

2022 Load-Frequency Control Annual Report

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From: System Operations Committee

Executive Summary

According to Article 16 of the Commission Regulation (EU) 2017/1485 of 2 August 2017, which establishes a guideline on electricity transmission system operation, the 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]. Subsequently, ENTSO-E is obligated to publish the annual report.

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

(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) The 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) The 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'.

(d) The FCR obligation and the initial FCR obligation of each TSO for each month of the preceding two years. Details are presented in Chapter 4, 'FCR Data'.

The main conclusion is that the respective synchronous area's frequency quality fit within the defined levels for all reported data. All LFC blocks and TSOs provided their data and have explained any mitigation measures where applicable.

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INTRODUCTION

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

Article 16 of SO GL requires 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. ENTSO-E is required to publish the annual report. On the grounds of SO GL Article 2(2), the synchronous areas of Cyprus and Iceland are excluded in this report as islands of Member States not operated synchronously with CE, GB, Nordic, IE/NI and Baltic are excepted from the annual LFC reporting requirement.

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

The LFC report aims to present the results of the frequency quality evaluation criteria for each synchronous area and LFC block, and the FCR obligations and the initial FCR obligations of each TSO for each month of the preceding two years. Additional details include a description and the 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.

SYNCHRONOUS AREAS, LFC BLOCKS AND TSO IDENTIFICATION

In this paragraph, the requirements of SO GL Article 16(2)(a), (b) and (c) 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. All LFC blocks and LFC block monitors are reported in Tables 1–5. TSO acronyms are explained in Appendix A. For the Baltic Synchronous Area, the data collection process is not performed. The Baltic states' power system is currently asynchronously connected to continental Europe through the LitPol Link between Lithuania and Poland and to the Nordic Synchronous Area through the NordBalt link 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 enable the Baltic TSOs to operate their systems under the frequency of the continental European System and in accordance with EU rules.



Figure 1 European Synchronous Areas and LFC Blocks

According to Article 133 of SO GL, all TSOs of a synchronous area shall, in the synchronous area operational agreement, appoint one TSO of that synchronous area 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 three months and within three months after the end of the analysed period.

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Article 118 of the SO GL establishes the following synchronous areas and associated monitors:

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

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

Table 1 Continental Europe SA identification of LFC blocks

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

Table 2 GB SA identification of LFC blocks

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

Table 3 IE/NI SA identification of LFC blocks

LFC Block	LFC Area	LFC Block Monitor	Country
Nordic	FG, SN, SvK, DK-E	SN	Finland, Norway, Sweden, Denmark-East

Table 4 Nordic identification of LFC blocks

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

Table 5 Baltic identification of LFC blocks

FREQUENCY QUALITY EVALUATION CRITERIA

Introduction and target parameters

To maintain 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 the application of Frequency Containment Reserves [hereinafter FCR]. These reserves are activated quickly (typically within 30 seconds), stabilising power system frequency and ensuring that the frequency deviation will not increase further. The Frequency Containment Process [hereinafter FCP] will stabilise the frequency with an offset from 50 Hz, but it is the change of speed of the rotating masses inertia that ensures that the frequency change is damped so that FCR can contain and stabilise 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. The SO GL defines two types of FRR: automatic (aFRR) and manual (mFRR). FRR is activated by an automatic control device or manually, which reduces the Frequency Restoration Control Error [hereinafter FRCE] to zero. For aFRR, this control device usually is called a Load-Frequency Controller [hereinafter LF Controller]. The LF Controller is a process computer implemented in the TSOs' control centre systems (SCADA/EMS/AGC). It collects FRCE measurements every 4–10 seconds and provides simultaneously automated instructions to balancing service providers that are connected by data communication links.

The Frequency Restoration Process [hereinafter FRP], aFRR and mFRR, restores frequency by replacing the power from the FCR. This principle applies to normal imbalances such as the activation of a light bulb, the start of a train or the sudden outage of a large power plant. Market behaviour, such as the stop and start of production units at hour shifts, will also create a power imbalance and result in frequency deviations.

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

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 6 Frequency quality defining 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

Table 7 Frequency quality target parameters of synchronous areas

Considering the information above for each synchronous area during operation in a normal state or an alert state, the following values are reported every monthly for the instantaneous frequency data:

- (i) The mean value.
- (ii) The standard deviation.
- (iii) The 1st, 5th, 10th, 90th, 95th and 99th percentiles.
- (iv) The total time during which the absolute value of the instantaneous frequency deviation was larger than the standard frequency deviation, distinguishing between positive and negative instantaneous frequency deviations.
- (v) The total time during which the absolute value of the instantaneous frequency deviation was larger than the maximum instantaneous frequency deviation, distinguishing between positive and negative 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

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the frequency restoration range for the GB, IE/NI and Nordic synchronous areas, within the time to restore frequency. The data distinguish between positive and negative 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 restore frequency, distinguishing between positive and negative frequency deviations.

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

(i) For a dataset containing the average values of the FRCE of the LFC block over time intervals equal to the frequency restoration time:

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

(ii) For a dataset containing the average values of the FRCE of the LFC block over time intervals with a length of one minute, the number of events every month 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 maximum time to restore frequency, distinguishing between positive and negative 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 each TSO in the LFC block is responsible for keeping its FRCE as low as possible, the Level 1 and Level 2 parameters must not be exploited to reduce or activate reserves. These parameters should rather be interpreted as an absolute warning limit that shows that the Area Control Error (ACE) quality is below the required standard and that the respective countermeasures have been reported and will be implemented urgently.

For the LFC blocks of GB and IE/NI, during operation in a normal state or alert state and in accordance with Article 18(1) and (2), the following data are presented monthly and for a dataset 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 positive and negative FRCE.

Performance – IE/NI

Ireland/Northern Ireland Synchronous Area Performance

The following tables and figures present data for the IE/NI synchronous area for 2021 and 2022. The input values for frequency are based on instantaneous frequency values. The mean value, standard deviation and percentiles were calculated based on the input values. Moreover, any time periods and events when the system frequency was outside of predefined ranges were also indicated. For data points when the frequency was outside the 200–1 000 mHz range, time is measured in minutes.

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2021

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	49.99999	50.00040	50.00010	49.99990	50.00020	49.99990	50.00020	50.00040	49.99980	50.00010	50.00040	50.00000	50.00012
The standard deviation	0.0409	0.0420	0.0405	0.0414	0.0426	0.0408	0.0412	0.0404	0.0410	0.0451	0.0448	0.0496	0.0425
1-percentile	49.911	49.912	49.912	49.911	49.907	49.913	49.907	49.910	49.910	49.904	49.899	49.891	49.907
5-percentile	49.935	49.935	49.936	49.935	49.934	49.936	49.933	49.935	49.936	49.930	49.928	49.920	49.933
10-percentile	49.949	49.949	49.949	49.948	49.948	49.949	49.946	49.949	49.949	49.944	49.944	49.938	49.947
90-percentile	50.054	50.056	50.053	50.054	50.055	50.053	50.052	50.052	50.053	50.060	50.058	50.064	50.055
95-percentile	50.067	50.072	50.067	50.067	50.069	50.065	50.064	50.065	50.068	50.076	50.073	50.082	50.070
99-percentile	50.092	50.097	50.091	50.092	50.097	50.088	50.085	50.089	50.092	50.103	50.098	50.109	50.094
Time(min) > 200 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -200 mHz	0	0	0	3	12	1	4	0	0	0	9	8	38
Time(min) > 1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -1000 mHz	0	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	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	0
No. of events freq.dev > 500 mHz and > 1 min	0	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	0

Table 8 IE/NI SA Performance for Year 2021

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2022

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00030	49.99990	50.00010	50.00020	50.00040	50.00020	49.99960	50.00040	49.99980	50.00010	50.00020	49.99990	50.00009
The standard deviation	0.0450	0.0467	0.0456	0.0414	0.0424	0.0409	0.0403	0.0407	0.0428	0.0437	0.0454	0.0431	0.0432
1-percentile	49.896	49.896	49.897	49.906	49.909	49.910	49.910	49.910	49.905	49.902	49.898	49.904	49.904
5-percentile	49.927	49.923	49.925	49.932	49.932	49.935	49.933	49.934	49.931	49.930	49.928	49.930	49.930
10-percentile	49.943	49.940	49.941	49.946	49.946	49.948	49.946	49.947	49.944	49.945	49.942	49.944	49.944
90-percentile	50.058	50.062	50.058	50.052	50.055	50.052	50.050	50.051	50.054	50.057	50.059	50.055	50.055
95-percentile	50.074	50.077	50.075	50.066	50.069	50.065	50.062	50.064	50.068	50.072	50.074	50.070	50.070
99-percentile	50.102	50.102	50.101	50.090	50.095	50.089	50.084	50.088	50.091	50.100	50.099	50.098	50.095
Time(min) > 200 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -200 mHz	2	0	1	1	0	0	0	3	0	0	0	0	7
Time(min) > 1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -1000 mHz	0	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	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	0
No. of events freq.dev > 500 mHz and > 1 min	0	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	0

Table 9 IE/NI SA Performance for Year 2022

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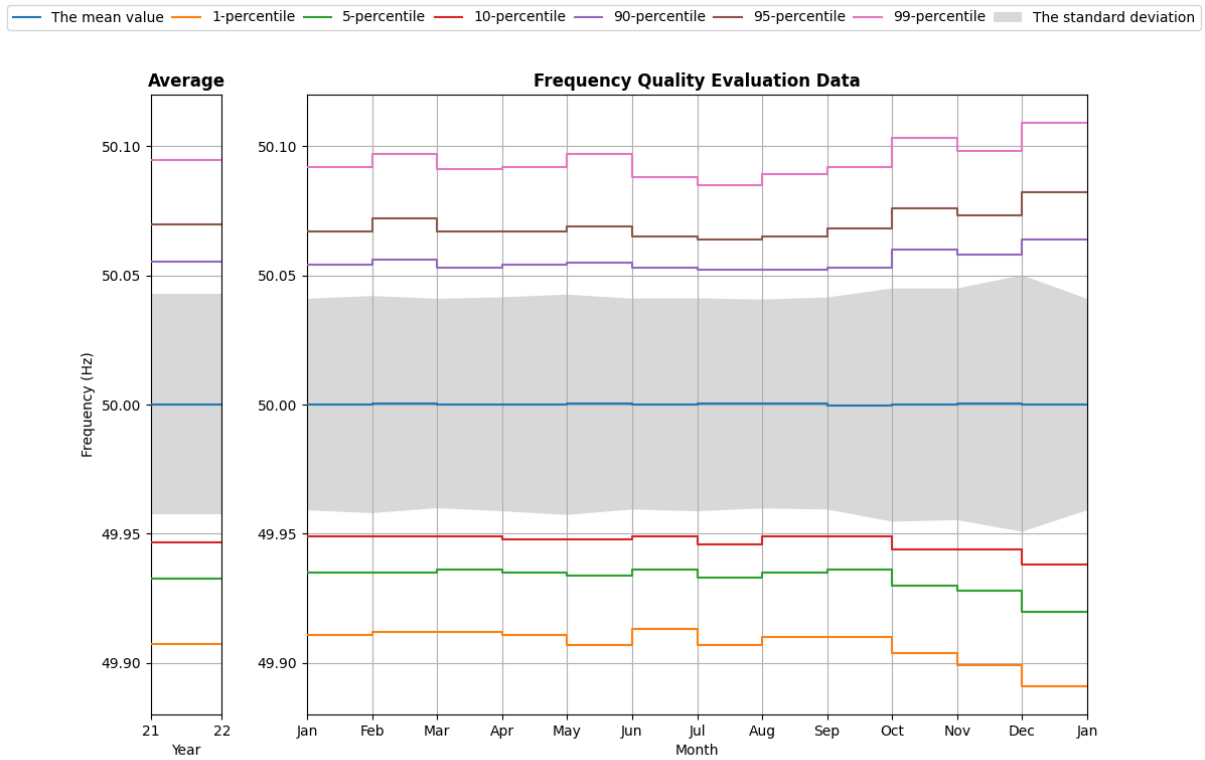


Figure 2 IE-NI SA 2021 frequency quality

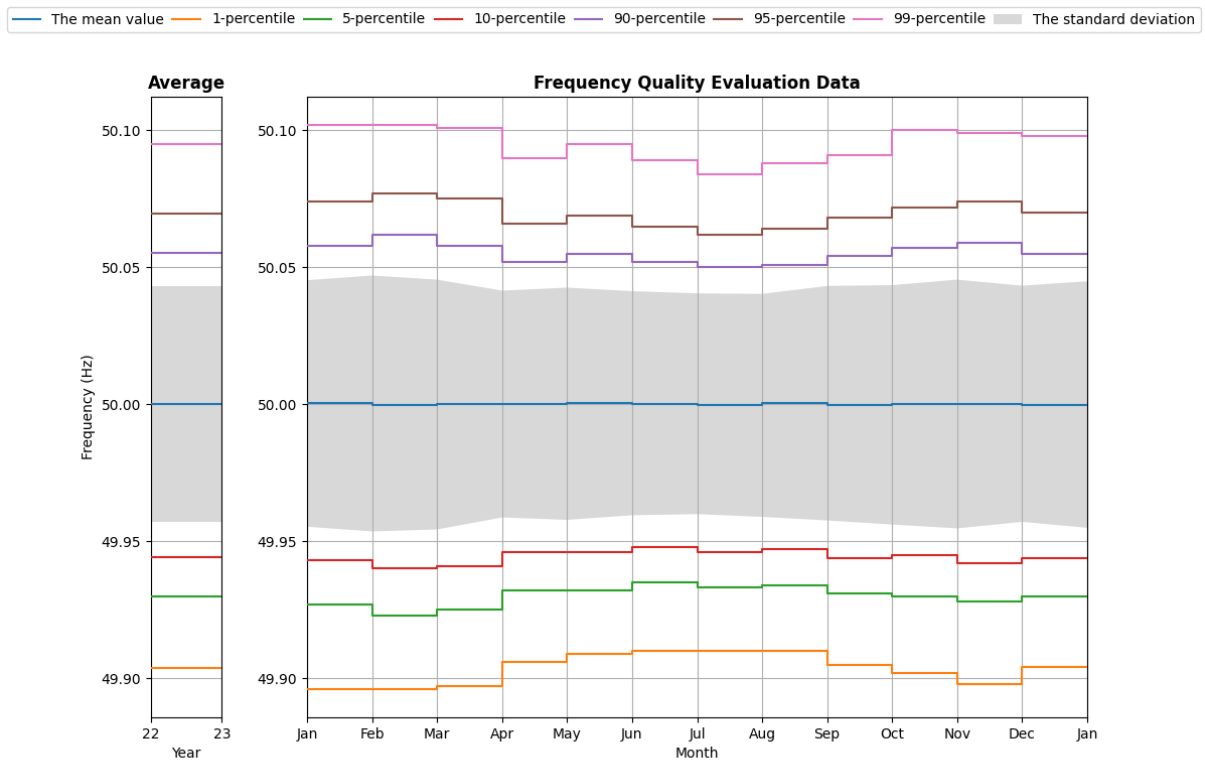


Figure 3 IE-NI SA 2022 frequency quality

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In Figures 4 and 5, the accumulated minutes outside standard ranges are presented for the years 2021 and 2022 respectively.

The red line shows the theoretical line in the case of a linear distribution (1/12 per month) of minutes outside standard ranges, considering the standard ranges from SO GL (15,000 minutes).

The black line shows the accumulated minutes outside standard ranges per month for the synchronous area. If black line is higher than the red line at the end of the year, this indicates that the synchronous area did not meet the required Frequency quality parameters.

The graphs in Figures 4, 5 and 5a below show that the frequency quality target parameters from SO GL were fulfilled for the respective years for the Ireland/Northern Ireland Synchronous Area.

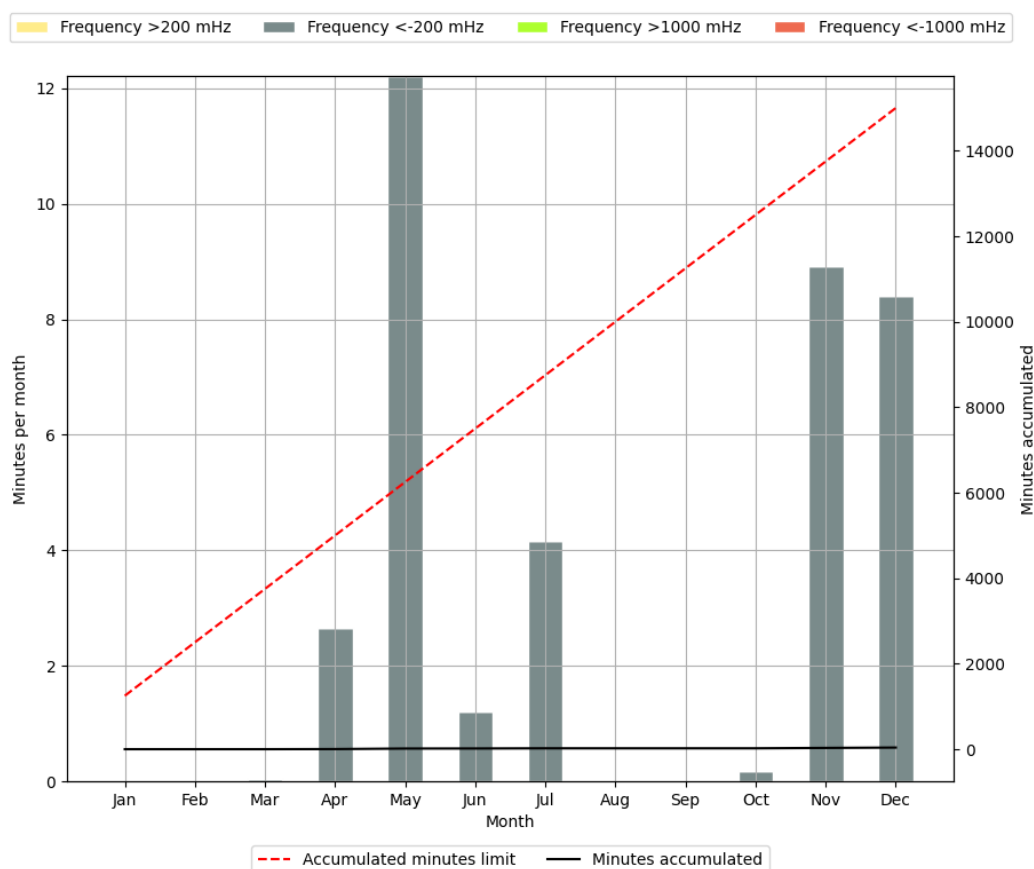


Figure 4 IE-NI SA 2021 frequency deviation

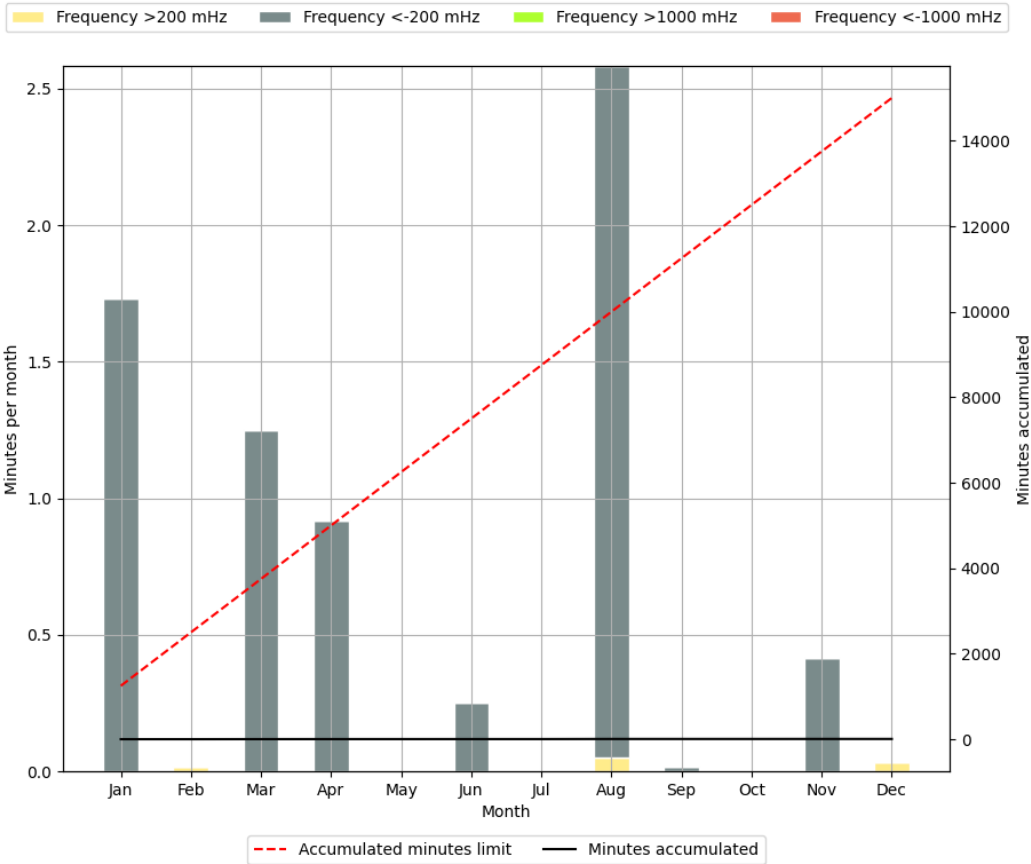


Figure 5 IE-NI SA 2022 frequency deviation

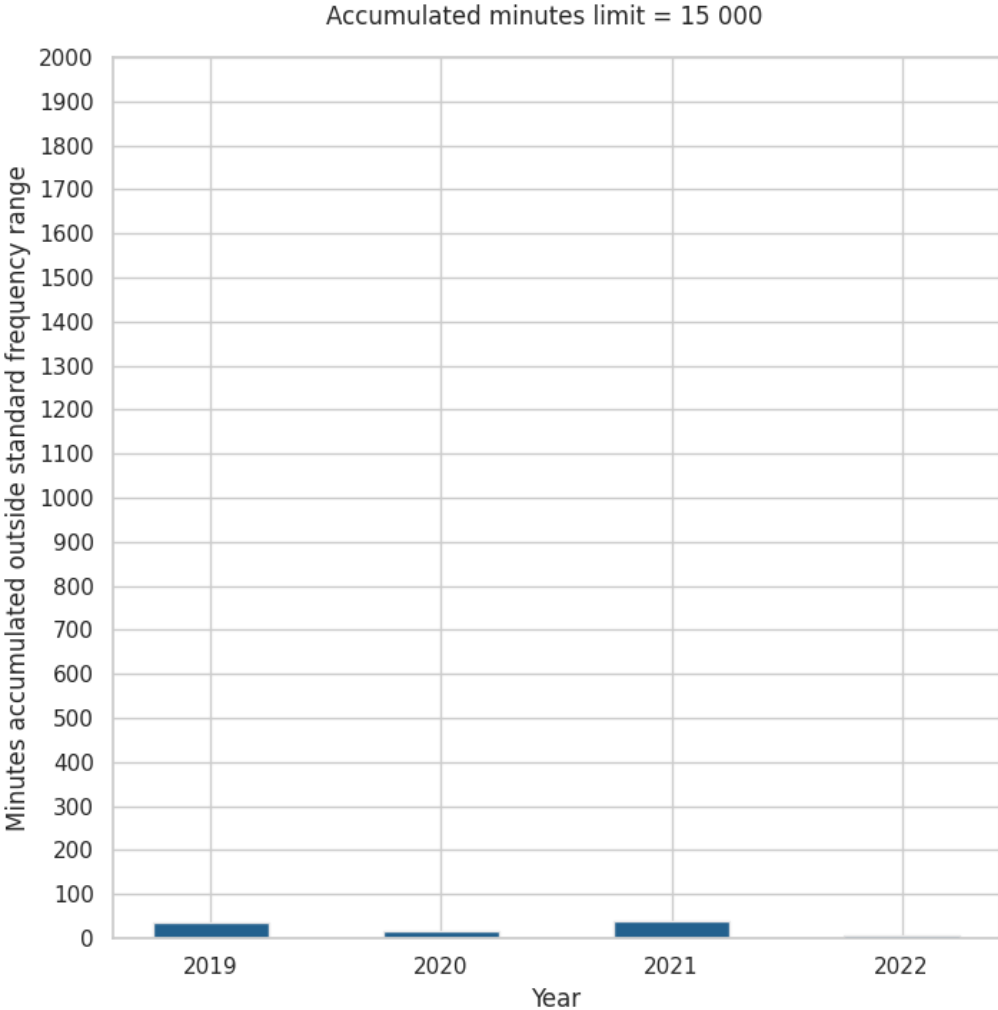


Figure 5a IE-NI SA frequency deviation trend

IE/NI Synchronous Area LFC Block Performance

Tables 10 and 11 show that there were no events where 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 the time to restore frequency, which corresponds to 15 minutes.

2021

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 10 IE/NI LFC FRCE Statistic for Year 2021

2022

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 2022

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 is calculated using the following procedure:

1. If the frequency deviation is ≥ 200 mHz over a 15 -minute period or ≤ -200 mHz over a 15-minutes period, this qualifies as a Level 1 event.
2. If the 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.

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Data item	2021	2022
Number of time intervals frequency deviates outside +/- 200 mHz	0	0
Number of time intervals frequency deviates outside +/- 500 mHz	0	0

Table 12 IE/NI LFC Number of Time Intervals Outside Range for Years 2021 and 2022

Performance – GB

Great Britain Synchronous Area Performance

The following tables and figures show data from 2021 and 2022 for the Great Britain synchronous area. Input values for frequency are based on instantaneous frequency values. Based on the input values, mean value, standard deviation and percentiles were calculated. Moreover, any time periods and events where the system frequency fell outside of predefined ranges were also indicated. For data points where the frequency was outside of the 200 mHz–800 mHz range, time is measured in minutes.

