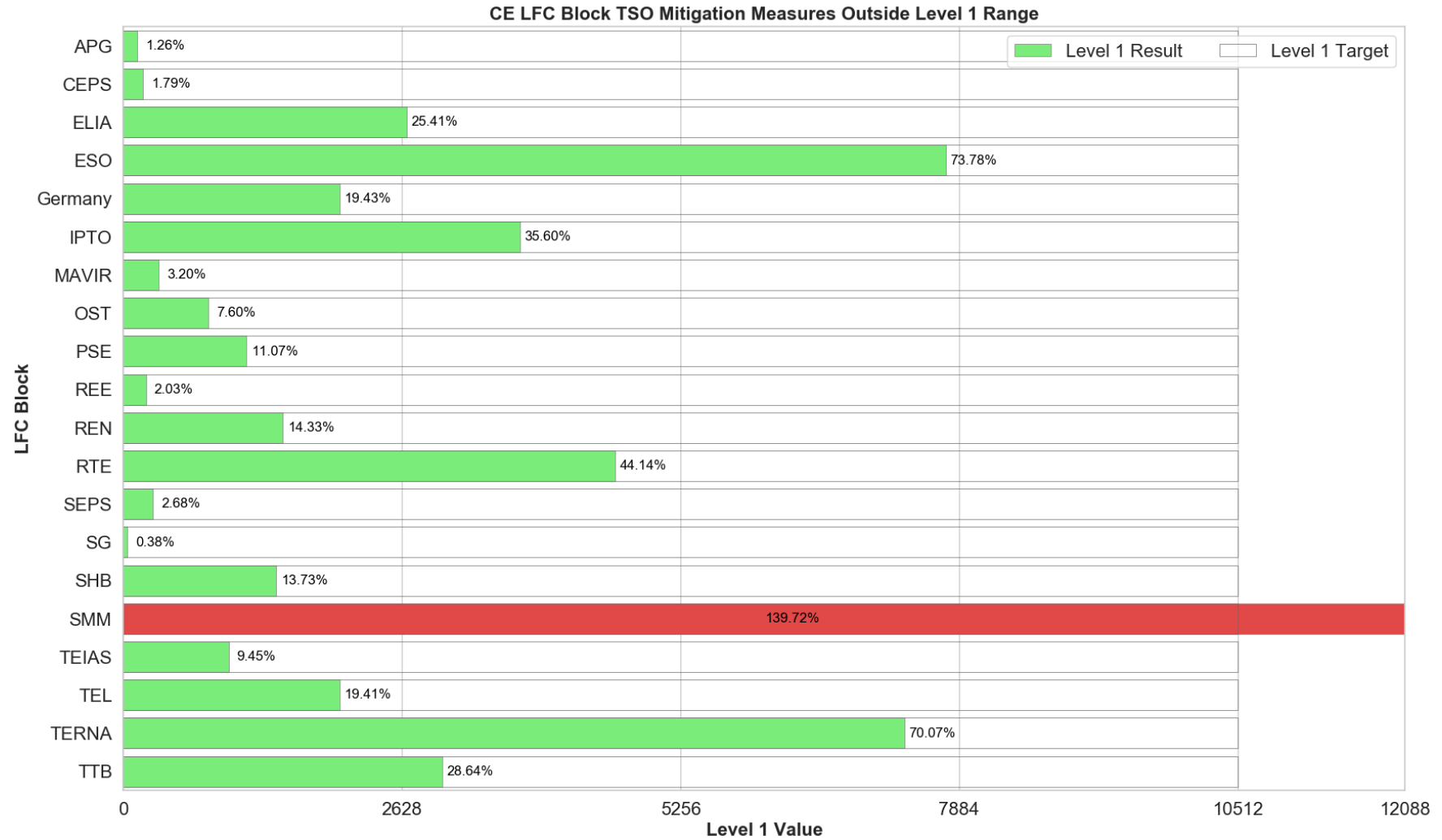


Figure 35 CE LFC Blocks 2017 TSO Mitigation Measures Level 1

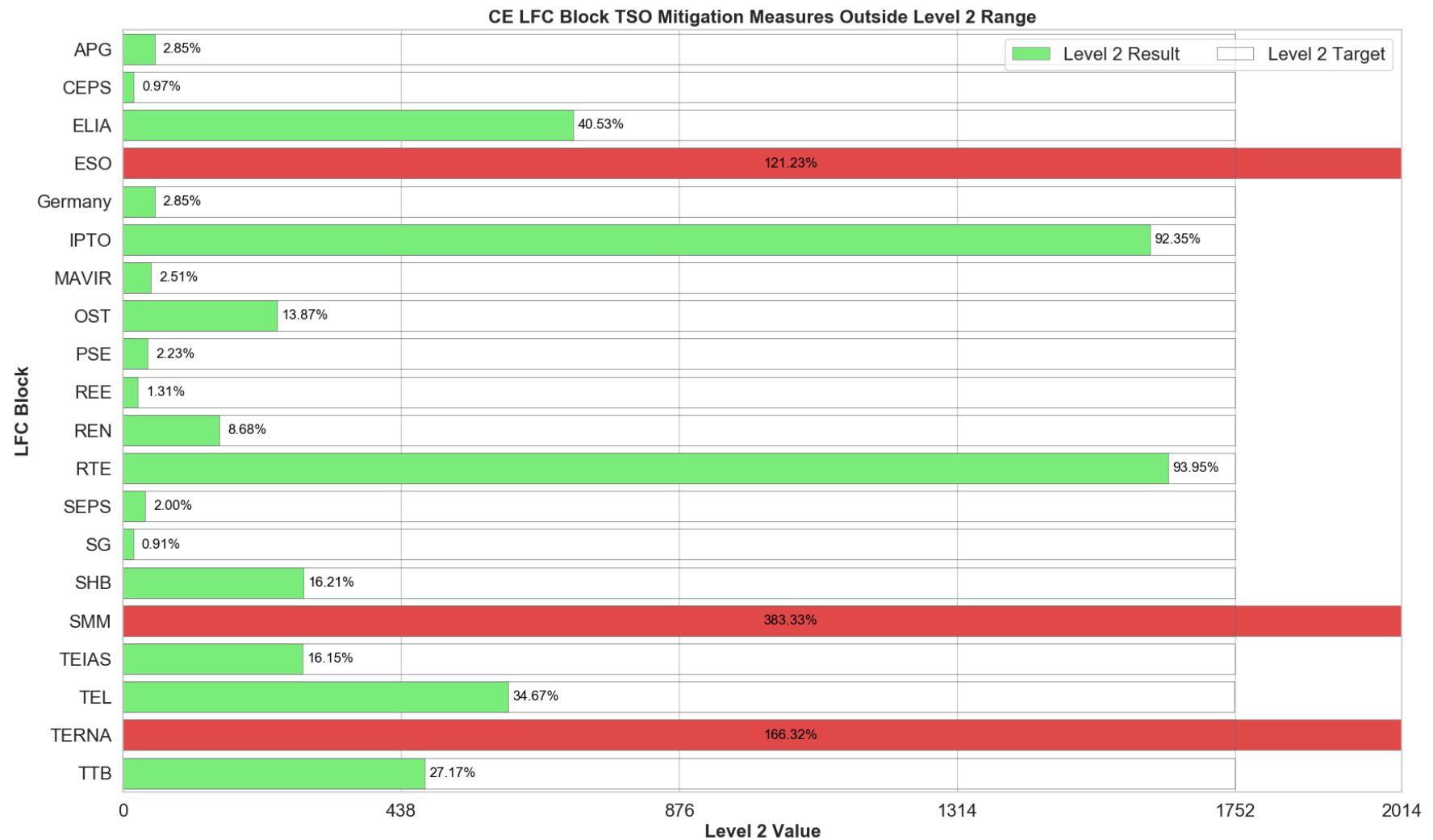


Figure 36 CE LFC Blocks 2017 TSO Mitigation Measures Level 2

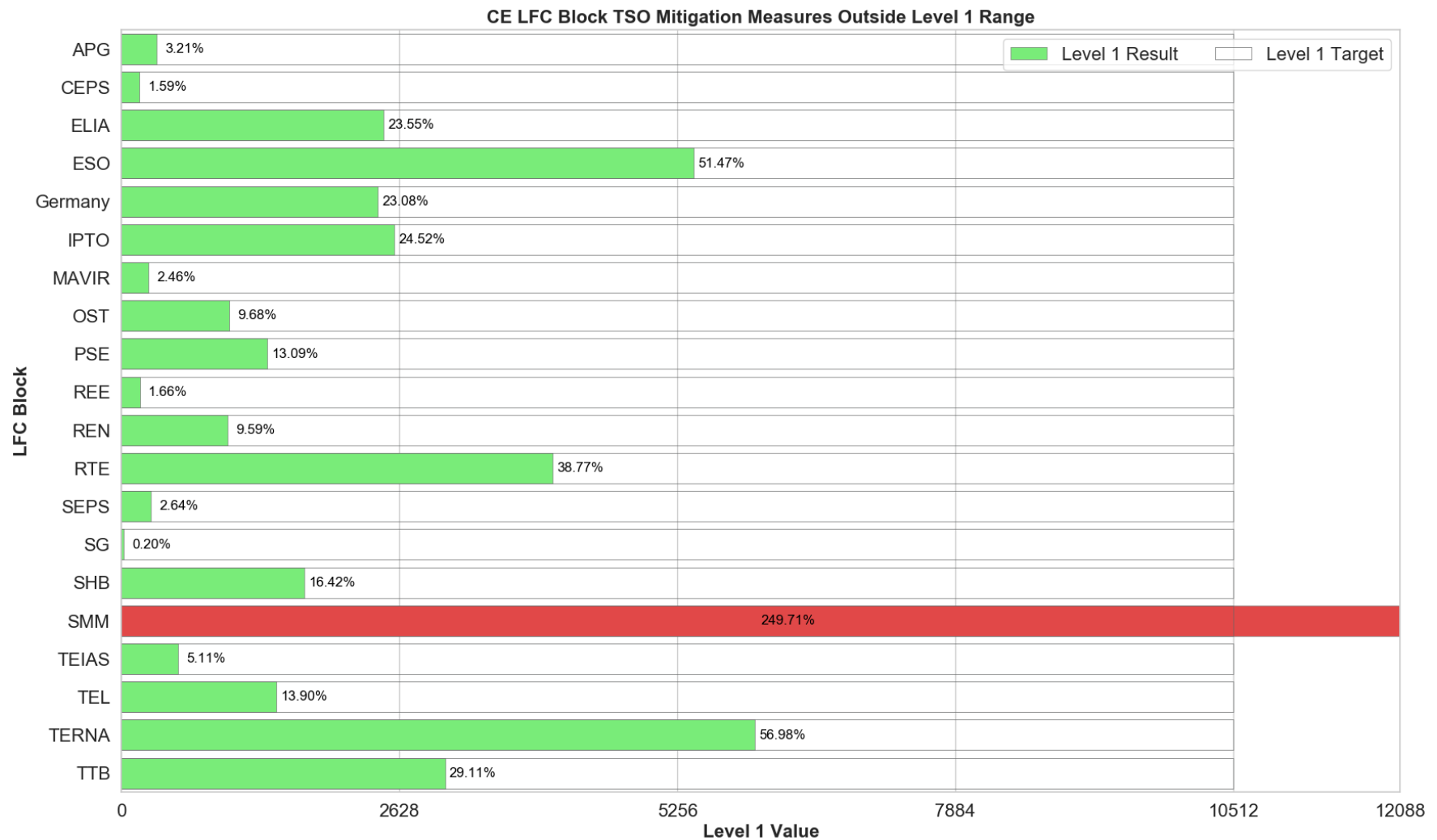


Figure 37 CE LFC Blocks 2018 TSO Mitigation Measures Level 1

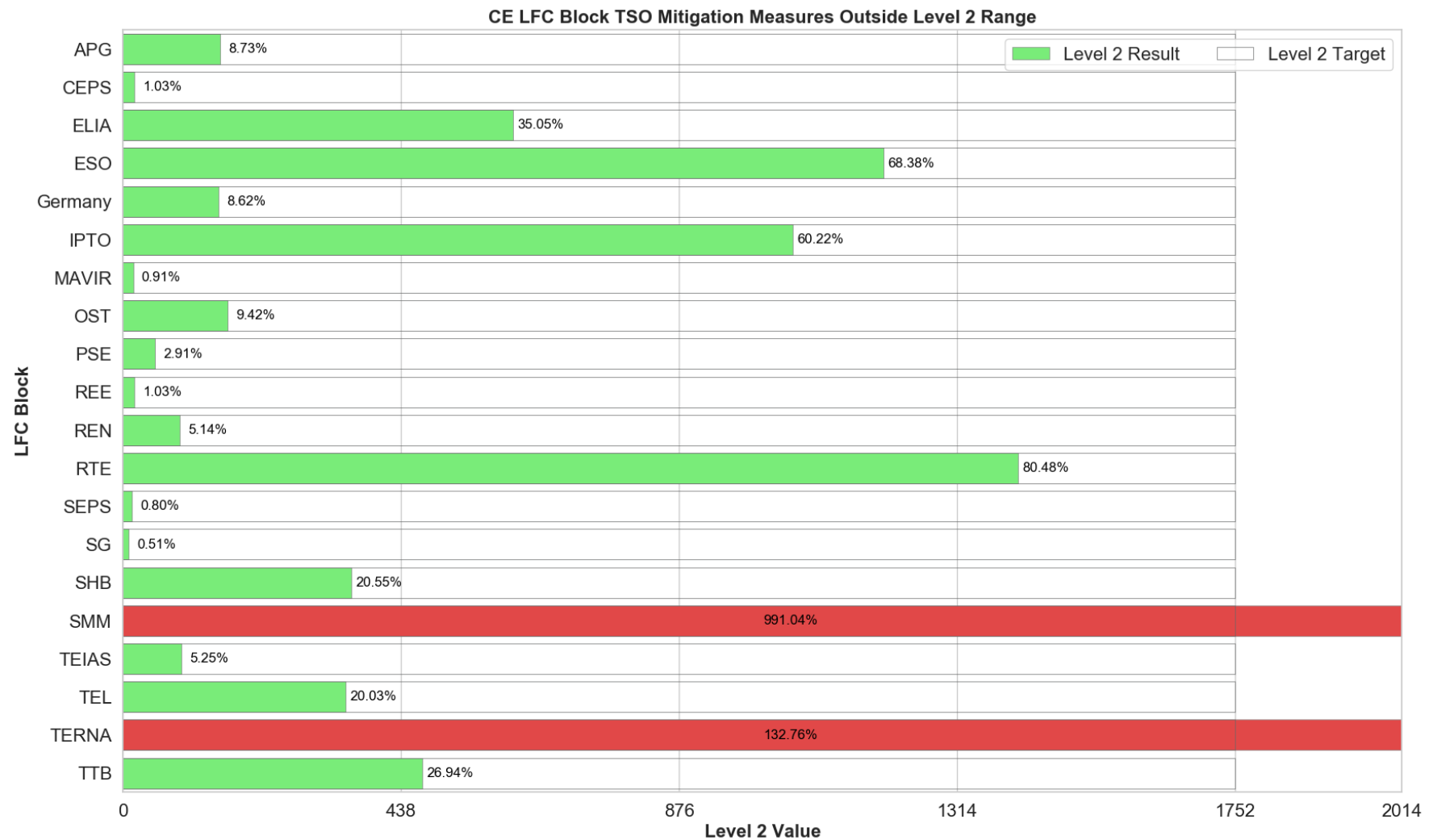


Figure 38 CE LFC Blocks 2018 TSO Mitigation Measures Level 2

I. Mitigation Measures Analysis

Annual report on load-frequency control provides a description and date of implementation of any mitigation measures and ramping requirements to alleviate deterministic frequency deviations taken in the previous calendar year in accordance with SO GL Articles 137 and 138, in which TSOs were involved.

In accordance to Article 138., when the values calculated for the period of one calendar year concerning the frequency quality target parameters are outside the targets set for the synchronous area, all TSOs of the relevant synchronous area should provide analysis and mitigation measures.

In accordance to Article 138., when the values calculated for the period of one calendar year concerning FRCE target parameters are outside the targets set for the LFC block, all TSOs of the relevant LFC block should provide analysis and mitigation measures.

According to SO GL Article 138, information contains:

(a) analysis whether the frequency quality target parameters or the FRCE target parameters will remain outside the targets set for the synchronous area or for the LFC block and in case of a justified risk that this may happen, analyse the causes and develop recommendations; and

(b) description of developed mitigation measures to ensure that the targets for the synchronous area or for the LFC block can be met in the future.

For the reporting period, Year 2017 and Year 2018, in line with Figures 35-38 following analysis and mitigation measures were reported from LFC blocks in Continental Europe:

Mitigation measures for year 2017:

ESO LFC Block

Analysis:

In the first months of year 2017 extremely cold weather was observed in Europe. This resulted in extremely high consumption and activation of all available reserves in the TSOs of the Balkan area. For several hours within the day there was no available capacity in the control areas.

SMM LFC Block

Analysis:

The FRCE quality for the SMM CB is very low due to an ongoing dispute in the SMM CB.

Mitigation measures:

EMS is covering partially the imbalance and discussions are ongoing to resolve this dispute.

Mitigation measures for year 2018:

SMM LFC Block

Analysis:

The FRCE quality for the SMM CB is very low due to an ongoing dispute in the SMM CB.

Mitigation measures:

EMS is covering partially the imbalance and discussions are ongoing to resolve this dispute.

TERNA LFC Block

Analysis:

The statistic shown is not representative of the real performance of Italian electrical system for years 2017 and 2018, as Terna as LFC Block monitor is implementing Art. 157 (FRR dimensioning rules) and Art. 137 (Ramping restrictions for active power output) in compliance with SO GL implementation process of Art. 119 (LFC Block Operational Agreement), fulfilling the timeline prescribed in Art. 119 and Art. 6. Calculation of Level 1 and Level 2 parameters is defined in accordance with Art. 118, whose entry into force was 14th April 2019 (Synchronous Area Framework Agreement); therefore Level 1 and Level 2 targets and results for years 2017 and 2018 did not exist.

