

LOAD FREQUENCY CONTROL

Annual Report

2024

Final | 30.09.2025

From: System Operations Committee

Executive Summary

According to Article 16 of the Commission Regulation (EU) 2017/1485 of 2 August 2017 (SOGI), which establishes a guideline on electricity transmission system operation, the transmission system operators (TSOs) of each European Union Member State are obliged to provide ENTSO-E with the necessary data and information for the preparation and creation of the annual LFC report (ALFC Report). Subsequently, ENTSO-E is obligated to publish the annual report.

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.

In 2024, the Synchronous Area Continental Europe (SA CE) reached their frequency quality target. With 14 670 minutes, the frequency quality target parameter stayed within the target of 15 000 minutes, as defined in the SOGI Annex III Table 2. 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 (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 (SOGL).

Article 16 of SOGL requires transmission system operators (TSOs) of each European Union Member State to provide ENTSO-E with the necessary data and information for the preparation and creation of the LFC annual report. ENTSO-E is required to publish the annual report. On the grounds of SOGL 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, Nordic, IE/NL 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 objectives of the report include:

- the identification, graphical representation, and associated monitors for each synchronous area, LFC block, and TSO of the four synchronous areas (Ireland/Northern Ireland, Nordic, Continental Europe, and Baltic).
- the frequency quality evaluation criteria results for each synchronous area and LFC block.
- 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.
- the FCR obligation and the initial FCR obligation of each TSO for each month of the preceding two years.

Synchronous areas, LFC blocks and TSO identification

In this paragraph, the requirements of SOGL 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 four synchronous areas included in this document are Continental Europe, Nordic, Ireland and Northern Ireland and Baltic, as shown in Tables 1–4 and graphically in Figure 1 below. All LFC blocks and LFC block monitors are reported in Tables 1-4. For the Baltic Synchronous Area, the data collection process for 2024 is not performed as the Baltic States power system was 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. With the Baltic synchronisation with Continental Europe in February 2025, operating their systems under the frequency of the Continental European System and under the EU rules, data will be collected from 2025 onwards.



Figure 1 European Synchronous Areas and LFC Blocks

According to Article 133 of the SOGL, 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 the SOGL and implement the criteria application process referred to in Article 129 of the SOGL.

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.

According to Article 118 of the SOGL, there exist the following synchronous areas and associated monitors:

- Swissgrid (south CE), Amprion (north CE),
- EirGrid (Ireland and Northern Ireland),
- Statnett SF-SN (Nordic),
- National Grid ESO or NGESO (Great Britain)¹.

LFC Block	LFC Area	LFC Block Monitor	Country
AK	OST, KOSTT	OST	Albania, Kosovo ²
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

¹ National Grid ESO or NGESO (Great Britain) has been removed from the scope of this report.

² This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

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

Table 2 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 3 Nordic identification of LFC blocks

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

Table 4 Baltic identification of LFC blocks

FREQUENCY QUALITY EVALUATION

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 (FCR). These reserves are activated quickly (typically within 30s), stabilising the power system frequency and ensuring that the frequency deviation will not further increase. The Frequency Containment Process (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 the frequency change is damped so that FCR is able to contain and stabilise the frequency at a value close to 50 Hz.

The second step is assigned to Frequency Restoration Reserves (FRR) which replace FCR and restore the frequency to the target frequency. SOGL defines two types of FRR: automatic (aFRR) and manual (mFRR). FRR is activated by an automatic control device or by manual activation, which reduces the Frequency Restoration Control Error (FRCE) to zero. For aFRR, this control device usually is called a Load-Frequency Controller (LF-Controller). The LF-Controller is physically a process computer that is implemented in the TSOs' control centre systems (SCADA/EMS/AGC) and collects FRCE measurements every 4–10s, thus providing—in the same time cycle—automated instructions to balancing service providers that are connected by data communication links.

The Frequency Restoration Process (FRP), aFRR and mFRR, restores frequency by replacing the power from the FCR. This principle is applicable for 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 shift, will also create a power imbalance and result in frequency deviations.

All frequency deviations are recorded carefully for further analyses. SOGL defines processes for the calculation and the evaluation of frequency data, and the required parameters for each synchronous area and each LFC block (defined in SOGL in Articles 127–131 and in Annex III–V) are presented below in Tables 5 and 6.

Data item	CE	GB	IE/Nl	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 5 Frequency quality defining parameters of synchronous areas, as shown in Annex III Table 1 of the SOGL

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

Table 6 Frequency quality target parameters of synchronous areas, as shown in Annex III Table 2 of the SOGL

Considering the aforementioned information for each synchronous area during operation in a normal state or an alert state, the following values are reported on a monthly basis 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 the frequency restoration range for IE/NL and Nordic synchronous areas, within the time to restore frequency. The data distinguish between positive and negative frequency deviations.
- vii. For the IE/NL synchronous area, 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; and
 - 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 FRCE 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 on a monthly basis for which the FRCE exceeded 60% of the reserve capacity on FRR and was not returned to 15% of the reserve capacity on FRR within the time to restore frequency, distinguishing between 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 it is the responsibility of each TSO in its LFC block to keep FRCE as low as possible, the Level 1 and Level 2 parameters must not be exploited to reduce reserves or reserves activation. These parameters should rather be interpreted as an absolute warning limit that shows that the FRCE quality is below the required standard and that the respective countermeasures have been reported and will be implemented urgently.

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

Continental Europe

Frequency Performance

In the following figures, data from 2023 and 2024 for the Continental Europe synchronous area are presented. Input values for frequency are based on instantaneous frequency values. Based on the input values, the mean value, standard deviation and percentiles were calculated. Moreover, any time periods and events where the system frequency was 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.

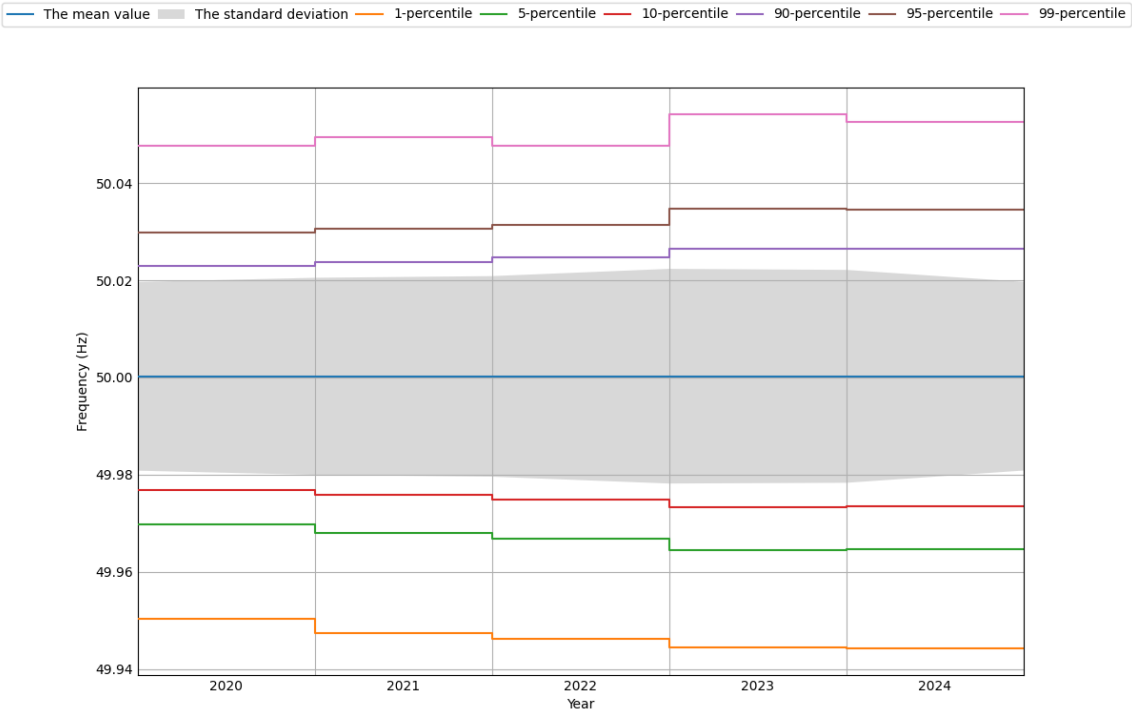


Figure 2 Annual frequency percentiles and standard deviation in Continental Europe for 2020–2024

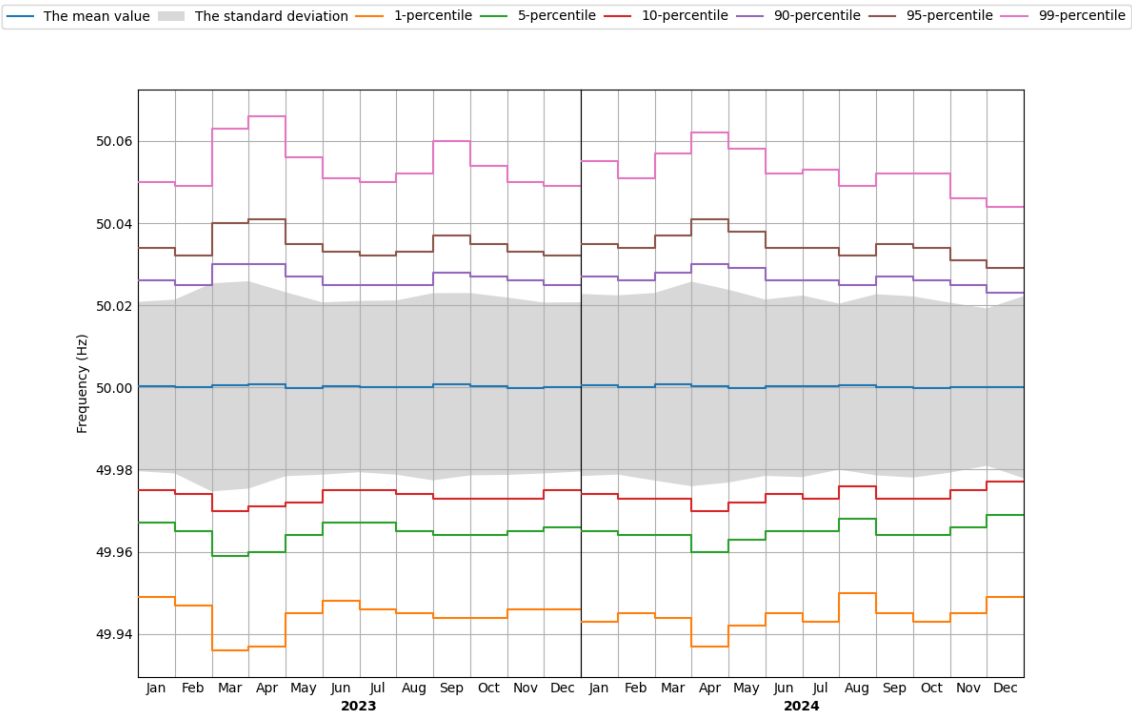


Figure 3 Monthly frequency percentiles and standard deviation in Continental Europe for 2023 and 2024

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In Figures 4 and 5, the accumulated minutes outside standard ranges are presented for the previous years. Figure 4 shows the annual number of minutes outside the standard range from 2020 to 2024. Figure 5 shows the monthly number of minutes outside the standard range from 2023 to 2024. The frequency quality target parameter, as defined in the SOGL, is 15000 minutes per year for each synchronous area. The monthly target parameter can be considered as 1/12 of this value, that is, 1250 minutes.

Figure 4 shows that the frequency quality target for 2023 was not fulfilled in Continental Europe. The reason behind exceeding the target were frequent situations of long-lasting frequency deviations (LLFD) in the first half of 2023, mostly in direction of over-frequency, and especially in the months of March, April and May. The control blocks of Bulgaria and France were the most significant contributors of the increase, but other control blocks contributed as well. Mitigation measures to reach quality target parameters are provided in the respective chapter. The frequency quality for 2024 slightly improved so the frequency quality target was fulfilled again.

The annual trend shows that between 2020 and 2022 the frequency was between 9 000 and 11 000 minutes outside the standard frequency range of ± 50 mHz in Continental Europe (CE) and for 2023 and 2024 this value has levelled off around 15 000 minutes. The measured values are much higher compared to the other synchronous areas; however, the other synchronous areas have much higher standard frequency ranges (e.g. ± 100 or ± 200 mHz).

Figure 5 shows that the monthly number of minutes outside the standard frequency ranges was exceptionally high between March and May 2023 and also for the same months in 2024 but improved for both years in the second half of the year. So that summarized for 2024 the frequency quality criteria was inside the limits of SOGL.

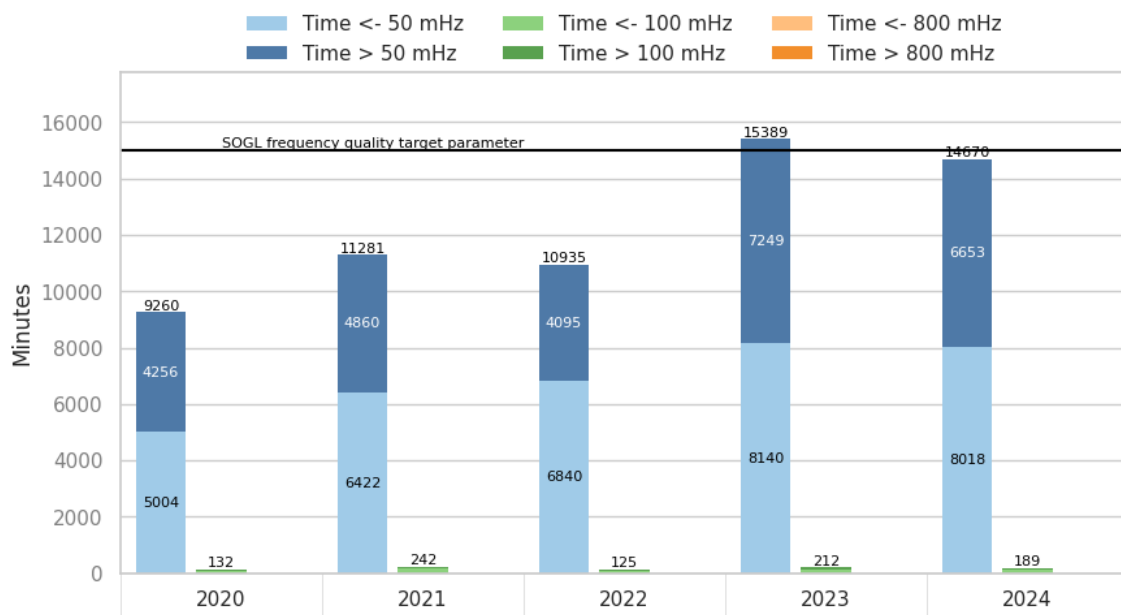


Figure 4 Annual number of minutes outside the standard ranges in Continental Europe for 2020–2024

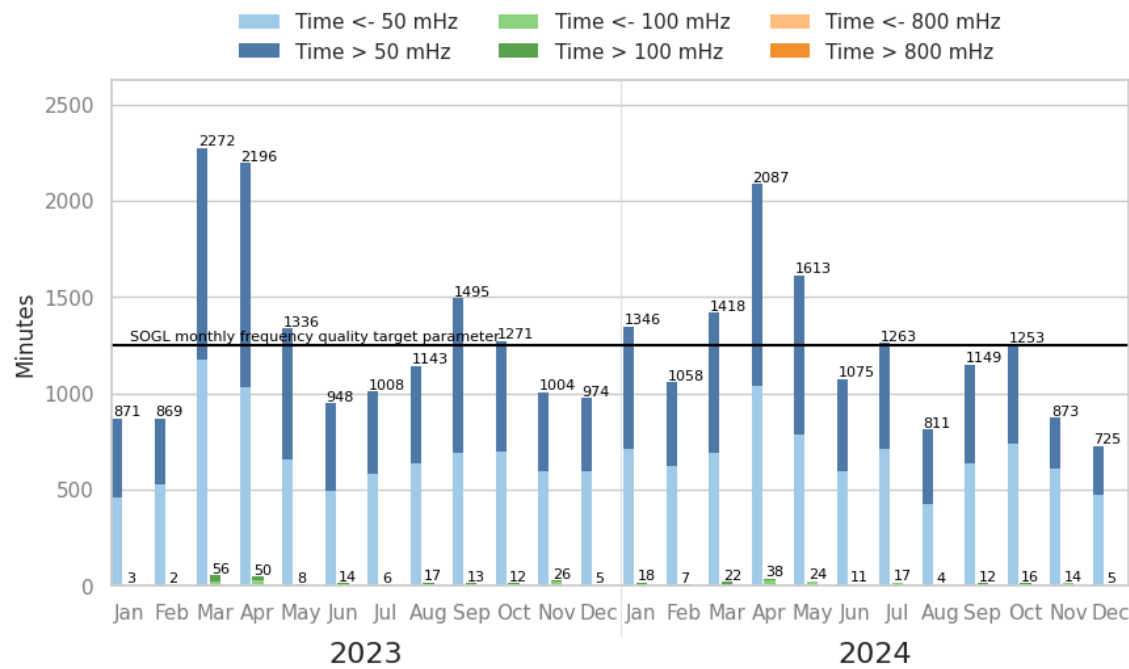


Figure 5 Monthly number of minutes outside the standard ranges in Continental Europe for 2023 and 2024

LFC Block Performance

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

Level 1 and Level 2 statistics

The level 1 and level 2 FRCE target parameters for the Continental Europe LFC blocks are presented in Table 7 for the respective years and measured in MW. Level 1 and level 2 FRCE ranges are the first and second range used for system frequency quality evaluation purposes on LFC block level, within which the FRCE should be kept for a specified percentage of the time.³

In Figure 6.1 and 6.2 the percentage of time where the average FRCE was outside the level 1 and level 2 targets for the respective years is shown. For better readability, TSOs with values close or equal to zero were excluded from the Figures 6.1 and 6.2.