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2021

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	49.99895	49.99966	49.99948	49.99994	49.99915	49.99960	49.99982	49.99940	49.99974	49.99970	49.99921	49.99933	49.99950
The standard deviation	0.0653	0.0653	0.0645	0.0614	0.0618	0.0568	0.0569	0.0570	0.0595	0.0623	0.0671	0.0657	0.0620
1-percentile	49.860	49.863	49.863	49.866	49.868	49.880	49.879	49.878	49.873	49.868	49.854	49.857	49.867
5-percentile	49.896	49.898	49.897	49.902	49.901	49.910	49.910	49.910	49.906	49.902	49.893	49.894	49.902
10-percentile	49.916	49.916	49.917	49.921	49.920	49.927	49.927	49.927	49.924	49.920	49.913	49.914	49.920
90-percentile	50.084	50.085	50.083	50.079	50.079	50.074	50.074	50.073	50.077	50.081	50.085	50.083	50.080
95-percentile	50.104	50.106	50.104	50.098	50.099	50.091	50.092	50.091	50.096	50.101	50.106	50.103	50.099
99-percentile	50.141	50.145	50.142	50.136	50.136	50.125	50.124	50.125	50.131	50.139	50.145	50.141	50.136
Time(min) > 200 mHz	30	12	11	14	15	5	2	3	10	13	32	23	170
Time(min) < -200 mHz	17	21	18	12	10	5	6	3	13	14	36	34	189
Time(min) > 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -800 mHz	0	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	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	0
No. of events freq.dev > 500 mHz and > 1 min	0	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	0

Table 13 GB SA Performance for Year 2021

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2022

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	49.99963	49.99879	50.00017	49.99938	50.00001	49.99931	49.99932	49.99993	49.99971	49.99950	49.99945	49.99965	49.99957
The standard deviation	0.0665	0.0675	0.0662	0.0659	0.0659	0.0661	0.0662	0.0633	0.0643	0.0679	0.0673	0.0687	0.0663
1-percentile	49.855	49.852	49.854	49.855	49.858	49.853	49.854	49.857	49.854	49.848	49.855	49.845	49.853
5-percentile	49.892	49.891	49.893	49.894	49.895	49.893	49.892	49.897	49.893	49.888	49.889	49.885	49.892
10-percentile	49.913	49.912	49.914	49.914	49.915	49.914	49.913	49.918	49.915	49.911	49.910	49.908	49.913
90-percentile	50.085	50.086	50.084	50.083	50.083	50.083	50.083	50.080	50.080	50.085	50.086	50.086	50.084
95-percentile	50.105	50.109	50.105	50.104	50.104	50.104	50.104	50.099	50.100	50.107	50.107	50.107	50.105
99-percentile	50.142	50.150	50.146	50.142	50.145	50.143	50.144	50.136	50.137	50.149	50.145	50.145	50.144
Time(min) > 200 mHz	26	31	23	40	39	18	32	10	5	23	22	18	287
Time(min) < -200 mHz	27	28	41	36	31	50	39	32	34	61	25	62	467
Time(min) > 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -800 mHz	0	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	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	0
No. of events freq.dev > 500 mHz and > 1 min	0	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	0

Table 14 GB SA Performance for Year 2022

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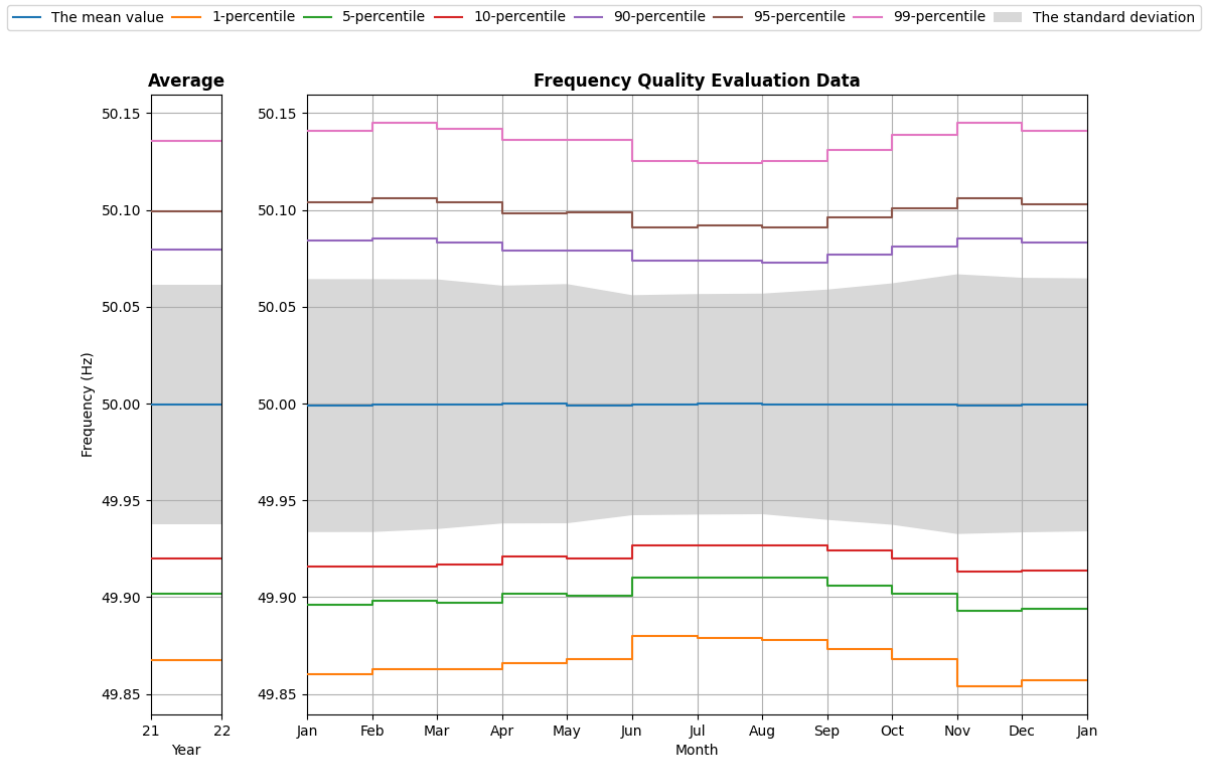


Figure 6 GB SA 2021 frequency quality

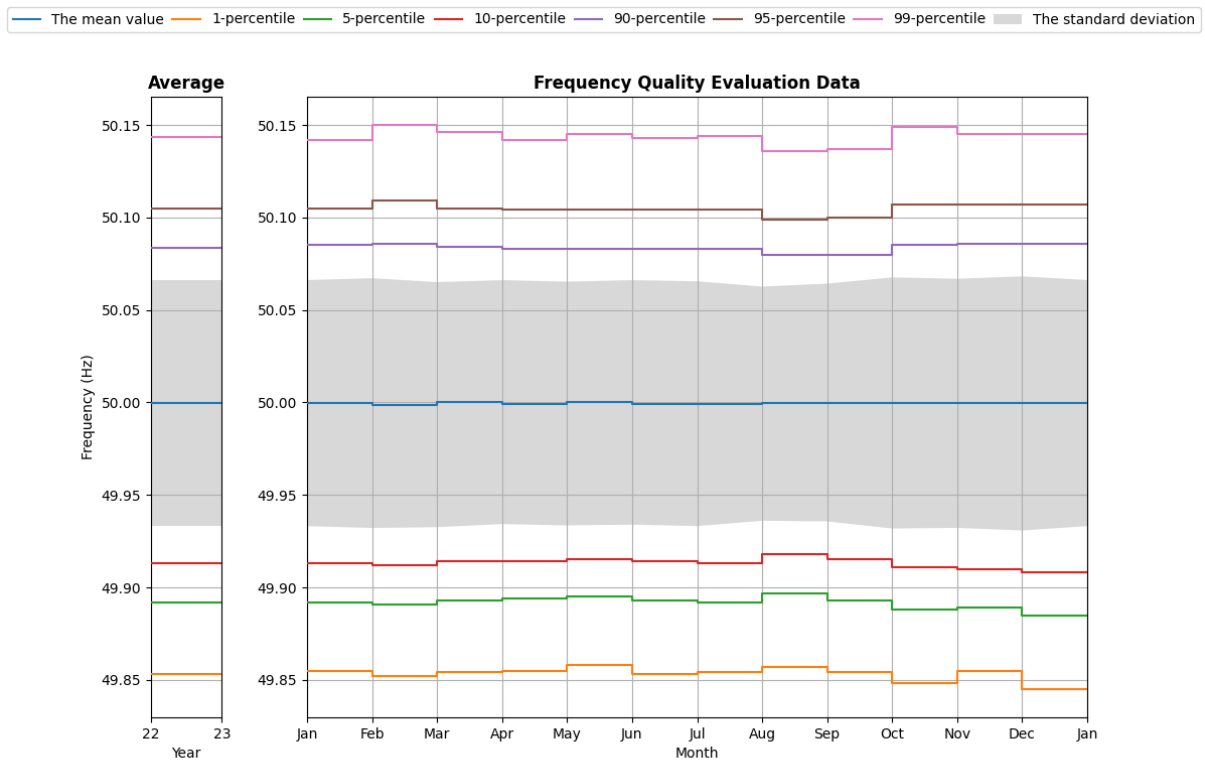


Figure 7 GB SA 2022 frequency quality

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Figures 8 and 9 illustrate the accumulated minutes outside standard ranges for 2021 and 2022, respectively.

The red line shows the theoretical line in the case of a linear distribution (1/12 per month) of minutes outside standard ranges, considering the standard ranges from SO GL (15 000 minutes).

The black line shows the accumulated minutes outside standard ranges per month for the synchronous area. If the black line is higher than the red line at the end of the year, this indicates that the synchronous area did not meet frequency quality parameters.

The graphs in Figures 8, 9 and 9a below show that the frequency quality target parameters from SO GL were fulfilled in the Great Britain Synchronous Area during the respective years.

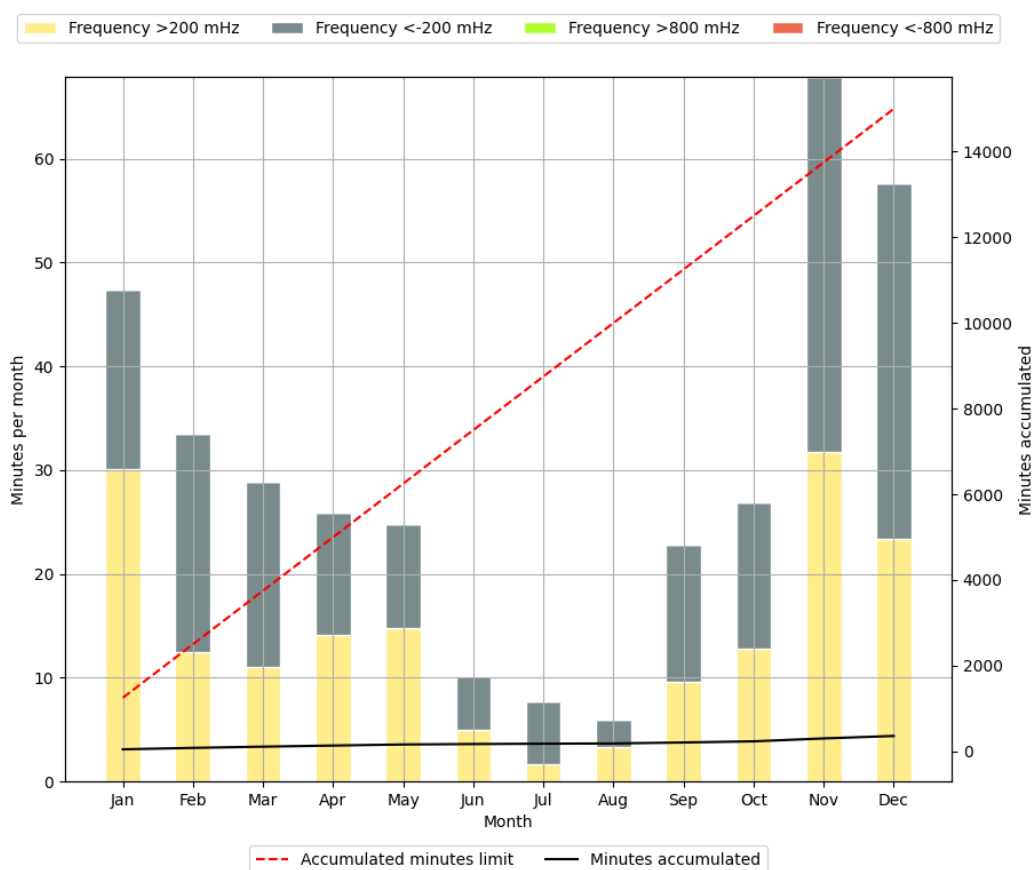


Figure 8 GB SA 2021 frequency deviation

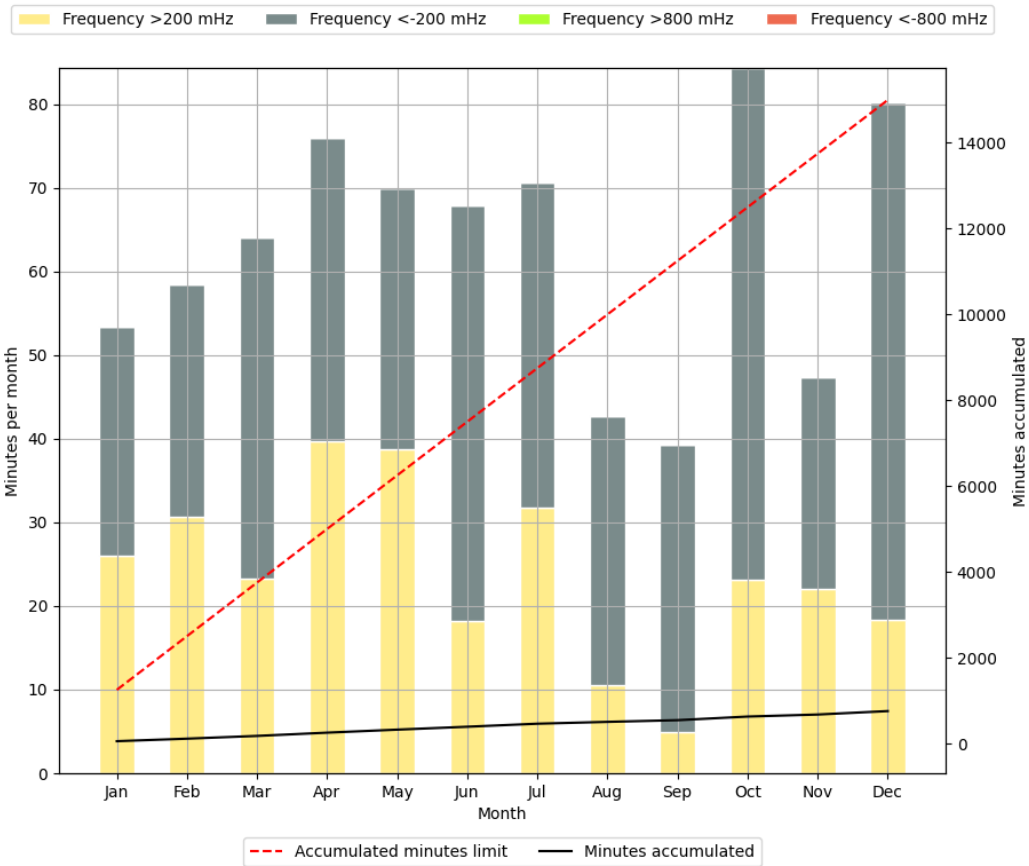


Figure 9 GB SA 2022 frequency deviation

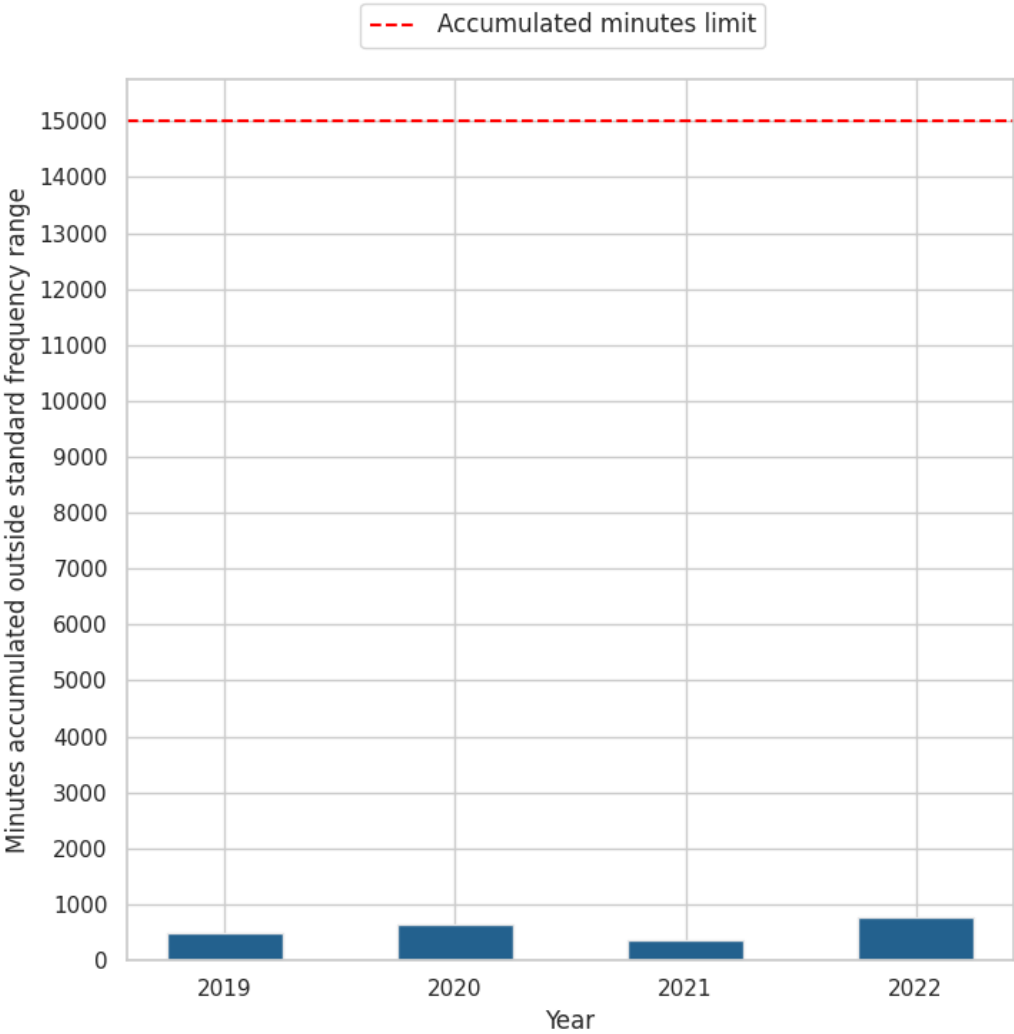


Figure 9a GB SA frequency deviation trend

GB Synchronous Area LFC Block Performance

Tables 15 and 16 show that there were no events in which the 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 the time to restore frequency, which corresponds to 15 minutes.

2021

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 15 GB LFC FRCE Statistic for Year 2021

2022

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 2022

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

1. If the frequency deviation is ≥ 200 mHz over a 15-minutes period or ≤ -200 mHz over a 15-minute period, this qualifies as a Level 1 event.
2. If the 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.

Data item	2021	2022
Number of time intervals frequency deviates outside +/- 200 mHz	0	0
Number of time intervals frequency deviates outside +/- 500 mHz	0	0

Table 17 GB LFC Number of Time Intervals Outside Range for Years 2021 and 2022

Performance – Nordic

Nordic Synchronous Area Performance

The following tables and figures present data from 2021 and 2022 for the Nordic synchronous area. The input values for frequency are based on instantaneous frequency values. The mean value, standard deviation and percentiles were calculated based on the input values. Moreover, any time periods and events where the system frequency occurred outside of predefined ranges were also indicated. For data points where the frequency was outside the 100–1 000 mHz range, time is measured in minutes.

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2021

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00026	49.99983	49.99995	49.99979	50.00021	50.00010	49.99981	50.00020	49.99993	50.00012	49.99987	49.99992	50.00000
The standard deviation	0.0388	0.0428	0.0435	0.0450	0.0436	0.0420	0.0388	0.0423	0.0413	0.0442	0.0422	0.0390	0.0420
1-percentile	49.911	49.900	49.902	49.892	49.899	49.901	49.909	49.902	49.906	49.897	49.900	49.908	49.902
5-percentile	49.937	49.932	49.931	49.927	49.930	49.931	49.937	49.932	49.934	49.929	49.931	49.937	49.932
10-percentile	49.951	49.948	49.946	49.944	49.946	49.947	49.951	49.947	49.949	49.945	49.947	49.951	49.948
90-percentile	50.050	50.055	50.056	50.057	50.056	50.053	50.049	50.053	50.053	50.056	50.053	50.050	50.053
95-percentile	50.066	50.072	50.074	50.075	50.073	50.069	50.064	50.070	50.069	50.074	50.070	50.065	50.070
99-percentile	50.094	50.106	50.109	50.110	50.106	50.100	50.095	50.107	50.101	50.111	50.105	50.096	50.103
Time(min) > 100 mHz	290	535	670	667	606	416	311	585	448	710	524	336	6098
Time(min) < -100 mHz	193	385	380	607	456	397	255	375	287	503	415	268	4521
Time(min) > 1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -1000 mHz	0	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	39	28	0	18	0	0	0	16	0	24	0	125
No.of events freq.deviation < -200 mHz and < -100 mHz within 15 minutes	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 18 Nordic SA Block Performance for Year 2021

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2022

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00003	49.99999	50.00006	50.00000	50.00006	50.00000	49.99994	50.00018	49.99998	49.99998	49.99995	49.99998	50.00001
The standard deviation	0.0404	0.0408	0.0393	0.0407	0.0425	0.0408	0.0383	0.0416	0.0401	0.0416	0.0380	0.0375	0.0401
1-percentile	49.904	49.902	49.906	49.901	49.899	49.900	49.909	49.899	49.908	49.903	49.906	49.911	49.904
5-percentile	49.935	49.934	49.936	49.932	49.931	49.933	49.939	49.933	49.936	49.933	49.938	49.940	49.935
10-percentile	49.950	49.950	49.951	49.948	49.947	49.949	49.953	49.933	49.949	49.950	49.952	49.954	49.949
90-percentile	50.050	50.051	50.049	50.053	50.054	50.051	50.048	50.052	50.050	50.053	50.047	50.046	50.050
95-percentile	50.067	50.068	50.065	50.070	50.071	50.067	50.063	50.069	50.067	50.070	50.061	50.062	50.067
99-percentile	50.100	50.102	50.096	50.104	50.104	50.097	50.096	50.104	50.101	50.105	50.091	50.098	50.100
Time(min) > 100 mHz	445	438	347	503	544	356	344	534	447	552	244	407	5161
Time(min) < -100 mHz	354	354	321	408	457	425	282	448	263	373	300	230	4215
Time(min) > 1000 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -1000 mHz	0	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	0	0	0	0	0	0	0	0	16	16
No.of events freq.deviation < -200 mHz and < -100 mHz within 15 minutes	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 19 Nordic SA Block Performance for Year 2022

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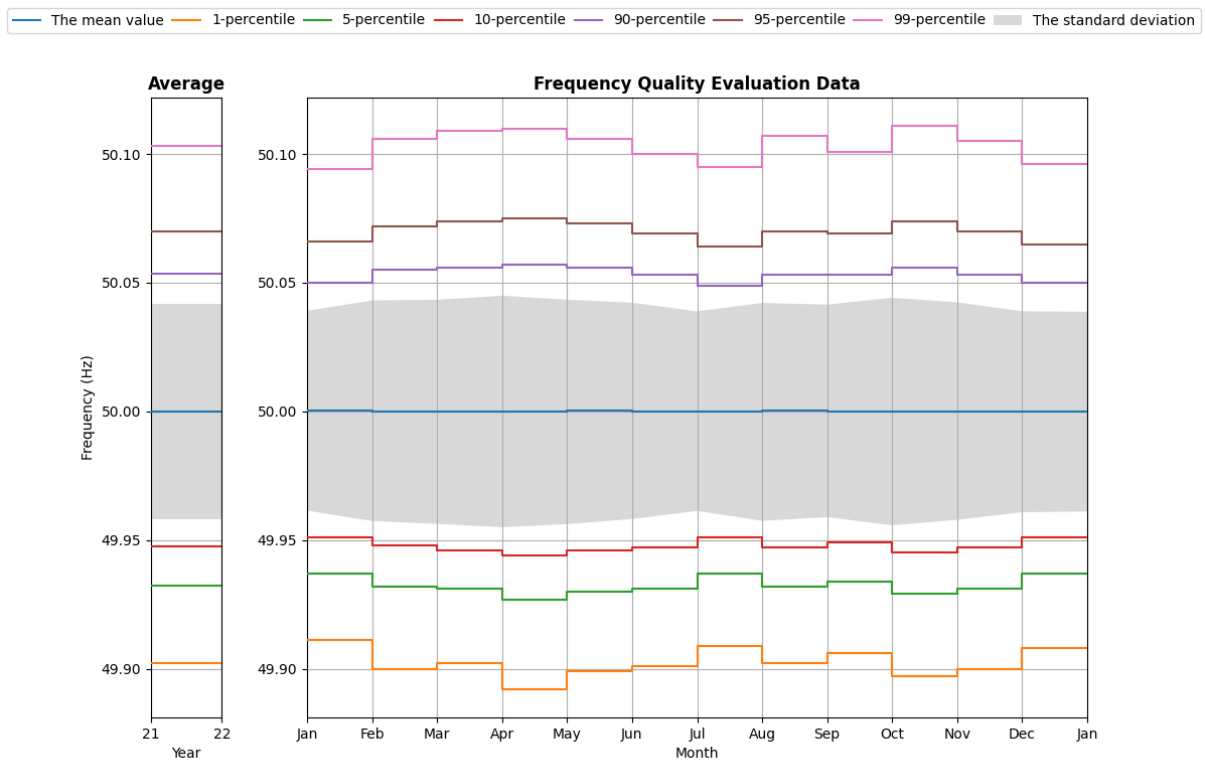