4. FCR data

A. Introduction

Annual report on load-frequency control provides information for the FCR obligation and the initial FCR obligation of each TSO, covering each month of at least 2 previous calendar years. In spite of that, SO GL requests to report two separate values regarding FCR with following definitions:

- FCR obligation means the part of all of the FCR that falls under the responsibility of a TSO; and
- Initial FCR obligation means the amount of FCR allocated to a TSO on the basis of a sharing key.

Initial FCR obligation is reported on a monthly basis as an average value of FCR in MWs for reported month. For TSOs which have the same value of initial FCR obligation for the whole Year, TSO reports same value for all months for reported Year. Otherwise, if initial FCR obligation is not constant during a time, TSO reports average value of FCR on a monthly level for reported Year.

IE/NI and GB TSOs

In Tables 27-30 below the FCR is presented from January (I) to December (XII) for 2017 and 2018, respectively. The FCR requirement for the Synchronous Area of IE/NI and GB is dynamic and it varies over a day therefore it is represented as a historical monthly MW average. In calculating the “Average monthly FCR” the record spot FCR values are averaged over the monthly period. The amount of FCR obtained inside the area of TSO is also given as a percentage.

Nordic TSOs

In Figures 39 and 40 FCR is pictured for every Nordic TSO from January (I) to December (XII) for 2017 and 2018, respectively. The initial determined initial capacity for each TSO covers is the capacity for FCR-D, Frequency containment reserve for disturbance Frequency deviations < 49.9 Hz. These capacities are insured by each TSO with combinations of mandatory requirement, internal markets and a common market. The Nordic TSOs ensure that the sum of FCR-D in the synchronous area is always equal to or greater than the dimensioning incident, however inside a month the actual individual TSO areas is challenging to calculated any percentage covered in the individual TSO-areas. If value is equal to 100 %, this means that all FCR is ensured inside TSO responsibility area.

Continental Europe TSOs

In Figures 41 and 42 FCR is pictured for every for every Continental Europe TSO from January (I) to December (XII) for 2017 and 2018, respectively. If more than one TSO is operating inside the Member State (e.g. Germany) the provided value per TSO is summarized for the Member State to enable comparability. The determined value describes the amount of initial FCR obligation inside the respective TSO, divided through the amount of procured FCR inside the TSO. This value is calculated in percentage. Values higher than 100 % indicate that respective TSO exported percentage amount of FCR to other TSOs, while if reported value is lower than 100 % means that respective TSO import part of FCR from other TSOs (Part of its initial FCR obligation is contracted outside its responsibility area). If value is equal to 100 %, this mean that all FCR is ensured inside TSO responsibility area. For the case of missing or not (timely) provided data the entry shows N/A.

Following tables and figures show FCR per TSOs separately for each Synchronous Area presented in this report.