Figure 7 – 10 show the monthly distribution of FRCE time intervals outside Level 1 and Level 2 ranges in absolute numbers. For better readability only the TOP 5 TSOs with the highest values were depicted. Regardless of the illustrations in Figure 6.1 – 10, all data is included in Appendix II.

In all figures dark colours indicate positives values whereas the light colours indicate negative ones. Level 1 values are depicted in blue and level 2 in red. The results for 2023 and 2024 and level 1 and level 2 are presented in different figures for better readability.

³ SOGL Art. 3 – Definitions (134) and (135)

LFC Block	2023		2024	
	Level 1	Level 2	Level 1	Level 2
AK	31	58	27	52
APG	76	145	71	135
CEPS	79	149	73	139
ELIA	85	160	81	153
ESO	56	106	53	100
Germany	220	416	203	384
IPTO	66	124	61	115
MAVIR	57	107	53	100
PSE	119	225	111	211
REE	156	295	148	281
REN	64	121	60	113
RTE	205	387	185	349
SEPS	49	93	44	83
SG	71	134	66	125
SHB	61	115	55	105
SMM	61	116	56	106
TEIAS	165	312	155	293
TEL	70	132	63	120
TERNA	157	297	147	279
TTB	95	179	88	166
UAMD	82	156	86	163

Table 7 Level 1 FRCE range and the level 2 FRCE range (in MW) for the Continental Europe Synchronous Area for 2023 and 2024

Limit	2023		2024	
	Level 1	Level 2	Level 1	Level 2
Limit for the maximum number of 15-minute time intervals per year outside the level 1 and level 2 FRCE ranges for each LFC Block	10512	1752	10512	1752

Table 8 Limits for the number of 15-minute time intervals per year outside the level 1 and level 2 FRCE ranges, as defined in Articles 3(134) and 3(135) of the SOGL for 2023 and 2024

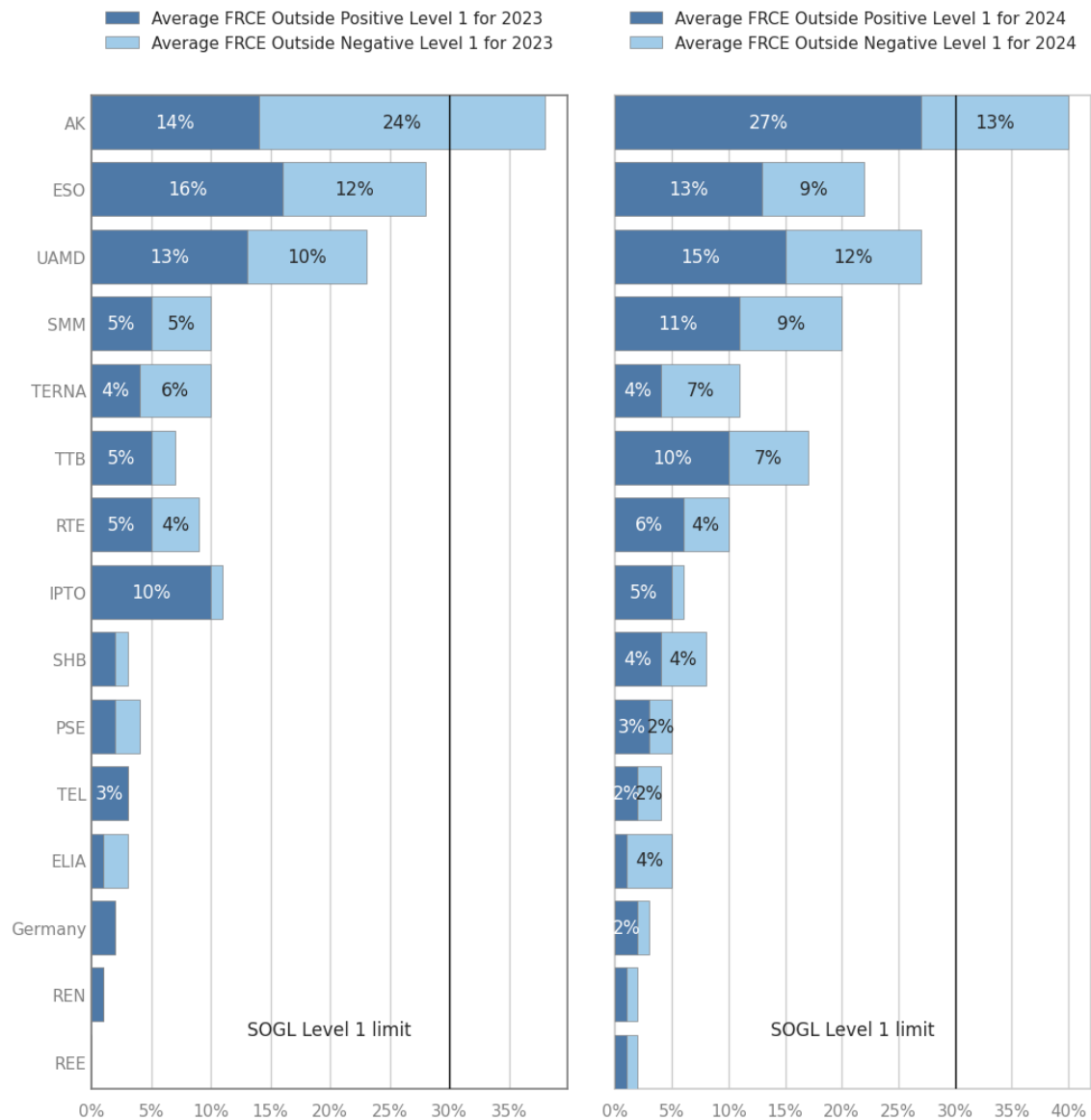


Figure 6.1 Percentage of time average FRCE was outside level 1 targets for 2023 and 2024
TSOs with values close to or equal to zero have been excluded from this figure. All values can be found in Appendix II.

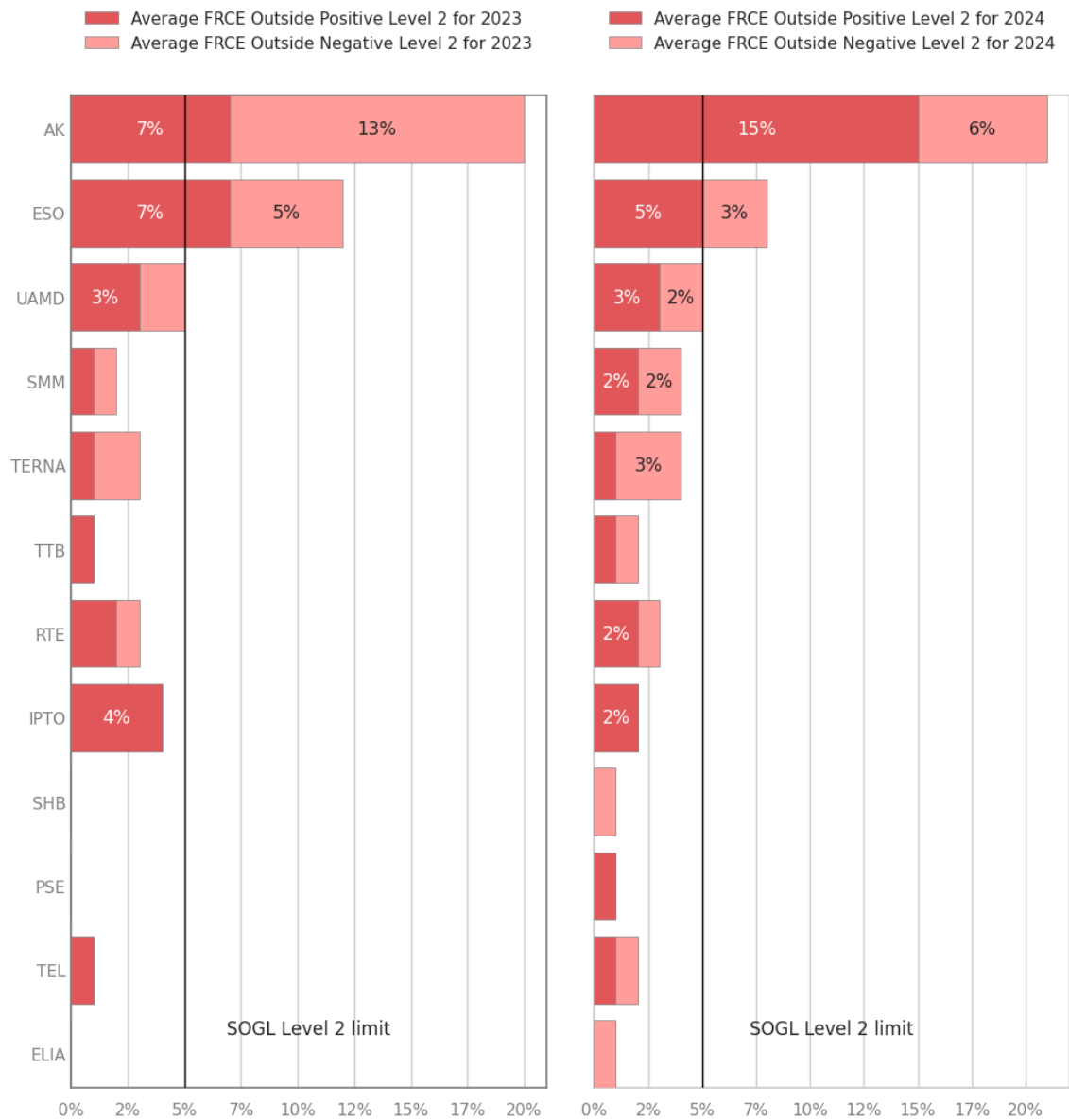


Figure 6.2 Percentage of time average FRCE was outside level 2 targets for 2023 and 2024
TSOs with values close to or equal to zero have been excluded from this figure. All values can be found in Appendix II.

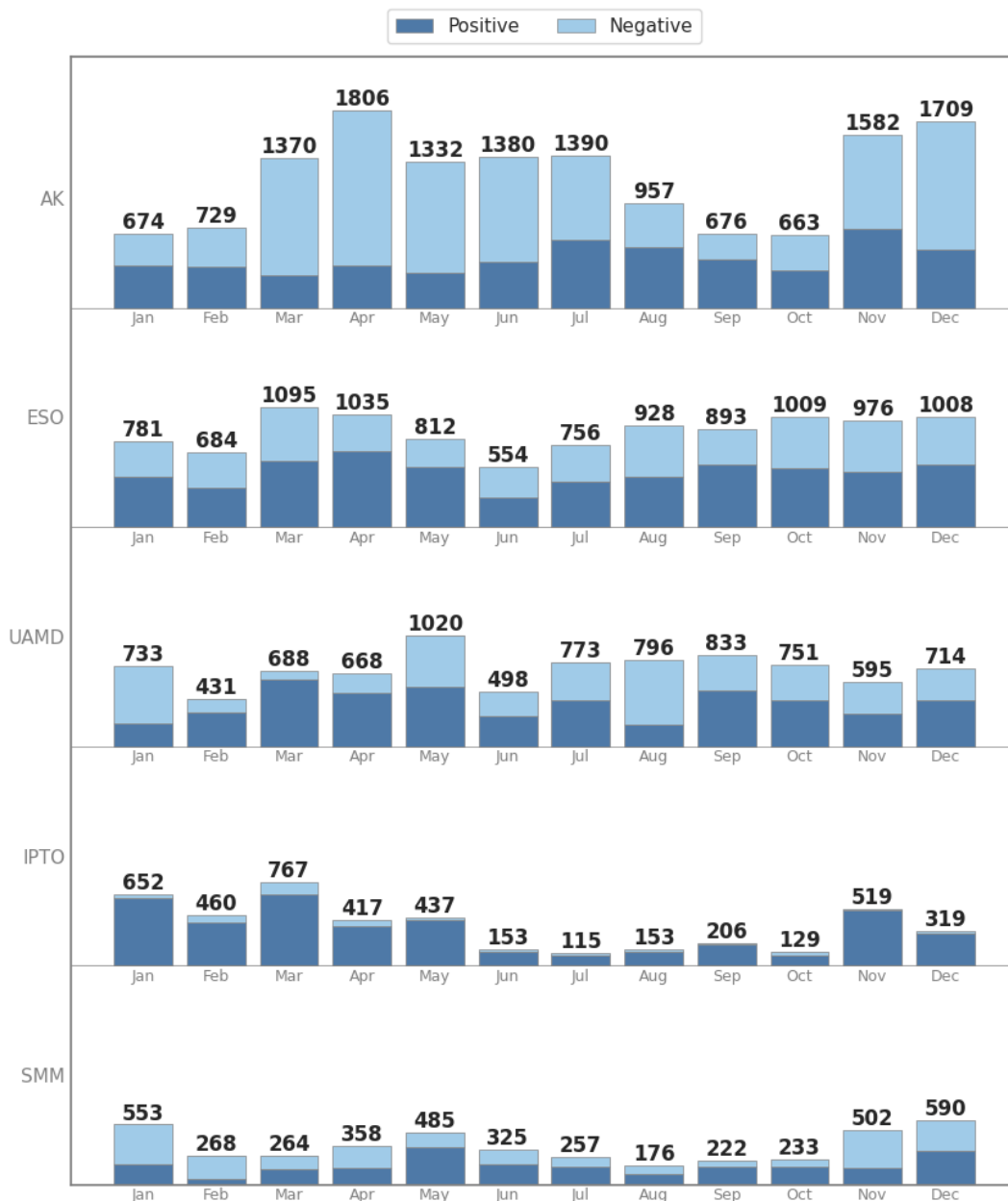


Figure 7 TOP 5 LFC Blocks in CE with the highest FRCE Time Intervals outside Level 1 Range for 2023
The data for lower ranking LFC Blocks is presented in Appendix II.