Figure 10 Nordic SA 2021 frequency quality

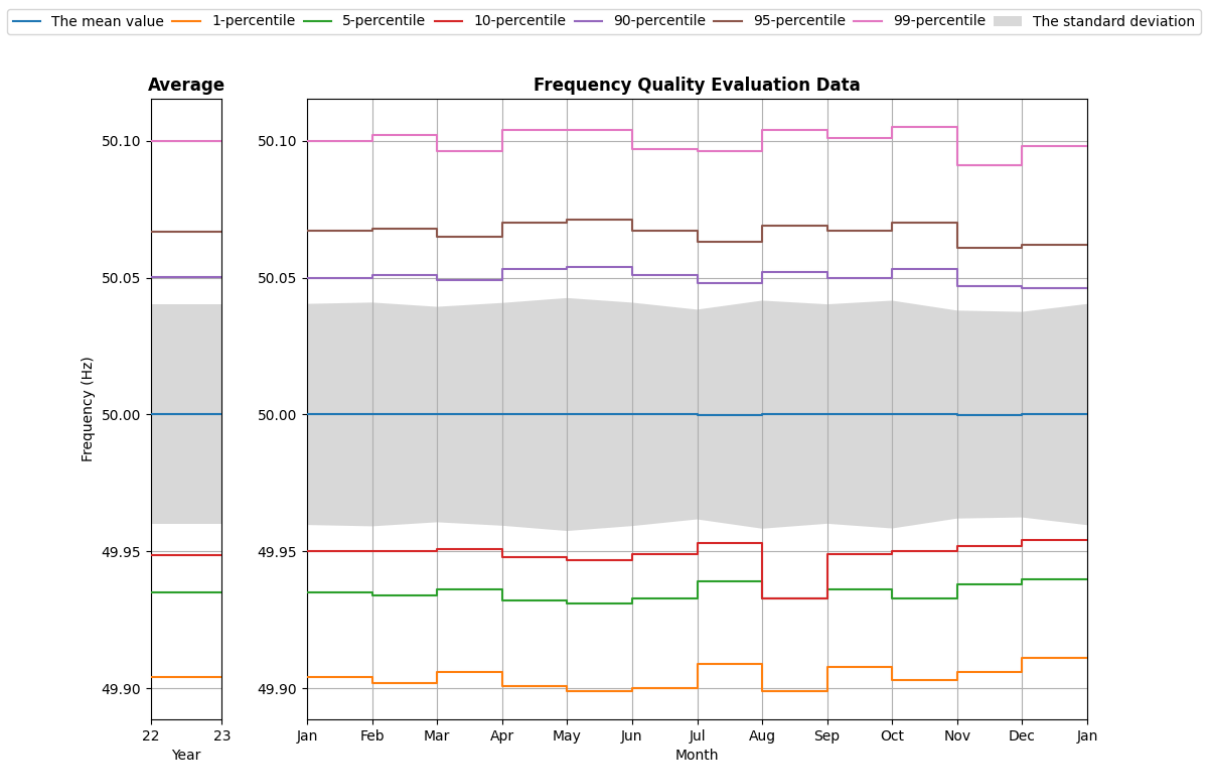


Figure 11 Nordic SA 2022 frequency quality

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Figures 12 and 13 illustrate the accumulated minutes outside standard ranges for 2021 and 2022.

The red line shows the theoretical line in the case of a linear distribution (1/12 per month) of minutes outside standard ranges, considering the standard ranges from SO GL (15 000 minutes).

The black line shows the accumulated minutes per month outside standard ranges for the synchronous area. If the black line is higher than the red line at the end of the year, this indicates that the synchronous area did not meet the required frequency quality parameters.

The graphs in Figures 12, 13 and 13a below show that the frequency quality target parameters from SO GL were fulfilled during the respective years in the Nordic Synchronous Area.

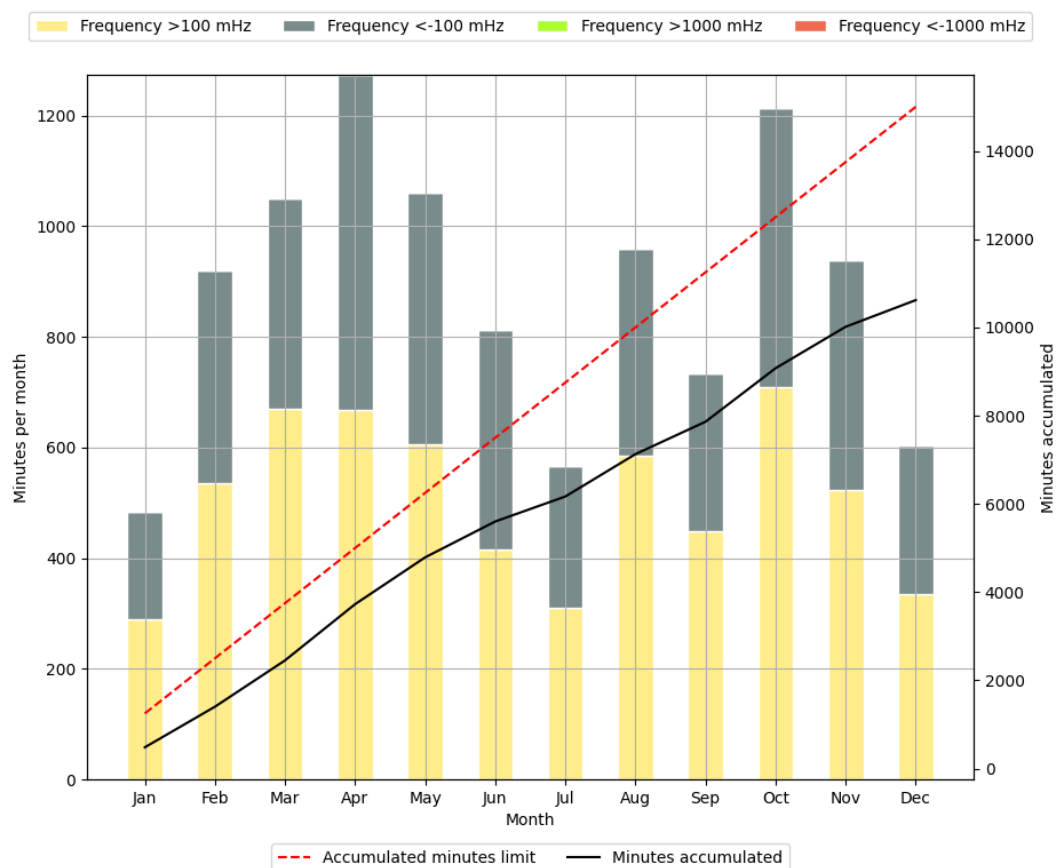


Figure 12 Nordic SA 2021 frequency deviation

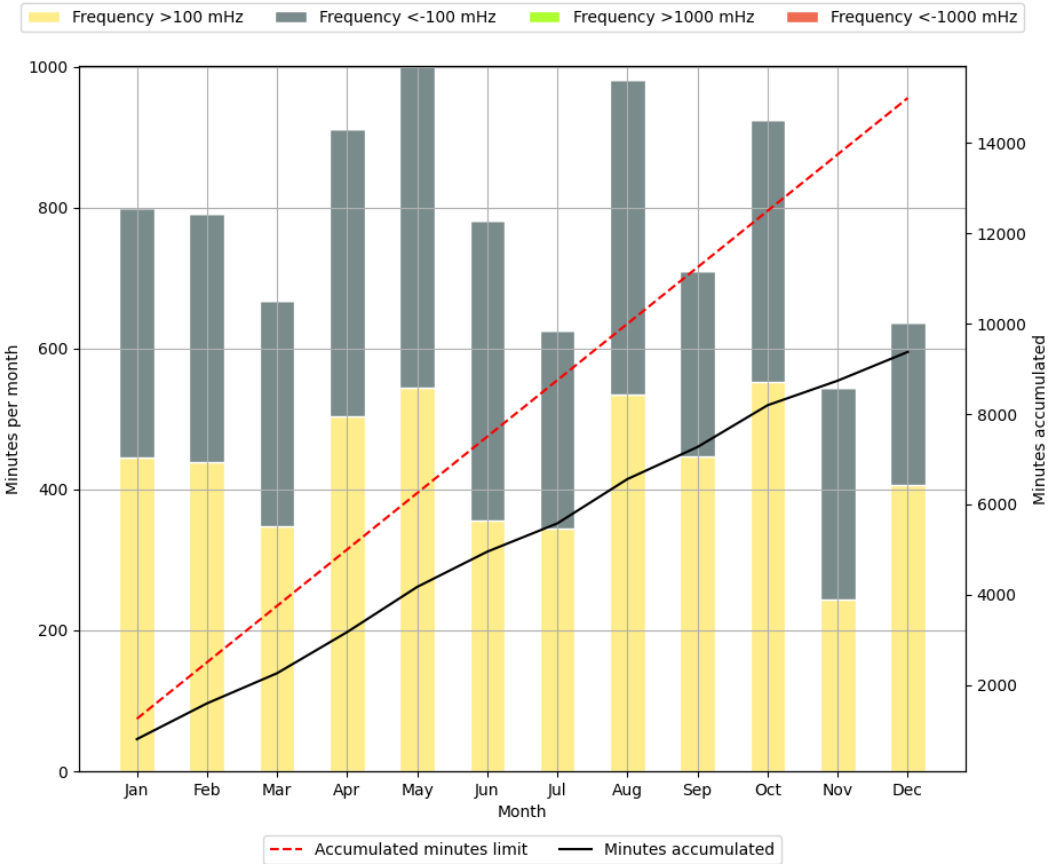


Figure 13 Nordic SA 2022 frequency deviation

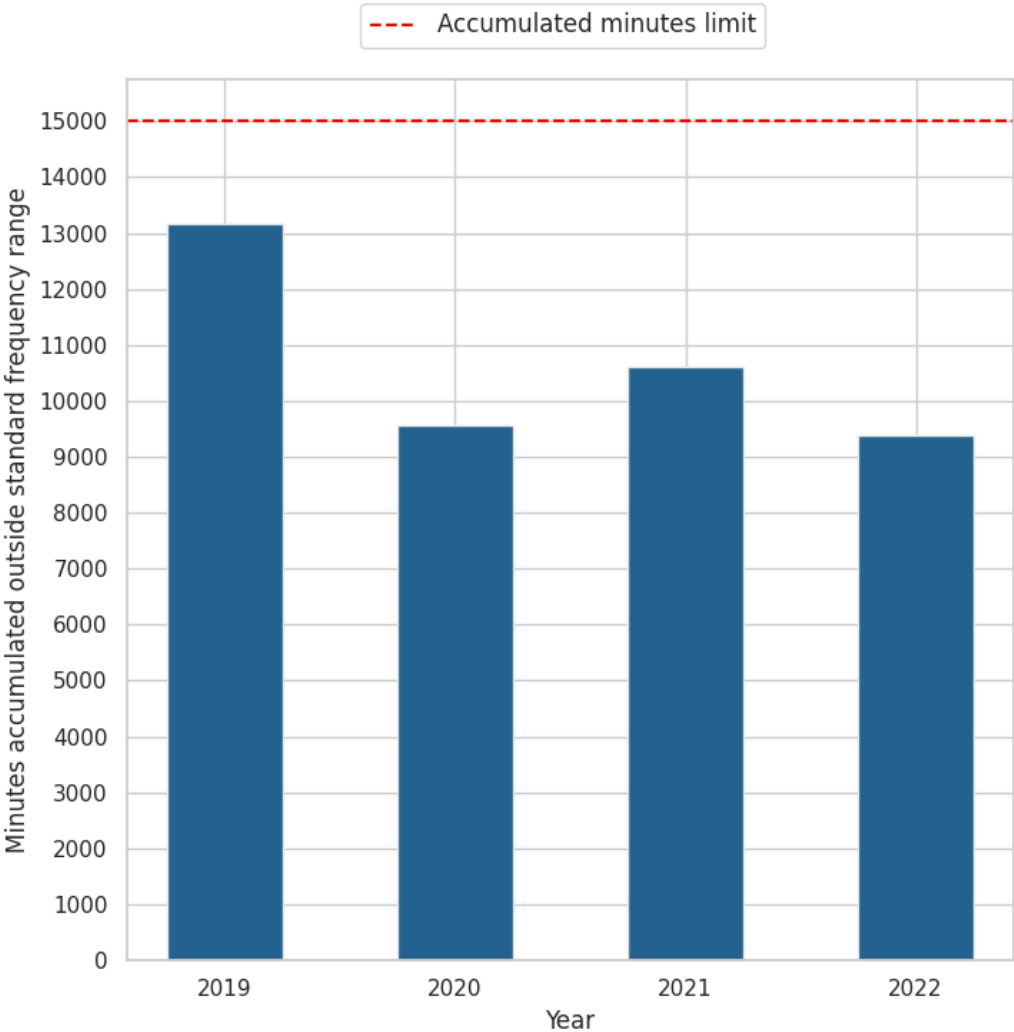


Figure 13a Nordic SA frequency deviation trend

Nordic Synchronous Area LFC Block Performance

The following table shows the Nordic LFC block performance. The Level 1 and Level 2 limits are calculated according to the methodology defined in the 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.

FRCE target parameters	Level 1	Level 2
FRCE range	39 mHz	73 mHz
Target for the maximum number of 15 minutes time intervals per year outside the level 1 and level 2 FRCE range	30 %	5%

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

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

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2021

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00026	49.99983	49.99995	49.99979	50.00021	50.00010	49.99981	50.00020	49.99993	50.00012	49.99987	49.99992	50.00000
The standard deviation	0.0388	0.0428	0.0435	0.0450	0.0436	0.0420	0.0388	0.0423	0.0413	0.0442	0.0422	0.0390	0.0420
1-percentile	49.911	49.900	49.902	49.892	49.899	49.901	49.909	49.902	49.906	49.897	49.900	49.908	49.902
5-percentile	49.937	49.932	49.931	49.927	49.930	49.931	49.937	49.932	49.934	49.929	49.931	49.937	49.932
10-percentile	49.951	49.948	49.946	49.944	49.946	49.947	49.951	49.947	49.949	49.945	49.947	49.951	49.948
90-percentile	50.050	50.055	50.056	50.057	50.056	50.053	50.049	50.053	50.053	50.056	50.053	50.050	50.053
95-percentile	50.066	50.072	50.074	50.075	50.073	50.069	50.064	50.070	50.069	50.074	50.070	50.065	50.070
99-percentile	50.094	50.106	50.109	50.110	50.106	50.100	50.095	50.107	50.101	50.111	50.105	50.096	50.103
Number of time intervals: average FRCE > Level 1 positive	350	378	397	384	349	253	236	263	263	325	326	316	3840
Number of time intervals: average FRCE < Level 1 negative	289	298	342	333	280	233	223	232	176	279	293	275	3253
Number of time intervals: average FRCE > Level 2 positive	47	64	82	72	54	22	35	49	37	55	59	40	616
Number of time intervals: average FRCE < Level 2 negative	31	51	39	65	30	30	14	21	13	30	43	29	396
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	0
No. of time intervals: FRCE < -60 % FRR capacity + and < -15 % FRR capacity + after 15 min	0	1	1	1	0	0	1	1	0	0	0	0	5

Table 21 Nordic LFC Block Performance for Year 2021

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2022

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00003	49.99999	50.00006	50.00000	50.00006	50.00000	49.99994	50.00018	49.99998	49.99998	49.99995	49.99998	50.00001
The standard deviation	0.0404	0.0408	0.0393	0.0407	0.0425	0.0408	0.0383	0.0416	0.0401	0.0416	0.0380	0.0375	0.0401
1-percentile	49.904	49.902	49.906	49.901	49.899	49.900	49.909	49.899	49.908	49.903	49.906	49.911	49.904
5-percentile	49.935	49.934	49.936	49.932	49.931	49.933	49.939	49.933	49.936	49.933	49.938	49.940	49.935
10-percentile	49.950	49.950	49.951	49.948	49.947	49.949	49.953	49.933	49.949	49.950	49.952	49.954	49.949
90-percentile	50.050	50.051	50.049	50.053	50.054	50.051	50.048	50.052	50.050	50.053	50.047	50.046	50.050
95-percentile	50.067	50.068	50.065	50.070	50.071	50.067	50.063	50.069	50.067	50.070	50.061	50.062	50.067
99-percentile	50.100	50.102	50.096	50.104	50.104	50.097	50.096	50.104	50.101	50.105	50.091	50.098	50.100
Number of time intervals: average FRCE > Level 1 positive	304	269	260	300	294	252	231	273	227	281	203	256	3150
Number of time intervals: average FRCE < Level 1 negative	259	219	227	248	231	197	169	219	173	205	184	189	2520
Number of time intervals: average FRCE > Level 2 positive	53	50	27	46	46	30	31	58	40	51	20	46	498
Number of time intervals: average FRCE < Level 2 negative	41	34	29	37	29	40	22	38	14	21	22	27	354
No. of time intervals: FRCE > 60 % FRR capacity + and < 15 % FRR capacity + after 15 min	0	0	0	0	0	0	0	0	33	76	113	0	222
No. of time intervals: FRCE < -60 % FRR capacity + and < -15 % FRR capacity + after 15 min	0	0	0	1	0	0	0	2	15	34	5	2	59

Table 22 Nordic LFC Block Performance for Year 2022

I. Level 1/Level 2 statistics

Figures 14–17 show the monthly distribution of FRCE time intervals outside the Level 1 and Level 2 ranges for positive and negative time intervals by month and year. If the maximum number of intervals exceeds 10 512 for Level 1 or 1 752 for Level 2, then mitigation measures must be proposed and taken.

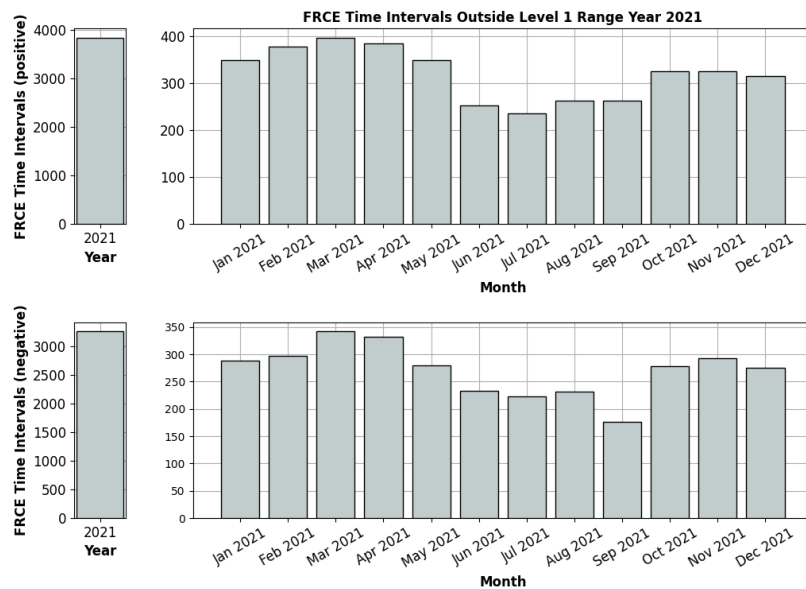


Figure 14 Nordic LFC 2021 FRCE Time Intervals Outside Level 1 Range

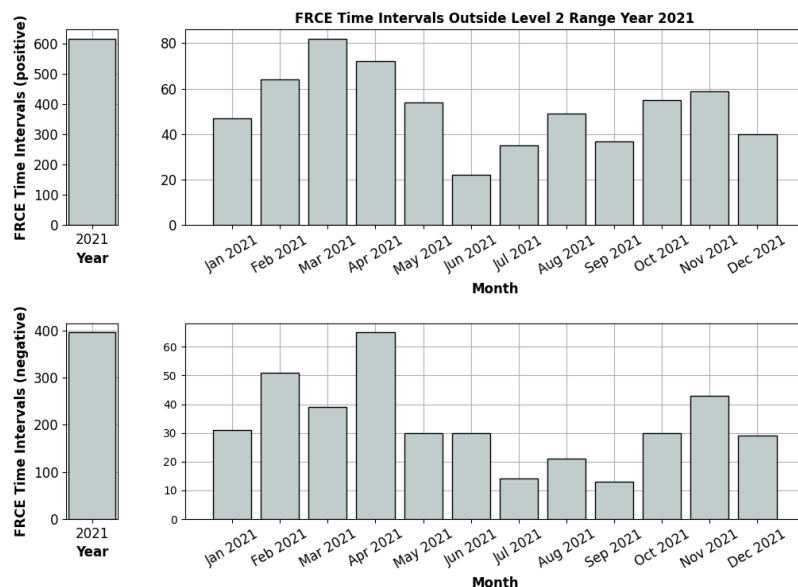


Figure 15 Nordic LFC 2021 FRCE Time Intervals Outside Level 2 Range

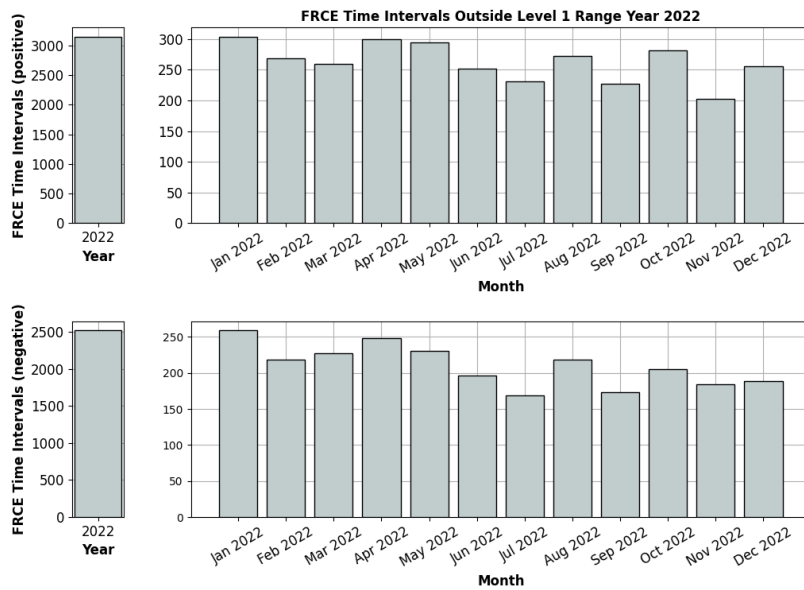


Figure 16 Nordic LFC 2022 FRCE Time Intervals Outside Level 1 Range

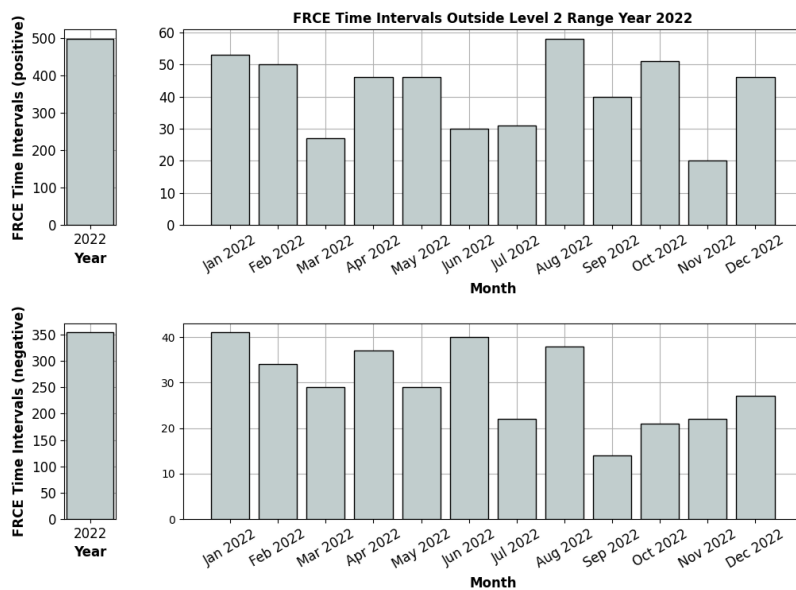


Figure 17 Nordic LFC 2022 FRCE Time Intervals Outside Level 2 Range

II. FRCE vs. FRR

The ability of an LFC block to regulate its own FRCE is presented by comparing its reserve capacity on FRR and its FRCE value according to the SO GL. Reserve capacity on FRR is defined as FRR capacity from the dimensioning process (SO GL, Art. 157). If during a dedicated time interval, a TSO 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 to as FRR+ in this document) for negative FRCE and a negative FRR (referred to as FRR- in this document) for a positive FRCE. FRCE is the value after the adjustment process for TSOs' part of an FRR activation process. The values include all correction signals for TSOs' part of the Imbalance Netting process. The values used are the 1-minute average values. The granularity of the instantaneous FRCE values (used to calculate the 1-minute average) is 10 seconds or lower.