B. TSO data

I. IE/NI TSO

Table 27 IE/NI TSO FCR Statistic Year 2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	310	295	301	308	298	299	301	293	282	274	308	289
FCR obtained inside the area of TSO [%]	69%	67%	69%	72%	81%	66%	66%	62%	61%	63%	74%	69%

Table 28 IE/NI TSO FCR Statistic Year 2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	281	301	280	274	302	313	313	303	289	294	278	284
FCR obtained inside the area of TSO [%]	69%	72%	84%	71%	73%	67%	66%	67%	70%	72%	71%	76%

II. GB TSO

Table 29 GB TSO FCR Statistic Year 2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	1372	1327	1560	1657	1580	1506	1460	1519	1621	1786	1799	1583
FCR obtained inside the area of TSO [%]	68%	74%	72%	72%	82%	79%	79%	79%	78%	72%	72%	73%

Table 30 GB TSO FCR Statistic Year 2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	1455	1472	1628	1710	1780	1721	1698	1740	1913	2009	2052	2068
FCR obtained inside the area of TSO [%]	74%	77%	81%	80%	86%	88%	89%	89%	91%	84%	86%	91%

III. Nordic TSOs

Obligation	I	II	III	IV	V	Month VI	VII	VIII	IX	X	XI	XII
DK-E	176.5 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
FG	258.8 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
SN	352.9 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
SvK	411.8 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
Nordic	1200 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %

Figure 39 Nordic LFCs 2017 TSO FCR Statistics

Obligation	I	II	III	IV	V	Month VI	VII	VIII	IX	X	XI	XII
DK-E	176.5 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
FG	258.8 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
SN	352.9 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
SvK	411.8 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
Nordic	1200 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %

Figure 40 Nordic LFCs 2018 TSO FCR Statistics

IV. CE TSOs

	Obligation	Month											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
APG	62 MW	137.90 %	120.20 %	94.00 %	146.10 %	154.80 %	149.70 %	151.60 %	143.50 %	144.00 %	153.60 %	153.90 %	169.80 %
CEPS	80 MW	109.80 %	109.94 %	109.23 %	109.00 %	109.08 %	109.23 %	109.10 %	108.91 %	109.99 %	109.19 %	109.33 %	109.68 %
DK-W	21 MW	52.40 %	52.40 %	52.40 %	52.40 %	52.40 %	52.40 %	52.40 %	52.40 %	52.40 %	52.40 %	52.40 %	52.40 %
ELIA	68 MW	47.30 %	46.74 %	90.42 %	59.22 %	34.25 %	62.60 %	57.35 %	64.47 %	55.05 %	42.54 %	41.96 %	41.41 %
ESO	46 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
Amprion	219 MW	71.48 %	84.75 %	69.89 %	74.41 %	76.51 %	71.19 %	75.71 %	79.91 %	69.04 %	69.69 %	65.66 %	69.13 %
TenneT DE	184 MW	43.18 %	39.87 %	35.34 %	53.10 %	55.19 %	19.87 %	25.26 %	46.74 %	40.94 %	53.75 %	63.68 %	67.23 %
TransnetBW	78 MW	185.86 %	199.36 %	191.56 %	215.98 %	224.98 %	340.04 %	293.22 %	259.51 %	258.12 %	300.00 %	292.52 %	189.11 %
50Hertz	122 MW	186.09 %	187.91 %	198.23 %	147.73 %	119.06 %	132.87 %	161.55 %	165.81 %	183.50 %	188.66 %	199.84 %	189.11 %
Germany	603 MW	100.83 %	106.75 %	101.05 %	101.06 %	97.82 %	102.79 %	105.82 %	110.40 %	108.08 %	118.69 %	121.55 %	114.47 %
IPTO	43 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
MAVIR	28 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
OST	6 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
PSE	158 MW	108.81 %	109.35 %	108.28 %	108.28 %	108.55 %	108.69 %	109.12 %	109.04 %	107.65 %	108.41 %	108.91 %	108.72 %
REE	380 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
REN	50 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
RTE	561 MW	108.00 %	108.00 %	105.00 %	106.00 %	109.00 %	96.00 %	99.00 %	91.00 %	97.00 %	90.00 %	86.00 %	89.00 %
SEPS	26 MW	73.67 %	75.18 %	72.84 %	75.53 %	78.08 %	73.85 %	74.74 %	74.84 %	71.13 %	75.77 %	74.39 %	71.35 %
SG	68 MW	121.00 %	74.00 %	101.00 %	81.00 %	93.00 %	153.00 %	149.00 %	150.00 %	132.00 %	114.00 %	115.00 %	143.00 %
HOPS	10 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
NOS BiH	16 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
ELES	14 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
EMS	42 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
MEPSO	5 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
CGES	3 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
SMM	50 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
TEIAS	267 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
TEL	61 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
TERNA	267 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
TTB	107 MW	48.60 %	59.95 %	73.74 %	69.35 %	74.59 %	45.45 %	39.92 %	54.09 %	48.38 %	40.58 %	45.02 %	44.35 %

Figure 41 CE LFCs 2017 TSO FCR Statistics

	Obligation	Month											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
APG	64 MW	140.23 %	115.63 %	115.00 %	129.30 %	112.50 %	94.38 %	120.31 %	128.44 %	137.89 %	123.44 %	106.56 %	99.61 %
CEPS	78 MW	109.47 %	109.54 %	110.17 %	109.81 %	110.14 %	108.55 %	109.51 %	109.54 %	109.62 %	109.79 %	110.13 %	110.13 %
DK-W	20 MW	50.00 %	50.00 %	50.00 %	50.00 %	50.00 %	50.00 %	50.00 %	50.00 %	50.00 %	50.00 %	50.00 %	50.00 %
ELIA	81 MW	52.61 %	37.04 %	34.14 %	37.33 %	49.90 %	34.40 %	33.17 %	55.56 %	42.65 %	43.65 %	40.04 %	39.35 %
ESO	41 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
Amprion	225 MW	63.70 %	59.38 %	71.46 %	72.49 %	61.79 %	51.72 %	53.59 %	65.91 %	64.79 %	67.89 %	69.13 %	65.94 %
TenneT DE	189 MW	55.50 %	57.22 %	54.12 %	51.80 %	28.38 %	44.36 %	51.36 %	50.20 %	57.83 %	61.80 %	58.17 %	61.84 %
TransnetBW	80 MW	267.74 %	246.43 %	308.67 %	274.56 %	282.46 %	249.38 %	163.99 %	198.47 %	225.88 %	223.02 %	251.71 %	253.99 %
50Hertz	126 MW	187.02 %	207.20 %	215.72 %	223.44 %	227.62 %	228.70 %	193.83 %	211.24 %	218.60 %	229.34 %	211.43 %	194.01 %
Germany	620 MW	112.59 %	112.90 %	126.10 %	122.92 %	113.78 %	110.95 %	95.66 %	107.76 %	114.71 %	118.86 %	118.26 %	114.98 %
IPTO	43 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
MAVIR	28 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
OST	7 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
PSE	155 MW	112.47 %	110.84 %	113.04 %	111.35 %	110.94 %	110.92 %	111.66 %	111.36 %	112.12 %	111.51 %	111.09 %	110.39 %
REE	368 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
REN	56 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
RTE	536 MW	93.21 %	98.96 %	92.22 %	95.45 %	96.46 %	99.68 %	111.11 %	91.29 %	89.42 %	92.00 %	94.57 %	90.80 %
SEPS	26 MW	70.70 %	70.58 %	72.93 %	81.51 %	81.90 %	79.18 %	73.31 %	72.51 %	79.39 %	76.16 %	71.32 %	71.22 %
SG	62 MW	158.00 %	170.00 %	97.00 %	76.00 %	161.00 %	212.00 %	221.00 %	249.00 %	207.00 %	157.00 %	160.00 %	187.00 %
HOPS	11 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
NOS BiH	16 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
ELES	15 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
EMS	43 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
MEPSO	5 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
CGES	3 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
SMM	51 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
TEIAS	275 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
TEL	63 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
TERNA	265 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
TTB	111 MW	44.41 %	31.15 %	31.04 %	31.47 %	31.85 %	30.81 %	31.07 %	32.05 %	31.05 %	30.63 %	31.14 %	31.36 %

Figure 42 CE LFCs 2018 TSO FCR Statistics

A. Appendix

Country	TSO (full company name)	TSO (short name)
Austria	Austrian Power Grid AG	APG
Belgium	Elia System Operator SA	Elia
Bosnia and Herzegovina	Nezavisni operator sustava u Bosni i Hercegovini	NOS BiH
Bulgaria	Electroenergien Sistemen Operator EAD	ESO
Croatia	HOPS d.o.o.	HOPS
Czech Republic	ČEPS a.s.	ČEPS
Denmark	Energinet	EN
Estonia	Elering AS	Elering AS
Finland	Fingrid Oyj	Fingrid
France	Réseau de Transport d'Electricité	RTE
Germany	TransnetBW GmbH	TransnetBW
Germany	TenneT TSO GmbH	TenneT DE
Germany	Amprion GmbH	Amprion
Germany	50Hertz Transmission GmbH	50Hertz
Great Britain	National Grid Electricity System Operator Limited	NGESO (National Grid ESO)
Great Britain	System Operator for Northern Ireland Ltd	SONI
Greece	Independent Power Transmission Operator S.A.	IPTO
Hungary	MAVIR Magyar Villamosenergia-ipari Átviteli Rendszerirányító Zártkörűen Működő Részvénytársaság	MAVIR ZRt.
Ireland	EirGrid plc	EirGrid
Italy	Terna - Rete Elettrica Nazionale SpA	Terna
Latvia	AS Augstsprieguma tīkls	AST
Lithuania	Litgrid AB	Litgrid
Luxembourg	Creos Luxembourg S.A.	CREOS
Montenegro	Crnogorski elektroprenosni sistem AD	CGES
Netherlands	TenneT TSO B.V.	TenneT NL
Norway	Statnett SF	Statnett
Poland	Polskie Sieci Elektroenergetyczne S.A.	PSE S.A.
Portugal	Rede Eléctrica Nacional, S.A.	REN
Republic of North Macedonia	Transmission System Operator of the Republic of North Macedonia	MEPSO
Romania	C.N. Transelectrica S.A.	Transelectrica
Serbia	Joint Stock Company Elektromreža Srbije	EMS
Slovak Republic	Slovenská elektrizačná prenosová sústava, a.s.	SEPS
Slovenia	Sistemiški operater prenosnega elektroenergetskega omrežja Republike Slovenije	ELES
Spain	Red Eléctrica de España S.A.	REE
Sweden	Svenska Kraftnät	SVENSKA KRAFTNÄT, SVK
Switzerland	Swissgrid AG	Swissgrid
Turkey	TEİAŞ	TEİAŞ

Abbreviation	Meaning
FCR	Frequency Containment Reserves
aFRR	Automatic Frequency Restoration Reserves
mFRR	Manual Frequency Restoration Reserves
TSO	Transmission System Operator
CE	Continental Europe
IE/NI	Ireland and Northern Ireland
FRCE	Frequency Restoration Control Error
StG	Steering Group Operations
SOC	System Operations Committee
TO	Transmission owner
GB	Great Britain
No.	Number
Avg.	Average
Level +	Level positive
Level -	Level negative
Dev	Deviation