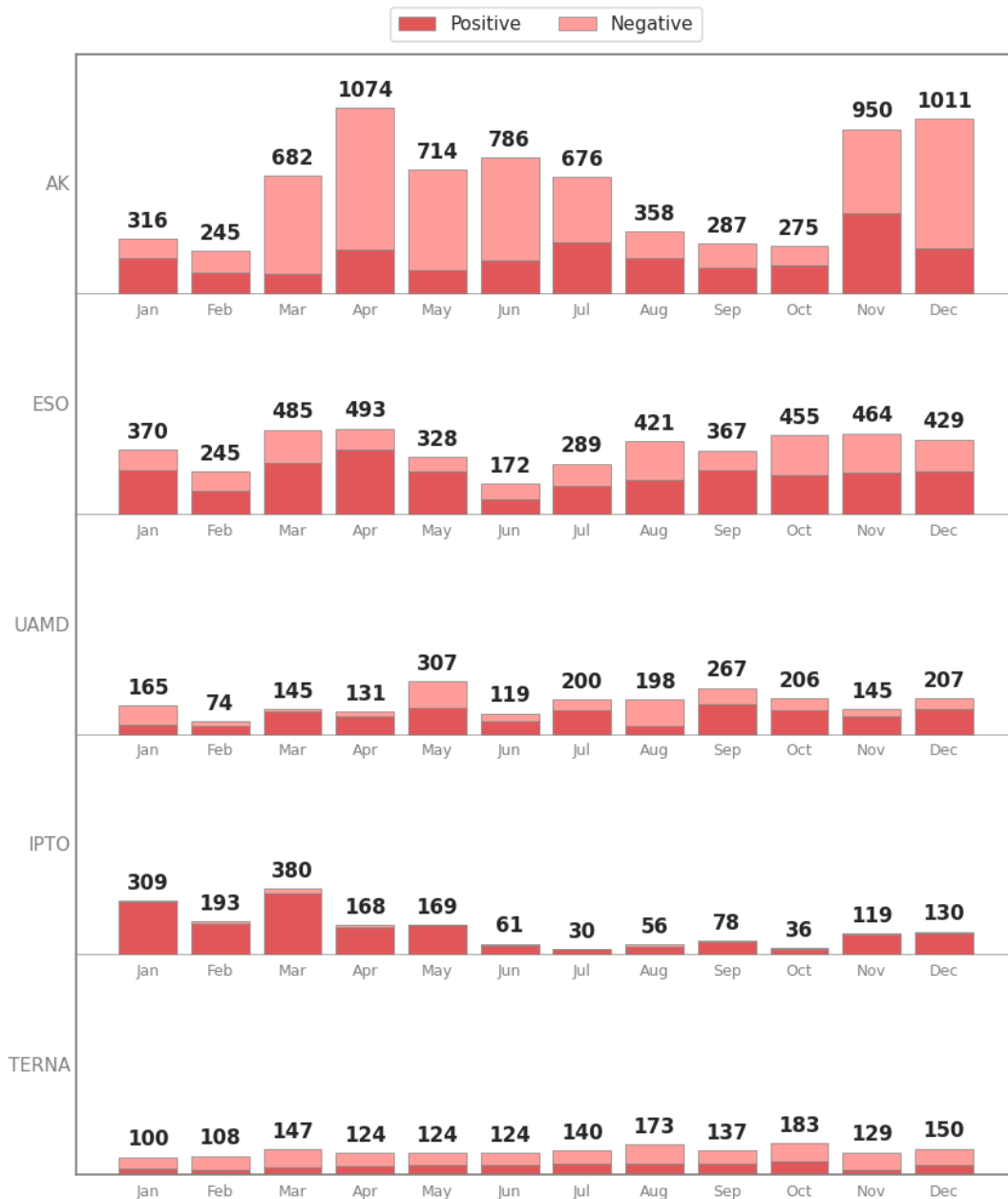


Figure 8 TOP 5 LFC Blocks in CE with the highest FRCE Time Intervals outside Level 2 Range for 2023
The data for lower ranking LFC Blocks is presented in Appendix II.

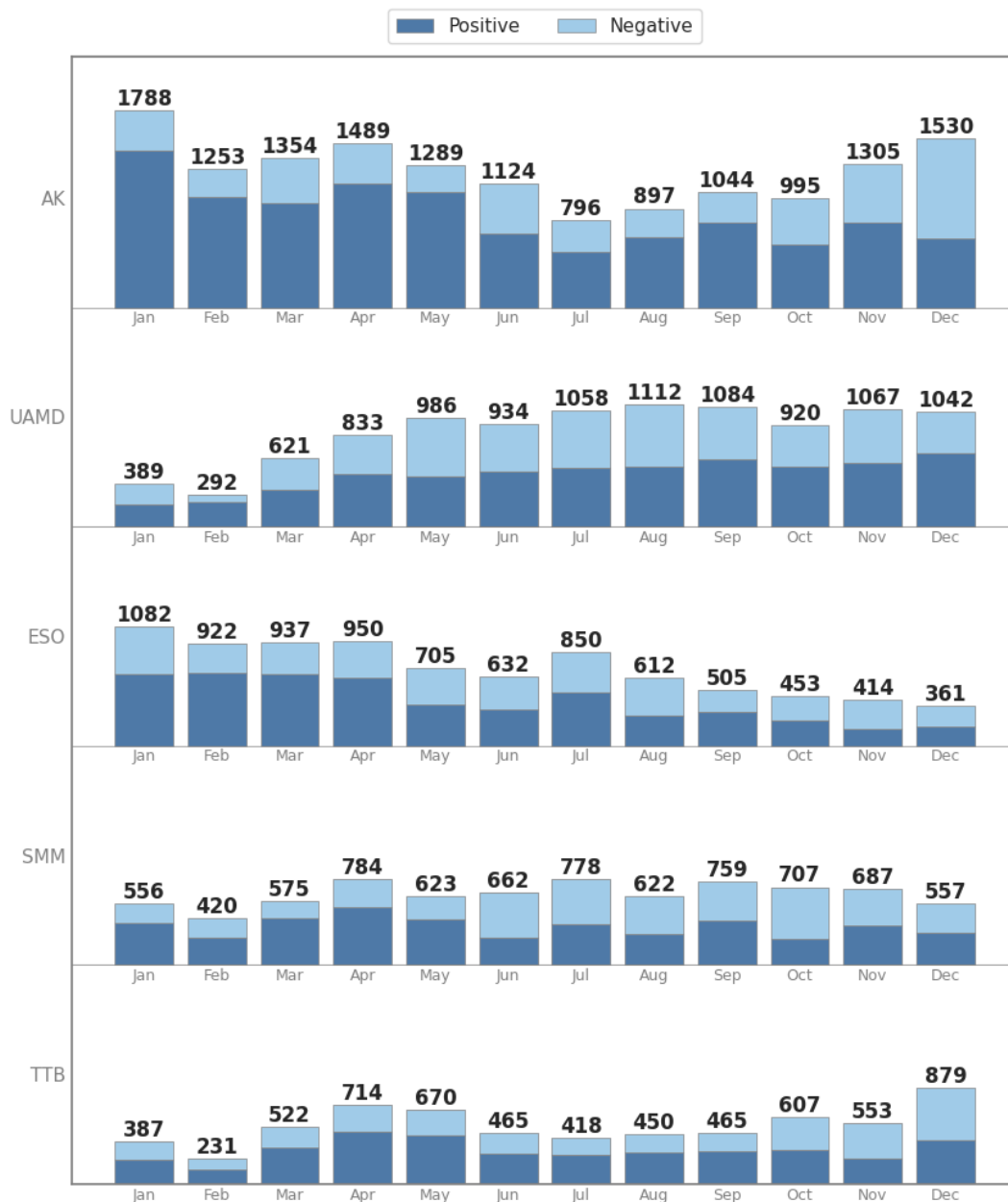


Figure 9 TOP 5 LFC Blocks in CE with the highest FRCE Time Intervals outside Level 1 Range for 2024
The data for lower ranking LFC Blocks is presented in Appendix II.

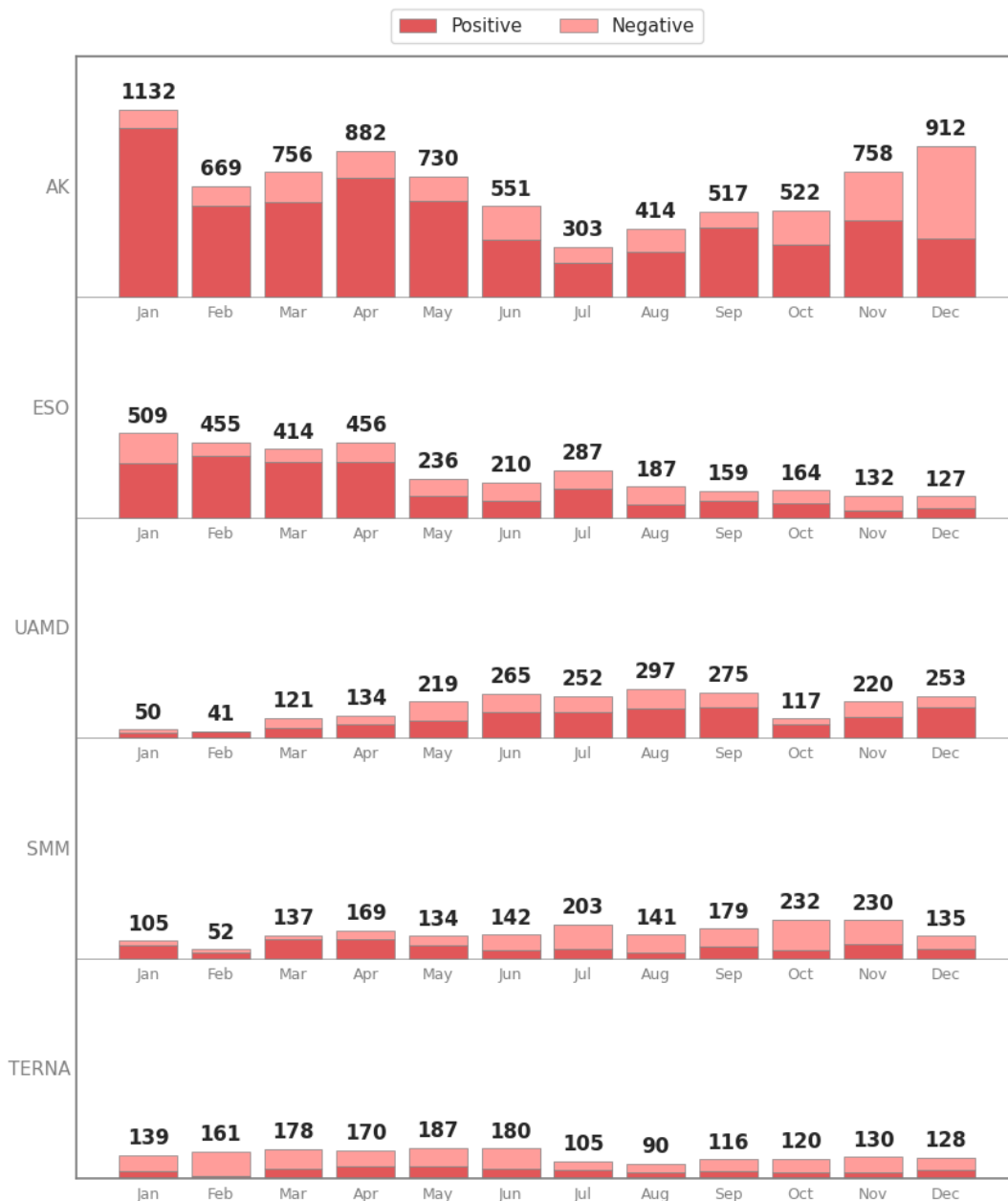


Figure 10 TOP 5 LFC Blocks in CE with the highest FRCE Time Intervals outside Level 2 Range for 2024
The data for lower ranking LFC Blocks is presented in Appendix II.

FRCE vs. FRR

The ability of LFC blocks to regulate their own FRCE can be assessed by comparing the FRCE to the reserve capacity from the dimensioning process, as described in Article 157 of the SOGL. Both automatic (aFRR) and manual (mFRR) FRR are included. Voluntary energy bids can optionally be included.

Positive and negative FRR is considered individually, that is, positive FRR (FRR+) is compared to the negative FRCE, and negative FRR (FRR-) is compared to the positive FRCE. FRCE values include all correction signals (e.g., for TSOs part of an Imbalance Netting Process) and is the value after the adjustment process for TSOs part of an FRR activation process. The values 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 (equal or higher than 60 % of dimensioned FRR) and an insufficient capability of LFC blocks to solve them during the time to restore frequency.⁴

For better visualization, Figures 11 and 12⁵ only show the TOP 5 LFC Blocks in CE with the highest FRCE Outside FRR Capacity within 15 minutes for 2023 and 2024. Regardless of the illustration, all data is included in Annex II.

⁴ SOGL Annex III, Table 1 - Frequency quality defining parameters of the synchronous areas

⁵ Figures 11 and 12: Terna's data to be updated due to internal issues occurred in the generation of the input data.

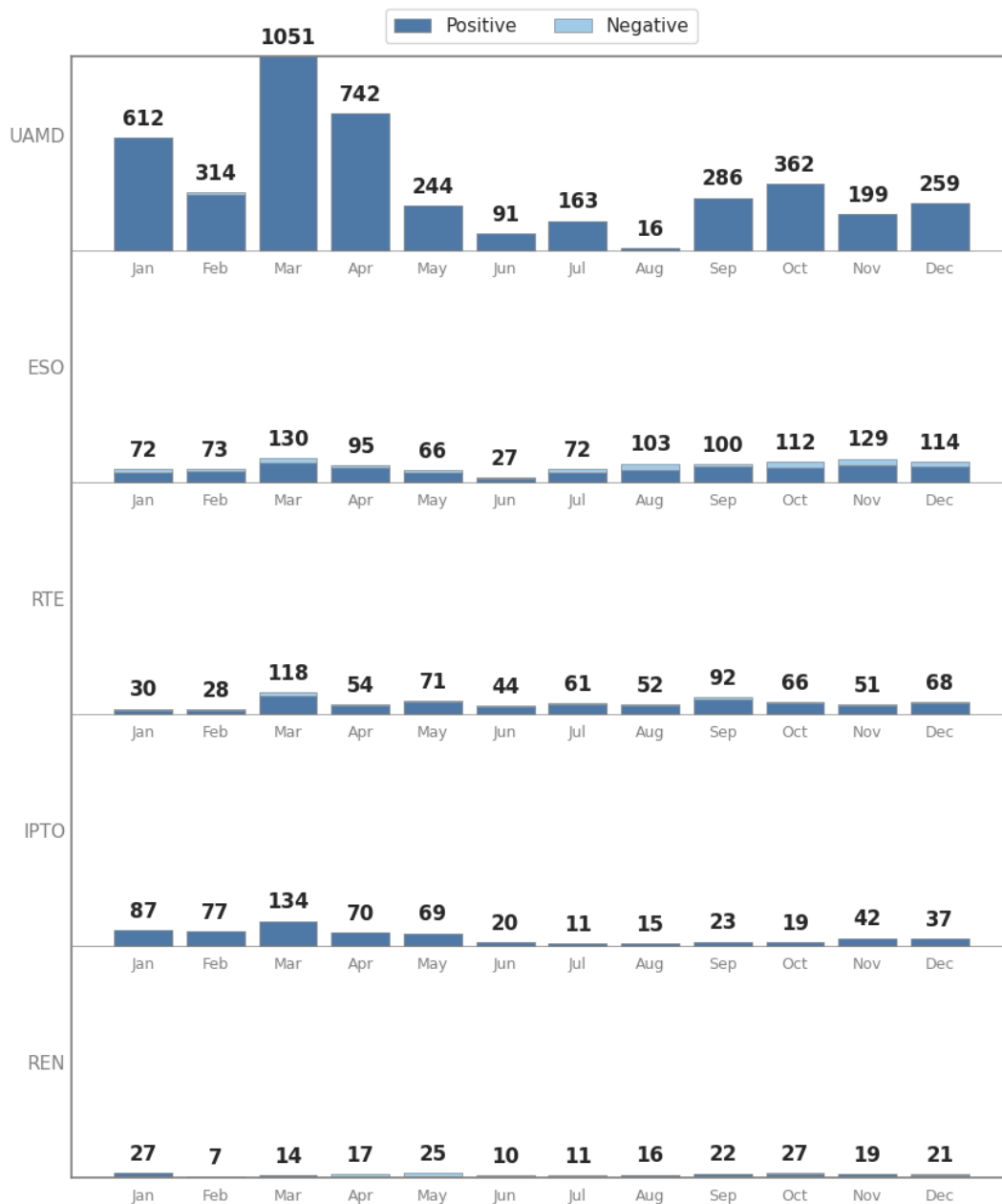


Figure 11 TOP 5 LFC Blocks in CE with the highest FRCE Outside FRR Capacity within 15 minutes for 2023. For better visualization the Figure only show the TOP 5 LFC Blocks in CE; regardless of the illustration, all data is included in Annex II.