The reported number of events indicates the occurrence of large imbalances in LFC blocks (60% of FRR) and an insufficient capability of LFC blocks to solve them within the maximum time to restore frequency.

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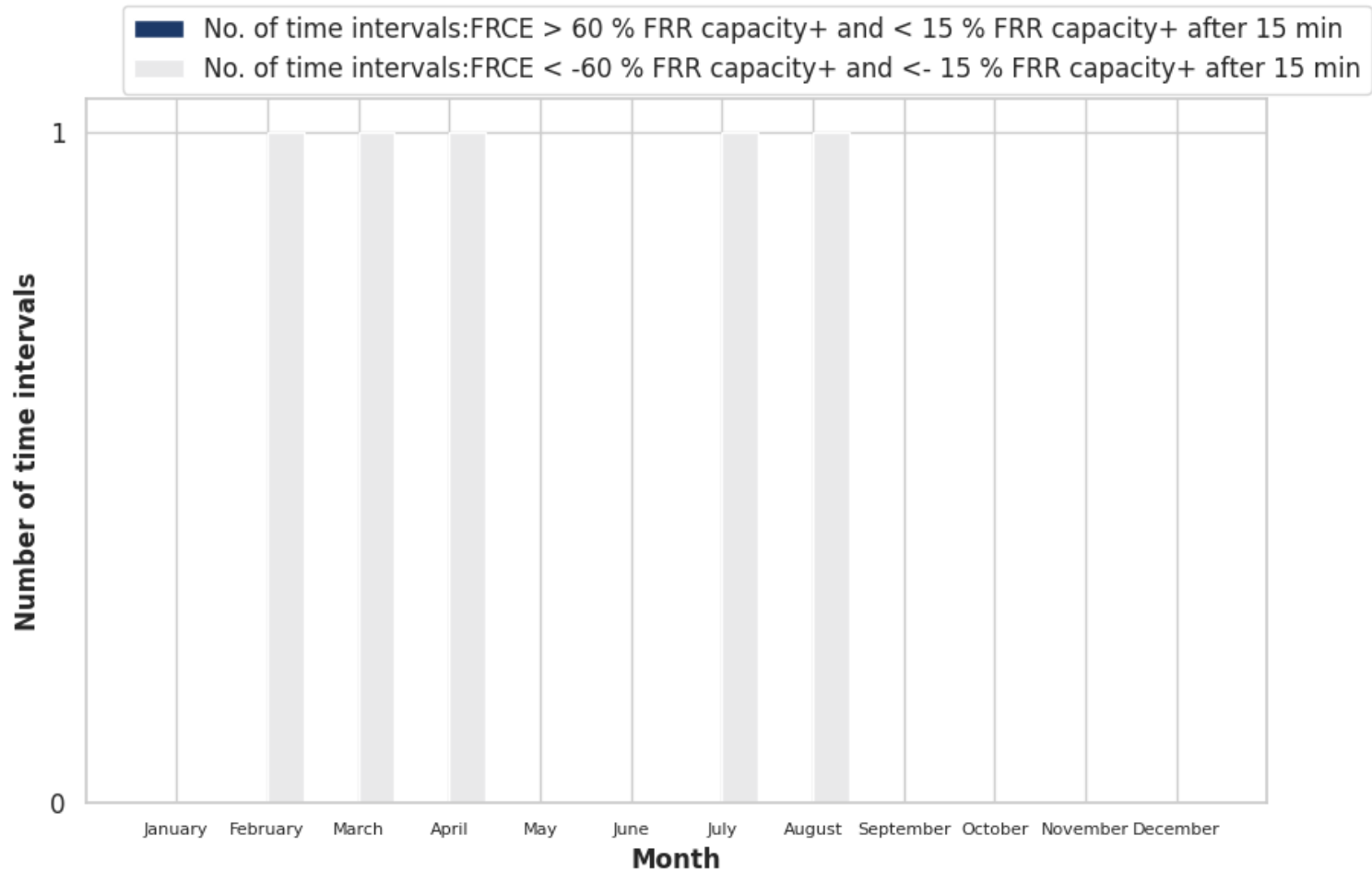


Figure 18 Nordic LFC 2021 FRCE Outside FRR Capacity within 15 minutes

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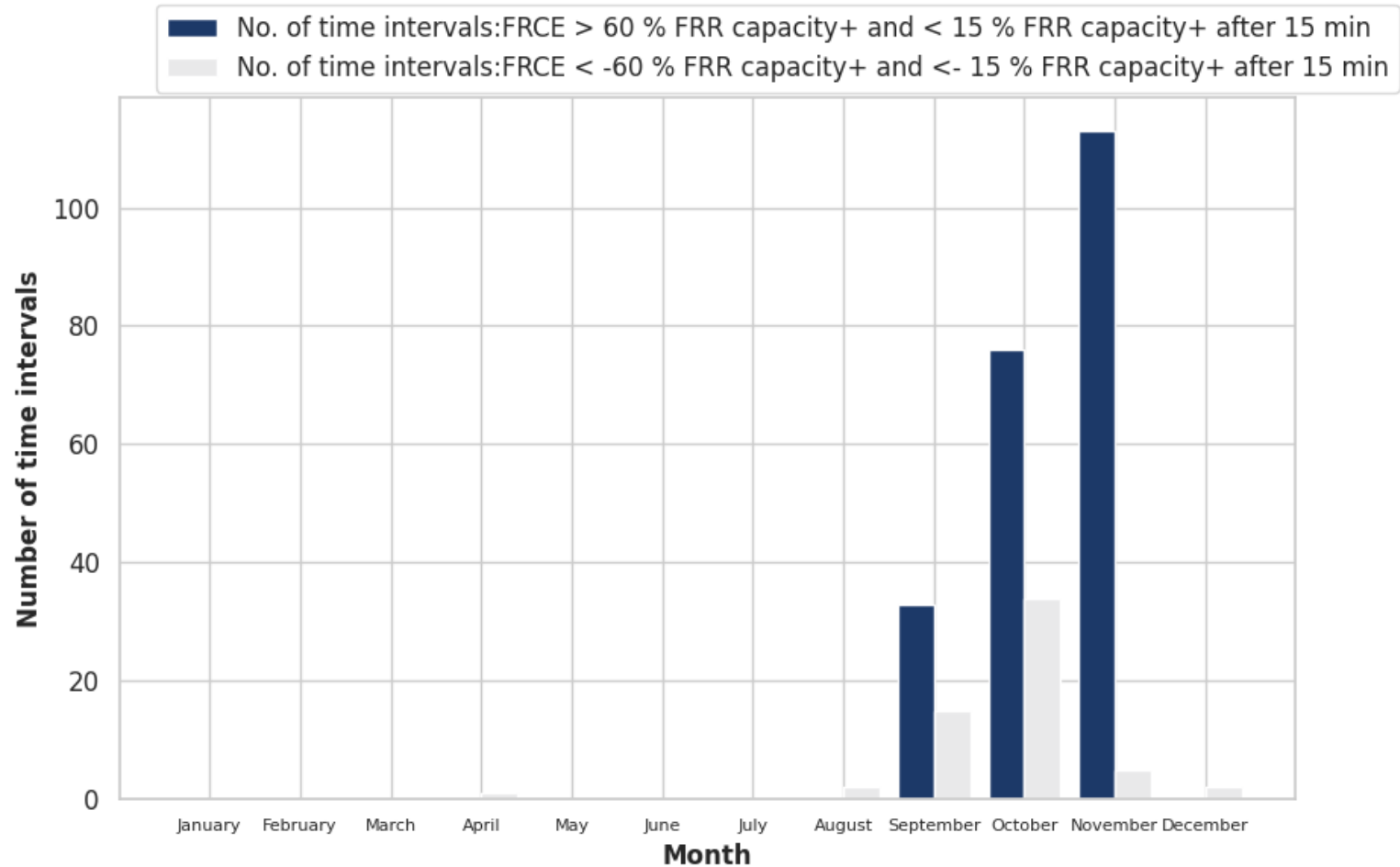


Figure 19 Nordic LFC 2022 FRCE Outside FRR Capacity within 15 minutes

Frequency quality evaluation

I. Mitigation Measures Analysis

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

In accordance with Article 138, when the values of the FRCE target parameters calculated for one calendar year 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) an analysis of 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, an analysis of the causes and a set of recommendations; and

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

For the reporting period, which included the years 2021 and 2022, in line with Figures 14–17, the following analysis and mitigation measures were reported from the Nordic LFC Block:

Mitigation measures for year 2021:

There were no mitigation measures applied as FRCE performance was in the required range.

Mitigation measures for year 2022:

There were no mitigation measures applied as FRCE performance was in the required range.

Performance – CE

Continental Europe Synchronous Area Performance

The following tables and figures present data from 2020 and 2021 for the Continental Europe synchronous area. Input values for frequency are based on instantaneous frequency values. The mean value, standard deviation and percentiles were calculated based on the input values. Moreover, any time periods and events where the system frequency appeared outside of predefined ranges were also indicated. For data points where the frequency was outside the 50 and 800 mHz range, time is measured in minutes.

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2021

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	49.99965	50.00142	49.99940	50.00029	50.00066	49.99953	50.00086	49.99993	50.00007	49.99960	50.00049	50.00076	50.00022
The standard deviation	0.0200	0.0211	0.0212	0.0204	0.0210	0.0188	0.0181	0.0184	0.0202	0.0221	0.0212	0.0209	0.0203
1-percentile	49.948	49.947	49.942	49.946	49.946	49.950	49.956	49.953	49.947	49.942	49.947	49.944	49.947
5-percentile	49.968	49.968	49.966	49.968	49.967	49.970	49.973	49.971	49.969	49.964	49.967	49.966	49.968
10-percentile	49.976	49.976	49.974	49.976	49.976	49.977	49.979	49.978	49.976	49.973	49.975	49.975	49.976
90-percentile	50.023	50.026	50.024	50.023	50.025	50.022	50.022	50.022	50.024	50.025	50.025	50.025	50.024
95-percentile	50.030	50.033	50.031	50.030	50.033	50.028	50.029	50.028	50.031	50.032	50.032	50.031	50.031
99-percentile	50.047	50.053	50.052	50.051	50.054	50.044	50.046	50.046	50.049	50.053	50.051	50.048	50.050
Time(min) > 50 mHz	336	466	499	440	588	232	304	277	395	518	454	350	4860
Time(min) < -50 mHz	497	486	728	562	577	421	269	354	517	798	537	675	6422
Time(min) > 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -800 mHz	0	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	1	1
No. of events freq. deviation < -100 mHz and not < -25 mHz	1	0	1	1	1	3	0	0	0	2	0	0	9

Table 23 CE SA Performance for Year 2021

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2022

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00015	49.99986	50.00057	50.00079	49.99974	50.00020	50.00037	49.99997	50.00031	50.00038	49.99974	50.00108	50.00026
The standard deviation	0.0211	0.0220	0.0215	0.0227	0.0205	0.0195	0.0193	0.0187	0.0204	0.0216	0.0205	0.0199	0.0206
1-percentile	49.944	49.941	49.943	49.944	49.944	49.949	49.948	49.950	49.949	49.945	49.947	49.950	49.946
5-percentile	49.966	49.964	49.966	49.965	49.966	49.969	49.970	49.970	49.967	49.965	49.966	49.968	49.967
10-percentile	49.975	49.973	49.974	49.973	49.975	49.976	49.977	49.977	49.975	49.973	49.974	49.976	49.975
90-percentile	50.025	50.026	50.026	50.028	50.024	50.023	50.023	50.022	50.025	50.026	50.024	50.025	50.025
95-percentile	50.031	50.033	50.033	50.035	50.031	50.029	50.029	50.028	50.032	50.033	50.031	50.031	50.031
99-percentile	50.050	50.051	50.050	50.055	50.047	50.044	50.043	50.042	50.047	50.050	50.046	50.047	50.048
Time(min) > 50 mHz	425	433	441	620	321	222	204	177	277	417	252	306	4095
Time(min) < -50 mHz	698	712	676	689	646	439	482	434	450	637	552	424	6840
Time(min) > 800 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -800 mHz	0	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	0	0
No. of events freq. deviation < -100 mHz and not < -25 mHz	0	0	1	1	0	1	1	0	0	0	0	0	4

Table 24 CE SA Performance for Year 2022

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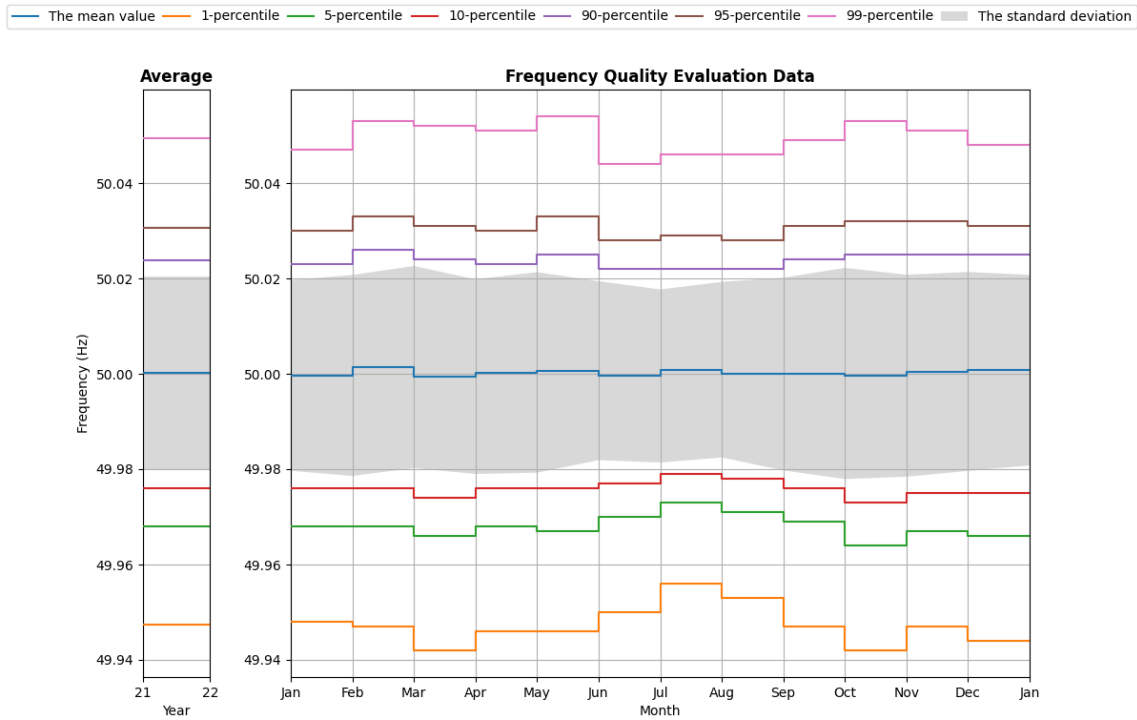


Figure 20 CE SA 2021 frequency quality

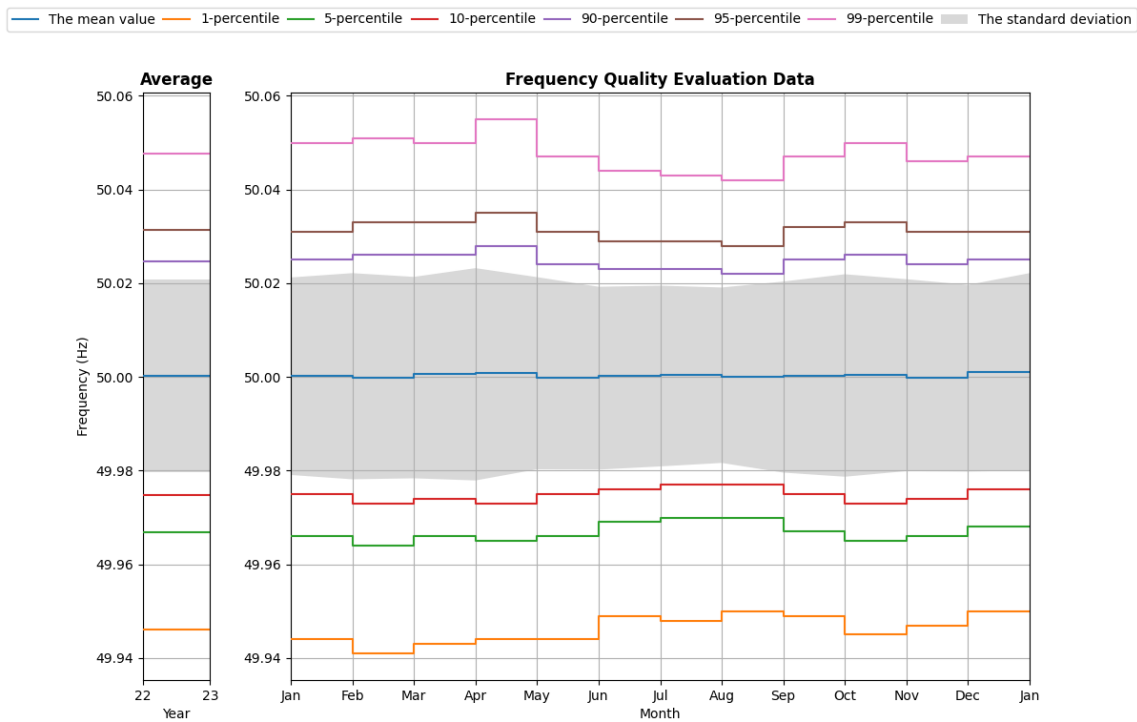


Figure 21 CE SA 2022 frequency quality

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Figures 22 and 23 present the accumulated minutes outside standard ranges for 2021 and 2022, respectively.

The red line shows the theoretical line in the case of a linear distribution (1/12 per month) of minutes outside standard ranges, considering standard ranges from SO GL (15 000 minutes).

The black line shows the accumulated minutes outside standard ranges per month for the synchronous area. If the black line is higher than the red line at the end of the year, this indicates that the synchronous area did not meet the required frequency quality parameters.

The graphs in Figures 22, 23 and 23a below show that the frequency quality target parameters from SO GL were fulfilled for the respective years for the Synchronous Area of Continental Europe.

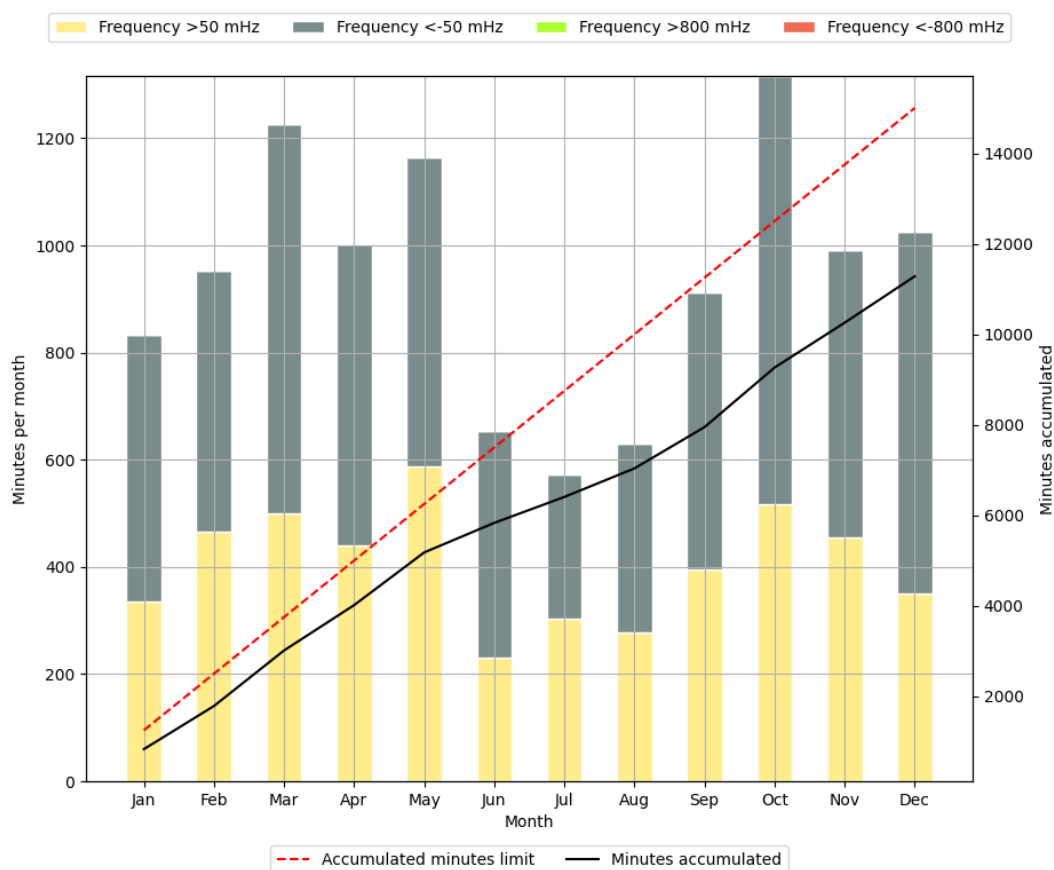


Figure 22 CE SA 2021 frequency deviation

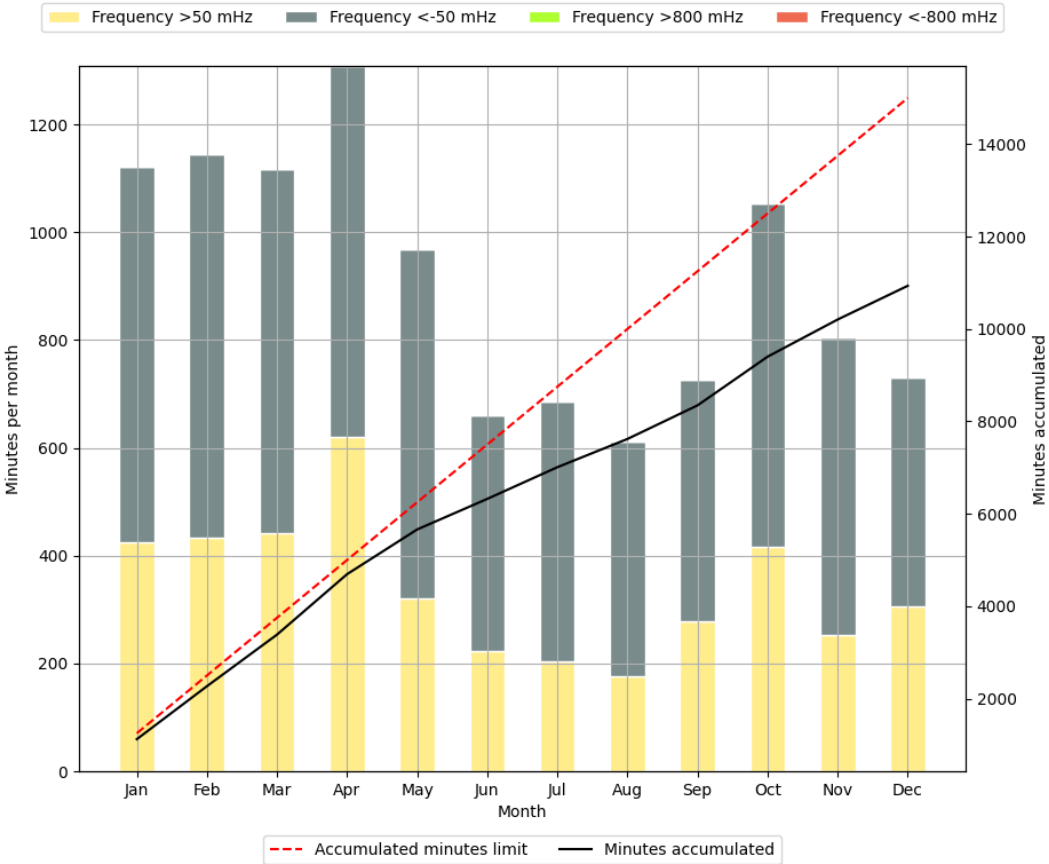


Figure 23 CE SA 2022 frequency deviation

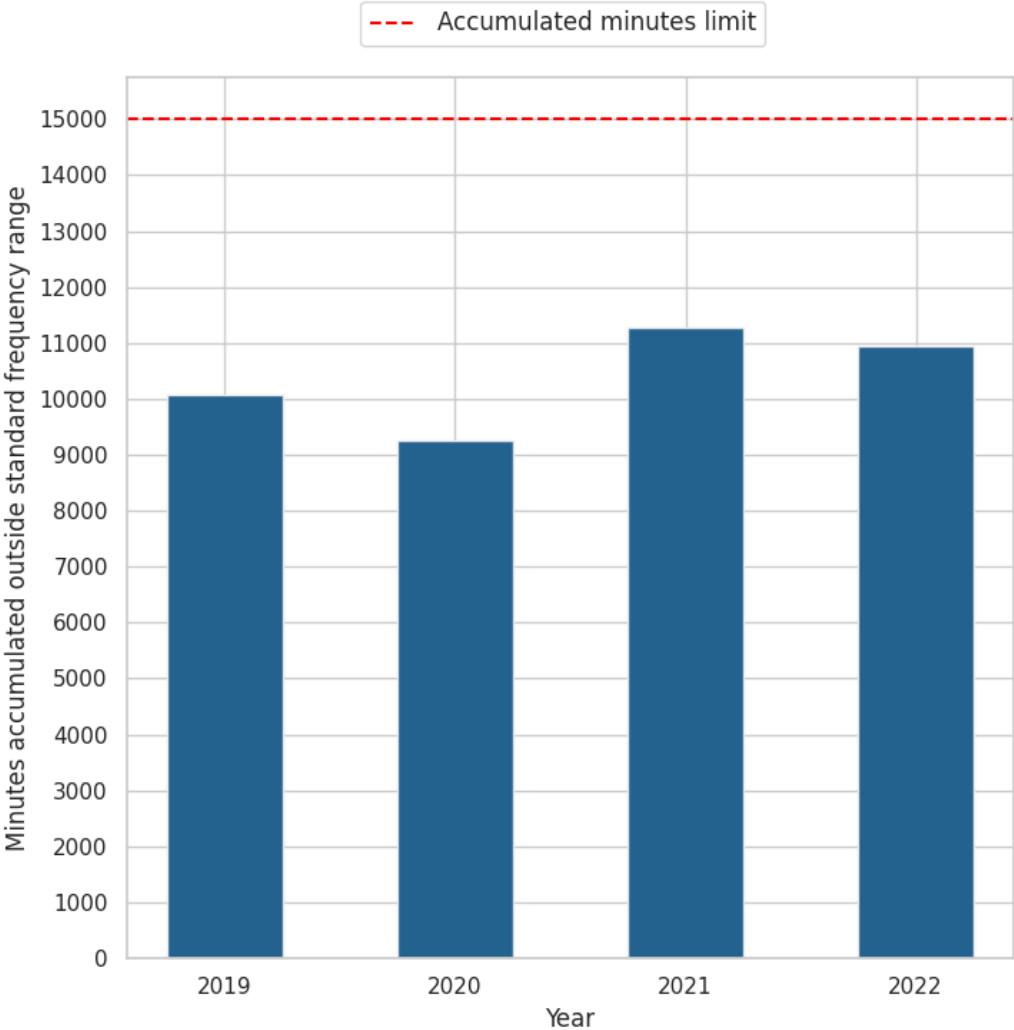


Figure 23a CE SA frequency deviation trend

Continental Europe Synchronous Area LFC Blocks Performance

This section provides an overview of the Continental Europe Frequency Quality Evaluation Criteria for LFC Blocks. Limits for Level 1 and Level 2 are calculated retroactively in line with the Synchronous Area Framework Agreement for Continental Europe, whose entry into force was 14 April 2019. FRCE values are calculated based on 15 min Area Control Error (ACE) data. Additionally, events that indicate where FRCE exceeds 60% of FRR used and not returned to 15% of FRR during a 15-minute time period are reported. A complete list of data provided by LFC blocks is shown in Appendix B.