B. Appendix – CE LFC Block data

APG

2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-1,6	0	0,4	-0,1	-0,3	1,1	0,7	-0,3	0	0,6	0,2	0,5	0,1
The standard deviation	31	29	31	29	26	32	23	23	20	28	25	24	27
1-percentile	-102	-79	-77	-80	-75	-72	-58	-64	-63	-83	-69	-67	-74
5-percentile	-40	-43	-44	-38	-37	-33	-28	-27	-26	-35	-33	-31	-35
10-percentile	-24	-29	-32	-25	-25	-22	-18	-17	-16	-22	-22	-20	-23
90-percentile	22	30	32	27	25	22	19	18	17	23	23	21	23
95-percentile	34	44	44	38	37	35	29	28	27	37	34	32	35
99-percentile	71	79	77	78	68	78	62	59	63	92	70	72	72
Number of time intervals: average FRCE > Level 1 positive	3	5	6	9	1	12	10	1	0	9	2	8	6
Number of time intervals: average FRCE < Level 1 negative	27	4	3	11	7	5	0	6	0	2	1	0	6
Number of time intervals: average FRCE > Level 2 positive	0	2	2	3	0	9	7	0	0	1	0	2	2
Number of time intervals: average FRCE < Level 2 negative	8	2	0	5	3	1	0	4	0	0	1	0	2
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	2	1	1	0	4	2	0	0	0	0	2	1
Number of events: FRCE < -60 % FRR capacity+ and not > 15 % FRR capacity+ within 15 min	3	1	0	1	0	0	0	2	0	0	0	0	1

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0,2	0,5	0	0,3	0,3	0,9	0,2	1,1	1,5	-4,3	0,6	-3,7	-0,2
The standard deviation	28	30	27	28	24	30	28	26	31	56	38	45	32
1-percentile	-80	-80	-80	-81	-77	-74	-84	-69	-83	-243	-114	-170	-103
5-percentile	-39	-43	-38	-35	-33	-34	-36	-26	-33	-66	-43	-66	-41
10-percentile	-26	-29	-25	-22	-19	-21	-20	-14	-17	-34	-24	-35	-24
90-percentile	26	29	26	23	20	22	22	15	19	27	25	27	23
95-percentile	38	43	38	36	34	36	36	28	36	47	44	43	38
99-percentile	70	81	73	87	78	87	82	82	104	126	117	104	91
Number of time intervals: average FRCE > Level 1 positive	3	6	4	8	2	17	4	18	22	29	18	19	12
Number of time intervals: average FRCE < Level 1 negative	10	0	8	5	1	8	4	1	3	82	15	90	19
Number of time intervals: average FRCE > Level 2 positive	0	3	2	2	0	10	1	10	11	10	6	7	5
Number of time intervals: average FRCE < Level 2 negative	2	0	2	1	0	4	2	0	2	47	5	26	8
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	2	0	1	0	4	2	3	4	5	0	2	2
Number of events: FRCE < -60 % FRR capacity+ and not > 15 % FRR capacity+ within 15 min	0	0	0	0	0	1	0	0	0	10	1	6	2

CEPS

2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0,1	-0,2	-0,1	0	-0,1	-0,1	-0,1	0	0,1	-0,2	-0,2	-0,4	-0,1
The standard deviation	50	46	48	46	41	37	33	38	43	46	46	48	44
1-percentile	-139	-137	-141	-129	-122	-99	-89	-104	-121	-137	-130	-144	-124
5-percentile	-61	-59	-62	-58	-51	-47	-45	-48	-55	-60	-58	-61	-55
10-percentile	-41	-39	-41	-38	-34	-32	-31	-32	-37	-40	-39	-41	-37
90-percentile	42	38	39	36	33	32	30	31	35	40	38	40	36
95-percentile	66	61	63	58	52	48	46	49	56	62	61	64	57
99-percentile	154	148	164	157	130	109	101	123	143	147	157	155	141
Number of time intervals: average FRCE > Level 1 positive	11	12	8	2	5	3	3	3	1	8	6	14	76
Number of time intervals: average FRCE < Level 1 negative	13	4	13	14	7	3	1	9	12	12	14	10	112
Number of time intervals: average FRCE > Level 2 positive	2	1	2	0	0	0	0	0	0	0	1	1	7
Number of time intervals: average FRCE < Level 2 negative	2	0	2	1	0	0	0	0	1	2	2	0	10
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	1	0	1
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	1	0	0	1

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0,4	0,2	-0,1	-0,2	0	-0,1	-0,1	0,2	-0,2	0,1	-0,1	0	-0,1
The standard deviation	45	49	46	46	40	39	32	33	42	51	46	42	43
1-percentile	-136	-144	-134	-138	-115	-109	-90	-91	-114	-158	-134	-120	-124
5-percentile	-59	-63	-60	-57	-50	-51	-44	-45	-56	-64	-59	-54	-55
10-percentile	-39	-41	-39	-37	-33	-36	-30	-30	-38	-43	-40	-37	-37
90-percentile	37	41	38	36	33	36	30	30	37	44	40	37	37
95-percentile	60	66	62	57	51	54	45	46	57	69	62	58	57
99-percentile	145	164	153	155	127	118	95	102	133	172	151	136	138
Number of time intervals: average FRCE > Level 1 positive	10	7	4	10	5	4	1	0	7	16	10	5	79
Number of time intervals: average FRCE < Level 1 negative	5	11	11	10	7	2	0	5	6	20	6	5	88
Number of time intervals: average FRCE > Level 2 positive	1	0	0	1	0	0	0	0	2	2	1	1	8
Number of time intervals: average FRCE < Level 2 negative	0	1	1	0	1	0	0	3	0	4	0	0	10
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	1	0	1	0	2
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

ELIA**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-7,6	12,8	12,2	1	-3,7	2,6	3,3	-1,2	-0,2	-1,4	-4,5	-2,9	0,8
The standard deviation	58	53	51	33	41	38	35	28	36	50	51	63	46
1-percentile	-209	-126	-113	-121	-153	-106	-113	-102	-133	-176	-177	-211	-152
5-percentile	-111	-53	-44	-43	-66	-41	-32	-38	-51	-92	-95	-94	-66
10-percentile	-65	-28	-23	-22	-32	-24	-16	-19	-23	-51	-55	-48	-32
90-percentile	37	71	64	28	21	31	28	17	25	43	41	34	37
95-percentile	64	111	104	48	41	55	51	32	48	73	71	68	65
99-percentile	155	191	193	108	112	136	136	80	118	142	145	210	151
Number of time intervals: average FRCE > Level 1 positive	110	234	221	61	61	99	74	29	68	130	102	122	1311
Number of time intervals: average FRCE < Level 1 negative	240	68	73	64	114	57	55	55	76	176	192	190	1360
Number of time intervals: average FRCE > Level 2 positive	30	64	75	9	13	22	24	3	10	24	26	50	350
Number of time intervals: average FRCE < Level 2 negative	73	10	14	12	30	12	13	12	15	55	53	61	360
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1,6	0,4	-3,4	1,7	-4,9	-3	-4,4	-2,2	1,6	-2,6	-4,4	-2,4	-1,9
The standard deviation	49	52	54	47	41	38	36	37	46	58	51	57	48
1-percentile	-182	-168	-196	-149	-161	-143	-145	-134	-136	-192	-183	-173	-167
5-percentile	-68	-81	-97	-73	-77	-58	-55	-51	-62	-98	-93	-90	-76
10-percentile	-36	-44	-51	-36	-42	-33	-30	-26	-33	-58	-52	-47	-40
90-percentile	42	43	41	41	24	23	17	18	38	48	37	33	33
95-percentile	76	79	72	79	46	43	31	39	74	84	69	63	63
99-percentile	161	182	168	169	121	116	87	107	158	174	141	174	150
Number of time intervals: average FRCE > Level 1 positive	119	112	104	116	50	54	29	47	111	132	91	94	1059
Number of time intervals: average FRCE < Level 1 negative	110	114	170	102	124	75	85	76	80	177	150	154	1417
Number of time intervals: average FRCE > Level 2 positive	25	32	30	30	17	4	8	10	24	34	16	32	262
Number of time intervals: average FRCE < Level 2 negative	36	27	48	21	28	16	25	13	17	48	42	31	352
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

ESO**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-2	5	11,4	1,6	7,2	3,8	3,7	-4,1	2	5,5	-0,3	3,7	3,1
The standard deviation	50	61	80	66	59	58	58	60	58	66	61	64	62
1-percentile	-139	-153	-198	-193	-157	-150	-159	-165	-155	-177	-155	-174	-164
5-percentile	-84	-85	-113	-112	-88	-92	-88	-106	-100	-106	-102	-101	-98
10-percentile	-61	-59	-79	-77	-57	-61	-57	-76	-66	-71	-74	-70	-67
90-percentile	50	70	105	78	78	73	68	67	72	82	71	76	75
95-percentile	77	103	146	111	112	104	99	96	99	113	104	111	107
99-percentile	128	198	240	170	182	170	181	145	152	185	161	192	181
Number of time intervals: average FRCE > Level 1 positive	208	287	573	363	364	334	309	308	321	396	323	380	4166
Number of time intervals: average FRCE < Level 1 negative	249	228	377	351	253	256	227	372	291	327	342	317	3590
Number of time intervals: average FRCE > Level 2 positive	35	87	218	110	114	92	85	64	67	117	82	114	1185
Number of time intervals: average FRCE < Level 2 negative	46	59	107	110	57	60	59	98	83	103	78	79	939
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	17	33	96	62	49	56	41	33	40	58	50	51	586
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	5	3	10	13	6	9	13	9	4	8	8	7	95

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	2,7	2,9	-1,6	4,3	0,5	1,8	2,1	0,5	-1,2	-0,6	-1,5	-1,9	0,6
The standard deviation	62	68	65	53	40	41	39	34	43	43	46	44	49
1-percentile	-161	-182	-180	-129	-108	-103	-99	-94	-126	-128	-136	-129	-140
5-percentile	-102	-110	-111	-77	-66	-62	-61	-57	-71	-77	-79	-80	-80
10-percentile	-69	-74	-80	-52	-46	-45	-43	-40	-51	-52	-54	-55	-54
90-percentile	73	78	72	61	46	48	48	39	47	47	46	49	54
95-percentile	106	111	103	87	67	66	65	56	67	67	72	68	78
99-percentile	180	192	169	168	110	118	113	94	112	117	123	111	141
Number of time intervals: average FRCE > Level 1 positive	376	370	364	270	162	157	166	113	166	165	176	169	2654
Number of time intervals: average FRCE < Level 1 negative	335	350	412	212	168	139	144	122	189	225	225	236	2757
Number of time intervals: average FRCE > Level 2 positive	111	121	110	74	21	27	27	9	22	29	35	20	606
Number of time intervals: average FRCE < Level 2 negative	99	117	127	36	18	16	14	8	38	39	41	39	592
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	57	57	52	22	10	10	7	6	9	10	16	6	262
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	4	12	7	3	0	1	1	0	1	0	2	3	34