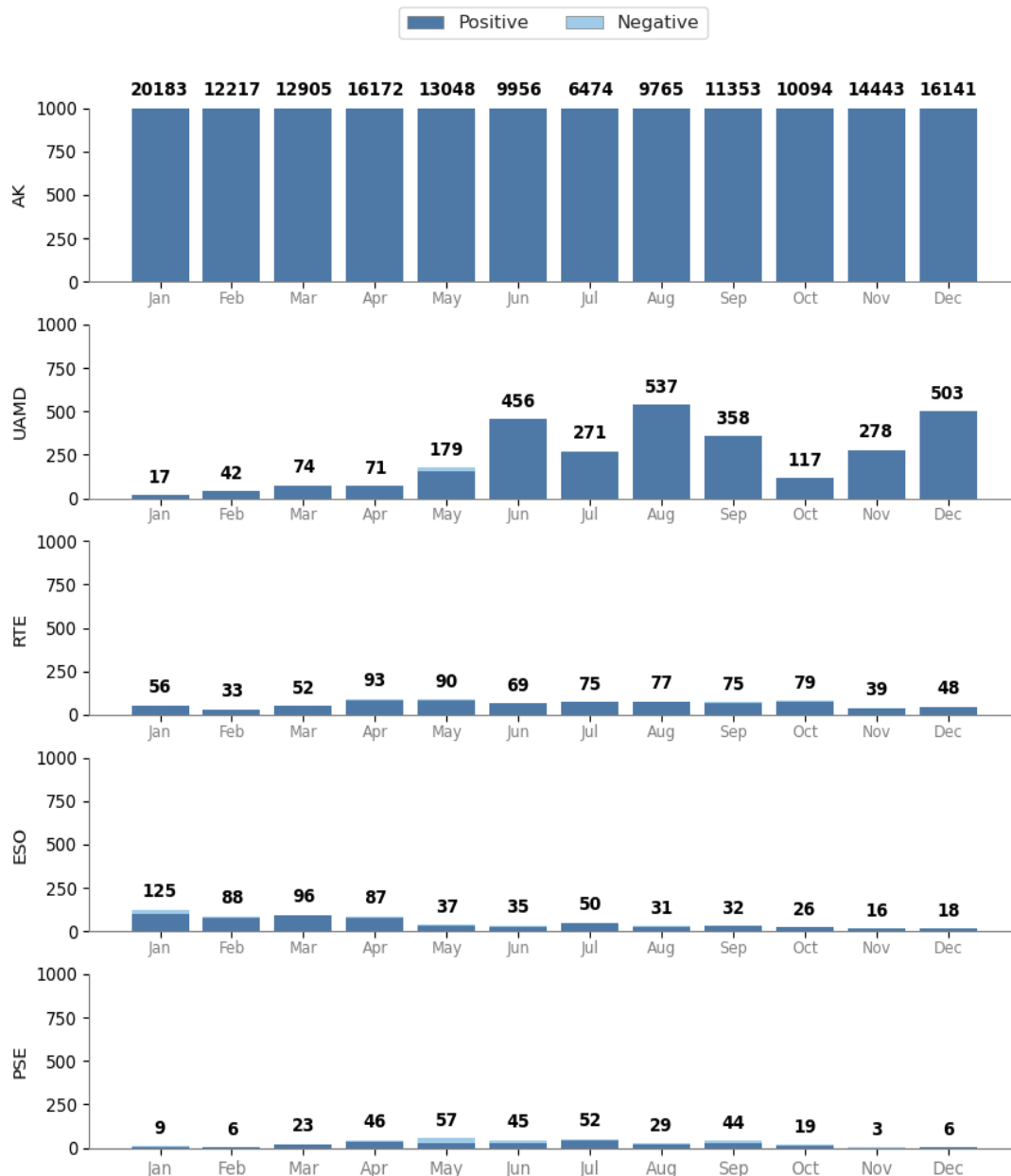


Figure 12 TOP 5 LFC Blocks in CE with the highest FRCE Outside FRR Capacity within 15 minutes for 2024⁶ – For better visualization the Figure only show the TOP 5 LFC Blocks in CE; regardless of the illustration, all data is included in Annex II. To improve readability, the bars were capped at a maximum value of 1000, which means the bars for AK are limited to this value.

⁶ For the AK LFC Block, the elevated number of negative deviations can primarily be attributed to two interacting factors, closely related to the values of FRCE (Frequency Restoration Control Error) and FRR+ (Frequency Restoration Reserve capacity):

-
1. Relative Magnitude of FRCE Deviations in relation to FRR+: During the months of January, February, April, and May, a high number of negative deviations was recorded, compared to other months. This is explained by the fact that the FRR+ values were relatively small.
 2. Recovery Duration: In addition to the deviation's magnitude, an event is only counted as a 'negative deviation' if the frequency does not recover within a specified time period (e.g., 15 minutes). A high number of events indicates that these frequency drops are not only frequent but also prolonged.

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 in which TSOs were involved taken in the previous calendar year to alleviate deterministic frequency deviations in accordance with SOGL Articles 137 and 138

In accordance with Article 138 of the SOGL, when the values calculated for the period of 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. Furthermore, 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 Article 138 of the SOGL, this information should contain:

- a) 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, analysis of the causes and a set of recommendations; and
- b) description of any mitigation measures developed to ensure that the targets for the synchronous area or for the LFC block can be met in the future.

For the reporting period, encompassing the years 2023 and 2024, in line with Figure 6.1 and Figure 6.2, the following analysis and mitigation measures were reported from LFC blocks in Continental Europe:

Mitigation measures for year 2023:

RTE

Analysis	Although the strike in 2023 can be considered an exceptional event, RTE will be implementing measures over the coming months and years that could have helped during the period.
Mitigation measures	The daily tender for aFRR, launched in 2021 and abandoned after few weeks, will be relaunched mid-2024. Change in the remuneration scheme of the reserve should avoid the arbitration that occurred during the strike. RTE will extend its mFRR/RR contracting process, today only performed for upward reserves, to downward reserves. RTE is going to connect to PICASSO in 2024, which could help to cope with problems of lack of aFRR in some cases. RTE intensifies its action towards Public Authorities to ensure that renewables will actively participate in the balancing mechanism and in the reserve procurement. Furthermore, work has been undertaken to make them subject to the same scheduling requirements as other production sectors. As well as improving our daily basis vision of the renewables production, this will improve the management of negative spot price episode.

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ESO

Analysis

Since the beginning of 2023, ESO FRCEs significant issue to follow interchange schedules, as a result of limited possibility to balancing own control area. In most of the cases when the control area FRCE exceeded the required limits for Level1, Level 2, DFD limit, as well as the 375MW limit, ESO had no downward regulation capability.

There are two main reasons for this – one market and one technical.

For the first mentioned reason, market measures in balancing market mechanism were not sufficient to prevent these imbalances in ESO control area, due to the delayed market changes.

For the second mentioned reason, technical, there was two unpredictable coincidences:

1. The accident in PSHPP Chaira, in the first trimester of 2022. This PSHPP was with capability of 880MW generation and 760MW consumption (pumps). The complete loss of this power plant, reduce dramatically capability for regulation.

2. The rehabilitation of the other HPPs, which reduce possibility for downward regulation, using pumps.

Mitigation measures

Mitigation measures that was taken by ESO:

1. ESO as a responsible for control of own CA, informed ministry and NRA for the situation. As a result of the formal correspondence, when we have a prediction for excess of generation, orders to all producers, connected to the transmission and distribution grid are issued to strictly follow its market schedules announced in advance to the system operator, between 10.00 to 17.00 p.m. For imbalances, restrictive measures towards the producers are taken from the ministry of energy according to the Bulgarian energy act.

2. Reducing the interchange transmission capacity in direction BG in compliance with HAR for the days with expected excess of RES generation. Expected additional actions:

1. Market changes, including negative prices introduction for balancing energy and removing cap for balancing energy prices was expected till middle of 2024.

2. Two units in PSHPP Chaira (210MW generation/180MW pump per unit) are expected to be in operation in late 2024 or early 2025.

AK

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 FRCE in KOSTT Control Area and in respective CB AK. For consequences the CB AK FRCE exceeded the limits of Level 1 and Level 2. Within the CB AK, mFRR reserves were activated in the OST Control Area, but the amount of mFRR was not sufficient to cover the entire imbalance.

Mitigation measures

TBD

UAMD

Analysis

- 1) significant loss of generation certified for ancillary services, caused by Russia's military aggression

- 2) 1-hour settlement period, which makes it impossible to adjust the schedule closer to the moment of real time

Mitigation measures 1) the need to develop new generation and ESS to ensure adequacy of reserves
 2) transition in the next 1-2 years to 15-minute settlement period on the electricity market

Mitigation measures for year 2024:

SMM

Analysis Occasional scarcity of reserve in North Macedonia

Mitigation measures MEPSO is going to join local imbalance netting process within SMM CB and remove obstacles for the cross-border exchange of mFRR reserve within SMM CB.

Ireland/Northern Ireland

Frequency Performance

The tables and figures in the Section present frequency performance for the synchronous area of Ireland/Northern Ireland for the years 2023 and 2024, along with five year annual values for 2020–2024. The input values for frequency are based on instantaneous frequency values. Based on the input values, the mean value, standard deviation and percentiles were calculated. 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 200–1000 mHz range, time is measured in minutes.

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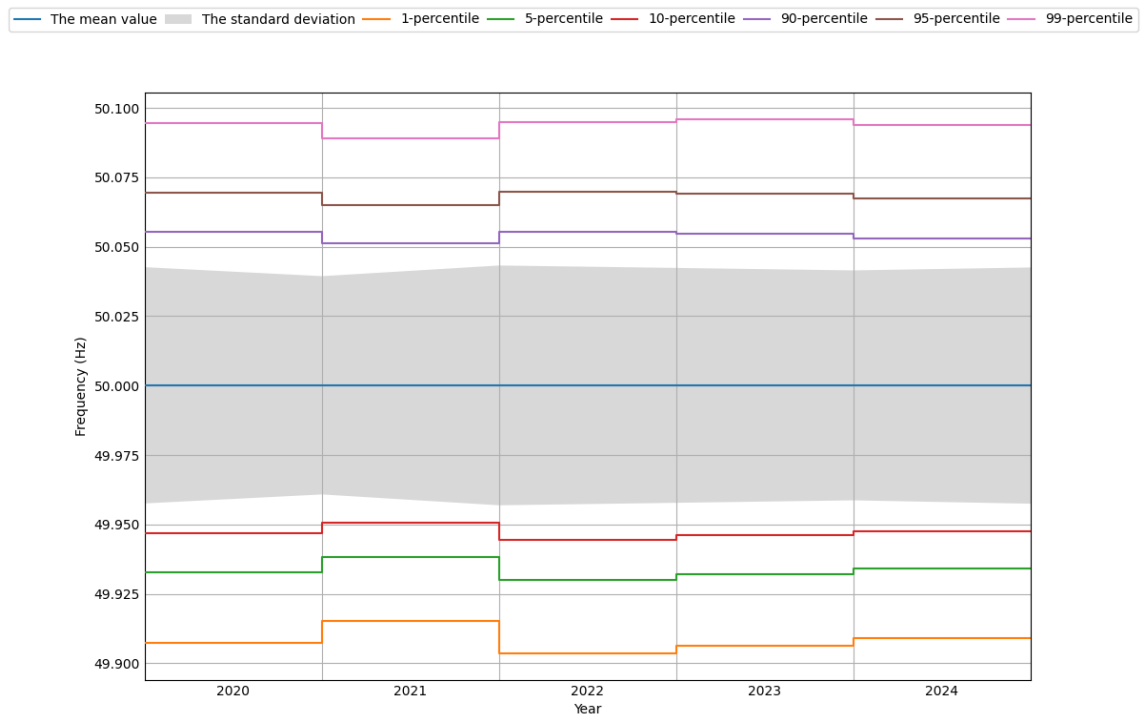


Figure 13 Annual frequency percentiles and standard deviation in Ireland/Northern Ireland for 2020–2024

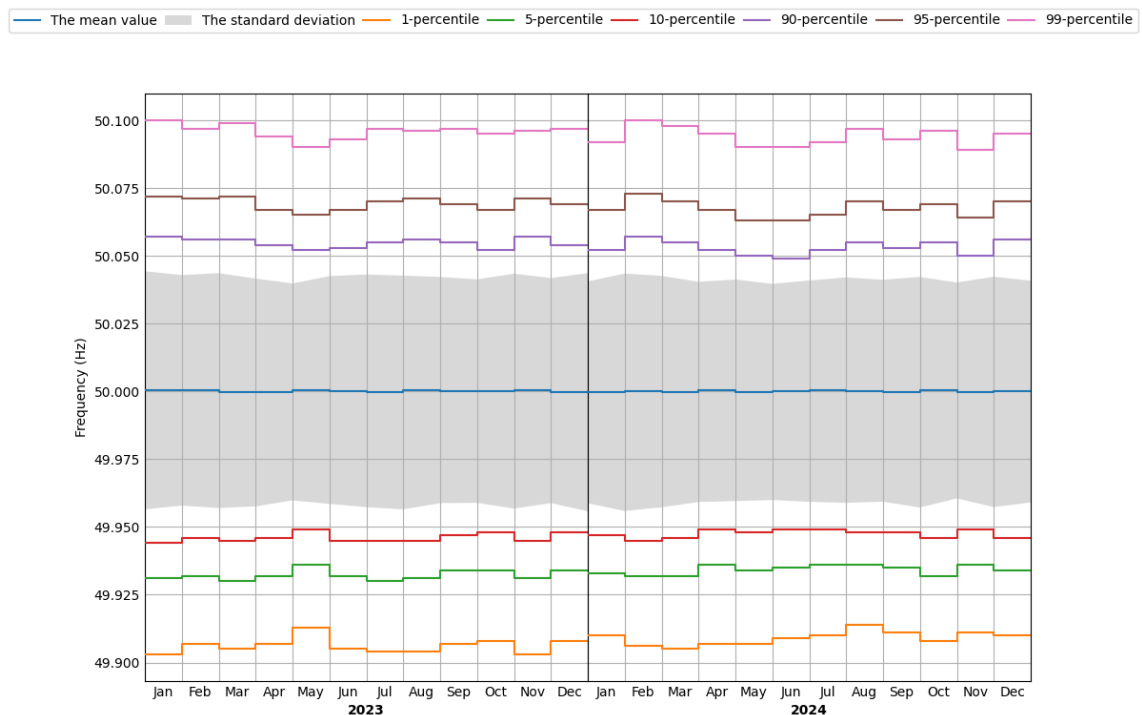


Figure 14 Monthly frequency percentiles and standard deviation in Ireland/Northern Ireland 2023 and 2024

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In Figures 15 and 16, the accumulated minutes outside standard ranges are presented for the years 2023 and 2024 respectively. The frequency quality target parameter, as defined in the SOGL, is 15000 minutes per year for each synchronous area. The monthly target parameter can be considered as 1/12 of this value, that is, 1250 minutes.

The following graphs below show that the frequency quality was exceptionally good and that all frequency quality target parameters from SOGL were fulfilled in the Ireland/Northern Ireland Synchronous Area for the respective years.