I. Level 1/Level 2 statistics

In the following graphs, the 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 and for reporting years from each LFC block in the Continental Europe Synchronous Area. The number of time intervals in which average FRCE was higher than Level 1 is shown with dots, while for the opposite direction it is denoted by the symbol 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 the respective years and measured in MW.

LFC Block	Level 1	Level 2
APG	89	168
CEPS	91	172
ELIA	98	186
ESO	64	121
Germany	255	481
IPTO	73	137
MAVIR	64	121
OST	26	49
PSE	135	256
REE	206	389
REN	74	141
RTE	238	450
SEPS	55	104
SG	86	163
SHB	69	131
SMM	74	140
TEIAS	184	348
TEL	80	151
TERNA	181	342
TTB	113	213
Target for the maximum number of 15 minutes time intervals per year outside the Level 1 and Level 2 FRCE range	10512	1752

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 2021

LFC Block	Level 1	Level 2
AK	32	60
APG	89	169
CEPS	89	169
ELIA	96	182
ESO	63	118
Germany	250	474
IPTO	72	136
MAVIR	64	122
PSE	132	249
REE	206	389
REN	75	141
RTE	231	436
SEPS	55	104
SG	83	158
SHB	69	130
SMM	70	133
TEIAS	187	353
TEL	79	149
TERNA	178	337
TTB	112	213
UAMD	123	233
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 2022. The Level 1 and 2 values for PSE and Ukrenergo were updated to the values above on 7 July 2022.

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

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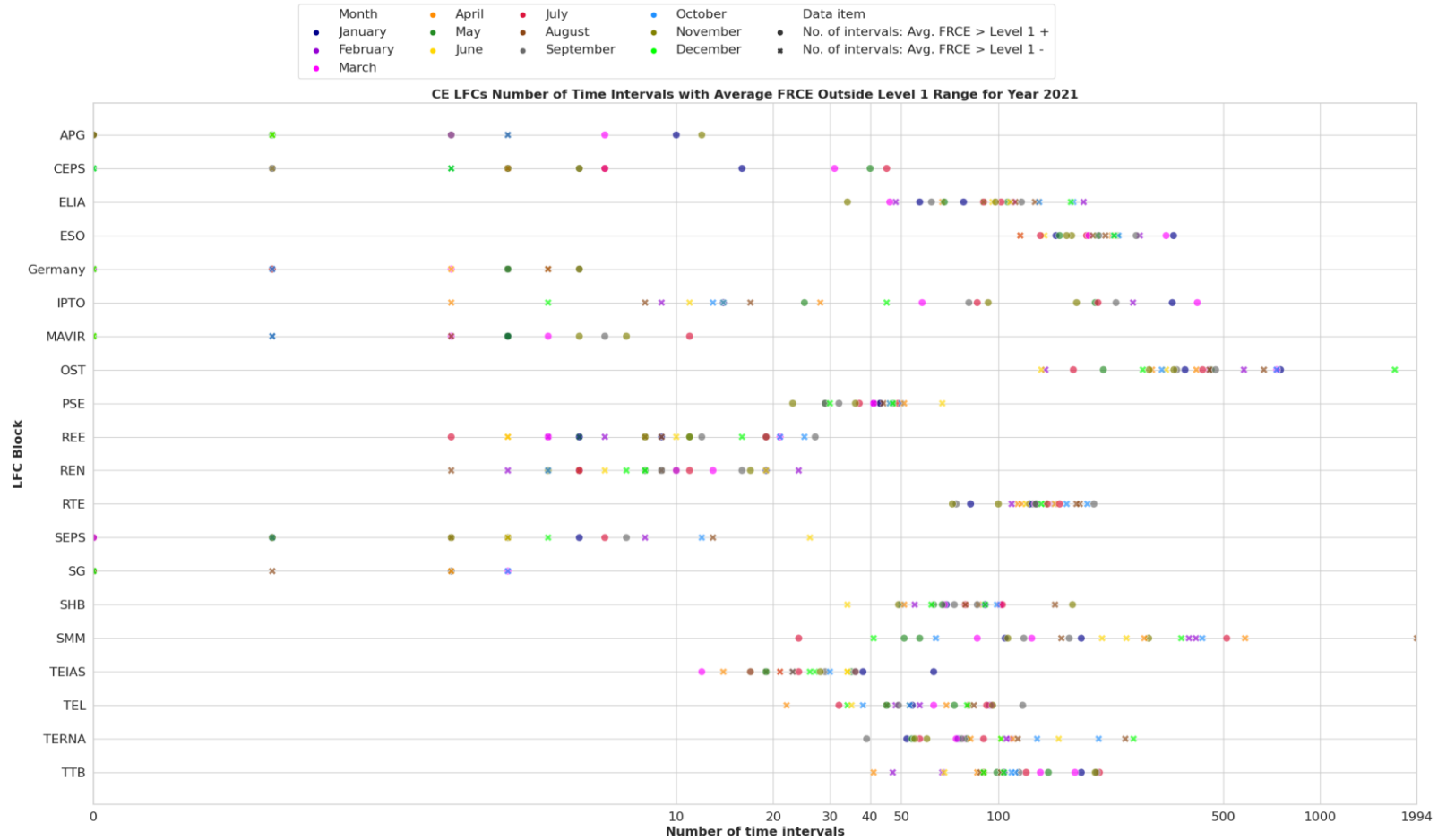


Figure 24 CE LFCs 2021 FRCE Time Intervals outside Level 1 Range

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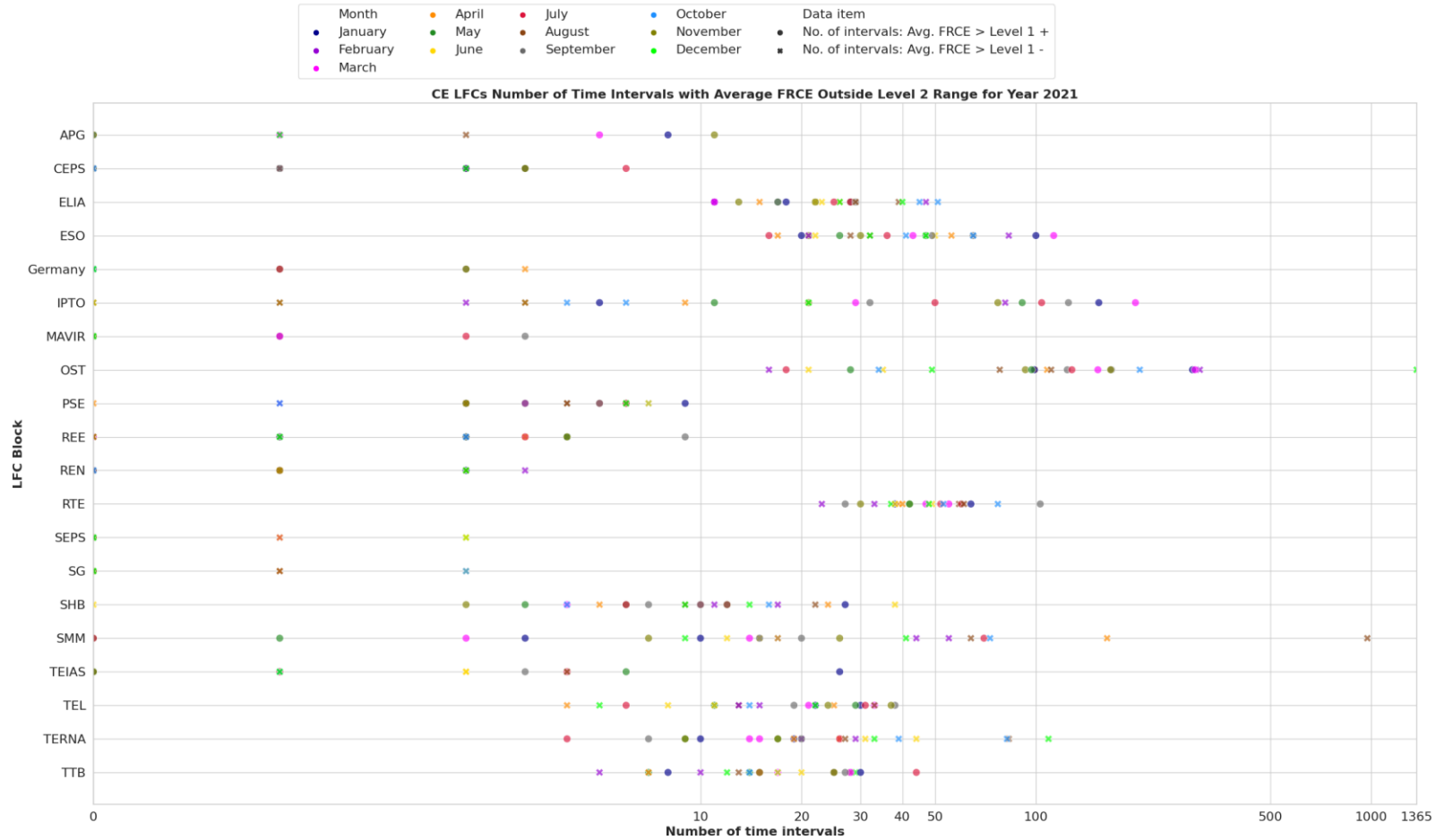


Figure 25 CE LFCs 2021 FRCE Time Intervals outside Level 2 Range

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Figure 26 CE LFCs 2022 FRCE Time Intervals outside Level 1 Range

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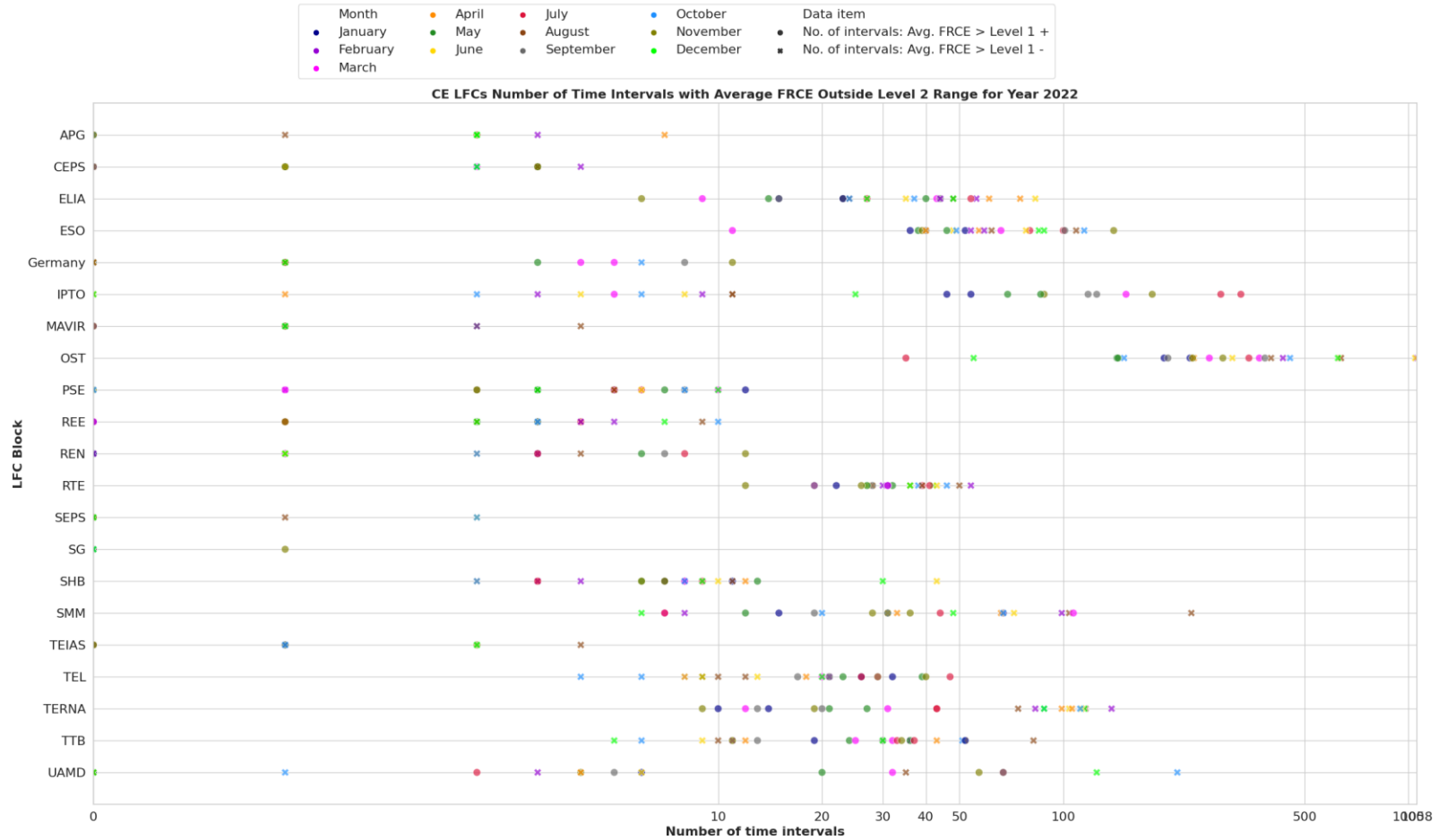


Figure 27 CE LFCs 2022 FRCE Time Intervals outside Level 2 Range

II. FRCE vs. FRR

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

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

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Figure 28 CE LFC Blocks 2021 FRCE Outside FRR Capacity within 15 minutes

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Figure 29 CE LFC Blocks 2022 FRCE Outside FRR Capacity within 15 minutes

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Frequency quality evaluation

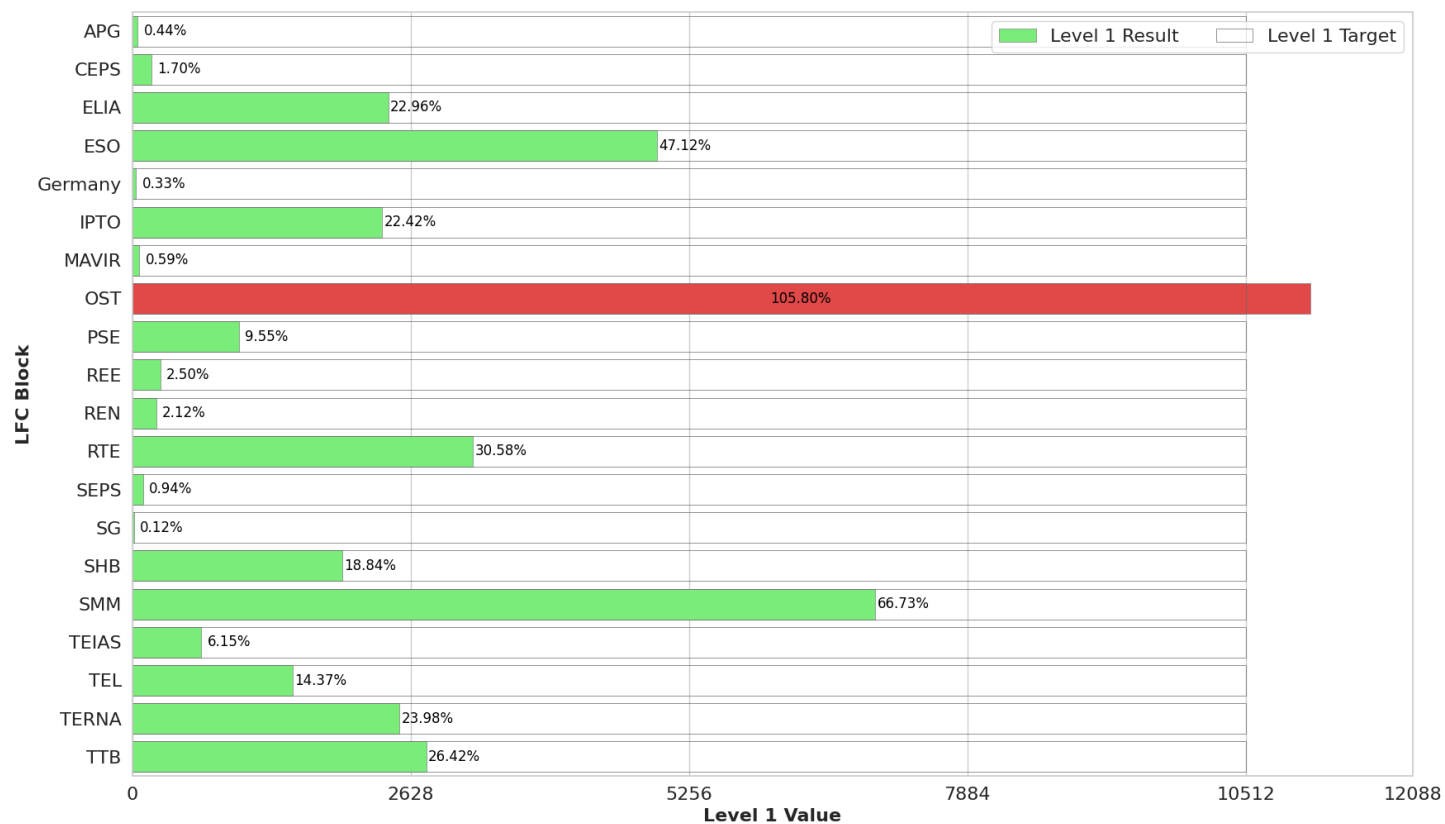


Figure 30 CE LFC Blocks 2021 TSO time Intervals with average FRCE outside Level 1 target

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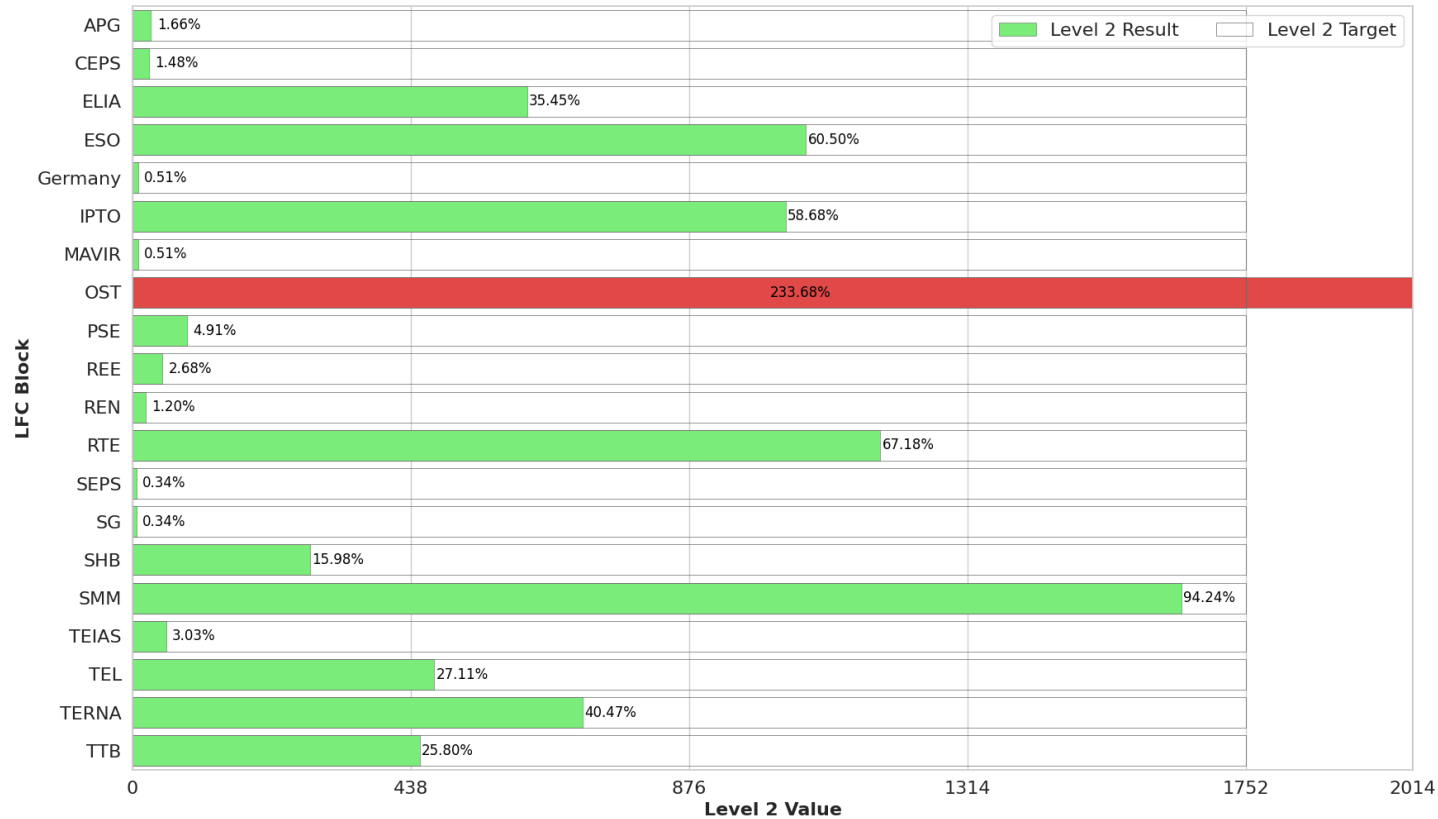


Figure 31 CE LFC Blocks 2021 TSO time Intervals with average FRCE outside Level 2 target

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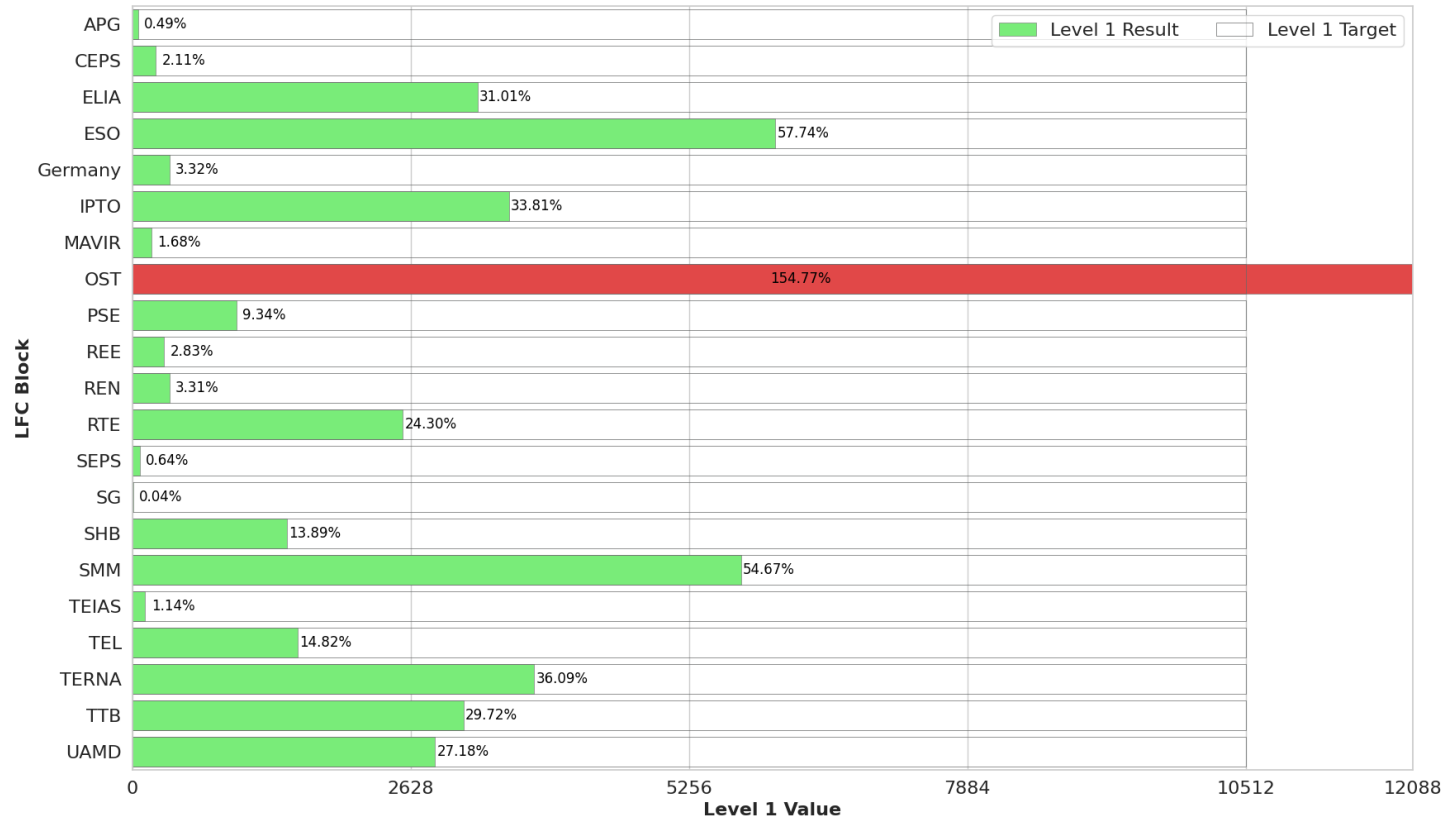