Germany

2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	21,8	33,2	20,8	30,5	25,5	11,4	0,6	-5,4	3	32,8	62,6	76,9	26,2
The standard deviation	143	140	128	125	115	112	106	112	119	133	133	125	124
1-percentile	-129	-116	-117	-101	-94	-85	-107	-110	-114	-148	-119	-91	-111
5-percentile	-72	-62	-67	-55	-56	-51	-67	-74	-71	-76	-26	-12	-58
10-percentile	-45	-32	-41	-35	-35	-35	-48	-57	-53	-41	-2	9	-34
90-percentile	82	93	82	97	86	61	49	46	58	106	124	150	86
95-percentile	103	116	105	114	104	80	66	65	77	127	142	169	106
99-percentile	159	169	165	151	138	122	101	106	122	168	192	212	150
Number of time intervals: average FRCE > Level 1 positive	7	5	11	3	0	1	0	0	4	0	4	10	45
Number of time intervals: average FRCE < Level 1 negative	3	1	2	1	0	0	1	0	1	4	5	0	18
Number of time intervals: average FRCE > Level 2 positive	0	0	1	0	0	0	0	0	1	0	0	4	6
Number of time intervals: average FRCE < Level 2 negative	1	0	0	0	0	0	0	0	0	0	2	0	0
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	1	0	1

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	64,7	48,9	24,4	36,5	13,9	-4,5	14	-3,3	16	27,4	3,5	2,6	20,3
The standard deviation	61	51	70	65	78	55	41	61	75	67	84	62	64
1-percentile	-80	-94	-117	-117	-152	-140	-84	-132	-136	-138	-231	-143	-130
5-percentile	-24	-41	-75	-66	-116	-91	-50	-90	-81	-81	-119	-90	-77
10-percentile	-1	-15	-54	-43	-94	-70	-35	-72	-57	-51	-80	-66	-53
90-percentile	118	106	109	108	100	59	63	63	89	100	93	73	90
95-percentile	137	122	136	128	120	79	79	93	114	128	130	105	114
99-percentile	200	172	194	184	163	124	117	169	169	202	232	174	175
Number of time intervals: average FRCE > Level 1 positive	16	2	11	9	3	2	1	11	12	15	24	11	117
Number of time intervals: average FRCE < Level 1 negative	1	0	3	2	5	3	0	3	6	3	24	3	53
Number of time intervals: average FRCE > Level 2 positive	9	0	4	1	0	0	0	1	2	2	1	1	21
Number of time intervals: average FRCE < Level 2 negative	0	0	0	0	2	0	0	0	2	1	6	1	12
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	1	0	2	1	0	0	0	0	1	0	0	0	5
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	2	0	0	1	3

IPTO**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-16,9	21,2	19,9	20,2	17,6	5,1	8,4	10,1	8,8	14,6	8	26,8	11,9
The standard deviation	77	59	52	55	50	30	37	39	37	43	32	67	51
1-percentile	-433	-67	-58	-74	-70	-68	-75	-63	-90	-39	-63	-59	-102
5-percentile	-125	-27	-21	-24	-21	-22	-23	-21	-26	-12	-14	-11	-25
10-percentile	-75	-15	-14	-14	-14	-14	-13	-12	-14	-6	-7	-5	-14
90-percentile	22	77	71	77	64	26	35	38	43	50	30	98	50
95-percentile	40	137	123	129	113	46	70	84	74	108	61	150	98
99-percentile	106	278	241	262	235	124	163	180	145	196	142	295	215
Number of time intervals: average FRCE > Level 1 positive	85	323	330	354	303	92	159	85	183	254	140	443	2751
Number of time intervals: average FRCE < Level 1 negative	336	34	21	33	34	31	39	336	54	18	28	27	991
Number of time intervals: average FRCE > Level 2 positive	21	161	156	165	133	31	69	21	52	116	48	233	1206
Number of time intervals: average FRCE < Level 2 negative	165	4	7	6	2	8	10	165	20	7	9	9	412
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	49	135	134	130	143	52	72	91	103	97	73	153	1232
Number of events: FRCE < -60 % FRR capacity+ and not > 15 % FRR capacity+ within 15 min	15	2	2	3	0	1	4	3	2	2	4	2	40

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	15,4	16,6	21,5	12	13	9,1	8,1	10,6	5,3	4,2	7,2	15,6	11,5
The standard deviation	44	46	54	45	34	28	27	36	24	23	32	47	38
1-percentile	-64	-54	-68	-53	-22	-15	-34	-43	-55	-46	-38	-38	-43
5-percentile	-13	-11	-14	-13	-8	-7	-9	-11	-13	-23	-10	-9	-21
10-percentile	-7	-6	-7	-7	-5	-4	-5	-6	-7	-12	-5	-5	-6
90-percentile	62	64	100	43	43	24	27	42	22	33	25	50	40
95-percentile	107	112	163	87	82	60	56	79	38	65	57	111	84
99-percentile	180	207	215	191	165	137	124	178	93	99	140	240	174
Number of time intervals: average FRCE > Level 1 positive	291	271	406	207	208	138	129	195	69	77	125	242	2358
Number of time intervals: average FRCE < Level 1 negative	30	24	32	20	2	2	11	22	25	19	18	15	220
Number of time intervals: average FRCE > Level 2 positive	105	118	232	91	76	41	36	68	18	16	39	136	976
Number of time intervals: average FRCE < Level 2 negative	15	12	9	6	0	1	5	7	8	5	8	3	79
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	148	116	131	83	94	61	75	91	44	40	71	107	1061
Number of events: FRCE < -60 % FRR capacity+ and not > 15 % FRR capacity+ within 15 min	5	7	0	1	0	0	2	2	1	3	2	2	25

MAVIR2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1,8	0,3	0,9	-0,3	0,3	0,9	1,2	1,2	0,2	-0,3	-0,8	1,1	0,5
The standard deviation	23	19	19	17	16	15	15	16	17	17	19	20	18
1-percentile	-41	-41	-42	-39	-38	-35	-31	-33	-38	-39	-39	-41	-38
5-percentile	-29	-27	-28	-25	-24	-23	-24	-23	-26	-27	-29	-28	-26
10-percentile	-22	-21	-22	-20	-18	-17	-18	-18	-20	-21	-23	-22	-20
90-percentile	29	24	24	20	20	20	20	21	21	22	21	25	22
95-percentile	39	32	34	27	26	26	26	27	28	30	31	34	30
99-percentile	68	54	53	43	40	41	38	41	44	48	47	53	48
Number of time intervals: average FRCE > Level 1 positive	70	32	33	9	5	7	2	9	13	21	16	32	249
Number of time intervals: average FRCE < Level 1 negative	11	11	16	13	11	3	1	1	2	4	6	8	87
Number of time intervals: average FRCE > Level 2 positive	16	0	0	0	0	3	1	1	0	0	4	1	26
Number of time intervals: average FRCE < Level 2 negative	2	4	3	3	2	0	0	1	0	0	3	0	18
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0,1	0,1	1,2	0,6	0,3	0,6	1,2	1,4	0,7	-0,1	0	-0,3	0,5
The standard deviation	19	18	18	17	16	17	15	16	16	16	18	17	17
1-percentile	-36	-38	-38	-40	-38	-39	-33	-33	-36	-34	-36	-37	-36
5-percentile	-26	-26	-26	-26	-25	-25	-23	-24	-24	-25	-26	-26	-25
10-percentile	-22	-21	-20	-20	-18	-19	-17	-18	-18	-20	-20	-20	-20
90-percentile	24	22	24	21	19	20	20	21	20	21	22	21	21
95-percentile	34	30	33	29	27	28	26	28	29	29	32	29	29
99-percentile	52	48	49	47	44	43	41	40	43	46	52	45	46
Number of time intervals: average FRCE > Level 1 positive	30	19	23	15	13	14	6	10	9	16	31	18	204
Number of time intervals: average FRCE < Level 1 negative	1	2	6	8	13	10	3	1	1	3	1	6	55
Number of time intervals: average FRCE > Level 2 positive	2	0	0	1	0	3	1	1	0	0	1	1	10
Number of time intervals: average FRCE < Level 2 negative	0	1	1	1	0	1	0	1	0	0	0	1	6
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	1	0	0	0	0	0	0	1
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

OST**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-6,8	0,8	-0,2	-0,5	1,1	-0,5	0	3,1	1,2	-0,3	1,6	-0,3	-0,1
The standard deviation	25	6	4	4	6	5	5	9	7	5	7	7	8
1-percentile	-112	-11	-11	-11	-12	-18	-13	-13	-13	-14	-12	-20	-22
5-percentile	-59	-7	-7	-7	-7	-9	-7	-8	-9	-8	-7	-10	-12
10-percentile	-25	-5	-5	-5	-5	-6	-5	-5	-6	-6	-6	-7	-7
90-percentile	4	6	4	4	8	5	5	18	9	5	10	6	7
95-percentile	8	10	6	6	13	6	7	25	13	8	14	10	10
99-percentile	23	24	10	11	25	10	13	32	24	14	29	28	20
Number of time intervals: average FRCE > Level 1 positive	33	32	0	0	47	2	7	179	33	6	52	37	428
Number of time intervals: average FRCE < Level 1 negative	308	1	0	2	0	8	9	4	4	11	1	23	371
Number of time intervals: average FRCE > Level 2 positive	7	0	0	0	0	1	1	5	0	1	6	7	28
Number of time intervals: average FRCE < Level 2 negative	210	0	0	0	0	0	3	0	0	1	0	1	215
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0,2	-5,7	2,2	3,2	0,4	0,6	0,1	0,1	0	0,2	0,7	0,3	0,2
The standard deviation	4	16	19	10	4	4	3	4	3	4	6	5	7
1-percentile	-11	-63	-68	-22	-11	-9	-9	-10	-10	-12	-12	-11	-21
5-percentile	-7	-39	-30	-8	-6	-5	-5	-6	-5	-6	-6	-6	-11
10-percentile	-5	-29	-18	-5	-4	-3	-4	-4	-4	-4	-4	-4	-7
90-percentile	4	6	24	14	5	5	4	4	4	4	6	5	7
95-percentile	6	9	31	25	6	6	6	5	6	6	9	8	10
99-percentile	11	17	45	40	10	11	9	10	10	11	28	15	18
Number of time intervals: average FRCE > Level 1 positive	1	3	273	142	0	1	0	1	0	6	35	5	467
Number of time intervals: average FRCE < Level 1 negative	2	313	206	17	3	1	0	0	0	6	1	2	551
Number of time intervals: average FRCE > Level 2 positive	0	0	17	4	0	0	0	0	0	0	4	0	25
Number of time intervals: average FRCE < Level 2 negative	0	60	77	1	2	0	0	0	0	0	0	0	140
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