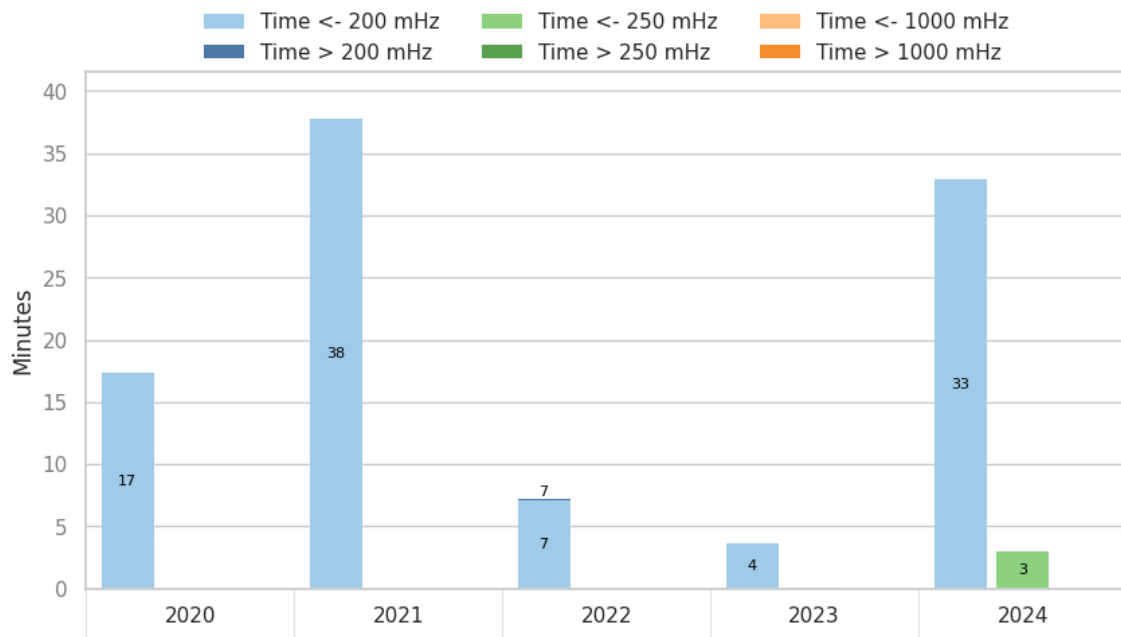


Figure 15 Annual number of minutes outside the standard ranges in Ireland/Northern Ireland for 2020–2024

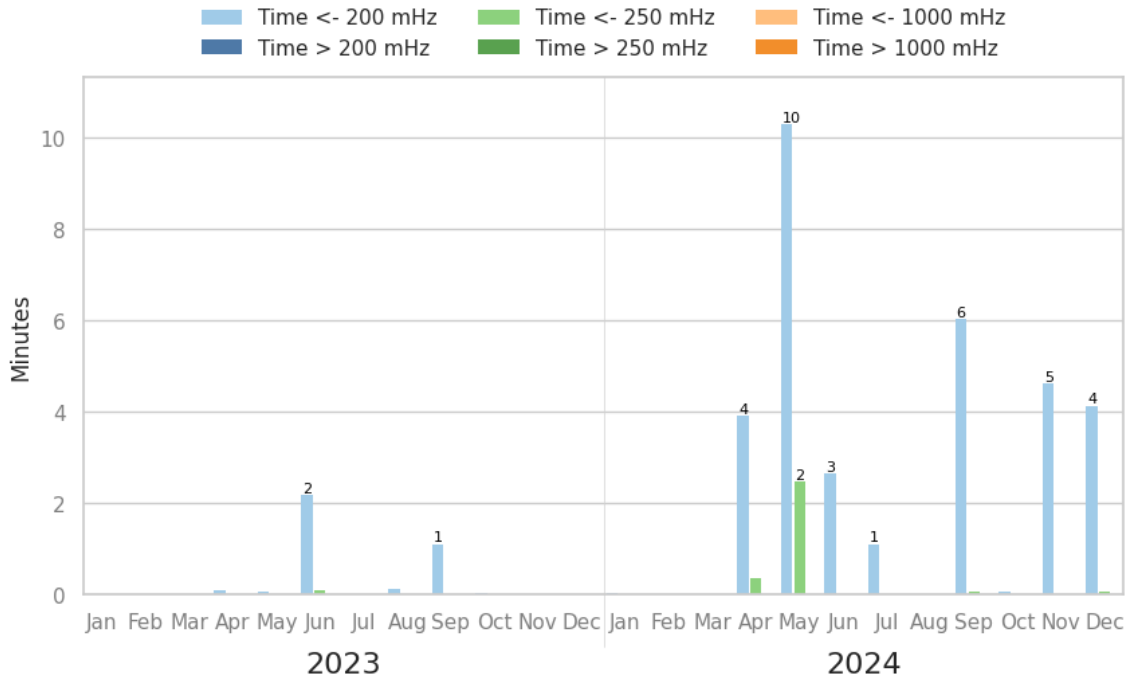


Figure 16 Monthly number of minutes outside the standard ranges in Ireland/Northern Ireland for 2023 and 2024 by month

The yearly trend shows that only very few minutes were observed where the frequency was outside the standard frequency range of +/- 200mHz for IE/Nl.

Nordic

Frequency Performance

In the following figures, data are presented from 2023 and 2024 for the Nordic synchronous area. Input values for frequency are based on instantaneous frequency values. Based on the input values, the mean value, standard deviation and percentiles were calculated. Moreover, any time periods and events where the system frequency was outside of predefined ranges were also indicated. For data points where the frequency was outside the 100–1000 mHz range, time is measured in minutes.

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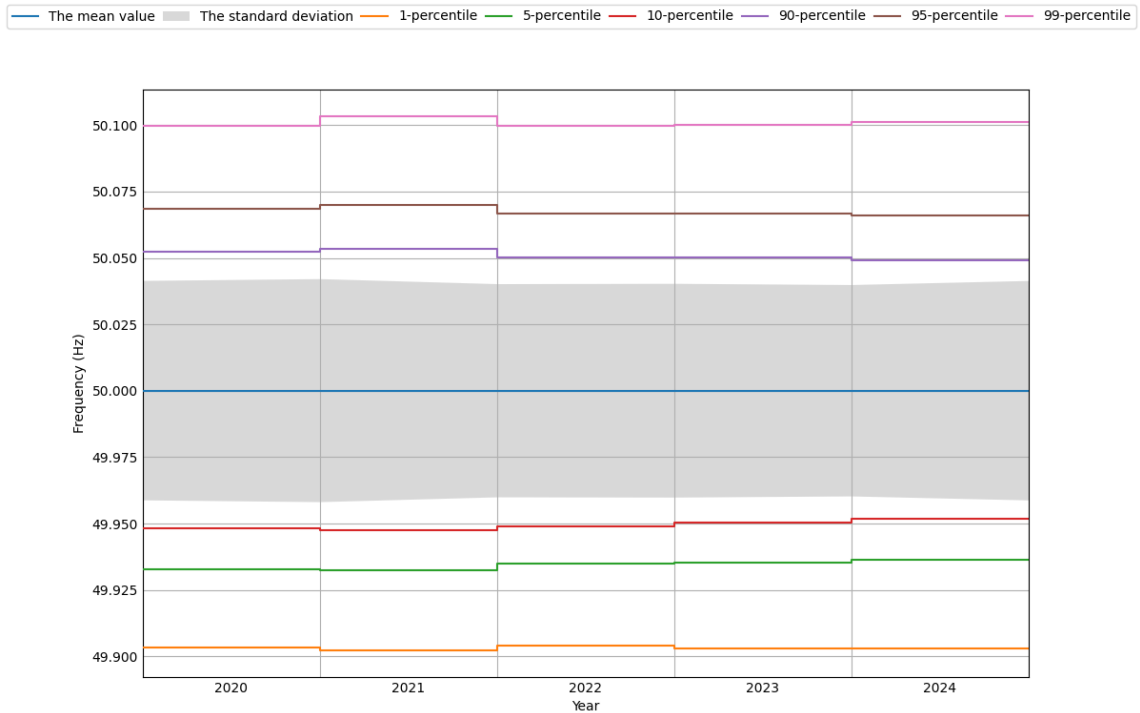


Figure 17 Annual frequency percentiles and standard deviation in the Nordic synchronous area for 2020–2024

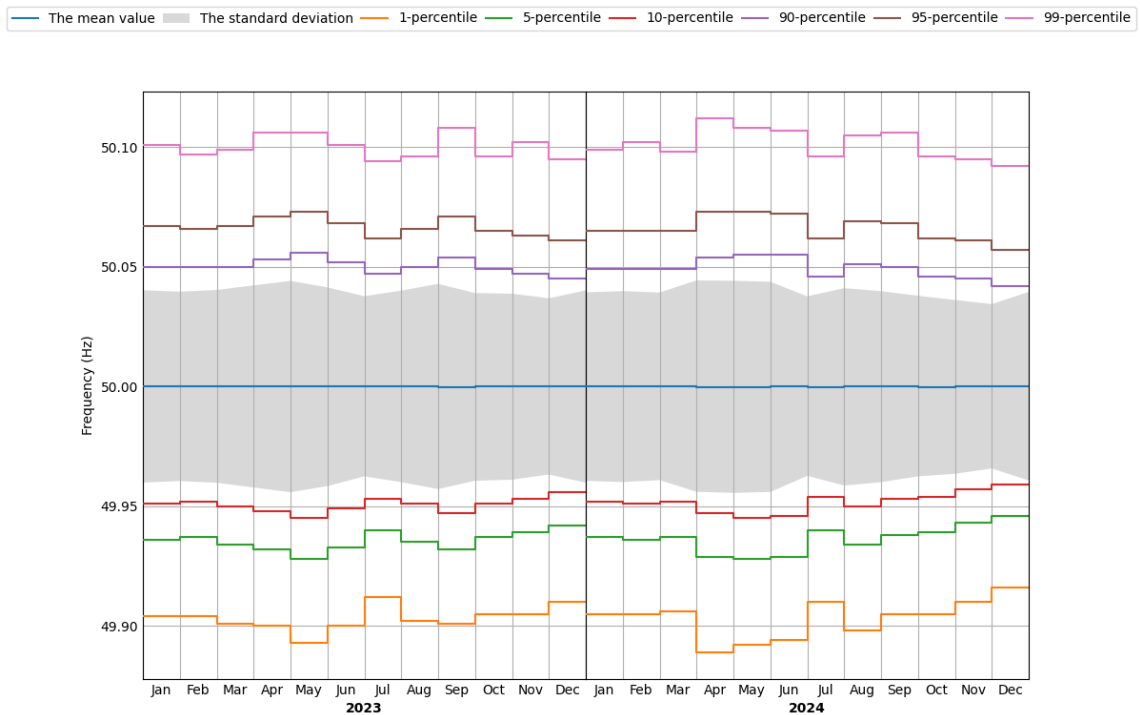


Figure 18 Monthly frequency percentiles and standard deviation in the Nordic synchronous area for 2023 and 2024

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In Figures 19 and 20, the accumulated minutes outside standard ranges are presented for the years 2020 to 2024. The frequency quality target parameter, as defined in the SOGL, is 15000 minutes per year for each synchronous area. The annual trend for 2020–2023 shows a stable trend, where the frequency was outside the standard frequency range (of +/- 100mHz) for around 10,000 minutes per year in the Nordics. In 2024, a significant improvement can be observed.

The graph below shows that the frequency quality target parameters from SOGL were fulfilled for the respective years in the Nordic Synchronous Area.

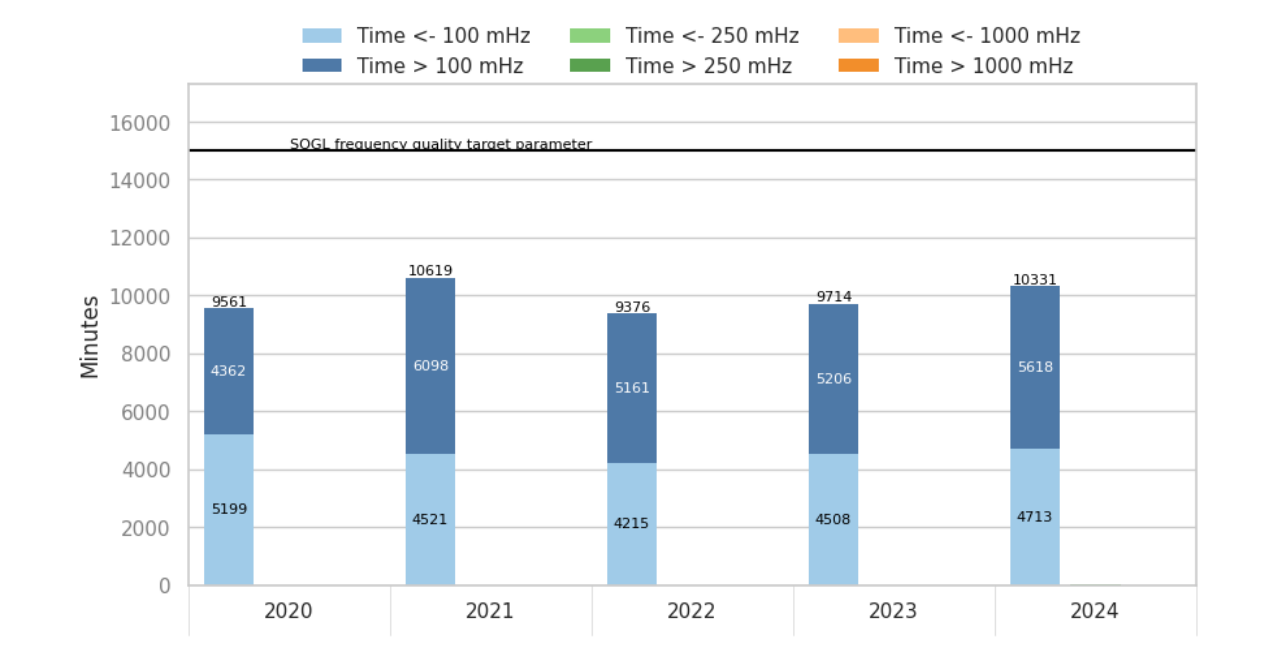


Figure 19 Annual number of minutes outside the standard ranges in the Nordic 2020–2024

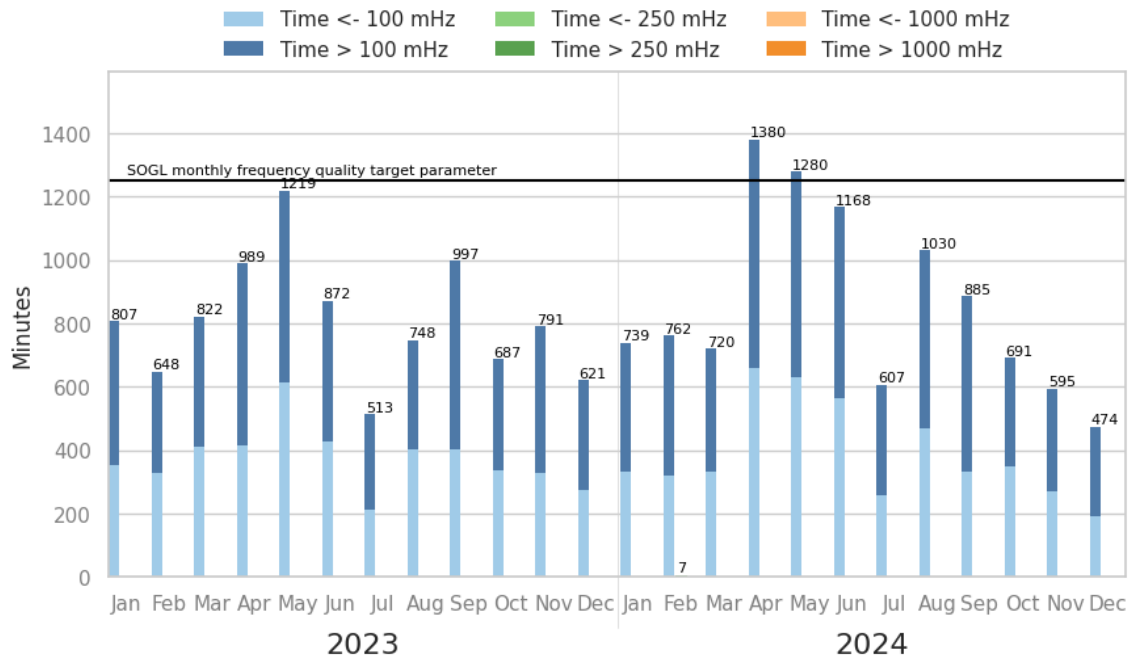


Figure 20 Monthly number of minutes outside the standard ranges in the Nordic synchronous area for 2023 and 2024

The frequency quality target parameter, as defined in the SOGL, is 15000 minutes per year for each synchronous area. The monthly target parameter can be considered as 1/12 of this value, that is, 1250 minutes. The graph shows that the frequency quality target parameters from SOGL were fulfilled for the respective months in the Nordic Synchronous Area with significant improvements in 2024.

Level 1 and Level 2 statistics

Figures 21 to 24 present the monthly distribution of FRCE time intervals outside the Level 1 range and Level 2 range for positive and negative time intervals is presented by month and year. If the maximum number of intervals exceeds 10512 for Level 1 or 1752 for Level 2, then mitigation measures must be proposed and taken.