Figure 32 CE LFC Blocks 2022 TSO time Intervals with average FRCE outside Level 1 target

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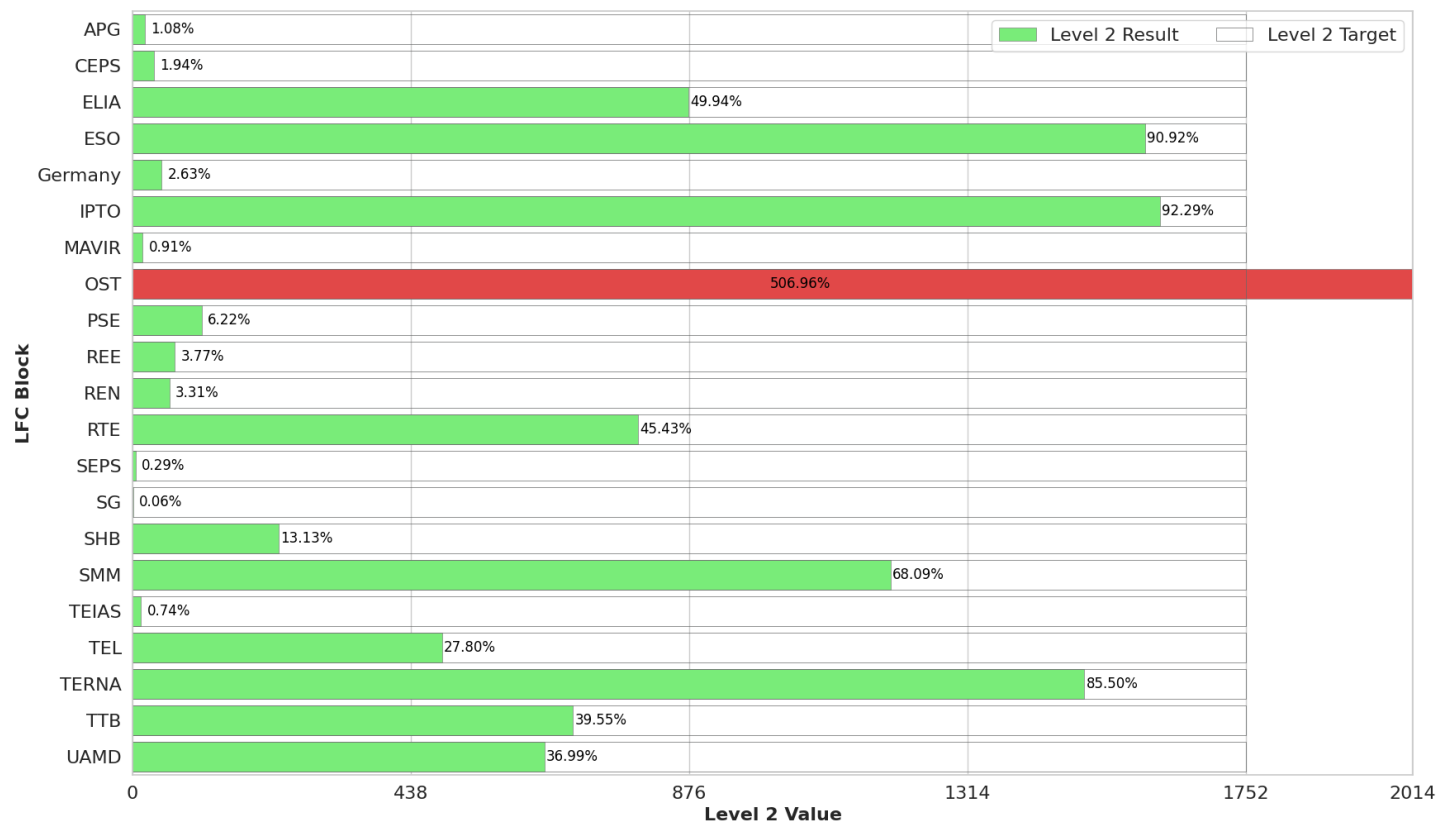


Figure 33 CE LFC Blocks 2022 TSO time Intervals with average FRCE outside Level 2 target

I. Mitigation Measures Analysis

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

In accordance with Article 138, when the values calculated for one calendar year with respect to 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 with Article 138, when the values calculated for one calendar year with respect to the 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, this information should contain:

(a) an analysis of 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, an analysis of the causes and a set of recommendations; and

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

For the reporting period, encompassing the years 2021 and 2022, in line with Figures 30–33, the following analysis and mitigation measures were reported from LFC blocks in Continental Europe:

Mitigation measures for year 2021:

OST LFC Block

Analysis:

In December 2021, KOSTT's units in KosovaB tripped, which led to high ACE in the KOSTT Control Area and in respective the Control Block (CB) AK. The outage of units lasted several days; hence, the CB AK ACE surpassed Level 1 and Level 2 limits. Within the CB AK, mFRR reserves in the OST Control Area were activated, but due to low hydro levels, the amount of mFRR was insufficient to cover the whole imbalance.

Mitigation measures:

As the root cause was a combination of several uncontrollable events by TSOs (low hydro levels, outage of the largest unit, disruptions in the energy market), OST will take measures to prevent this from happening again.

Mitigation measures for year 2022:

OST LFC Block

Analysis:

The main cause was the combination of several events uncontrollable by KOSTT (outage of the largest unit, need for additional import), which led to high ACE in KOSTT Control Area and in respective the Control Block (CB) AK. Hence, the CB AK ACE exceeded the Level 1 and Level 2 limits. Within the CB AK, mFRR reserves were activated in the OST Control Area, but was not sufficient to cover the entire imbalance.

Mitigation measures:

As the root cause was a combination of several uncontrollable events by TSOs (low hydro levels, outage of the largest unit, disruptions in the energy market), OST will take measures to prevent this from happening again.

FCR DATA

Introduction

The annual report on load-frequency control provides information on the FCR obligations and the initial FCR obligations of each TSO, covering each month of at least two previous calendar years. Despite that, SO GL requests that companies report two separate values regarding FCR with the following definitions:

FCR obligation refers to the portion of all the FCR that falls under the responsibility of a TSO; and

Initial FCR obligation refers to the amount of FCR allocated to a TSO on the basis of a sharing key.

The initial FCR obligation is reported monthly as an average value of FCR in MW for the reported month. This value is the same for each month if the value of a TSO's initial FCR obligation is constant for the whole year. If the initial FCR obligation is not constant during a period, the TSO reports an average value of the FCR on a monthly level for the reported year.

IE/NI and GB TSOs

Tables 27 to 30 below present the FCR from January (I) to December (XII) for 2020 and 2021. The FCR requirement for the synchronous areas 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 TSO area is also given as a percentage.

Nordic TSOs

Figures 31 and 32 depict the FCR for every Nordic TSO from January (I) to December (XII) for 2020 and 2021, respectively. The initial FCR obligation for each TSO is the FCR-D capacity, i.e., the frequency containment reserve used to stabilise the frequency deviations between 49.5 Hz or 50.5 Hz during disturbances. Each TSO ensures these capacities with a combination of mandatory requirements, internal markets and a common market.

Continental Europe TSOs

Figures 33 and 34 show the FCR for every Continental Europe TSO from January (I) to December (XII) for 2020 and 2021, respectively. If more than one TSO is operating inside the Member State (e.g. Germany), the provided value per TSO is summarised for the Member State to enable comparability. The determined value describes the amount of initial FCR obligation inside the respective TSO, divided by the amount of procured FCR inside the TSO area. This value is calculated as a percentage. Values higher than 100% indicate that the respective TSO exported a percentage amount of FCR to other TSOs, and values lower than 100% indicate that the TSO imported part of its FCR from other TSOs (i.e. part of its initial FCR obligation is contracted outside of its responsibility area). If the value is equal to 100 all FCR was ensured inside the TSO's responsibility area. If data is missing or was not provided in a timely manner, the entry shows N/A.

The following tables and figures show FCR per TSO separately for each Synchronous Area presented in this report.

TSO data

I. IE/NI TSO

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	289	265	285	314	312	312	341	305	291	267	277	261
FCR obtained inside the area of TSO [%]	71%	70%	70%	74%	75%	75%	82%	80%	77%	77%	78%	79%

Table 27 IE/NI TSO FCR Statistic Year 2021. The 2021 values for IE/NI have been corrected and are therefore not the same as in the 2021 Annual LFC Report.

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	282	237	277	288	291	294	301	303	303	266	271	291
FCR obtained inside the area of TSO [%]	77%	77%	82%	86%	79%	77%	85%	80%	83%	79%	80%	78%

Table 28 IE/NI TSO FCR Statistic Year 2022

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II. GB TSO

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	1026	1027	1044	1121	1047	908	903	904	909	891	1230	1189
FCR obtained inside the area of TSO [%]	95%	95%	95%	92%	95%	95%	95%	95%	94%	94%	96%	96%

Table 29 GB TSO FCR Statistic Year 2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	1204	1252	1221	1415	1666	1791	1856	1719	1807	1772	1629	1305
FCR obtained inside the area of TSO [%]	96%	96%	96%	96%	98%	1%	100%	100%	100%	1%	100%	100%

Table 30 GB TSO FCR Statistic Year 2022

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III. Nordic TSOs

2021

Name	Initial obligation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energinet (Nordic)	40 MW	41.00 %	41.00 %	41.00 %	41.00 %	40.71 %	38.17 %	39.84 %	39.94 %	40.00 %	40.00 %	38.67 %	38.71 %
Fingrid	288 MW	299.82 %	298.81 %	298.89 %	299.00 %	295.24 %	286.05 %	287.47 %	289.64 %	290.18 %	290.32 %	288.07 %	288.84 %
Statnett	566 MW	861.57 %	891.58 %	899.10 %	925.15 %	891.12 %	953.15 %	989.41 %	879.96 %	909.70 %	897.94 %	921.46 %	896.40 %
Svenska kraftnät	556 MW	454.85 %	449.64 %	477.85 %	536.62 %	570.38 %	583.25 %	586.52 %	566.11 %	562.96 %	594.29 %	541.98 %	506.32 %

Table 31 Nordic TSO FCR Statistic Year 2021

2022

Name	Initial obligation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energinet (Nordic)	39 MW	102.73 %	102.77 %	102.40 %	102.62 %	102.60 %	95.47 %	100.00 %	100.08 %	102.63 %	101.59 %	96.67 %	100.00 %
Fingrid	552 MW	91.33 %	85.39 %	85.31 %	94.22 %	108.36 %	106.67 %	105.08 %	105.69 %	104.24 %	107.67 %	99.49 %	92.96 %
Statnett	286 MW	102.97 %	100.52 %	100.49 %	100.10 %	84.30 %	95.52 %	100.00 %	99.91 %	100.63 %	100.17 %	100.38 %	100.04 %
Svenska kraftnät	39 MW	102.73 %	102.77 %	102.40 %	102.62 %	102.60 %	95.47 %	100.00 %	100.08 %	102.63 %	101.59 %	96.67 %	100.00 %

Table 32 Nordic TSO FCR Statistic Year 2022

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IV. CE TSOs

2021

Name	Initial obligation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50Hertz	114 MW	229.35 %	213.00 %	204.33 %	230.30 %	188.86 %	199.08 %	219.26 %	241.00 %	263.68 %	233.06 %	248.30 %	251.12 %
Amprion	209 MW	77.60 %	80.89 %	81.99 %	83.05 %	81.98 %	71.03 %	69.43 %	76.15 %	70.30 %	76.06 %	74.55 %	75.08 %
APG	71 MW	102.62 %	87.48 %	105.76 %	131.35 %	139.77 %	123.51 %	138.45 %	123.83 %	152.41 %	161.75 %	139.30 %	132.23 %
CEPS	74 MW	109.46 %	109.46 %	109.46 %	109.46 %	109.46 %	108.12 %	109.46 %	109.46 %	109.46 %	101.35 %	101.35 %	101.35 %
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 %
ELES	15 MW	60.00 %	4.00 %	5.00 %	17.00 %	8.00 %	6.00 %	27.00 %	21.00 %	26.00 %	52.00 %	41.00 %	32.00 %
Elia	87 MW	32.48 %	37.41 %	32.15 %	32.04 %	33.02 %	31.95 %	32.59 %	31.73 %	32.04 %	32.21 %	31.77 %	31.35 %
EMS	34 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 %
Energinet (CE)	20 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	96.77 %	97.01 %	100.00 %	100.00 %	100.00 %	100.00 %	94.04 %
ESO	37 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 %
HOPS	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 %
IPTO	47 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 %
KOSTT	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 %
MAVIR	37 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.79 %	100.00 %	104.01 %	100.00 %	100.00 %	100.78 %	100.18 %	100.00 %
MEPSO	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 %
NOS BiH	13 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	157 MW	109.60 %	109.38 %	110.22 %	109.89 %	110.92 %	110.06 %	109.42 %	109.74 %	109.98 %	111.18 %	110.87 %	109.14 %
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	508 MW	115.00 %	121.00 %	120.00 %	109.00 %	118.00 %	116.00 %	94.00 %	93.00 %	91.00 %	94.00 %	97.00 %	99.00 %
SEPS	27 MW	70.20 %	76.50 %	72.00 %	78.00 %	73.10 %	71.50 %	71.90 %	69.70 %	72.90 %	75.40 %	68.10 %	65.90 %
Swissgrid	67 MW	157.00 %	148.00 %	146.00 %	143.00 %	163.00 %	194.00 %	224.00 %	191.00 %	157.00 %	154.00 %	143.00 %	110.00 %
TEIAS	304 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 %
TenneT DE	170 MW	79.37 %	88.78 %	88.67 %	93.58 %	92.61 %	90.94 %	94.42 %	96.88 %	101.80 %	99.04 %	99.32 %	107.94 %
TenneT NL	114 MW	36.78 %	36.94 %	36.73 %	36.64 %	42.64 %	43.25 %	55.57 %	56.37 %	53.10 %	59.08 %	56.90 %	63.27 %
Terna	295 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 %
Transelectrica	57 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 %
TransnetBW	73 MW	34.55 %	31.27 %	35.09 %	43.09 %	12.29 %	31.48 %	81.37 %	81.74 %	68.94 %	59.60 %	61.05 %	52.89 %
Western WPS	8 MW	96.77 %	100.00 %	80.11 %	93.61 %	100.00 %	100.00 %	100.00 %	71.91 %	95.14 %	100.00 %	98.33 %	100.00 %

Table 33 Continental Europe TSO FCR Statistic Year 2021. The 2021 values for APG have been corrected and are therefore not the same as in the 2021 Annual LFC Report.

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Name	Initial obligation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50Hertz	112 MW	236.48 %	230.08 %	261.35 %	236.15 %	233.75 %	247.15 %	241.65 %	258.50 %	261.18 %	244.24 %	228.23 %	213.01 %
Amprion	204 MW	79.18 %	78.99 %	79.26 %	75.91 %	67.91 %	76.93 %	77.52 %	75.34 %	79.47 %	82.66 %	80.65 %	78.88 %
APG	73 MW	104.77 %	113.48 %	114.92 %	129.71 %	133.99 %	123.14 %	135.62 %	127.40 %	123.29 %	124.66 %	130.14 %	120.55 %
CEPS	73 MW	109.59 %	109.59 %	110.96 %	106.85 %	108.22 %	108.22 %	104.11 %	105.48 %	106.85 %	110.96 %	108.22 %	109.59 %
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 %
ELES	15 MW	25.00 %	20.00 %	20.00 %	17.00 %	15.00 %	13.00 %	14.00 %	9.00 %	12.00 %	24.00 %	10.00 %	12.00 %
Elia	86 MW	31.52 %	31.67 %	32.65 %	32.23 %	32.61 %	31.50 %	31.26 %	31.85 %	34.91 %	35.27 %	32.91 %	37.49 %
EMS	45 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 %
Energinet (CE)	22 MW	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	8.18 %	10.83 %	3.99 %	5.72 %
ESO	36 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 %
HOPS	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 %
IPTO	48 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 %
KOSTT	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 %
MAVIR	38 MW	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.34 %	101.96 %	100.61 %	100.00 %	100.00 %
MEPSO	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 %
NOS BiH	13 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	159 MW	107.38 %	107.22 %	108.68 %	107.48 %	107.76 %	105.10 %	107.02 %	106.80 %	107.73 %	108.76 %	107.61 %	106.70 %
REE	388 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	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 %
RTE	489 MW	111.00 %	110.00 %	104.00 %	110.00 %	112.00 %	112.00 %	104.00 %	99.00 %	102.00 %	111.00 %	122.00 %	125.00 %
SEPS	28 MW	74.60 %	78.60 %	74.60 %	80.70 %	76.10 %	64.60 %	58.90 %	57.90 %	56.10 %	64.60 %	73.90 %	77.90 %
Swissgrid	62 MW	86.00 %	88.00 %	73.00 %	89.00 %	144.00 %	143.00 %	149.00 %	128.00 %	100.00 %	82.00 %	53.00 %	61.00 %
TEIAS	320 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 %
TenneT DE	167 MW	105.48 %	106.22 %	101.01 %	103.62 %	94.77 %	84.43 %	86.63 %	91.43 %	92.28 %	86.52 %	89.37 %	96.87 %
TenneT NL	116 MW	61.84 %	70.15 %	57.60 %	59.60 %	58.88 %	55.76 %	55.76 %	61.62 %	58.45 %	66.14 %	63.32 %	52.94 %
Terna	293 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 %
Transeletrica	57 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 %
TransnetBW	72 MW	49.24 %	39.58 %	72.53 %	43.40 %	25.92 %	27.65 %	67.05 %	82.87 %	80.60 %	46.14 %	29.80 %	32.56 %
Ukrenergo	0 MW	0.00 %	0.00 %	105.00 %	104.71 %	85.70 %	78.95 %	66.47 %	74.20 %	66.24 %	82.38 %	78.83 %	48.16 %

Table 34 Continental Europe TSO FCR Statistic Year 2022

It should be noted that eleven TSOs participated in the **FCR Cooperation** to procure their FCR in 2021 and 2022. Therefore, the value of procured FCR can be different from the initial FCR obligation due to export and import. These countries (TSOs) are Austria (APG), Belgium (Elia), Switzerland (Swissgrid), Germany (50Hertz, Amprion, TenneT DE, TransnetBW), Slovenia (ELES), Western Denmark (Energinet), France (RTE) and the Netherlands (TenneT NL). More information about the FCR Cooperation can be found at https://www.entsoe.eu/network_codes/eb/fcr/. Furthermore, bilateral cooperation between TSOs might impact the procured FCR.

APPENDIX

Country	TSO (full company name)	TSO (short name)
Albania	Operatori i Sistemit te Transmeimit	OST
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	CEPS a.s.	CEPS
Denmark-East	Energinet	Energinet (Nordic)
Denmark-West	Energinet	Energinet (CE)
Finland	Fingrid Oyj	Fingrid
France	Réseau de Transport d'Electricité	RTE
Germany	TransnetBW GmbH	TransnetBW
Germany	Amprion GmbH	Amprion
Germany	TenneT TSO GmbH	TenneT DE
Germany	50Hertz Transmission GmbH	50Hertz
Great Britain	National Grid Electricity System Operator Limited	National Grid ESO
Greece	Independent Power Transmission Operator S.A.	IPTO
Hungary	MAVIR Magyar Villamosenergia-ipari Atviteli Rendszerirányító Zártkörűen Működő Részvénytársaság	MAVIR
Ireland	EirGrid plc	EirGrid
Italy	Terna - Rete Elettrica Nazionale SpA	Terna
Kosovo	KOSTT SH.A. është Operatori i Sistemit, Transmisionit dhe Tregut të energjisë elektrike të Kosovës	KOSTT
Luxembourg	Creos Luxembourg S.A.	CREOS
Moldova	Moldelectrica	Moldelectrica
Montenegro	Crnogorski elektroprenosni sistem AD	CGES
Netherlands	TenneT TSO B.V.	TenneT NL
North Macedonia	Transmission System Operator of the Republic of North Macedonia	MEPSO
Northern Ireland	System Operator for Northern Ireland Ltd	SONI
Norway	Statnett SF	Statnett
Poland	Polskie Sieci Elektroenergetyczne S.A.	PSE
Portugal	Rede Eléctrica Nacional, S.A.	REN
Romania	C.N. Transelectrica S.A.	Transelectrica
Serbia	Joint Stock Company Elektromreza 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
Switzerland	Swissgrid AG	Swissgrid
Turkey	TEİAŞ	TEIAS
Ukraine	Ukrenergo	Ukrenergo
Ukraine	Western WPS	Western WPS

Abbreviation	Meaning
AGC	Automatic Generation Control
CE	Continental Europe
EMS	Energy Management System
FRCE	Frequency Restoration Control Error
GB	Great Britain
IE/NI	Ireland and Northern Ireland
SCADA	Supervisory Control And Data Acquisition
SOC	System Operations Committee
StG Op	Steering Group Operations
TO	Transmission owner
TSO	Transmission System Operator
aFRR	Automatic Frequency Restoration Reserves
mFRR	Manual Frequency Restoration Reserves

APPENDIX – CE LFC BLOCK DATA

APG

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.0	0.0	0.0	0.0	0.2	1.7	1.2	0.7	0.1	0.0	0.0	0.0	0.3
The standard deviation	31	38	30	26	29	40	35	32	25	30	30	25	31
1-percentile	-99	-118	-90	-79	-87	-83	-79	-80	-76	-91	-92	-77	-88
5-percentile	-52	-60	-50	-41	-46	-44	-43	-43	-41	-47	-46	-39	-46
10-percentile	-31	-37	-32	-26	-31	-29	-28	-27	-26	-31	-30	-24	-29
90-percentile	31	38	31	25	30	29	28	28	25	31	30	23	29
95-percentile	49	58	46	39	45	45	43	42	38	46	44	35	44
99-percentile	90	108	83	73	83	89	81	80	70	82	81	66	82
Number of time intervals: average FRCE > Level 1 positive	0	2	1	0	2	12	10	6	0	0	0	0	33
Number of time intervals: average FRCE < Level 1 negative	1	0	0	3	0	0	0	1	1	3	3	1	13
Number of time intervals: average FRCE > Level 2 positive	0	1	0	0	0	11	8	5	0	0	0	0	25
Number of time intervals: average FRCE < Level 2 negative	1	0	0	2	0	0	0	0	0	0	0	1	4
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	1	0	1	0	1	2	0	0	0	0	5
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	0	1	0	0	0	0	0	0	0	0	1

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.3	-0.9	0.2	0.2	0.4	0.0	0.1	-0.2	0.0	0.3	0.1	0.4	0.0
The standard deviation	28	32	29	31	29	24	22	22	23	22	22	21	25
1-percentile	-86	-100	-85	-93	-87	-71	-67	-70	-73	-67	-66	-62	-77
5-percentile	-41	-50	-45	-49	-47	-37	-34	-35	-37	-34	-34	-32	-40
10-percentile	-25	-32	-29	-31	-30	-24	-22	-22	-23	-21	-21	-20	-25
90-percentile	24	30	28	31	31	23	22	21	23	22	20	20	25
95-percentile	38	45	43	48	47	35	33	33	36	33	31	31	38
99-percentile	73	79	79	87	87	63	62	59	68	63	60	58	70
Number of time intervals: average FRCE > Level 1 positive	1	0	1	5	2	3	0	0	1	0	0	3	16
Number of time intervals: average FRCE < Level 1 negative	6	12	1	3	1	4	0	4	2	0	1	2	36
Number of time intervals: average FRCE > Level 2 positive	0	0	0	2	0	2	0	0	0	0	0	0	4
Number of time intervals: average FRCE < Level 2 negative	3	7	0	1	0	2	0	0	0	0	0	2	15
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	1	0	0	2	0	1	0	0	0	0	0	0	4
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	3	0	0	0	1	0	0	0	0	0	1	5