PSE**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1,4	1,5	2,8	1,7	2,2	1,2	1,9	2,6	2,5	4	1,9	1,4	N/A
The standard deviation	55	55	57	57	56	55	53	59	58	56	56	58	N/A
1-percentile	-135	-135	-126	-134	-127	-137	-126	-137	-131	-133	-144	-131	N/A
5-percentile	-92	-89	-86	-91	-87	-85	-83	-91	-94	-87	-85	-95	N/A
10-percentile	-67	-68	-67	-68	-65	-63	-62	-68	-68	-64	-64	-72	N/A
90-percentile	68	70	72	73	71	68	68	74	75	72	69	72	N/A
95-percentile	90	94	94	98	94	91	93	99	96	98	94	93	N/A
99-percentile	140	142	151	155	150	146	143	157	153	149	143	151	N/A
Number of time intervals: average FRCE > Level 1 positive	42	47	59	68	61	56	39	73	66	64	51	61	687
Number of time intervals: average FRCE < Level 1 negative	55	37	33	37	30	38	31	48	36	37	52	43	477
Number of time intervals: average FRCE > Level 2 positive	2	0	5	2	3	2	1	4	3	1	2	2	27
Number of time intervals: average FRCE < Level 2 negative	0	0	1	0	3	1	0	1	2	0	3	1	12
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	1	1	2	0	0	0	2	2	1	2	0	1	12
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	1	0	0	0	0	1	0	0	1	0	3

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	3,2	3,9	2,4	1,7	1,9	1	0,5	0,4	0,2	0,7	0,1	0,9	N/A
The standard deviation	57	57	57	58	56	56	59	60	62	61	60	57	N/A
1-percentile	-134	-140	-137	-140	-135	-141	-137	-143	-154	-159	-151	-151	N/A
5-percentile	-89	-87	-90	-89	-90	-90	-93	-93	-107	-98	-99	-92	N/A
10-percentile	-63	-66	-67	-69	-67	-68	-70	-72	-75	-72	-71	-68	N/A
90-percentile	73	75	73	72	69	69	73	75	76	75	70	70	N/A
95-percentile	96	100	95	96	91	94	97	103	103	100	94	94	N/A
99-percentile	144	150	153	151	142	137	159	154	153	157	146	143	N/A
Number of time intervals: average FRCE > Level 1 positive	55	64	56	52	48	52	73	84	67	73	54	52	730
Number of time intervals: average FRCE < Level 1 negative	43	40	44	50	44	42	50	49	82	78	71	53	646
Number of time intervals: average FRCE > Level 2 positive	4	1	0	2	4	2	1	3	2	0	3	0	22
Number of time intervals: average FRCE < Level 2 negative	3	0	2	2	1	3	2	1	4	5	2	4	29
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	3	1	0	1	2	0	0	0	1	0	1	0	9
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	1	0	1	0	0	0	1	1	1	0	0	1	6

REE**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-10,5	-3,7	0,2	-3,1	-5,3	-3,3	0,5	4,5	-4	-5,2	2,3	-1,1	-2,4
The standard deviation	53	53	46	44	45	42	42	40	42	46	50	50	46
1-percentile	-163	-137	-121	-123	-120	-102	-101	-87	-103	-117	-139	-129	-122
5-percentile	-93	-82	-72	-70	-69	-63	-60	-54	-66	-73	-74	-72	-70
10-percentile	-66	-57	-51	-52	-53	-49	-45	-41	-51	-54	-53	-52	-52
90-percentile	41	50	46	43	41	42	47	49	40	45	54	50	46
95-percentile	59	68	61	60	59	58	62	66	59	63	74	71	64
99-percentile	136	135	110	106	102	111	117	131	109	121	132	132	122
Number of time intervals: average FRCE > Level 1 positive	11	12	5	7	6	5	6	4	6	10	12	15	99
Number of time intervals: average FRCE < Level 1 negative	20	15	11	6	14	5	8	0	4	8	13	10	114
Number of time intervals: average FRCE > Level 2 positive	2	1	0	0	3	0	0	0	1	1	1	5	14
Number of time intervals: average FRCE < Level 2 negative	1	2	2	0	2	1	0	0	0	0	1	0	9
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	3	3	0	0	3	0	1	0	1	0	0	3	14
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	2	0	0	1	2	0	0	0	0	0	0	5

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0,9	2,5	2	-10,8	-9,9	-4,3	-0,4	-9,8	-6,7	-3,5	-6,5	-8,3	-4,6
The standard deviation	48	52	50	46	40	39	38	38	44	49	49	38	45
1-percentile	-116	-142	-135	-121	-120	-112	-99	-104	-111	-120	-142	-105	-120
5-percentile	-66	-81	-80	-78	-68	-61	-60	-68	-72	-74	-74	-68	-71
10-percentile	-50	-56	-55	-60	-54	-47	-44	-52	-55	-54	-57	-51	-53
90-percentile	50	57	54	39	32	40	42	33	40	49	45	35	43
95-percentile	69	74	75	58	47	53	55	46	53	69	63	52	60
99-percentile	129	122	123	121	83	87	85	80	107	124	135	92	110
Number of time intervals: average FRCE > Level 1 positive	14	8	5	11	3	1	1	2	12	10	11	3	81
Number of time intervals: average FRCE < Level 1 negative	6	14	10	8	5	9	6	3	8	10	13	1	93
Number of time intervals: average FRCE > Level 2 positive	3	1	1	0	1	0	0	0	1	0	1	0	8
Number of time intervals: average FRCE < Level 2 negative	1	2	2	1	1	0	0	1	1	1	0	0	10
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	2	1	0	3	1	0	0	0	2	2	3	1	15
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	1	0	0	0	0	0	0	2	1	1	0	0	5

REN**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0,1	-0,7	-1	-0,6	-0,9	0,6	-2	-2,1	-2,8	-2,8	-1,8	2,7	-0,9
The standard deviation	23	23	23	26	24	30	31	30	35	34	38	36	30
1-percentile	-67	-77	-69	-84	-77	-83	-90	-94	-99	-104	-121	-97	-91
5-percentile	-33	-36	-39	-40	-37	-45	-52	-48	-62	-61	-62	-53	-50
10-percentile	-19	-22	-23	-24	-23	-27	-38	-33	-44	-44	-44	-37	-33
90-percentile	19	20	18	22	20	28	35	31	38	37	43	45	31
95-percentile	29	34	31	37	35	46	50	46	54	53	57	60	47
99-percentile	72	66	70	84	70	94	83	81	83	85	96	105	85
Number of time intervals: average FRCE > Level 1 positive	35	26	34	51	35	53	55	55	71	72	90	113	690
Number of time intervals: average FRCE < Level 1 negative	30	40	33	52	43	60	72	75	112	104	116	79	816
Number of time intervals: average FRCE > Level 2 positive	6	1	7	7	5	14	8	1	5	1	9	11	75
Number of time intervals: average FRCE < Level 2 negative	1	4	0	5	4	1	5	8	9	8	23	9	77
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	14	18	11	25	6	10	7	8	5	4	3	16	127
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	10	13	22	22	16	15	17	19	35	10	16	195

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-1,8	-1,4	-2	-0,7	-0,9	-0,3	-1	-0,2	0,1	-1,5	0,6	2,7	-0,5
The standard deviation	24	20	21	20	18	27	29	29	33	39	38	34	29
1-percentile	-79	-69	-69	-64	-59	-80	-72	-71	-75	-111	-90	-82	-80
5-percentile	-43	-35	-35	-31	-29	-44	-50	-46	-50	-64	-60	-44	-46
10-percentile	-25	-20	-20	-18	-16	-27	-37	-33	-37	-47	-42	-32	-31
90-percentile	18	16	15	14	13	26	35	35	39	42	45	39	30
95-percentile	33	26	24	25	23	42	48	50	55	60	64	56	46
99-percentile	66	55	58	57	53	83	75	81	94	106	102	113	84
Number of time intervals: average FRCE > Level 1 positive	25	12	13	16	17	46	35	47	69	94	91	75	540
Number of time intervals: average FRCE < Level 1 negative	40	18	28	19	15	39	28	28	32	103	76	42	468
Number of time intervals: average FRCE > Level 2 positive	2	1	1	1	3	5	3	1	5	11	8	20	61
Number of time intervals: average FRCE < Level 2 negative	1	1	4	0	1	2	0	1	5	5	2	7	29
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	26	9	21	12	12	11	3	2	2	15	5	25	143
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	15	10	8	8	8	27	6	5	14	26	13	9	149

RTE**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	19,2	14,9	26,8	12,2	10,8	12,7	22,2	25,1	18,2	21,7	16,5	11,7	17,7
The standard deviation	199	183	204	177	174	189	198	197	198	218	202	190	195
1-percentile	-530	-500	-514	-490	-479	-521	-475	-434	-503	-601	-540	-554	-508
5-percentile	-273	-257	-255	-247	-230	-255	-232	-210	-253	-281	-281	-264	-254
10-percentile	-166	-158	-149	-151	-148	-150	-142	-132	-160	-180	-180	-161	-155
90-percentile	188	173	200	159	152	164	181	171	180	221	192	176	178
95-percentile	351	279	375	264	271	278	343	306	311	386	347	302	318
99-percentile	727	662	784	609	629	714	773	859	724	757	698	689	731
Number of time intervals: average FRCE > Level 1 positive	245	185	274	189	183	196	247	214	220	291	244	207	2695
Number of time intervals: average FRCE < Level 1 negative	201	159	174	169	153	169	151	129	169	217	213	190	2094
Number of time intervals: average FRCE > Level 2 positive	109	72	121	70	76	87	105	101	86	122	99	77	1125
Number of time intervals: average FRCE < Level 2 negative	58	40	46	37	42	46	50	29	46	72	55	59	580
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	83	62	102	61	63	69	89	73	70	94	73	74	914
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	3	4	4	6	1	4	1	1	3	1	5	4	37

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	9,5	14,2	22,8	31,1	17	20,3	2,5	6,4	11	15	10,3	8,2	14
The standard deviation	164	173	198	206	187	180	159	170	178	197	182	162	180
1-percentile	-484	-459	-464	-465	-493	-397	-476	-483	-476	-515	-523	-427	-467
5-percentile	-222	-221	-237	-225	-224	-197	-232	-222	-247	-269	-243	-237	-232
10-percentile	-143	-146	-154	-142	-138	-137	-146	-139	-157	-169	-166	-152	-149
90-percentile	148	161	185	194	155	151	134	134	172	188	162	146	159
95-percentile	235	270	342	382	312	258	201	227	284	312	275	229	282
99-percentile	540	654	744	907	781	701	615	591	635	708	637	591	678
Number of time intervals: average FRCE > Level 1 positive	158	173	250	251	214	164	135	150	196	232	186	150	2259
Number of time intervals: average FRCE < Level 1 negative	139	128	159	143	146	125	151	146	164	196	165	155	1817
Number of time intervals: average FRCE > Level 2 positive	58	62	107	118	98	82	60	59	82	89	71	60	946
Number of time intervals: average FRCE < Level 2 negative	38	32	39	34	41	16	43	48	40	55	49	29	464
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	57	54	89	90	77	80	55	48	72	71	63	65	822
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	2	3	2	4	3	1	1	1	2	3	3	4	29