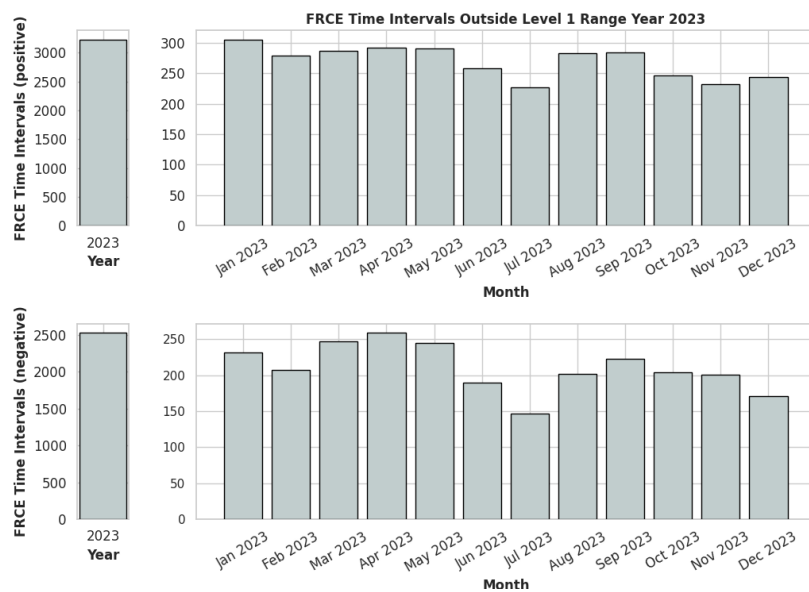


Figure 21 Nordic LFC 2023 FRCE Time Intervals Outside Level 1 Range

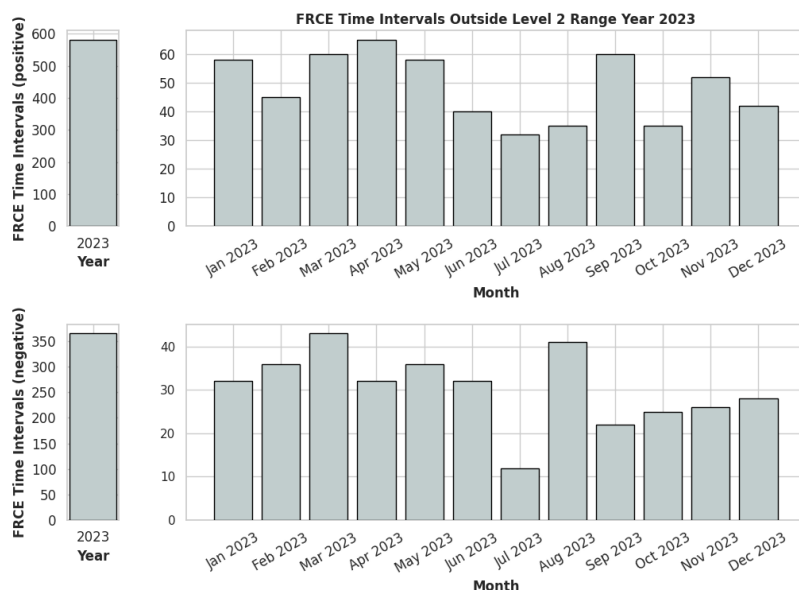


Figure 22 Nordic LFC 2023 FRCE Time Intervals Outside Level 2 Range

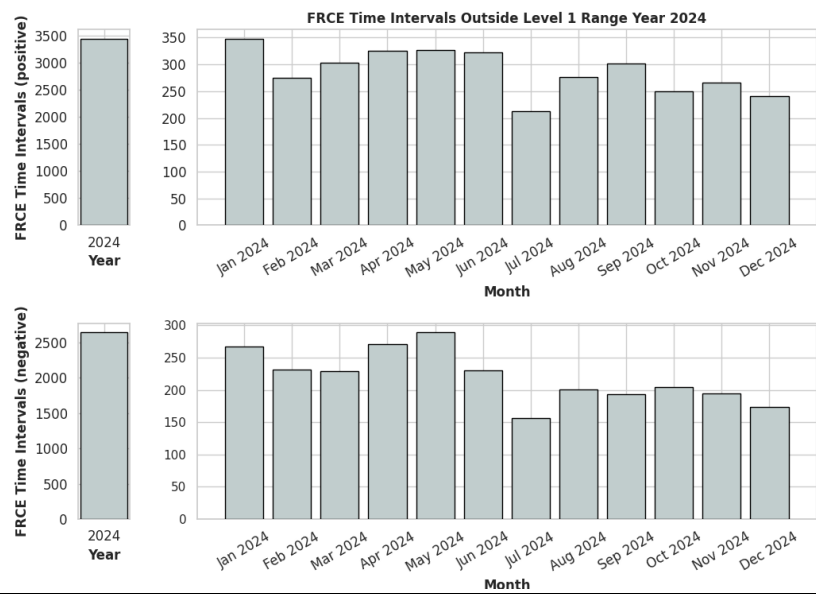


Figure 23 Nordic LFC 2024 FRCE Time Intervals Outside Level 1 Range

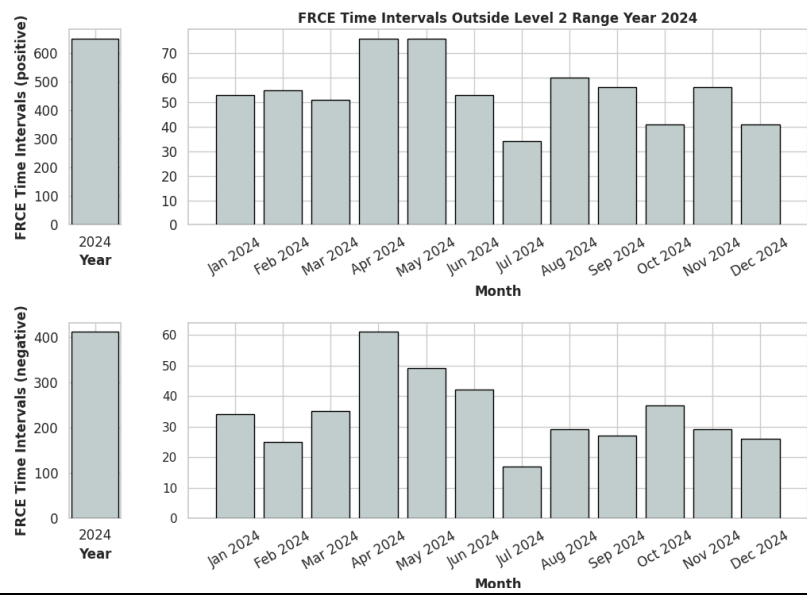


Figure 24 Nordic LFC 2024 FRCE Time Intervals Outside Level 2 Range

FRCE vs. FRR

The ability of LFC blocks to regulate their own FRCE can be assessed by comparing the FRCE to the reserve capacity from the dimensioning process, as described in Article 157 of the SOGL. Both automatic (aFRR) and manual (mFRR) FRR are included. Voluntary energy bids can optionally be included. Positive and negative FRR is considered individually, that is, positive FRR (FRR+) is compared to the negative FRCE, and a negative FRR (FRR-) is compared to the positive FRCE. FRCE values include all correction signals (e.g., for TSOs part of an Imbalance Netting Process) and is the value after the adjustment process for TSOs part of an FRR activation process. The values 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 (equal or higher than 60 % of dimensioned FRR) and an insufficient capability of LFC blocks to solve them during the time to restore frequency.

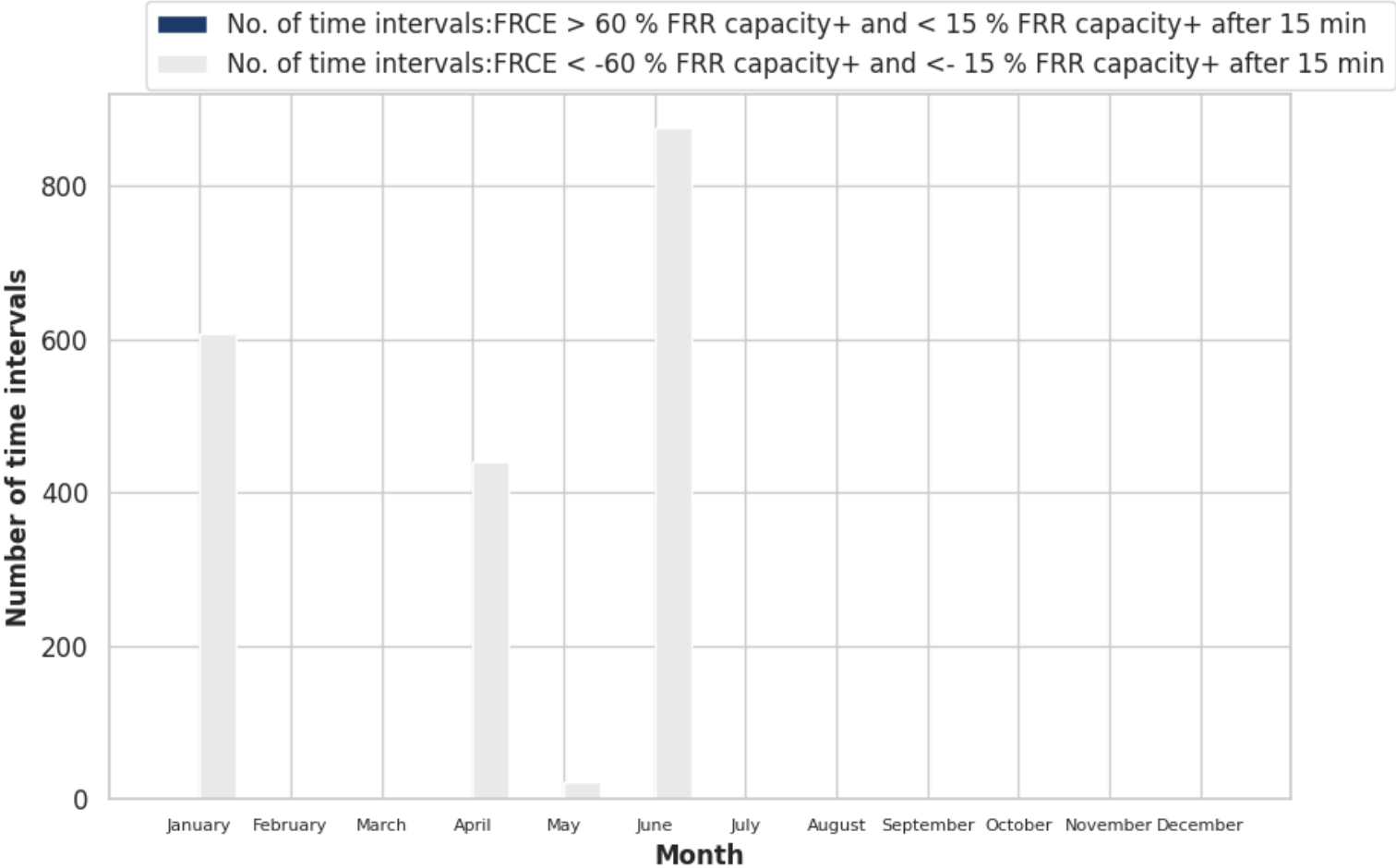


Figure 25 Nordic LFC 2023 FRCE Outside FRR Capacity within 15 minutes

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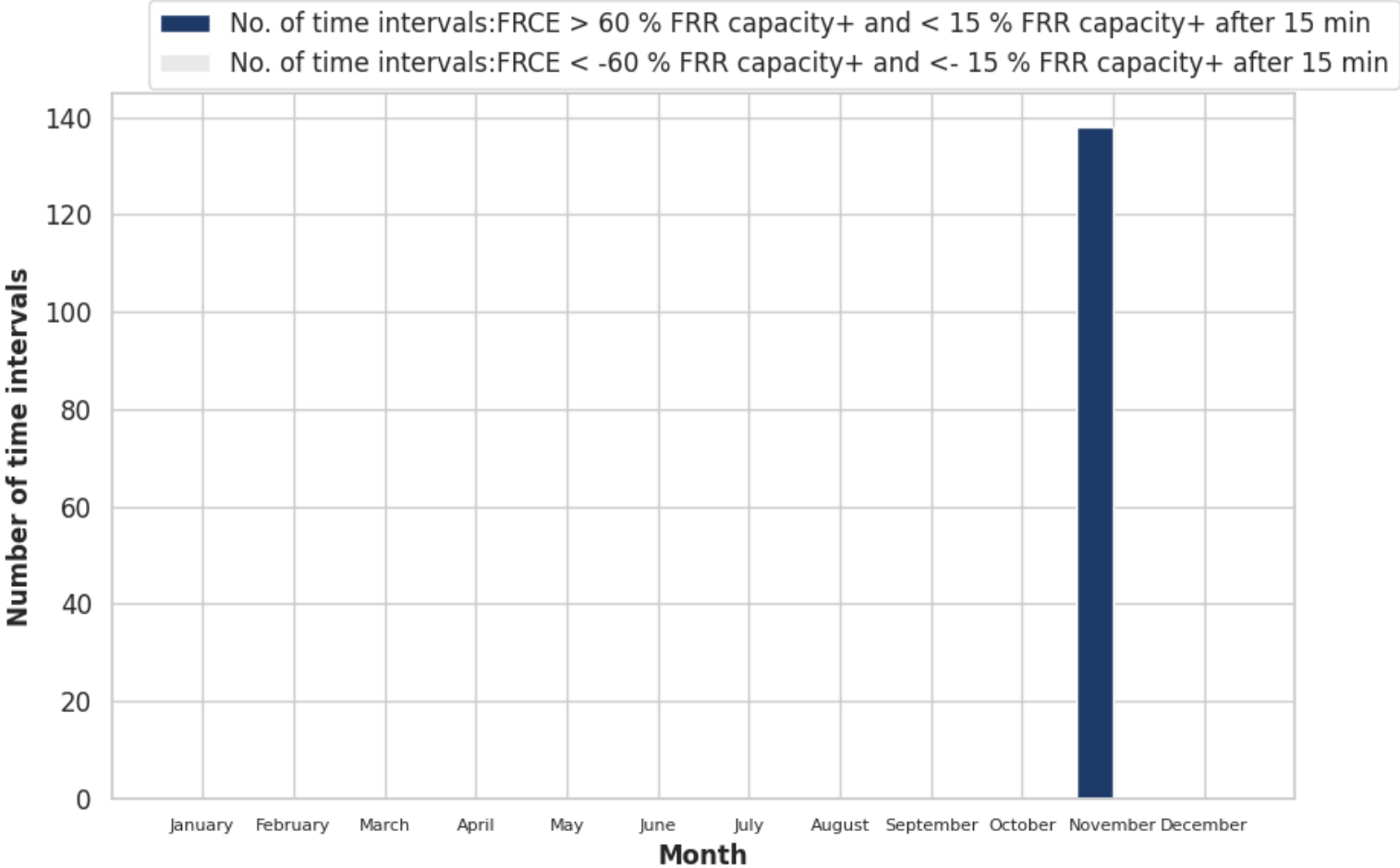


Figure 26 Nordic LFC 2024 FRCE Outside FRR Capacity within 15 minutes

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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 SOGL Articles 137 and 138, in which TSOs were involved.

In accordance with Article 138 of the SOGL, when the values of the frequency quality target parameters calculated for the period of 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. Furthermore, when the FRCE target parameter values are outside the targets set for the LFC block, all TSOs of the relevant LFC block should provide analysis and mitigation measures.

According to Article 138 of the SOGL, the information contains:

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

For the reporting period, which included the years 2023 and 2024, in line with Figures 21–24, the following analysis and mitigation measures were reported from the Nordic LFC Block:

Mitigation measures for year 2023:

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

Mitigation measures for year 2024:

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

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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. Furthermore, the SOGL requests that companies report two separate values regarding FCR with the following definitions:

- a) FCR obligation refers to the portion of all the FCR that falls under the responsibility of a TSO; and
- b) Initial FCR obligation refers to the amount of FCR allocated to a TSO on the basis of a sharing key.

Initial FCR obligation is reported on a monthly basis as an average value of FCR in MWs for the reported month. For TSOs that have the same value of initial FCR obligation for the whole year, TSO reports the same value for all months for the reported year. Otherwise, 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.

Continental Europe TSOs

In Table 9 and 10, the FCR is given for every Continental Europe TSO from January (I) to December (XII) for 2023 and 2024, 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. This value is calculated as a percentage. Values higher than 100% indicate that respective TSO exported a percentage amount of FCR to other TSOs, while if the reported value is lower than 100%, this means that the TSO imported part of its FCR from other TSOs (Part of its initial FCR obligation is contracted outside its responsibility area). If the value is equal to 100%, this mean that all FCR is ensured inside the TSO’s area of responsibility. For the case of missing data or data that was not provided in a timely manner, the entry shows N/A.