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CEPS

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.0	0.1	0.1	0.3	0.2	0.4	0.2	0.4	1.3	2.2	3.4	4.0	1.0
The standard deviation	37	37	39	40	34	36	34	36	44	48	48	48	40
1-percentile	-106	-102	-108	-110	-90	-96	-89	-94	-120	-133	-128	-115	-108
5-percentile	-51	-52	-53	-53	-47	-48	-45	-49	-54	-60	-61	-58	-53
10-percentile	-35	-36	-36	-37	-34	-34	-33	-35	-37	-39	-41	-40	-36
90-percentile	35	35	36	37	33	35	33	35	40	46	51	50	39
95-percentile	53	53	54	55	48	50	47	51	62	75	82	80	59
99-percentile	113	117	120	130	107	105	98	112	147	171	170	174	130
Number of time intervals: average FRCE > Level 1 positive	1	3	3	6	0	6	5	5	16	31	40	45	161
Number of time intervals: average FRCE < Level 1 negative	2	2	2	2	0	1	0	0	3	3	1	2	18
Number of time intervals: average FRCE > Level 2 positive	0	3	0	2	0	2	1	0	2	3	3	6	22
Number of time intervals: average FRCE < Level 2 negative	0	2	1	0	0	1	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	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

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	2.3	0.6	2.2	-0.8	-1.2	0.2	-1.2	0.0	-0.3	-0.1	-0.5	-0.5	0.1
The standard deviation	45	40	46	48	41	40	41	41	38	36	36	45	41
1-percentile	-118	-114	-124	-141	-124	-111	-125	-110	-103	-102	-103	-132	-117
5-percentile	-56	-55	-58	-75	-62	-58	-61	-63	-57	-53	-52	-69	-60
10-percentile	-39	-38	-39	-50	-42	-41	-43	-44	-40	-38	-36	-47	-41
90-percentile	45	40	46	47	40	41	42	45	40	38	36	47	42
95-percentile	73	59	72	74	60	59	59	65	58	54	52	70	63
99-percentile	154	130	156	145	114	114	110	114	107	97	96	135	123
Number of time intervals: average FRCE > Level 1 positive	27	11	29	13	2	11	6	7	5	1	0	1	113
Number of time intervals: average FRCE < Level 1 negative	5	4	11	16	15	9	17	5	6	6	8	7	109
Number of time intervals: average FRCE > Level 2 positive	3	0	3	1	0	3	1	2	1	0	0	1	15
Number of time intervals: average FRCE < Level 2 negative	1	2	2	3	2	0	4	0	1	0	2	2	19
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	1	0	0	0	1	0	0	0	1	0	3
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

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ELIA

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-7.8	1.1	0.4	-2.5	-1.2	-5.9	2.4	-1.5	-2.6	-1.7	-11.1	-4.9	-2.9
The standard deviation	59	60	55	67	66	45	38	42	48	59	58	59	55
1-percentile	-208	-184	-175	-204	-224	-177	-119	-148	-177	-186	-223	-204	-186
5-percentile	-110	-97	-79	-93	-89	-67	-45	-62	-72	-82	-113	-105	-85
10-percentile	-66	-55	-45	-54	-43	-36	-27	-33	-39	-47	-68	-63	-48
90-percentile	43	53	45	49	42	21	33	30	33	42	35	46	39
95-percentile	68	90	78	82	81	34	57	49	56	72	61	78	67
99-percentile	161	187	185	188	185	110	146	123	158	172	138	166	160
Number of time intervals: average FRCE > Level 1 positive	78	111	107	102	118	34	57	46	68	90	62	98	971
Number of time intervals: average FRCE < Level 1 negative	184	133	109	130	134	90	48	67	96	113	171	168	1443
Number of time intervals: average FRCE > Level 2 positive	18	28	28	28	29	13	11	11	17	25	17	22	247
Number of time intervals: average FRCE < Level 2 negative	47	26	23	39	45	26	11	15	22	29	51	40	374
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	1	1	4	6	7	8	8	2	4	0	0	1	42

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-9.1	-2.1	-8.6	0.7	1.2	-7.2	-4.2	-13.7	-1.1	5.5	-0.8	-5.1	-3.7
The standard deviation	61	79	77	70	68	59	59	57	55	57	50	45	62
1-percentile	-226	-249	-247	-217	-203	-213	-206	-225	-199	-176	-172	-177	-209
5-percentile	-116	-139	-141	-102	-94	-102	-94	-113	-88	-80	-77	-75	-102
10-percentile	-74	-84	-89	-61	-57	-62	-54	-66	-51	-44	-45	-44	-61
90-percentile	47	75	62	63	57	41	44	29	51	62	46	32	51
95-percentile	73	112	107	101	100	74	75	48	84	93	69	51	82
99-percentile	144	222	216	228	215	166	165	124	159	173	152	99	172
Number of time intervals: average FRCE > Level 1 positive	93	180	172	159	156	85	94	46	106	137	75	34	1337
Number of time intervals: average FRCE < Level 1 negative	198	230	268	155	145	160	145	192	130	108	95	97	1923
Number of time intervals: average FRCE > Level 2 positive	15	43	40	54	44	23	23	9	14	27	15	6	313
Number of time intervals: average FRCE < Level 2 negative	56	75	83	48	37	48	44	61	35	24	24	27	562
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	3	1	4	16	9	3	5	2	5	2	0	1	51

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ESO

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	3.5	7.5	2.2	-0.7	2.0	-1.5	0.5	3.9	0.4	-2.2	0.5	-3.6	1.0
The standard deviation	66	62	50	46	54	44	37	41	42	40	52	47	48
1-percentile	-181	-150	-148	-129	-154	-122	-108	-101	-113	-119	-131	-143	-133
5-percentile	-92	-84	-79	-80	-82	-74	-57	-54	-63	-73	-77	-84	-75
10-percentile	-60	-57	-55	-53	-55	-53	-40	-37	-44	-50	-57	-58	-52
90-percentile	72	75	57	50	60	49	43	48	44	41	53	45	53
95-percentile	103	109	82	71	85	68	64	72	68	60	77	70	78
99-percentile	186	210	138	127	150	107	111	137	117	106	145	130	139
Number of time intervals: average FRCE > Level 1 positive	350	332	234	188	268	169	151	191	155	135	205	163	2541
Number of time intervals: average FRCE < Level 1 negative	275	225	231	215	236	203	117	117	139	197	228	229	2412
Number of time intervals: average FRCE > Level 2 positive	100	113	47	36	65	21	20	43	26	16	49	30	566
Number of time intervals: average FRCE < Level 2 negative	83	56	50	32	65	32	21	17	22	28	41	47	494
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	42	43	28	16	34	14	12	20	13	5	10	12	249
Number of events: FRCE < -60 % FRR capacity + and not > -15 % FRR capacity + within 15 min	11	6	2	1	7	1	0	1	2	1	1	4	37

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.8	4.1	0.0	1.0	-2.4	-5.0	-3.5	-5.3	-4.2	-2.0	-0.2	6.8	-0.8
The standard deviation	49	53	47	54	47	55	49	40	62	65	70	80	56
1-percentile	-143	-149	-140	-139	-141	-158	-148	-126	-170	-194	-185	-173	-155
5-percentile	-75	-77	-79	-83	-75	-92	-83	-75	-90	-103	-108	-95	-86
10-percentile	-50	-50	-55	-60	-54	-65	-57	-50	-60	-72	-69	-63	-59
90-percentile	54	62	52	60	48	55	49	38	57	68	63	71	56
95-percentile	79	91	76	89	68	78	69	55	83	100	97	116	83
99-percentile	135	165	124	161	127	128	123	89	136	176	230	362	163
Number of time intervals: average FRCE > Level 1 positive	240	262	229	270	180	232	187	113	238	324	288	351	2914
Number of time intervals: average FRCE < Level 1 negative	215	192	241	274	224	300	248	210	269	361	323	299	3156
Number of time intervals: average FRCE > Level 2 positive	52	66	38	80	40	39	36	11	46	100	101	140	749
Number of time intervals: average FRCE < Level 2 negative	54	57	48	62	49	85	59	40	78	109	115	88	844
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	19	24	19	28	15	21	9	2	23	5	33	35	233
Number of events: FRCE < -60 % FRR capacity + and not > -15 % FRR capacity + within 15 min	6	4	3	5	8	5	8	3	7	1	10	10	70

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Germany

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-2.0	-1.0	-13.0	-5.0	-4.0	-10.0	-3.0	-5.0	10.0	-14.0	-13.0	-9.0	-5.8
The standard deviation	44	43	43	46	44	38	37	47	55	45	47	48	45
1-percentile	-111	-102	-115	-112	-89	-105	-94	-86	-132	-115	-112	-113	-107
5-percentile	-72	-62	-76	-74	-58	-67	-63	-53	-53	-76	-76	-74	-67
10-percentile	-53	-46	-59	-56	-44	-50	-46	-40	-37	-61	-60	-57	-51
90-percentile	52	51	36	52	44	32	43	35	64	36	36	43	44
95-percentile	71	71	58	72	62	48	58	52	87	56	63	63	63
99-percentile	118	115	106	119	95	92	94	91	144	101	136	115	111
Number of time intervals: average FRCE > Level 1 positive	1	2	0	0	3	1	0	0	3	1	5	5	21
Number of time intervals: average FRCE < Level 1 negative	0	0	2	3	0	0	0	4	0	4	1	0	14
Number of time intervals: average FRCE > Level 2 positive	0	0	0	0	2	0	0	0	1	1	0	2	6
Number of time intervals: average FRCE < Level 2 negative	0	0	0	0	0	0	0	3	0	0	0	0	3
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

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-6.0	9.0	-5.0	3.0	-6.0	4.0	-16.0	5.0	-6.0	16.0	32.0	22.0	4.3
The standard deviation	45	64	61	44	41	54	74	82	79	73	98	82	66
1-percentile	-104	-96	-210	-94	-101	-88	-221	-207	-217	-181	-229	-211	-163
5-percentile	-69	-55	-105	-57	-66	-54	-132	-110	-124	-92	-105	-104	-89
10-percentile	-52	-39	-65	-42	-51	-41	-94	-77	-85	-58	-59	-62	-60
90-percentile	40	57	59	54	41	49	60	96	68	98	135	111	72
95-percentile	60	78	80	70	59	66	94	131	108	138	198	160	104
99-percentile	128	124	150	134	119	121	185	240	244	229	336	251	188
Number of time intervals: average FRCE > Level 1 positive	7	7	3	7	4	14	14	24	30	19	80	33	242
Number of time intervals: average FRCE < Level 1 negative	2	1	17	1	0	0	17	10	15	8	21	15	107
Number of time intervals: average FRCE > Level 2 positive	1	4	0	1	0	11	1	5	3	1	8	1	36
Number of time intervals: average FRCE < Level 2 negative	0	1	0	0	0	0	1	0	1	0	6	1	10
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	1	0	0	0	0	1	2	2	1	1	4	12
Number of events: FRCE < -60 % FRR capacity + and not > -15 % FRR capacity + within 15 min	0	0	1	1	0	0	1	1	2	2	2	3	13

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IPTO

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	6.6	30.1	15.6	15.8	17.8	7.5	0.9	4.0	2.1	6.3	5.7	8.4	10.1
The standard deviation	85	68	46	52	58	31	17	30	29	41	31	49	45
1-percentile	-185	-80	-43	-42	-47	-34	-45	-30	-42	-56	-45	-115	-64
5-percentile	-107	-23	-19	-21	-22	-18	-17	-12	-16	-18	-15	-28	-26
10-percentile	-66	-11	-11	-12	-13	-11	-11	-8	-10	-12	-10	-15	-16
90-percentile	88	117	52	48	54	27	12	11	13	18	19	41	42
95-percentile	146	165	104	103	119	54	19	18	20	40	42	88	76
99-percentile	258	294	214	263	292	124	50	138	70	199	148	199	188
Number of time intervals: average FRCE > Level 1 positive	347	415	200	204	232	93	14	58	25	86	81	175	1930
Number of time intervals: average FRCE < Level 1 negative	262	28	11	8	13	4	9	2	14	17	14	45	427
Number of time intervals: average FRCE > Level 2 positive	154	198	91	104	125	21	5	29	11	50	32	77	897
Number of time intervals: average FRCE < Level 2 negative	81	9	1	1	4	0	2	0	3	3	6	21	131
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	147	173	91	80	76	59	11	12	18	36	44	87	834
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	15	4	2	1	3	0	2	0	3	1	2	5	38

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	10.3	23.1	11.3	39.5	21.3	13.3	2.8	-1.8	9.1	33.6	16.3	19.1	16.5
The standard deviation	36	56	40	91	51	44	39	27	56	80	56	75	54
1-percentile	-51	-31	-46	-92	-52	-61	-83	-74	-92	-86	-71	-125	-72
5-percentile	-19	-13	-17	-23	-16	-23	-44	-46	-47	-40	-42	-61	-33
10-percentile	-12	-9	-10	-12	-10	-14	-32	-32	-34	-26	-30	-39	-22
90-percentile	38	89	40	156	82	48	35	26	47	136	71	92	72
95-percentile	80	146	85	241	125	98	54	37	93	209	124	150	120
99-percentile	179	255	192	400	220	198	160	70	263	336	259	334	239
Number of time intervals: average FRCE > Level 1 positive	161	301	174	546	328	188	104	28	178	518	276	355	3157
Number of time intervals: average FRCE < Level 1 negative	14	4	16	36	21	15	36	35	48	41	26	105	397
Number of time intervals: average FRCE > Level 2 positive	54	152	69	327	125	88	46	5	86	286	118	181	1537
Number of time intervals: average FRCE < Level 2 negative	3	0	4	11	6	0	9	1	8	11	2	25	80
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	69	129	70	140	150	94	49	33	77	170	118	127	1226
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	2	1	4	6	2	2	7	3	0	3	2	6	38

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MAVIR

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.9	-0.5	-0.1	-1.2	-1.1	0.0	1.2	1.0	0.3	-1.2	-1.2	-0.8	-0.4
The standard deviation	17	17	17	17	15	16	14	15	14	18	18	15	16
1-percentile	-35	-37	-37	-40	-36	-37	-34	-36	-34	-37	-35	-39	-36
5-percentile	-26	-26	-26	-26	-24	-25	-22	-23	-22	-28	-25	-24	-25
10-percentile	-21	-21	-21	-21	-20	-19	-17	-17	-16	-22	-21	-18	-19
90-percentile	22	21	22	21	18	20	19	18	19	22	21	17	20
95-percentile	30	29	30	27	24	26	25	25	25	31	29	25	27
99-percentile	45	45	44	41	38	42	39	44	37	47	43	42	42
Number of time intervals: average FRCE > Level 1 positive	3	2	0	3	3	7	3	4	3	11	6	5	50
Number of time intervals: average FRCE < Level 1 negative	0	1	3	2	1	3	0	0	0	1	1	0	12
Number of time intervals: average FRCE > Level 2 positive	1	0	0	0	1	0	0	1	0	2	3	0	8
Number of time intervals: average FRCE < Level 2 negative	0	0	1	0	0	0	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
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

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.8	1.2	0.7	1.3	1.0	0.4	0.4	0.4	0.4	0.0	-0.1	0.0	0.5
The standard deviation	15	17	19	17	14	16	17	14	17	20	25	16	17
1-percentile	-45	-49	-56	-49	-41	-43	-44	-41	-48	-59	-39	-45	-47
5-percentile	-24	-27	-31	-27	-21	-25	-27	-24	-26	-32	-24	-27	-26
10-percentile	-15	-18	-21	-19	-14	-18	-19	-17	-18	-22	-15	-18	-18
90-percentile	16	19	21	20	16	17	18	17	19	21	15	16	18
95-percentile	23	27	30	28	23	24	24	23	27	30	21	24	25
99-percentile	42	49	52	52	40	42	45	38	49	52	36	42	45
Number of time intervals: average FRCE > Level 1 positive	6	8	9	16	4	1	4	1	3	15	3	7	77
Number of time intervals: average FRCE < Level 1 negative	5	12	20	5	4	4	10	2	8	20	4	6	100
Number of time intervals: average FRCE > Level 2 positive	0	0	1	1	1	0	0	0	0	0	0	1	4
Number of time intervals: average FRCE < Level 2 negative	0	0	2	0	0	2	2	0	0	4	1	1	12
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

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AK

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	3.2	15.6	-3.6	-10.9	2.0	2.4	6.1	4.3	9.9	0.8	-5.4	-94.7	-5.9
The standard deviation	65	52	28	34	34	31	28	38	29	39	46	141	47
1-percentile	-199	-120	-72	-96	-70	-86	-57	-93	-66	-100	-119	-511	-132
5-percentile	-107	-60	-53	-63	-51	-51	-35	-63	-35	-63	-78	-378	-86
10-percentile	-70	-40	-38	-55	-38	-34	-22	-48	-22	-48	-62	-312	-66
90-percentile	68	73	26	27	41	36	43	51	46	46	56	44	46
95-percentile	103	101	41	41	64	57	59	70	63	65	74	75	68
99-percentile	163	195	67	60	114	90	90	100	98	108	107	137	111
Number of time intervals: average FRCE > Level 1 positive	752	732	212	171	358	294	380	452	458	431	473	351	5064
Number of time intervals: average FRCE < Level 1 negative	579	300	332	668	322	281	140	412	136	453	732	1703	6058
Number of time intervals: average FRCE > Level 2 positive	293	298	28	18	124	93	99	153	97	128	168	167	1666
Number of time intervals: average FRCE < Level 2 negative	308	99	35	78	34	49	16	108	21	111	204	1365	2428
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

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-35.8	-11.4	-40.7	-13.3	10.1	15.8	-11.6	0.0	-4.7	-25.8	-18.1	-21.8	-13.1
The standard deviation	77	69	67	76	49	41	51	49	44	44	70	66	59
1-percentile	-214	-193	-217	-253	-123	-73	-155	-149	-125	-210	-151	-212	-173
5-percentile	-157	-131	-154	-155	-60	-37	-114	-85	-78	-95	-94	-144	-109
10-percentile	-131	-93	-126	-110	-37	-21	-80	-55	-59	-70	-74	-101	-80
90-percentile	46	71	40	70	70	59	47	56	40	8	42	46	50
95-percentile	85	98	65	103	94	86	70	73	61	26	78	83	77
99-percentile	182	171	115	159	162	165	113	113	131	65	143	151	139
Number of time intervals: average FRCE > Level 1 positive	418	637	331	595	728	702	422	648	367	109	363	397	5717
Number of time intervals: average FRCE < Level 1 negative	1494	975	1521	967	341	174	822	491	631	1033	990	1113	10552
Number of time intervals: average FRCE > Level 2 positive	233	370	143	345	384	290	196	265	144	35	201	237	2843
Number of time intervals: average FRCE < Level 2 negative	1058	632	1046	638	150	55	433	239	309	400	454	625	6039
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

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PSE

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1.0	1.0	-0.2	0.5	-1.6	-0.2	0.5	0.0	-0.2	0.6	0.0	0.0	0.1
The standard deviation	54	55	53	57	65	47	54	54	61	55	53	55	55
1-percentile	-144	-153	-153	-148	-156	-143	-153	-164	-192	-149	-150	-158	-155
5-percentile	-87	-92	-89	-90	-87	-77	-90	-88	-99	-89	-89	-91	-89
10-percentile	-59	-63	-60	-63	-58	-53	-60	-59	-67	-62	-60	-61	-60
90-percentile	59	63	60	63	55	53	62	61	65	60	60	60	60
95-percentile	91	94	85	88	79	76	88	88	90	84	84	85	86
99-percentile	153	156	134	157	135	130	145	149	170	143	138	143	146
Number of time intervals: average FRCE > Level 1 positive	43	41	29	49	29	23	43	41	47	37	32	36	450
Number of time intervals: average FRCE < Level 1 negative	41	49	46	42	50	30	41	51	67	44	46	47	554
Number of time intervals: average FRCE > Level 2 positive	9	3	2	5	5	2	2	3	6	6	3	2	48
Number of time intervals: average FRCE < Level 2 negative	2	0	2	4	7	2	1	2	7	4	1	6	38
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	3	3	1	4	2	0	2	2	6	3	2	2	30
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	1	0	4	3	6	3	2	2	4	1	3	5	34

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.1	2.5	1.2	3.3	1.4	-1.9	1.6	-1.1	0.7	3.3	-0.2	-0.4	0.9
The standard deviation	53	57	56	57	61	59	58	54	54	53	46	49	55
1-percentile	-136	-148	-152	-133	-154	-163	-142	-154	-142	-145	-136	-144	-146
5-percentile	-89	-87	-89	-86	-87	-94	-89	-90	-86	-81	-78	-82	-87
10-percentile	-61	-61	-65	-60	-59	-64	-65	-62	-59	-56	-55	-57	-60
90-percentile	60	64	63	65	63	60	65	60	60	61	53	54	61
95-percentile	83	94	90	96	84	86	94	85	84	86	70	76	86
99-percentile	134	174	149	174	145	137	166	134	146	152	113	119	145
Number of time intervals: average FRCE > Level 1 positive	29	52	45	64	39	32	63	31	45	54	17	20	491
Number of time intervals: average FRCE < Level 1 negative	32	34	45	28	50	51	45	52	39	40	33	42	491
Number of time intervals: average FRCE > Level 2 positive	5	10	7	6	8	0	12	1	3	5	2	2	61
Number of time intervals: average FRCE < Level 2 negative	3	2	2	3	8	10	1	5	6	5	0	3	48
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	2	5	1	7	2	0	6	1	2	4	2	2	34
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	2	2	1	1	3	6	2	3	3	3	0	1	27

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REE

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	18.1	23.2	11.9	22.4	22.9	5.5	9.6	16.8	16.7	10.5	-4.4	1.4	12.9
The standard deviation	52	56	49	50	68	42	44	42	50	53	55	53	51
1-percentile	-121	-116	-115	-112	-179	-103	-112	-87	-93	-135	-183	-148	-125
5-percentile	-54	-46	-51	-51	-67	-53	-45	-35	-39	-57	-84	-73	-55
10-percentile	-31	-26	-30	-30	-36	-33	-29	-22	-24	-34	-58	-48	-33
90-percentile	73	79	63	80	85	50	58	68	74	66	44	48	66
95-percentile	92	105	86	96	107	73	79	93	97	93	68	67	88
99-percentile	155	192	134	132	188	128	128	144	180	174	146	141	153
Number of time intervals: average FRCE > Level 1 positive	9	21	11	2	27	8	5	4	19	19	12	11	148
Number of time intervals: average FRCE < Level 1 negative	6	5	10	8	25	5	4	3	3	9	21	16	115
Number of time intervals: average FRCE > Level 2 positive	2	2	2	1	9	0	1	0	4	3	1	4	29
Number of time intervals: average FRCE < Level 2 negative	4	1	3	1	4	1	1	0	0	0	2	1	18
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	4	3	1	8	0	2	0	5	4	2	3	32
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	1	2	5	2	2	1	1	0	0	1	6	4	25

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	2.7	-0.6	5.4	3.9	-2.0	-3.2	4.3	5.4	8.2	6.3	5.6	9.1	3.8
The standard deviation	56	55	51	69	60	49	42	43	52	48	54	49	52
1-percentile	-154	-151	-149	-212	-189	-173	-118	-122	-127	-132	-141	-115	-148
5-percentile	-77	-72	-63	-86	-84	-73	-56	-56	-62	-61	-69	-56	-68
10-percentile	-48	-50	-42	-51	-54	-48	-36	-37	-40	-37	-41	-34	-43
90-percentile	54	50	57	63	50	41	47	51	60	54	55	57	53
95-percentile	82	77	81	87	74	58	61	67	79	72	76	77	74
99-percentile	179	155	155	197	142	101	96	110	135	124	148	133	140
Number of time intervals: average FRCE > Level 1 positive	21	11	13	28	11	3	0	1	8	8	11	14	129
Number of time intervals: average FRCE < Level 1 negative	12	14	11	31	24	17	7	10	13	10	11	8	168
Number of time intervals: average FRCE > Level 2 positive	0	1	3	4	1	1	0	0	2	1	3	1	17
Number of time intervals: average FRCE < Level 2 negative	5	4	0	9	10	7	4	1	2	2	3	2	49
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	5	2	4	5	2	1	0	0	2	0	2	2	25
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	4	3	1	8	6	1	3	0	0	1	2	2	31

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REN

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.3	3.6	2.0	1.0	0.7	0.3	1.0	0.9	0.3	-0.1	0.4	1.7	0.9
The standard deviation	19	15	13	13	15	12	12	12	13	14	13	16	14
1-percentile	-67	-27	-24	-37	-42	-38	-27	-32	-35	-47	-40	-44	-38
5-percentile	-25	-10	-10	-14	-18	-13	-10	-12	-14	-14	-15	-12	-14
10-percentile	-13	-6	-7	-9	-9	-8	-6	-7	-8	-8	-9	-7	-8
90-percentile	13	15	11	11	11	9	9	9	9	9	10	12	11
95-percentile	24	26	16	17	18	13	13	13	14	14	16	21	17
99-percentile	60	59	48	42	50	40	33	40	38	35	41	62	46
Number of time intervals: average FRCE > Level 1 positive	19	13	10	11	16	4	5	10	8	5	9	17	127
Number of time intervals: average FRCE < Level 1 negative	24	4	6	2	5	7	3	5	19	9	4	8	96
Number of time intervals: average FRCE > Level 2 positive	0	1	2	1	2	0	2	0	0	0	0	1	9
Number of time intervals: average FRCE < Level 2 negative	3	1	1	0	0	0	0	1	2	2	0	2	12
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	25	12	6	9	12	10	7	12	8	6	8	27	142
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	6	2	1	0	3	1	1	1	2	2	1	5	25