SEPS

2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1,3	-0,6	-1	-0,8	-0,6	-0,4	-0,7	0,1	-0,5	-1,7	0	-0,8	-0,5
The standard deviation	17	13	12	13	13	12	12	14	13	20	18	15	14
1-percentile	-65	-35	-33	-33	-31	-34	-31	-38	-34	-39	-49	-39	-38
5-percentile	-27	-20	-18	-21	-19	-19	-19	-23	-22	-26	-27	-24	-22
10-percentile	-17	-14	-13	-15	-13	-13	-14	-18	-16	-20	-19	-17	-16
90-percentile	13	14	14	15	15	13	14	17	16	18	18	19	16
95-percentile	18	20	20	20	19	19	19	23	22	23	24	23	21
99-percentile	33	36	32	34	32	33	31	33	31	56	36	42	36
Number of time intervals: average FRCE > Level 1 positive	12	14	8	6	6	9	6	3	4	44	11	17	140
Number of time intervals: average FRCE < Level 1 negative	51	9	7	3	1	7	4	7	5	16	27	5	142
Number of time intervals: average FRCE > Level 2 positive	1	1	1	0	1	1	0	0	0	12	1	4	22
Number of time intervals: average FRCE < Level 2 negative	6	0	0	0	0	0	0	0	0	2	4	1	13
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not > 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0,7	-0,7	-0,6	-0,4	-0,4	-0,7	-0,3	0	-0,2	0,1	-0,3	0,1	-0,3
The standard deviation	15	15	16	16	15	14	13	13	15	15	15	16	15
1-percentile	-41	-41	-39	-39	-42	-38	-33	-35	-39	-42	-43	-41	-39
5-percentile	-25	-25	-25	-25	-25	-22	-21	-20	-21	-24	-25	-24	-23
10-percentile	-17	-18	-18	-18	-17	-15	-15	-14	-15	-17	-17	-17	-17
90-percentile	19	18	19	18	18	17	15	14	16	17	17	16	17
95-percentile	24	24	26	25	24	23	21	20	22	22	23	22	23
99-percentile	39	40	42	46	43	36	32	34	40	37	36	35	38
Number of time intervals: average FRCE > Level 1 positive	14	9	15	22	15	11	5	7	14	6	7	10	135
Number of time intervals: average FRCE < Level 1 negative	11	9	14	10	11	7	6	6	14	16	18	21	143
Number of time intervals: average FRCE > Level 2 positive	1	0	1	1	0	3	0	0	0	0	1	0	7
Number of time intervals: average FRCE < Level 2 negative	0	0	0	0	0	0	0	0	4	1	0	2	7
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not > 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

SG

2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-1,3	0	-0,1	0	-0,1	-0,3	0	-0,1	0	0	-0,1	0	-0,2
The standard deviation	9	9	9	9	9	9	9	9	9	9	9	9	9
1-percentile	-18	-12	-12	-11	-10	-10	-10	-10	-11	-13	-11	-10	-11
5-percentile	-7	-7	-8	-7	-6	-6	-6	-6	-7	-7	-7	-6	-7
10-percentile	-5	-5	-5	-4	-4	-4	-4	-4	-4	-5	-5	-4	-4
90-percentile	5	5	5	4	4	4	4	4	4	5	5	4	4
95-percentile	6	7	7	6	5	5	6	5	6	7	6	6	6
99-percentile	11	11	11	10	9	9	9	9	10	12	10	10	10
Number of time intervals: average FRCE > Level 1 positive	4	3	0	1	1	3	1	1	0	0	0	0	14
Number of time intervals: average FRCE < Level 1 negative	15	1	1	1	1	4	0	1	0	1	1	0	26
Number of time intervals: average FRCE > Level 2 positive	1	0	0	1	1	0	0	0	0	0	0	0	3
Number of time intervals: average FRCE < Level 2 negative	8	0	1	0	1	3	0	0	0	0	0	0	13
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0,2	0	-0,2	0	0	-0,5	-0,1	0,2	-0,1	-0,1	0,1	0	0
The standard deviation	8	8	8	8	8	8	8	8	8	8	8	8	8
1-percentile	-13	-12	-12	-11	-9	-8	-9	-10	-12	-12	-10	-11	-11
5-percentile	-8	-7	-7	-6	-5	-5	-5	-5	-6	-7	-7	-6	-6
10-percentile	-5	-5	-5	-4	-4	-3	-3	-4	-4	-5	-4	-4	-4
90-percentile	5	5	5	4	3	3	3	4	4	5	4	4	4
95-percentile	7	6	6	6	5	4	4	5	6	6	6	6	6
99-percentile	11	11	10	10	8	7	7	8	10	11	10	9	9
Number of time intervals: average FRCE > Level 1 positive	4	1	0	0	0	0	0	3	0	0	4	1	13
Number of time intervals: average FRCE < Level 1 negative	0	0	4	0	0	2	0	0	1	0	1	0	8
Number of time intervals: average FRCE > Level 2 positive	2	0	0	0	0	0	0	2	0	0	1	0	5
Number of time intervals: average FRCE < Level 2 negative	0	0	2	0	0	2	0	0	0	0	0	0	4
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	1	0	0	0	0	1
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

SHB**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-3	-0,2	2,4	1	1,6	2,6	3,3	1,7	0,7	-0,3	-1,6	-1,8	0,5
The standard deviation	29	28	23	26	25	25	24	24	25	33	31	29	27
1-percentile	-108	-78	-69	-83	-76	-68	-60	-72	-86	-121	-116	-101	-86
5-percentile	-44	-33	-29	-36	-28	-24	-22	-28	-33	-47	-47	-47	-35
10-percentile	-23	-19	-15	-18	-16	-14	-13	-15	-18	-24	-24	-24	-19
90-percentile	14	17	22	21	22	21	23	20	20	24	20	16	20
95-percentile	26	33	39	42	41	37	39	36	35	44	37	32	37
99-percentile	77	91	83	88	82	105	103	88	86	98	95	93	91
Number of time intervals: average FRCE > Level 1 positive	45	56	52	70	59	67	70	64	55	87	57	64	746
Number of time intervals: average FRCE < Level 1 negative	88	44	30	62	39	32	26	42	53	101	95	85	697
Number of time intervals: average FRCE > Level 2 positive	10	8	10	9	7	16	20	12	7	14	13	14	140
Number of time intervals: average FRCE < Level 2 negative	21	8	2	5	7	8	6	6	8	29	26	18	144
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	1	3	5	2	1	4	2	2	2	6	4	3	35
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	1	1	0	0	0	0	0	0	0	0	1	1	4

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0,4	-4,1	-11	2	-0,2	-0,9	7,2	3	3,9	0,4	1,1	0,1	0,1
The standard deviation	26	30	36	30	27	26	60	24	26	32	26	27	31
1-percentile	-94	-118	-148	-98	-85	-93	-73	-64	-76	-96	-94	-98	-95
5-percentile	-40	-54	-82	-38	-40	-37	-25	-21	-30	-38	-35	-38	-40
10-percentile	-22	-32	-52	-20	-23	-20	-14	-13	-16	-19	-18	-20	-22
90-percentile	19	18	14	26	20	16	19	20	28	22	24	23	21
95-percentile	34	30	25	47	41	32	39	43	51	39	40	38	38
99-percentile	89	83	75	104	99	91	212	90	101	90	85	78	100
Number of time intervals: average FRCE > Level 1 positive	60	50	39	99	68	56	85	76	103	71	54	58	819
Number of time intervals: average FRCE < Level 1 negative	66	106	227	57	58	65	38	30	50	84	60	66	907
Number of time intervals: average FRCE > Level 2 positive	11	6	8	19	17	10	40	15	8	16	8	7	165
Number of time intervals: average FRCE < Level 2 negative	11	25	61	18	10	15	5	2	1	16	12	19	195
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	2	1	6	3	1	3	1	3	2	0	1	23
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

SMM**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-44,7	-17,2	31,2	5,1	13,2	47	35,6	26,7	23,3	19,6	-19,9	-56,9	5,3
The standard deviation	94	91	92	89	79	102	99	93	98	112	142	98	99
1-percentile	-302	-283	-192	-288	-197	-302	-299	-230	-274	-323	-561	-287	-294
5-percentile	-221	-172	-122	-159	-120	-99	-114	-137	-176	-207	-150	-203	-157
10-percentile	-177	-132	-83	-107	-87	-52	-64	-85	-102	-127	-112	-171	-108
90-percentile	73	96	158	120	129	178	164	145	150	153	89	55	126
95-percentile	108	140	204	154	168	219	207	185	190	188	125	111	167
99-percentile	187	216	308	219	233	294	302	264	258	270	230	311	258
Number of time intervals: average FRCE > Level 1 positive	272	385	877	635	639	1029	889	914	860	969	372	218	8059
Number of time intervals: average FRCE < Level 1 negative	1081	707	333	476	392	201	184	364	388	496	555	1451	6628
Number of time intervals: average FRCE > Level 2 positive	83	142	428	202	273	605	441	361	377	437	110	111	3570
Number of time intervals: average FRCE < Level 2 negative	512	252	98	174	89	509	102	143	195	278	178	616	3146
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	10	15	49	21	28	40	43	39	41	38	13	16	353
Number of events: FRCE < -60 % FRR capacity+ and not > 15 % FRR capacity+ within 15 min	16	9	1	3	1	1	5	4	4	11	4	9	68

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-188,2	-380,6	-152,9	-15,3	-57,7	-154,1	-121,4	-86,5	-129	-74	-110,4	-146,8	-133,1
The standard deviation	148	107	241	115	89	88	90	83	75	82	77	89	107
1-percentile	-458	-701	-399	-347	-275	-492	-447	-366	-401	-289	-321	-369	-403
5-percentile	-386	-600	-451	-201	-191	-350	-270	-240	-254	-209	-241	-301	-306
10-percentile	-348	-530	-260	-150	-161	-247	-231	-196	-218	-179	-209	-266	-248
90-percentile	21	-257	-107	132	62	-57	-5	19	-32	43	-1	-22	-15
95-percentile	81	-224	2	187	95	-24	27	52	0	74	36	19	29
99-percentile	334	-143	197	322	206	49	85	120	76	147	105	104	136
Number of time intervals: average FRCE > Level 1 positive	168	0	565	596	234	9	29	65	18	119	45	33	1881
Number of time intervals: average FRCE < Level 1 negative	2393	2685	1746	894	1512	2625	2189	1725	2384	1670	2110	2436	24369
Number of time intervals: average FRCE > Level 2 positive	83	0	351	276	49	0	2	11	9	24	7	7	819
Number of time intervals: average FRCE < Level 2 negative	2213	2673	1480	339	573	1780	1360	791	1504	796	1266	1769	16544
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	3	0	43	31	3	0	0	3	1	2	1	3	90
Number of events: FRCE < -60 % FRR capacity+ and not > 15 % FRR capacity+ within 15 min	58	11	24	10	7	20	25	12	15	8	18	40	248