Nordic TSOs

In Table 11 and 12, the FCR is pictured for every Nordic TSO from January (I) to December (XII) for 2023 and 2024, respectively. The initial FCR obligation for each TSO is FCR-D capacity, that is, the frequency containment reserve (FCR) used to stabilise the frequency deviations between 50.5 to 50.1 and 49.9 to 49.5 Hz during disturbances. Each TSO ensures these capacities with a combination of mandatory provision, internal markets, and a common market.

IE/Nl

In Table 13 to 14 below, the FCR is presented from January (I) to December (XII) for 2023 and 2024. The FCR requirement for the Synchronous Area of IE/Nl is dynamic and it varies over a day; therefore, it is represented as a historical monthly MW average. In calculating the ‘Average monthly FCR’, the record spot FCR values are averaged over the monthly period. The amount of FCR obtained inside the area of TSO is also given as a percentage.

The following tables (Table 9-14) show FCR per TSO separately for each Synchronous Area presented in this report.

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TSO data

Continental Europe

It should be noted that twelve TSOs participated in the **FCR Cooperation** to procure their FCR in 2023 and 2024. 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), Czech Republic (CEPS), France (RTE), Germany (50Hertz, Amprion, TenneT DE, TransnetBW), the Netherlands (TenneT NL), Slovenia (ELES), Switzerland (Swissgrid) and Western Denmark (Energinet). 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. For example, SEPS imported FCR from CEPS. Additionally, due to non-divisible bids TSO could procure slightly more FCR than obligated like in the case of PSE.

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2023

Name	Initial obligation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50Hertz	115 MW	205.5 %	230.6 %	220.2 %	210.9 %	221.2 %	198.6 %	203.8 %	224.6 %	221.6 %	234.3 %	247.8 %	225.2 %
APG	72 MW	122.0 %	127.8 %	128.3 %	99.2 %	70.3 %	123.6 %	115.3 %	92.7 %	106.8 %	117.8 %	101.0 %	86.2 %
Amprion	210 MW	75.6 %	82.2 %	90.0 %	113.2 %	95.9 %	103.9 %	103.2 %	100.5 %	94.2 %	81.7 %	82.5 %	95.7 %
CEPS	76 MW	109.2 %	109.2 %	72.4 %	59.2 %	51.3 %	39.5 %	46.1 %	47.4 %	51.3 %	50.0 %	64.5 %	68.4 %
CGES	4 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
ELES	15 MW	11.0 %	6.5 %	10.6 %	3.4 %	4.9 %	4.7 %	5.3 %	2.2 %	3.1 %	6.0 %	2.2 %	5.3 %
EMS	36 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
ESO	39 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Elia	88 MW	36.1 %	34.0 %	36.6 %	34.5 %	32.1 %	33.9 %	32.5 %	31.6 %	32.8 %	31.8 %	32.4 %	31.8 %
Energinet (CE)	23 MW	4.6 %	3.0 %	7.3 %	0.7 %	5.8 %	4.0 %	8.0 %	7.0 %	7.9 %	16.0 %	15.4 %	18.3 %
HOPS	17 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
IPTO	53 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
KOSTT	3 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
MAVIR	39 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.4 %	100.0 %	100.0 %	100.0 %	100.0 %
MEPSO	6 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.4 %	100.0 %	100.0 %	100.0 %	100.0 %
NOS BiH	14 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
OST	9 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
PSE	174 MW	102.4 %	103.7 %	102.1 %	101.0 %	99.9 %	100.1 %	100.0 %	99.8 %	99.8 %	99.8 %	100.7 %	101.2 %
REN	50 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
RTE	514 MW	128.1 %	120.4 %	121.4 %	123.5 %	124.5 %	128.4 %	125.3 %	124.5 %	125.2 %	125.5 %	128.6 %	129.1 %
Red Eléctrica	299 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
SEPS	30 MW	69.6 %	72.8 %	57.2 %	59.5 %	57.0 %	61.5 %	52.3 %	56.0 %	48.3 %	55.5 %	57.9 %	62.5 %
Swissgrid	62 MW	93.5 %	90.3 %	117.7 %	140.3 %	129.0 %	135.5 %	116.1 %	109.7 %	67.7 %	85.5 %	80.6 %	77.4 %
TEIAS	334 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
TenneT DE	171 MW	90.2 %	87.0 %	85.8 %	90.6 %	91.2 %	82.9 %	82.0 %	89.5 %	87.1 %	90.5 %	88.0 %	86.4 %
TenneT NL	111 MW	52.3 %	63.0 %	65.4 %	62.2 %	62.4 %	54.8 %	48.0 %	48.7 %	45.4 %	45.4 %	45.2 %	51.9 %
Terna	310 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Transelectrica	60 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
TransnetBW	74 MW	25.3 %	9.4 %	20.3 %	9.5 %	12.3 %	6.6 %	8.1 %	11.7 %	9.5 %	9.5 %	10.4 %	9.9 %
Ukrenergo	129 MW	16.9 %	19.2 %	35.6 %	40.8 %	57.9 %	57.7 %	36.6 %	32.3 %	48.2 %	54.0 %	58.6 %	41.9 %

Table 9 FCR statistics for each TSO in Continental Europe for 2023

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2024

Name	Initial obligation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50Hertz	116 MW	210.0 %	206.4 %	215.1 %	203.1 %	211.3 %	190.8 %	182.0 %	175.4 %	196.8 %	214.9 %	220.7 %	201.1 %
APG	72 MW	101.4 %	106.9 %	119.4 %	136.1 %	116.7 %	65.3 %	127.8 %	134.7 %	84.7 %	94.4 %	125.0 %	122.2 %
Amprion	204 MW	97.7 %	100.7 %	98.5 %	94.4 %	80.4 %	97.5 %	93.3 %	98.7 %	94.8 %	93.4 %	90.3 %	94.3 %
CEPS	76 MW	100.0 %	98.7 %	100.0 %	101.3 %	101.3 %	88.2 %	101.3 %	101.3 %	101.3 %	100.0 %	100.0 %	100.0 %
CGES	3 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
ELES	14 MW	3.8 %	2.7 %	1.6 %	14.0 %	10.6 %	16.5 %	15.5 %	9.5 %	10.2 %	2.9 %	4.0 %	3.5 %
EMS	35 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
ESO	40 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Elia	93 MW	30.2 %	30.1 %	30.1 %	30.1 %	32.2 %	34.6 %	32.8 %	30.9 %	30.6 %	30.1 %	32.9 %	32.6 %
Energinet (CE)	25 MW	12.8 %	12.6 %	9.1 %	16.0 %	14.2 %	15.2 %	12.2 %	11.5 %	12.5 %	8.0 %	6.4 %	9.3 %
HOPS	17 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
IPTO	53 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
KOSTT	3 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
MAVIR	40 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
MEPSO	6 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Moldelectrica	5 MW	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
NOS BiH	13 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
OST	7 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
PSE	177 MW	100.6 %	100.0 %	101.1 %	100.0 %	100.0 %	101.7 %	99.4 %	100.6 %	100.6 %	100.0 %	99.4 %	100.6 %
REN	51 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
RTE	486 MW	129.8 %	129.8 %	129.8 %	129.8 %	129.8 %	129.9 %	128.2 %	128.2 %	128.0 %	125.9 %	119.0 %	118.9 %
Red Eléctrica	299 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
SEPS	28 MW	103.5 %	103.0 %	103.6 %	99.6 %	103.2 %	103.4 %	105.5 %	102.6 %	95.6 %	103.8 %	105.7 %	101.7 %
Swissgrid	62 MW	98.4 %	75.8 %	69.4 %	103.2 %	140.3 %	183.9 %	193.5 %	172.6 %	166.1 %	114.5 %	129.0 %	100.0 %
TEIAS	343 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
TenneT DE	172 MW	88.8 %	101.9 %	102.5 %	84.8 %	94.0 %	92.2 %	88.4 %	92.9 %	97.0 %	100.7 %	100.6 %	102.4 %
TenneT NL	110 MW	52.8 %	63.6 %	66.0 %	62.8 %	63.0 %	55.3 %	48.5 %	49.2 %	45.9 %	45.8 %	45.6 %	52.3 %
Terna	310 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Transelectrica	57 MW	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
TransnetBW	72 MW	12.7 %	4.9 %	4.2 %	8.9 %	11.0 %	9.2 %	10.2 %	8.8 %	9.5 %	10.0 %	8.5 %	9.6 %
Ukrenergo	99 MW	34.7 %	45.6 %	36.1 %	15.6 %	5.1 %	7.0 %	27.8 %	23.6 %	30.3 %	51.1 %	67.6 %	49.4 %

Table 10 FCR statistics for each TSO in Continental Europe for 2024

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Nordic

2023													
Name	Initial obligation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energinet (Nordic)	44 MW	97.7 %	100.0 %	100.0 %	100.0 %	97.7 %	97.7 %	97.7 %	97.7 %	100.0 %	97.7 %	100.0 %	100.0 %
Fingrid	290 MW	98.6 %	98.6 %	98.3 %	97.9 %	81.4 %	97.9 %	96.9 %	96.6 %	97.2 %	100.0 %	99.3 %	99.3 %
Statnett	553 MW	157.3 %	160.6 %	154.2 %	151.0 %	140.1 %	145.9 %	148.8 %	135.6 %	142.0 %	134.2 %	146.5 %	153.0 %
Svenska kraftnät	554 MW	99.1 %	97.8 %	97.3 %	104.2 %	108.3 %	99.8 %	53.1 %	62.8 %	107.2 %	114.1 %	96.9 %	98.6 %

Table 11 FCR statistics for each TSO in the Nordics for 2023

2024													
Name	Initial obligation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energinet (Nordic)	42 MW	102.2 %	103.4 %	103.4 %	101.5 %	95.7 %	103.4 %	103.4 %	103.4 %	102.9 %	103.0 %	103.4 %	103.4 %
Fingrid	284 MW	101.8 %	102.3 %	102.8 %	100.4 %	87.0 %	89.3 %	100.3 %	101.5 %	101.6 %	102.1 %	102.7 %	104.0 %
Statnett	527 MW	160.6 %	162.4 %	168.9 %	162.1 %	140.2 %	145.9 %	171.2 %	157.5 %	149.6 %	158.6 %	152.1 %	165.0 %
Svenska kraftnät	547 MW	96.7 %	97.6 %	96.3 %	94.0 %	101.6 %	109.6 %	110.8 %	111.6 %	108.0 %	105.4 %	104.3 %	114.6 %

Table 12 FCR statistics for each TSO in the Nordics for 2024

Ireland/Northern Ireland

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	282	302	311	300	326	323	312	296	307	327	304	262
FCR obtained inside the area of TSO [%]	33.0 %	31.5 %	29.9 %	31.0 %	27.9 %	28.2 %	29.8 %	31.4 %	30.0 %	28.4 %	30.9 %	35.9 %

Table 13 FCR statistics for each TSO in Ireland/Northern Ireland for Year 2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Monthly FCR [MW]	408	407	400	428	446	445	449	434	430	421	435	402
FCR obtained inside the area of TSO [%]	118.9 %	120.9 %	122.0 %	111.8 %	109.8 %	110.8 %	107.3 %	116.3 %	114.8 %	125.3 %	119.4 %	144.9 %

Table 14 FCR statistics for each TSO in Ireland/Northern Ireland for 2024

GLOSSARY

Abbreviation	Meaning
AGC	Automatic Generation Control
CE	Continental Europe
CE SA	Continental Europe Synchronous Area
EMS	Energy Management System
FCP	Frequency Containment Process
FCR	Frequency Containment Reserve
FRCE	Frequency Restoration Control Error
FRP	Frequency Restoration Process
FRR	Frequency Restoration Reserves
IE/Ni	Ireland and Northern Ireland
LF-Controller	Load-Frequency Controller
LFC	Load-Frequency Control
PGM	Power-Generating Module
SCADA	Supervisory Control And Data Acquisition
SOC	System Operations Committee
TO	Transmission owner
TSO	Transmission System Operator
aFRR	Automatic Frequency Restoration Reserves
mFRR	Manual Frequency Restoration Reserves

Table 15 Abbreviations

APPENDIX I – SYNCHRONOUS AREA DATA

Continental Europe

2023

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00022	50.00002	50.00061	50.00079	49.99974	50.00020	49.99997	50.00016	50.00079	50.00030	49.99986	50.00013	50.00023
The standard deviation	0.0206	0.0212	0.0253	0.0252	0.0224	0.0210	0.0208	0.0212	0.0228	0.0222	0.0216	0.0208	0.0221
1-percentile	49.949	49.947	49.936	49.937	49.945	49.948	49.946	49.945	49.944	49.944	49.946	49.946	49.944
5-percentile	49.967	49.965	49.959	49.960	49.964	49.967	49.967	49.965	49.964	49.964	49.965	49.966	49.964
10-percentile	49.975	49.974	49.970	49.971	49.972	49.975	49.975	49.974	49.973	49.973	49.973	49.975	49.973
90-percentile	50.026	50.025	50.030	50.030	50.027	50.025	50.025	50.025	50.028	50.027	50.026	50.025	50.027
95-percentile	50.034	50.032	50.040	50.041	50.035	50.033	50.032	50.033	50.037	50.035	50.033	50.032	50.035
99-percentile	50.050	50.049	50.063	50.066	50.056	50.051	50.050	50.052	50.060	50.054	50.050	50.049	50.054
Time(min) > 50 mHz	414	340	1099	1164	678	455	429	505	803	574	412	377	7249
Time(min) < -50 mHz	456	530	1173	1032	658	493	579	639	692	698	592	598	8140
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	3	5	1	1	0	2	1	1	0	0	14
No. of events freq. deviation < -100 mHz and not < -25 mHz	0	0	4	1	0	1	0	0	2	1	2	0	11

Table 19 CE SA Performance for Year 2023

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2024

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00060	50.00016	50.00086	50.00032	49.99994	50.00027	50.00020	50.00065	50.00012	49.99994	50.00009	50.00005	50.00027
The standard deviation	0.0222	0.0218	0.0228	0.0249	0.0235	0.0215	0.0221	0.0202	0.0220	0.0220	0.0207	0.0191	0.0219
1-percentile	49.943	49.945	49.944	49.937	49.942	49.945	49.943	49.950	49.945	49.943	49.945	49.949	49.944
5-percentile	49.965	49.964	49.964	49.960	49.963	49.965	49.965	49.968	49.964	49.964	49.966	49.969	49.965
10-percentile	49.974	49.973	49.973	49.970	49.972	49.974	49.973	49.976	49.973	49.973	49.975	49.977	49.974
90-percentile	50.027	50.026	50.028	50.030	50.029	50.026	50.026	50.025	50.027	50.026	50.025	50.023	50.027
95-percentile	50.035	50.034	50.037	50.041	50.038	50.034	50.034	50.032	50.035	50.034	50.031	50.029	50.035
99-percentile	50.055	50.051	50.057	50.062	50.058	50.052	50.053	50.049	50.052	50.052	50.046	50.044	50.053
Time(min) > 50 mHz	633	437	730	1051	825	483	555	387	514	518	265	256	6653
Time(min) < -50 mHz	713	622	688	1036	788	591	708	424	635	736	608	470	8018
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	3	1	1	0	0	0	0	1	0	0	6
No.of events freq.deviation < -100 mHz and not < -25 mHz	0	0	0	0	1	0	1	0	0	0	0	0	2

Table 20 CE SA Performance for Year 2024

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Ireland/Northern Ireland

2023

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00040	50.00030	49.99960	49.99980	50.00050	50.00020	49.99960	50.00050	50.00010	50.00010	50.00030	49.99970	50.00009
The standard deviation	0.0439	0.0425	0.0433	0.0420	0.0400	0.0420	0.0429	0.0431	0.0417	0.0412	0.0433	0.0415	0.0423
1-percentile	49.903	49.907	49.905	49.907	49.913	49.905	49.904	49.904	49.907	49.908	49.903	49.908	49.906
5-percentile	49.931	49.932	49.930	49.932	49.936	49.932	49.930	49.931	49.934	49.934	49.931	49.934	49.932
10-percentile	49.944	49.946	49.945	49.946	49.949	49.945	49.945	49.945	49.947	49.948	49.945	49.948	49.946
90-percentile	50.057	50.056	50.056	50.054	50.052	50.053	50.055	50.056	50.055	50.052	50.057	50.054	50.055
95-percentile	50.072	50.071	50.072	50.067	50.065	50.067	50.070	50.071	50.069	50.067	50.071	50.069	50.069
99-percentile	50.100	50.097	50.099	50.094	50.090	50.093	50.097	50.096	50.097	50.095	50.096	50.097	50.096
Time(min) > 200 mHz	0	0	0	0	0	0	0	0	0	0	0	0	0
Time(min) < -200 mHz	0	0	0	0	0	2	0	0	1	0	0	0	4
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 21 IE/Ni SA Performance for Year 2023