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1.4	0.1	1.9	1.5	0.2	1.2	0.9	1.7	2.5	2.0	4.0	5.0	1.9
The standard deviation	15	15	15	15	14	17	16	15	21	21	21	21	17
1-percentile	-32	-45	-42	-38	-39	-49	-62	-38	-46	-52	-39	-35	-43
5-percentile	-12	-18	-14	-13	-15	-17	-18	-14	-17	-14	-16	-12	-15
10-percentile	-8	-10	-8	-8	-9	-10	-9	-8	-9	-8	-10	-8	-9
90-percentile	11	10	13	11	10	12	13	13	16	13	19	22	14
95-percentile	19	16	22	18	16	22	23	22	29	22	36	38	23
99-percentile	50	53	55	53	34	56	52	55	70	70	83	90	60
Number of time intervals: average FRCE > Level 1 positive	13	9	17	10	6	18	14	13	28	26	38	52	244
Number of time intervals: average FRCE < Level 1 negative	7	12	6	8	6	9	17	5	11	15	4	4	104
Number of time intervals: average FRCE > Level 2 positive	3	1	1	3	0	1	0	1	6	8	7	12	43
Number of time intervals: average FRCE < Level 2 negative	3	2	0	0	1	0	0	1	1	4	2	1	15
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	15	14	15	8	5	6	11	12	11	11	17	20	145
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	1	2	1	5	4	5	13	4	5	6	10	4	60

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RTE

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-1.1	9.3	3.7	-3.6	10.2	-1.5	12.3	8.4	5.4	-2.6	-9.5	-8.4	1.9
The standard deviation	187	170	178	178	226	159	161	165	159	186	154	149	173
1-percentile	-465	-527	-544	-586	-685	-508	-418	-527	-554	-551	-541	-527	-536
5-percentile	-242	-221	-240	-276	-290	-229	-198	-196	-223	-265	-257	-229	-239
10-percentile	-150	-135	-150	-173	-165	-136	-126	-128	-142	-168	-152	-138	-147
90-percentile	118	139	136	145	159	122	135	140	144	137	111	105	133
95-percentile	170	234	221	259	305	180	218	216	229	230	171	156	216
99-percentile	494	564	648	566	921	534	651	629	565	666	449	448	595
Number of time intervals: average FRCE > Level 1 positive	82	132	128	155	198	100	125	130	131	142	74	72	1469
Number of time intervals: average FRCE < Level 1 negative	149	115	150	179	189	140	110	118	122	175	163	136	1746
Number of time intervals: average FRCE > Level 2 positive	38	47	60	52	103	42	64	55	42	60	27	30	620
Number of time intervals: average FRCE < Level 2 negative	33	39	49	59	77	37	23	40	38	61	53	48	557
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	29	50	42	56	73	36	55	51	45	46	30	29	542
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	7	5	8	8	12	9	1	4	3	6	3	5	71

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-2.8	0.7	-1.0	-2.2	-6.0	-10.8	-14.3	-7.8	-9.4	1.6	-12.4	-4.8	-5.8
The standard deviation	136	129	140	158	140	136	158	141	150	147	133	136	142
1-percentile	-451	-445	-406	-596	-477	-505	-578	-466	-506	-482	-530	-486	-494
5-percentile	-204	-198	-202	-227	-212	-228	-270	-215	-248	-214	-230	-201	-221
10-percentile	-130	-130	-133	-144	-130	-133	-156	-136	-152	-136	-137	-122	-137
90-percentile	107	114	112	122	106	105	112	108	117	127	99	100	111
95-percentile	158	163	160	175	151	148	162	155	167	196	138	145	160
99-percentile	404	403	446	523	408	310	446	447	427	489	344	422	422
Number of time intervals: average FRCE > Level 1 positive	82	75	87	100	67	50	79	79	81	119	49	67	935
Number of time intervals: average FRCE < Level 1 negative	120	94	121	135	133	141	184	136	162	128	143	122	1619
Number of time intervals: average FRCE > Level 2 positive	22	19	32	39	28	12	31	31	27	41	19	26	327
Number of time intervals: average FRCE < Level 2 negative	30	28	27	50	38	42	54	36	43	39	46	36	469
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	23	21	33	39	26	18	28	23	24	33	25	24	317
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	1	0	4	6	3	6	12	3	4	1	5	4	49

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SEPS

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.4	-0.4	-0.2	-0.2	-0.4	-1.3	-0.9	-0.5	-1.0	-1.0	-1.2	-0.6	-0.7
The standard deviation	7	6	6	6	7	9	8	8	12	11	11	8	8
1-percentile	-20	-20	-19	-18	-25	-31	-25	-26	-52	-43	-41	-30	-29
5-percentile	-10	-9	-8	-8	-9	-12	-11	-10	-18	-19	-18	-12	-12
10-percentile	-6	-6	-5	-5	-6	-8	-7	-7	-10	-10	-10	-7	-7
90-percentile	6	5	5	5	6	6	5	6	9	8	8	7	6
95-percentile	9	8	7	8	9	9	8	9	14	13	13	10	10
99-percentile	16	14	16	15	17	19	20	21	28	28	28	21	20
Number of time intervals: average FRCE > Level 1 positive	0	0	0	1	0	3	5	0	1	6	7	2	25
Number of time intervals: average FRCE < Level 1 negative	1	0	1	2	1	3	8	3	26	13	12	4	74
Number of time intervals: average FRCE > Level 2 positive	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of time intervals: average FRCE < Level 2 negative	1	0	0	0	0	2	0	1	2	0	0	0	6
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

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.1	-0.3	-0.3	0.1	-0.2	-0.1	-0.2	-0.2	-0.8	-0.6	-0.8	-0.3	-0.3
The standard deviation	7	7	7	5	6	7	7	7	9	8	9	8	7
1-percentile	-25	-25	-25	-17	-15	-21	-27	-26	-31	-30	-34	-28	-25
5-percentile	-9	-10	-11	-6	-7	-9	-9	-11	-14	-12	-13	-10	-10
10-percentile	-6	-6	-6	-4	-4	-6	-6	-7	-8	-7	-8	-7	-6
90-percentile	6	6	6	4	4	6	6	7	7	6	7	6	6
95-percentile	9	8	8	7	6	8	9	10	10	9	9	8	8
99-percentile	16	18	18	15	12	15	15	16	18	16	16	16	16
Number of time intervals: average FRCE > Level 1 positive	0	0	2	1	1	0	0	0	1	3	0	2	10
Number of time intervals: average FRCE < Level 1 negative	7	1	1	1	3	2	5	7	10	7	8	5	57
Number of time intervals: average FRCE > Level 2 positive	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of time intervals: average FRCE < Level 2 negative	0	0	0	0	0	0	0	0	2	1	2	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	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

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SG

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.1	0.0	-0.2	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.4	0.0	-0.1
The standard deviation	6	7	7	7	7	5	6	6	6	9	9	9	7
1-percentile	-20	-21	-21	-20	-19	-17	-16	-16	-19	-19	-20	-18	-19
5-percentile	-12	-13	-13	-12	-10	-9	-9	-9	-10	-12	-12	-10	-11
10-percentile	-7	-8	-8	-8	-7	-5	-6	-6	-6	-7	-8	-6	-7
90-percentile	7	8	8	7	7	5	5	6	6	7	7	6	7
95-percentile	10	11	11	10	10	7	8	8	9	10	10	9	9
99-percentile	16	17	17	17	18	13	14	13	15	15	17	13	15
Number of time intervals: average FRCE > Level 1 positive	0	0	0	0	2	0	0	3	0	0	0	0	5
Number of time intervals: average FRCE < Level 1 negative	0	0	2	0	0	0	0	2	0	1	3	0	8
Number of time intervals: average FRCE > Level 2 positive	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of time intervals: average FRCE < Level 2 negative	0	0	2	0	0	0	0	1	0	1	2	0	6
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

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1
The standard deviation	6	6	6	6	6	6	6	6	6	6	6	6	6
1-percentile	-19	-23	-21	-20	-17	-18	-16	-18	-23	-20	-20	-18	-19
5-percentile	-12	-12	-12	-11	-9	-10	-10	-10	-12	-12	-11	-10	-11
10-percentile	-8	-8	-7	-7	-6	-7	-7	-6	-7	-7	-7	-6	-7
90-percentile	7	7	7	6	6	6	6	6	7	7	7	6	7
95-percentile	10	10	9	9	8	9	8	8	10	10	9	8	9
99-percentile	16	16	15	16	14	15	13	14	15	16	15	14	15
Number of time intervals: average FRCE > Level 1 positive	0	0	0	0	1	0	0	0	0	0	0	1	2
Number of time intervals: average FRCE < Level 1 negative	0	0	0	2	0	0	0	0	0	0	0	0	2
Number of time intervals: average FRCE > Level 2 positive	0	0	0	0	0	0	0	0	0	0	0	1	1
Number of time intervals: average FRCE < Level 2 negative	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
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

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SHB

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1.1	2.0	5.4	3.2	12.7	4.2	-0.5	7.8	9.0	-0.3	4.6	13.9	5.2
The standard deviation	42	35	37	35	29	31	38	35	29	39	37	39	35
1-percentile	-86	-128	-150	-101	-85	-100	-99	-83	-72	-123	-110	-103	-103
5-percentile	-38	-52	-48	-51	-31	-47	-59	-43	-39	-69	-60	-51	-49
10-percentile	-24	-32	-26	-35	-16	-31	-38	-27	-23	-46	-39	-31	-31
90-percentile	27	36	38	39	44	34	31	42	39	38	43	57	39
95-percentile	42	53	52	55	58	47	51	58	53	58	56	72	55
99-percentile	99	91	81	100	90	83	124	108	93	97	99	108	98
Number of time intervals: average FRCE > Level 1 positive	69	68	63	79	86	49	91	102	67	103	73	170	1020
Number of time intervals: average FRCE < Level 1 negative	55	87	101	79	50	62	101	51	34	150	99	91	960
Number of time intervals: average FRCE > Level 2 positive	12	4	3	10	7	2	27	12	6	6	10	12	111
Number of time intervals: average FRCE < Level 2 negative	11	24	38	9	4	14	17	5	0	22	16	9	169
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	5	0	0	3	2	1	5	2	3	2	2	1	26
Number of events: FRCE < -60 % FRR capacity + and not > -15 % FRR capacity + within 15 min	1	0	1	0	0	0	0	0	0	0	0	0	2

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	9.7	13.3	9.3	12.7	10.4	9.5	6.1	1.9	-8.6	-5.2	1.3	-3.3	4.8
The standard deviation	25	26	31	27	23	34	31	32	40	30	31	37	31
1-percentile	-71	-65	-79	-72	-62	-93	-85	-87	-148	-101	-86	-129	-90
5-percentile	-30	-25	-34	-25	-21	-47	-42	-47	-69	-55	-47	-62	-42
10-percentile	-14	-15	-19	-13	-11	-27	-26	-33	-49	-39	-32	-43	-27
90-percentile	30	40	37	41	32	42	35	31	30	24	37	30	34
95-percentile	41	55	50	55	43	54	52	46	48	39	50	44	48
99-percentile	83	95	89	93	82	87	97	95	96	72	82	79	88
Number of time intervals: average FRCE > Level 1 positive	55	67	60	83	51	69	77	68	65	33	59	47	734
Number of time intervals: average FRCE < Level 1 negative	36	26	37	30	21	64	51	64	143	80	55	119	726
Number of time intervals: average FRCE > Level 2 positive	7	8	6	9	8	6	11	8	13	3	7	7	93
Number of time intervals: average FRCE < Level 2 negative	4	2	10	3	2	9	3	12	43	11	8	30	137
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	3	0	3	2	3	1	4	2	7	3	2	1	31
Number of events: FRCE < -60 % FRR capacity + and not > -15 % FRR capacity + within 15 min	1	0	0	0	0	2	0	0	2	0	0	0	5

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SMM

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-28.8	-33.9	-14.2	15.0	0.8	21.7	-14.3	-10.6	-18.7	134.3	-17.3	-21.6	-21.4
The standard deviation	73	81	46	103	60	51	64	53	49	104	70	60	68
1-percentile	-202	-283	-146	-471	-118	-86	-180	-163	-146	-396	-221	-186	-217
5-percentile	-121	-186	-93	-85	-60	-49	-120	-111	-101	-317	-141	-114	-125
10-percentile	-94	-133	-69	-58	-43	-33	-91	-78	-77	-272	-101	-89	-95
90-percentile	43	52	38	105	52	81	63	50	36	-5	61	45	52
95-percentile	67	77	57	135	73	106	87	67	52	20	87	70	75
99-percentile	116	153	92	231	127	164	137	107	92	72	147	125	130
Number of time intervals: average FRCE > Level 1 positive	105	127	57	512	120	293	181	86	51	24	166	107	1829
Number of time intervals: average FRCE < Level 1 negative	411	584	210	157	64	41	391	284	250	1994	430	370	5186
Number of time intervals: average FRCE > Level 2 positive	3	14	0	70	20	26	10	2	1	0	15	7	168
Number of time intervals: average FRCE < Level 2 negative	55	163	12	64	17	9	44	17	15	973	73	41	1483
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	3	8	0	22	5	6	5	1	1	0	8	3	62
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	7	17	0	2	1	0	2	0	2	30	1	2	64

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-25.4	-2.9	-13.9	-21.5	0.3	8.5	10.3	4.3	-8.7	-12.0	-9.3	-6.8	-6.4
The standard deviation	57	62	60	53	41	44	50	70	46	81	59	55	57
1-percentile	-198	-163	-164	-183	-111	-91	-97	-229	-144	-286	-169	-155	-166
5-percentile	-118	-107	-110	-119	-50	-52	-61	-81	-72	-204	-102	-93	-97
10-percentile	-95	-79	-84	-87	-36	-37	-43	-52	-50	-80	-73	-71	-66
90-percentile	40	74	61	35	46	69	76	68	33	57	50	56	56
95-percentile	63	99	83	62	66	86	101	111	54	83	75	85	81
99-percentile	108	135	134	104	115	131	155	212	104	145	137	139	135
Number of time intervals: average FRCE > Level 1 positive	122	288	228	106	122	278	357	285	82	215	160	204	2447
Number of time intervals: average FRCE < Level 1 negative	562	331	435	433	77	73	93	192	159	326	315	304	3300
Number of time intervals: average FRCE > Level 2 positive	15	7	31	7	19	28	67	107	12	44	31	36	404
Number of time intervals: average FRCE < Level 2 negative	99	33	72	104	20	6	8	66	31	235	67	48	789
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	2	4	2	0	4	3	11	9	1	6	4	8	54
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	3	0	3	1	1	0	0	2	1	13	2	2	28

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TEIAS

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	9.9	8.9	13.4	14.4	9.4	4.2	21.9	9.3	11.8	11.1	11.1	6.5	11.0
The standard deviation	90	87	86	88	90	91	103	88	86	87	92	90	90
1-percentile	-208	-194	-187	-192	-202	-218	-222	-211	-206	-205	-227	-228	-208
5-percentile	-122	-123	-113	-115	-124	-129	-121	-123	-115	-116	-124	-127	-121
10-percentile	-90	-93	-83	-86	-93	-96	-85	-90	-83	-86	-90	-93	-89
90-percentile	116	115	118	120	116	110	135	114	113	115	118	113	117
95-percentile	155	152	155	158	156	149	176	149	149	150	156	147	154
99-percentile	252	243	241	250	259	244	320	235	228	232	247	237	249
Number of time intervals: average FRCE > Level 1 positive	38	17	35	36	36	17	63	12	19	24	29	28	354
Number of time intervals: average FRCE < Level 1 negative	21	14	34	19	23	27	21	21	34	23	30	26	293
Number of time intervals: average FRCE > Level 2 positive	0	0	6	4	1	0	26	0	0	1	3	0	41
Number of time intervals: average FRCE < Level 2 negative	0	0	2	0	0	0	1	1	2	4	1	1	12
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	0	0	0	0	1	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	1	0	0	0	1	0	1	0	3

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-2.9	-2.6	-4.0	-5.7	-5.0	-5.0	-3.7	-2.7	-3.0	0.3	-1.2	-1.4	-3.1
The standard deviation	27	26	28	32	25	25	21	20	19	27	22	21	25
1-percentile	-90	-87	-96	-128	-109	-105	-72	-72	-73	-126	-90	-78	-94
5-percentile	-52	-56	-61	-69	-58	-57	-50	-46	-47	-53	-45	-44	-53
10-percentile	-41	-45	-49	-54	-46	-44	-40	-37	-37	-38	-35	-34	-42
90-percentile	36	36	34	35	29	26	26	25	25	39	31	30	31
95-percentile	50	48	48	50	41	37	37	35	35	50	41	39	43
99-percentile	101	108	110	99	83	74	66	75	63	85	65	63	83
Number of time intervals: average FRCE > Level 1 positive	4	8	13	6	5	5	6	3	0	8	3	3	64
Number of time intervals: average FRCE < Level 1 negative	4	0	3	11	7	4	3	3	0	15	4	2	56
Number of time intervals: average FRCE > Level 2 positive	1	0	1	0	1	2	0	0	0	0	0	0	5
Number of time intervals: average FRCE < Level 2 negative	1	0	0	4	0	0	0	0	0	0	1	2	8
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
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	0	1	0	0	0	0	0	0	0	0	1

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TERNA

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-2.4	-3.4	-3.0	-0.9	-5.4	-4.5	-7.7	0.6	-11.7	-20.6	-23.8	-27.4	-9.2
The standard deviation	106	105	104	118	108	103	100	99	111	130	130	136	113
1-percentile	-310	-342	-347	-335	-409	-368	-340	-298	-398	-502	-535	-580	-397
5-percentile	-161	-160	-151	-161	-172	-152	-160	-139	-187	-254	-244	-282	-185
10-percentile	-109	-113	-106	-106	-111	-99	-104	-90	-119	-156	-138	-163	-118
90-percentile	91	103	95	95	102	86	91	90	92	96	76	82	92
95-percentile	132	142	142	146	138	126	124	137	129	133	110	122	132
99-percentile	278	285	294	328	300	283	209	288	239	232	205	212	263
Number of time intervals: average FRCE > Level 1 positive	75	79	80	90	77	60	52	74	54	57	39	55	792
Number of time intervals: average FRCE < Level 1 negative	109	111	102	115	132	102	106	82	154	248	205	263	1729
Number of time intervals: average FRCE > Level 2 positive	19	14	17	26	20	17	10	15	9	4	7	9	167
Number of time intervals: average FRCE < Level 2 negative	20	26	31	27	39	33	29	19	44	83	82	109	542
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	109	36	60	187	104	57	18	148	58	27	21	42	867
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	68	106	89	192	178	118	139	95	176	386	534	571	2652

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-19.1	-17.7	-21.9	-21.4	-20.6	-31.4	-35.0	-26.5	-25.8	-6.6	-26.7	-17.8	-22.5
The standard deviation	121	150	138	157	130	136	144	124	147	135	139	130	138
1-percentile	-491	-579	-510	-589	-531	-597	-597	-532	-603	-494	-585	-557	-555
5-percentile	-228	-286	-279	-307	-245	-284	-310	-274	-287	-203	-295	-233	-269
10-percentile	-133	-149	-157	-169	-144	-165	-187	-136	-170	-126	-156	-130	-152
90-percentile	82	103	84	93	84	69	80	70	94	105	79	84	86
95-percentile	116	158	126	148	123	103	120	106	133	169	113	118	128
99-percentile	208	398	302	411	270	196	234	198	304	377	240	296	286
Number of time intervals: average FRCE > Level 1 positive	51	112	75	106	60	40	62	38	86	127	55	72	884
Number of time intervals: average FRCE < Level 1 negative	207	221	257	274	232	265	311	234	275	180	257	197	2910
Number of time intervals: average FRCE > Level 2 positive	10	31	21	43	20	9	14	12	27	43	13	19	262
Number of time intervals: average FRCE < Level 2 negative	83	99	104	116	88	115	138	106	113	74	112	88	1236
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	38	163	105	453	129	59	92	63	196	308	90	132	1828
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	516	769	759	1139	685	921	995	1042	866	456	948	821	9917

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TEL

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	4.5	2.3	1.9	4.1	7.0	3.6	0.3	2.5	2.1	-3.2	0.7	1.8	2.3
The standard deviation	54	43	36	38	40	37	36	31	31	36	35	43	38
1-percentile	-112	-142	-107	-101	-93	-86	-104	-67	-93	-157	-116	-140	-110
5-percentile	-40	-42	-41	-30	-28	-33	-35	-24	-30	-47	-39	-48	-36
10-percentile	-24	-23	-25	-20	-19	-20	-20	-15	-18	-25	-24	-23	-21
90-percentile	31	30	27	28	34	25	19	17	23	21	25	28	26
95-percentile	60	59	45	52	67	45	30	33	38	30	40	55	46
99-percentile	150	159	146	161	164	142	114	128	114	84	114	162	136
Number of time intervals: average FRCE > Level 1 positive	94	95	73	92	119	81	54	63	45	32	49	96	893
Number of time intervals: average FRCE < Level 1 negative	57	69	53	45	38	34	48	22	35	84	53	80	618
Number of time intervals: average FRCE > Level 2 positive	30	33	29	31	38	24	22	21	11	6	19	37	301
Number of time intervals: average FRCE < Level 2 negative	15	25	8	13	11	5	13	4	11	33	14	22	174
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

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	4.9	6.0	5.0	6.6	3.6	5.8	3.7	1.5	4.9	4.6	3.2	2.9	4.4
The standard deviation	42	44	40	39	27	38	35	30	33	37	30	41	36
1-percentile	-123	-114	-100	-90	-48	-74	-101	-100	-91	-88	-75	-107	-92
5-percentile	-37	-27	-25	-21	-18	-22	-23	-24	-22	-23	-22	-20	-24
10-percentile	-20	-17	-16	-13	-11	-15	-14	-15	-13	-14	-14	-12	-15
90-percentile	34	32	26	27	17	23	19	16	24	22	18	19	23
95-percentile	73	69	63	69	34	62	44	31	56	48	37	44	52
99-percentile	158	157	155	177	109	167	134	114	141	136	125	145	143
Number of time intervals: average FRCE > Level 1 positive	140	112	125	124	54	107	85	51	94	85	61	82	1120
Number of time intervals: average FRCE < Level 1 negative	64	41	45	34	17	24	40	41	30	35	24	43	438
Number of time intervals: average FRCE > Level 2 positive	32	29	39	47	17	40	26	20	23	26	21	29	349
Number of time intervals: average FRCE < Level 2 negative	21	18	13	12	4	9	8	9	8	10	6	20	138
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

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TTB

2021

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	8.2	6.1	3.9	8.1	4.1	-1.6	15.6	14.3	10.4	13.6	10.3	10.6	8.6
The standard deviation	58	67	59	67	65	66	60	59	62	71	71	70	65
1-percentile	-147	-201	-180	-213	-182	-212	-130	-136	-157	-175	-175	-150	-171
5-percentile	-78	-94	-85	-95	-95	-93	-66	-65	-79	-88	-100	-90	-86
10-percentile	-53	-62	-55	-57	-58	-63	-38	-44	-49	-58	-66	-60	-55
90-percentile	75	78	69	78	70	61	83	85	83	97	95	90	80
95-percentile	101	113	98	104	100	95	122	122	113	131	129	126	113
99-percentile	162	185	164	177	190	179	214	206	190	249	210	207	194
Number of time intervals: average FRCE > Level 1 positive	104	135	99	122	116	90	181	173	143	206	202	200	1771
Number of time intervals: average FRCE < Level 1 negative	67	86	90	102	113	104	47	41	68	88	110	90	1006
Number of time intervals: average FRCE > Level 2 positive	8	17	7	15	25	15	30	28	14	44	27	25	255
Number of time intervals: average FRCE < Level 2 negative	10	25	20	28	17	29	5	7	17	13	14	12	197
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	1	2	3	5	11	2	3	2	2	8	0	1	40
Number of events: FRCE < -60 % FRR capacity + and not > -15 % FRR capacity + within 15 min	9	10	31	14	12	27	19	14	28	21	26	17	228

2022

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-1.6	3.5	-3.6	-2.2	-5.9	1.1	13.7	3.8	14.6	14.9	9.3	6.2	4.5
The standard deviation	75	83	81	94	110	76	70	59	63	65	52	52	73
1-percentile	-233	-246	-267	-305	-286	-219	-139	-153	-124	-146	-131	-145	-199
5-percentile	-111	-134	-136	-151	-119	-105	-78	-84	-68	-70	-65	-74	-100
10-percentile	-77	-83	-88	-91	-83	-71	-55	-56	-47	-48	-40	-48	-66
90-percentile	73	94	83	85	72	72	93	68	86	91	63	62	79
95-percentile	99	128	114	121	103	105	142	97	122	137	94	87	112
99-percentile	178	219	199	219	214	235	255	204	229	231	186	155	210
Number of time intervals: average FRCE > Level 1 positive	107	188	159	166	129	133	225	98	170	196	102	86	1759
Number of time intervals: average FRCE < Level 1 negative	145	163	213	216	178	130	56	74	42	45	44	59	1365
Number of time intervals: average FRCE > Level 2 positive	19	32	24	33	30	34	52	25	36	37	13	11	346
Number of time intervals: average FRCE < Level 2 negative	36	43	52	82	51	30	11	12	9	10	6	5	347
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	1	2	3	13	10	8	10	4	4	1	0	1	57
Number of events: FRCE < -60 % FRR capacity + and not > -15 % FRR capacity + within 15 min	9	10	31	39	24	20	11	23	13	7	8	10	205