TEIAS2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	10,3	10	3,5	11,7	14,4	8,3	2,8	14,1	5,3	11,5	11,9	14	N/A
The standard deviation	80	83	126	98	120	99	115	102	88	93	88	93	N/A
1-percentile	-165	-176	-369	-201	-278	-224	-296	-221	-198	-207	-202	-198	N/A
5-percentile	-106	-110	-198	-127	-135	-138	-155	-119	-124	-122	-110	-109	N/A
10-percentile	-81	-82	-126	-97	-101	-104	-113	-88	-94	-91	-81	-80	N/A
90-percentile	106	106	136	125	133	126	122	119	108	118	112	113	N/A
95-percentile	140	142	199	169	193	166	170	164	143	156	146	153	N/A
99-percentile	231	250	390	316	464	273	347	340	246	256	251	290	N/A
Number of time intervals: average FRCE > Level 1 positive	11	20	130	60	109	23	62	57	23	24	27	43	589
Number of time intervals: average FRCE < Level 1 negative	5	10	170	10	49	16	65	25	11	9	18	16	404
Number of time intervals: average FRCE > Level 2 positive	1	1	51	21	55	3	14	17	3	7	4	8	185
Number of time intervals: average FRCE < Level 2 negative	1	2	50	1	19	2	8	2	1	3	4	5	98
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	4	3	5	0	2	6	0	2	1	0	23
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	1	6	0	2	0	5	0	0	1	0	0	15

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	10,4	6,8	8,6	-1,9	8,2	16,6	7,7	5,5	8,4	15,3	7	16,7	N/A
The standard deviation	93	95	87	85	95	94	82	92	92	87	89	98	N/A
1-percentile	-215	-208	-188	-190	-216	-206	-193	-205	-201	-181	-202	-253	N/A
5-percentile	-113	-120	-117	-128	-124	-108	-111	-121	-116	-107	-118	-110	N/A
10-percentile	-83	-90	-88	-99	-92	-79	-81	-91	-88	-80	-88	-79	N/A
90-percentile	109	107	109	95	112	119	103	104	107	114	107	120	N/A
95-percentile	147	146	142	129	154	155	140	140	146	151	143	159	N/A
99-percentile	287	276	249	234	288	281	241	270	284	263	250	290	N/A
Number of time intervals: average FRCE > Level 1 positive	42	34	27	17	32	34	14	27	31	26	19	36	339
Number of time intervals: average FRCE < Level 1 negative	25	17	13	4	18	20	11	22	11	7	16	34	198
Number of time intervals: average FRCE > Level 2 positive	6	4	3	1	4	6	2	7	9	3	1	5	51
Number of time intervals: average FRCE < Level 2 negative	6	4	2	0	2	5	1	5	2	3	3	8	41
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	4	0	1	2	0	2	0	2	2	0	0	2	15
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	2	0	0	0	0	2	1	1	0	1	0	0	7

TERNA2017

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	14,3	17,7	62,6	31	28,4	20,2	28,2	19,3	39,6	26,4	8,6	15,1	N/A
The standard deviation	167	162	202	184	164	161	160	145	170	189	164	176	N/A
1-percentile	-437	-435	-390	-432	-376	-428	-365	-344	-347	-500	-457	-505	N/A
5-percentile	-230	-215	-186	-209	-188	-203	-175	-157	-171	-240	-229	-218	N/A
10-percentile	-150	-144	-125	-141	-122	-125	-115	-105	-113	-151	-153	-143	N/A
90-percentile	187	183	316	231	202	182	192	174	223	233	172	194	N/A
95-percentile	286	291	486	386	329	294	310	288	375	377	261	297	N/A
99-percentile	584	577	771	672	612	587	619	576	661	663	567	616	N/A
Number of time intervals: average FRCE > Level 1 positive	355	328	604	426	393	341	365	326	438	436	313	381	4706
Number of time intervals: average FRCE < Level 1 negative	278	235	197	225	205	218	181	146	165	280	273	257	2660
Number of time intervals: average FRCE > Level 2 positive	138	131	325	210	175	138	160	140	197	210	116	146	2086
Number of time intervals: average FRCE < Level 2 negative	92	74	54	70	53	75	41	40	43	94	93	99	828
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	87	87	192	142	138	103	104	99	128	141	76	109	1406
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	72	54	42	69	52	63	32	38	37	89	81	75	704

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	25,9	16,2	22,2	56,2	28,3	14,2	7,3	21,4	15,8	12	18,8	18,3	N/A
The standard deviation	167	158	164	191	157	136	130	124	131	153	141	168	N/A
1-percentile	-381	-453	-394	-343	-371	-377	-395	-308	-332	-429	-348	-454	N/A
5-percentile	-194	-197	-200	-158	-181	-166	-159	-113	-141	-219	-177	-216	N/A
10-percentile	-125	-138	-139	-110	-106	-88	-93	-70	-83	-134	-115	-139	N/A
90-percentile	186	174	177	276	193	129	107	134	134	168	164	185	N/A
95-percentile	303	285	302	443	321	243	223	264	258	268	269	307	N/A
99-percentile	640	545	621	766	600	507	484	474	518	494	480	591	N/A
Number of time intervals: average FRCE > Level 1 positive	360	301	356	501	371	239	213	267	240	322	302	365	3837
Number of time intervals: average FRCE < Level 1 negative	217	202	234	140	178	155	147	102	120	237	177	244	2153
Number of time intervals: average FRCE > Level 2 positive	149	116	150	261	167	108	92	114	113	117	122	152	1661
Number of time intervals: average FRCE < Level 2 negative	56	63	58	41	55	51	58	31	45	81	45	81	665
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	90	76	102	149	125	85	66	92	74	80	80	94	1113
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	51	44	55	37	53	46	49	27	30	61	37	60	550

TEL**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	2,5	1,9	3,4	0,5	2,8	1,2	2	1,4	0,9	1,6	0,6	0,8	N/A
The standard deviation	47	44	52	41	43	36	44	41	38	42	33	37	N/A
1-percentile	-153	-138	-154	-135	-128	-119	-123	-133	-133	-141	-102	-118	N/A
5-percentile	-57	-58	-56	-45	-49	-47	-46	-44	-46	-47	-45	-50	N/A
10-percentile	-32	-32	-31	-27	-28	-27	-28	-26	-28	-29	-29	-30	N/A
90-percentile	41	38	41	31	37	34	33	30	30	37	29	32	N/A
95-percentile	68	66	74	53	58	50	53	50	48	54	47	54	N/A
99-percentile	158	150	196	136	130	117	132	132	128	136	99	120	N/A
Number of time intervals: average FRCE > Level 1 positive	133	98	147	86	95	64	94	80	75	96	59	84	1111
Number of time intervals: average FRCE < Level 1 negative	102	83	96	75	70	63	82	76	68	71	55	88	929
Number of time intervals: average FRCE > Level 2 positive	38	31	55	22	23	21	26	26	20	25	11	19	317
Number of time intervals: average FRCE < Level 2 negative	35	24	36	26	21	20	21	24	26	29	11	17	290
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1,4	1,1	2,1	2,9	0,9	0,8	0,5	1,1	1,1	1,3	1,1	1,1	N/A
The standard deviation	35	37	42	45	30	32	27	27	31	35	32	35	N/A
1-percentile	-99	-106	-146	-120	-86	-118	-84	-73	-97	-103	-87	-111	N/A
5-percentile	-45	-48	-51	-47	-41	-40	-32	-30	-38	-39	-38	-40	N/A
10-percentile	-29	-30	-30	-26	-25	-25	-21	-19	-24	-25	-26	-25	N/A
90-percentile	30	33	38	35	28	29	23	20	26	30	26	27	N/A
95-percentile	48	54	61	66	43	44	33	33	42	51	40	45	N/A
99-percentile	119	119	145	153	104	100	81	100	111	109	102	114	N/A
Number of time intervals: average FRCE > Level 1 positive	73	68	106	126	60	49	37	42	54	75	52	67	809
Number of time intervals: average FRCE < Level 1 negative	67	59	86	74	38	56	39	24	44	58	43	64	652
Number of time intervals: average FRCE > Level 2 positive	16	14	32	34	9	9	9	12	14	12	13	17	191
Number of time intervals: average FRCE < Level 2 negative	11	12	30	21	11	13	7	5	10	12	12	16	160
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

TTB**2017**

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-1,3	4,3	3,7	1,6	-1,6	3	9,1	5,9	8,4	13,7	20,9	11,2	6,6
The standard deviation	73	65	56	60	58	56	48	46	48	62	65	66	59
1-percentile	-206	-184	-173	-175	-202	-170	-109	-114	-120	-148	-128	-168	-158
5-percentile	-124	-103	-87	-96	-88	-78	-59	-62	-64	-79	-75	-87	-83
10-percentile	-88	-68	-56	-62	-59	-50	-39	-41	-43	-52	-48	-58	-55
90-percentile	73	76	64	69	56	64	65	57	68	88	100	85	72
95-percentile	104	110	94	93	85	90	94	81	94	117	131	116	101
99-percentile	197	183	155	145	160	163	174	154	152	192	218	205	175
Number of time intervals: average FRCE > Level 1 positive	162	157	131	113	93	113	130	90	122	228	283	206	1828
Number of time intervals: average FRCE < Level 1 negative	233	138	107	131	108	86	39	40	41	80	72	108	1183
Number of time intervals: average FRCE > Level 2 positive	33	21	13	14	14	11	16	17	6	32	49	38	264
Number of time intervals: average FRCE < Level 2 negative	42	24	19	25	33	19	5	5	3	11	8	18	212
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	1	1
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	1	1	1	1	1	4	2	2	0	1	4	18

2018

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	6,3	5,7	0,7	5	-4,2	5,6	4,2	6,5	11	13,2	11	10,4	6,3
The standard deviation	63	69	69	63	61	59	49	58	62	63	62	61	62
1-percentile	-172	-193	-193	-188	-201	-151	-116	-150	-173	-143	-150	-141	-164
5-percentile	-95	-102	-104	-84	-96	-73	-69	-82	-81	-84	-79	-83	-86
10-percentile	-62	-68	-71	-57	-67	-49	-48	-53	-56	-56	-57	-54	-58
90-percentile	79	79	76	74	59	67	60	72	85	89	87	78	76
95-percentile	109	114	108	102	81	94	84	99	113	114	114	110	103
99-percentile	178	207	177	174	146	163	163	169	171	189	180	200	176
Number of time intervals: average FRCE > Level 1 positive	172	165	166	140	86	111	108	141	186	209	190	176	1850
Number of time intervals: average FRCE < Level 1 negative	132	134	156	101	122	75	54	91	89	92	79	85	1210
Number of time intervals: average FRCE > Level 2 positive	21	34	19	21	15	20	15	15	15	25	25	32	257
Number of time intervals: average FRCE < Level 2 negative	19	27	30	26	32	15	4	15	17	12	11	7	215
Number of events: FRCE > 60 % FRR capacity- and not < 15 % FRR capacity- within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of events: FRCE < -60 % FRR capacity+ and not >- 15 % FRR capacity+ within 15 min	0	0	1	1	1	0	0	0	1	0	0	1	5