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2024

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	49.99966	49.99993	49.99981	50.00040	49.99979	50.00008	50.00047	50.00024	49.99970	50.00033	49.99981	49.99993	50.00001
The standard deviation	0.0409	0.0438	0.0427	0.0406	0.0408	0.0399	0.0408	0.0416	0.0409	0.0425	0.0398	0.0425	0.0414
1-percentile	49.910	49.906	49.905	49.907	49.907	49.909	49.910	49.914	49.911	49.908	49.911	49.910	49.909
5-percentile	49.933	49.932	49.932	49.936	49.934	49.935	49.936	49.936	49.935	49.932	49.936	49.934	49.934
10-percentile	49.947	49.945	49.946	49.949	49.948	49.949	49.949	49.948	49.948	49.946	49.949	49.946	49.948
90-percentile	50.052	50.057	50.055	50.052	50.050	50.049	50.052	50.055	50.053	50.055	50.050	50.056	50.053
95-percentile	50.067	50.073	50.070	50.067	50.063	50.063	50.065	50.070	50.067	50.069	50.064	50.070	50.067
99-percentile	50.092	50.100	50.098	50.095	50.090	50.090	50.092	50.097	50.093	50.096	50.089	50.095	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	4	10	3	1	0	6	0	5	4	33
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 22 IE/NI SA Performance for Year 2024

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Nordic

2023

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00006	50.00006	50.00004	49.99998	49.99991	50.00011	50.00007	50.00001	49.99985	49.99993	50.00004	49.99998	50.00000
The standard deviation	0.0401	0.0395	0.0402	0.0422	0.0441	0.0415	0.0376	0.0400	0.0428	0.0392	0.0388	0.0368	0.0402
1-percentile	49.904	49.904	49.901	49.900	49.893	49.900	49.912	49.902	49.901	49.905	49.905	49.910	49.903
5-percentile	49.936	49.937	49.934	49.932	49.928	49.933	49.940	49.935	49.932	49.937	49.939	49.942	49.935
10-percentile	49.951	49.952	49.950	49.948	49.945	49.949	49.953	49.951	49.947	49.951	49.953	49.956	49.951
90-percentile	50.050	50.050	50.050	50.053	50.056	50.052	50.047	50.050	50.054	50.049	50.047	50.045	50.050
95-percentile	50.067	50.066	50.067	50.071	50.073	50.068	50.062	50.066	50.071	50.065	50.063	50.061	50.067
99-percentile	50.101	50.097	50.099	50.106	50.106	50.101	50.094	50.096	50.108	50.096	50.102	50.095	50.100
Time(min) > 100 mHz	455	318	410	576	606	443	302	344	595	349	462	346	5206
Time(min) < -100 mHz	352	330	412	413	613	429	211	404	402	338	329	275	4508
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	16	0	0	16	0	43	0	44	0	119
No.of events freq.deviation < -200 mHz and < -100 mHz within 15 minutes	0	0	0	0	0	0	0	25	0	0	0	0	25

Table 23 Nordic SA Performance for Year 2023

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2024													
Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	49.99997	50.00008	50.00018	49.99988	49.99985	50.00018	49.99986	49.99993	50.00020	49.99984	50.00010	50.00014	50.00002
The standard deviation	0.0394	0.0398	0.0391	0.0441	0.0443	0.0439	0.0375	0.0412	0.0399	0.0377	0.0363	0.0343	0.0398
1-percentile	49.905	49.905	49.906	49.889	49.892	49.894	49.910	49.898	49.905	49.905	49.910	49.916	49.903
5-percentile	49.937	49.936	49.937	49.929	49.928	49.929	49.940	49.934	49.938	49.939	49.943	49.946	49.936
10-percentile	49.952	49.951	49.952	49.947	49.945	49.946	49.954	49.950	49.953	49.954	49.957	49.959	49.952
90-percentile	50.049	50.049	50.049	50.054	50.055	50.055	50.046	50.051	50.050	50.046	50.045	50.042	50.049
95-percentile	50.065	50.065	50.065	50.073	50.073	50.072	50.062	50.069	50.068	50.062	50.061	50.057	50.066
99-percentile	50.099	50.102	50.098	50.112	50.108	50.107	50.096	50.105	50.106	50.096	50.095	50.092	50.101
Time(min) > 100 mHz	125	99	84	232	229	121	38	83	179	139	109	75	1513
Time(min) < -100 mHz	21	25	16	104	133	112	0	77	18	40	41	18	605
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	23	24	0	0	16	0	0	19	16	0	0	0	98
No.of events freq.deviation < -200 mHz and< -100 mHz within 15 minutes	0	0	0	42	19	0	0	18	0	0	0	0	79

Table 24 Nordic SA Performance for Year 2024

APPENDIX II – BLOCK DATA

Continental Europe

AK

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-25.4	-23.6	-19.4	-4.5	5.5	4.7	-3.9	3.3	1.2	-21.3	-0.9	-27.3	-9.3
The standard deviation	69	57	59	43	37	41	36	39	31	45	66	75	50
1-percentile	-181	-212	-185	-112	-95	-175	-90	-96	-118	-132	-161	-291	-154
5-percentile	-130	-117	-144	-70	-61	-53	-54	-52	-45	-97	-104	-154	-90
10-percentile	-102	-95	-102	-57	-42	-23	-34	-31	-29	-79	-78	-109	-65
90-percentile	48	39	45	46	51	41	38	40	37	29	84	55	46
95-percentile	95	59	66	71	69	61	62	81	53	51	120	87	73
99-percentile	216	105	100	121	114	117	111	158	97	104	175	144	130
Number of time intervals: average FRCE > Level 1 positive	388	322	420	623	559	438	343	382	372	303	725	528	5403
Number of time intervals: average FRCE < Level 1 negative	1418	1010	960	767	398	238	320	292	357	1067	857	1181	8865
Number of time intervals: average FRCE > Level 2 positive	254	133	193	293	204	150	162	207	122	115	466	264	2563
Number of time intervals: average FRCE < Level 2 negative	820	581	593	383	154	137	113	109	123	567	484	747	4811
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

Table 27 LFC Block Performance for Block AK for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	35.9	20.3	14.8	22.6	20.0	6.9	6.2	8.6	15.5	4.8	7.8	10.2	12.8
The standard deviation	36	21	24	33	18	22	14	20	18	22	25	29	23
1-percentile	-32	-20	-29	-28	-18	-41	-20	-43	-10	-29	-37	-73	-32
5-percentile	-16	-12	-25	-28	-5	-24	-16	-18	-5	-19	-23	-66	-22
10-percentile	-6	-7	-19	-11	1	-20	-14	-16	0	-12	-17	-42	-14
90-percentile	73	45	48	73	44	31	20	28	37	29	53	25	42
95-percentile	87	52	55	75	56	33	25	36	41	40	56	35	49
99-percentile	131	58	61	76	59	54	38	54	63	71	64	41	64
Number of time intervals: average FRCE > Level 1 positive	1428	999	949	1122	1046	671	504	635	768	569	769	625	10085
Number of time intervals: average FRCE < Level 1 negative	360	254	405	367	243	453	292	262	276	426	536	905	4779
Number of time intervals: average FRCE > Level 2 positive	1020	550	576	722	579	347	208	274	420	319	463	351	5829
Number of time intervals: average FRCE < Level 2 negative	112	119	180	160	151	204	95	140	97	203	295	561	2317
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	2345	1769	3145	3273	2167	3974	2211	3033	2709	3963	5765	9807	44161
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	17838	10448	9760	12899	10881	5982	4263	6732	8644	6131	8678	6334	108590

Table 28 LFC Block Performance for Block AK for Year 2024

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APG

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.2	0.4	0.3	0.6	0.9	0.2	0.2	0.6	0.3	0.4	0.3	0.4	0.4
The standard deviation	21	24	26	30	31	22	25	27	21	25	27	21	25
1-percentile	-67	-74	-78	-84	-87	-72	-78	-81	-68	-81	-83	-62	-76
5-percentile	-33	-36	-39	-41	-41	-35	-38	-40	-33	-37	-37	-32	-37
10-percentile	-20	-22	-23	-25	-24	-22	-23	-24	-19	-21	-21	-20	-22
90-percentile	20	23	24	25	26	22	23	24	19	22	21	20	22
95-percentile	32	36	39	42	43	35	39	40	33	37	36	31	37
99-percentile	60	73	74	85	101	68	78	85	69	78	79	58	76
Number of time intervals: average FRCE > Level 1 positive	0	4	1	4	13	0	1	7	0	2	2	5	39
Number of time intervals: average FRCE < Level 1 negative	1	0	2	1	3	0	1	0	0	1	5	2	16
Number of time intervals: average FRCE > Level 2 positive	0	0	1	3	11	0	1	2	0	0	2	0	20
Number of time intervals: average FRCE < Level 2 negative	0	0	0	0	3	0	1	0	0	0	0	2	6
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	0	0	1	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	1	1	2	0	0	1	1	0	1	0	7

Table 29 LFC Block Performance for Block APG for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.2	0.2	0.2	0.1	0.5	0.5	0.4	0.2	0.2	0.0	-0.4	-0.1	0.2
The standard deviation	26	25	30	31	35	33	32	38	37	34	22	23	31
1-percentile	-85	-82	-91	-95	-102	-98	-94	-115	-110	-105	-71	-77	-94
5-percentile	-41	-39	-47	-51	-53	-49	-51	-63	-60	-56	-34	-37	-48
10-percentile	-23	-23	-28	-31	-31	-29	-34	-40	-39	-35	-20	-22	-30
90-percentile	24	24	29	31	32	30	33	40	38	34	19	22	30
95-percentile	40	40	47	50	53	49	51	61	59	55	31	35	48
99-percentile	82	78	92	96	107	102	94	108	112	106	61	66	92
Number of time intervals: average FRCE > Level 1 positive	1	0	5	0	4	8	2	2	6	0	0	2	30
Number of time intervals: average FRCE < Level 1 negative	0	0	4	1	0	3	0	1	2	0	4	2	17
Number of time intervals: average FRCE > Level 2 positive	0	0	2	0	3	5	2	0	2	0	0	1	15
Number of time intervals: average FRCE < Level 2 negative	0	0	0	0	0	1	0	0	0	0	4	0	5
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	1	0	1	0	1	1	1	0	0	0	0	0	5
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 30 LFC Block Performance for Block APG for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

CEPS

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.0	0.0	0.0	-0.5	0.1	0.0	-0.3	-0.8	-0.2	0.2	0.1	0.1	-0.1
The standard deviation	38	39	38	37	32	32	36	35	35	36	32	33	35
1-percentile	-109	-121	-107	-108	-90	-87	-91	-97	-91	-98	-86	-87	-98
5-percentile	-56	-58	-57	-54	-49	-47	-49	-48	-49	-52	-48	-49	-51
10-percentile	-39	-39	-40	-37	-35	-34	-35	-34	-36	-38	-35	-36	-37
90-percentile	39	39	40	37	35	35	35	34	36	38	35	36	37
95-percentile	56	57	57	53	49	48	49	47	49	54	48	49	51
99-percentile	109	116	111	105	89	84	91	88	88	101	88	88	97
Number of time intervals: average FRCE > Level 1 positive	2	1	3	0	0	1	1	2	1	1	1	0	13
Number of time intervals: average FRCE < Level 1 negative	1	1	2	7	0	4	3	14	5	6	2	1	46
Number of time intervals: average FRCE > Level 2 positive	0	0	1	0	0	0	1	0	1	0	0	0	3
Number of time intervals: average FRCE < Level 2 negative	1	0	0	3	0	1	2	5	2	2	1	0	17
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

Table 31 LFC Block Performance for Block CEPS for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.0	-0.2	-0.1	-0.5	-0.9	0.2	0.1	0.1	0.1	0.0	0.0	0.1	-0.1
The standard deviation	28	27	29	32	30	38	32	35	38	37	33	33	33
1-percentile	-87	-89	-93	-100	-91	-96	-85	-94	-101	-101	-89	-87	-93
5-percentile	-38	-38	-44	-50	-45	-57	-49	-55	-60	-60	-52	-50	-50
10-percentile	-21	-22	-27	-32	-29	-41	-35	-39	-42	-42	-37	-36	-34
90-percentile	22	22	27	31	27	42	35	40	42	42	38	37	34
95-percentile	38	38	45	48	44	58	49	56	59	60	54	52	50
99-percentile	85	84	91	93	89	98	84	96	100	99	93	91	92
Number of time intervals: average FRCE > Level 1 positive	3	0	1	3	2	3	1	2	3	0	0	1	19
Number of time intervals: average FRCE < Level 1 negative	6	2	4	3	3	5	0	0	1	0	0	1	25
Number of time intervals: average FRCE > Level 2 positive	1	0	1	0	1	0	0	0	1	0	0	1	5
Number of time intervals: average FRCE < Level 2 negative	2	0	0	1	0	1	1	0	0	0	0	0	5
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	0	0	0	0	0	0	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

Table 32 LFC Block Performance for Block CEPS for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

ELIA

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-6.1	-5.2	-7.5	-2.6	-3.2	-3.4	5.8	0.0	0.5	0.9	1.0	2.6	-1.4
The standard deviation	44	44	52	49	41	38	41	35	39	42	35	34	41
1-percentile	-180	-158	-218	-176	-158	-143	-128	-125	-145	-167	-113	-119	-153
5-percentile	-78	-80	-93	-79	-72	-57	-48	-52	-61	-63	-52	-45	-65
10-percentile	-44	-49	-55	-48	-42	-38	-27	-30	-34	-37	-30	-24	-38
90-percentile	29	35	37	39	32	29	44	33	37	42	37	35	36
95-percentile	46	53	53	59	53	45	65	49	55	62	51	48	53
99-percentile	91	100	101	136	93	90	114	92	96	108	95	81	100
Number of time intervals: average FRCE > Level 1 positive	23	34	33	61	40	32	79	40	41	64	39	22	508
Number of time intervals: average FRCE < Level 1 negative	104	95	139	99	114	82	67	67	91	98	63	59	1078
Number of time intervals: average FRCE > Level 2 positive	5	2	3	18	3	7	18	6	6	5	1	2	76
Number of time intervals: average FRCE < Level 2 negative	28	19	45	26	29	23	19	16	22	30	13	16	286
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	0	1	4	2	3	2	1	1	0	0	0	17

Table 33 LFC Block Performance for Block ELIA for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-7.8	-9.2	-11.2	-9.7	-18.9	-13.8	12.5	12.1	-16.4	-22.5	19.2	-8.1	-13.5
The standard deviation	40	35	50	54	45	55	43	45	49	39	40	24	43
1-percentile	-156	-127	-193	-165	-155	-198	172	184	-175	-164	167	-71	-160
5-percentile	-66	-59	-81	-76	-80	-90	-75	-71	-84	-86	-88	-40	-75
10-percentile	-42	-41	-51	-50	-58	-58	-50	-47	-55	-61	-56	-30	-50
90-percentile	30	25	31	32	19	27	24	25	25	14	16	17	24
95-percentile	43	39	51	52	39	47	42	40	46	29	29	32	41
99-percentile	95	73	111	123	121	121	92	89	89	57	68	54	91
Number of time intervals: average FRCE > Level 1 positive	39	17	65	61	62	61	45	36	39	14	14	5	458
Number of time intervals: average FRCE < Level 1 negative	110	79	146	123	147	180	123	129	153	167	166	21	1544
Number of time intervals: average FRCE > Level 2 positive	8	2	18	18	15	16	11	6	10	2	1	0	107
Number of time intervals: average FRCE < Level 2 negative	24	17	41	30	31	53	37	41	43	36	37	5	395
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	0	0	0	8	5	0	0	0	0	0	13
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	1	0	2	7	10	1	0	0	1	1	0	0	23

Table 34 LFC Block Performance for Block ELIA for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

ESO

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	17.8	2.5	12.3	37.8	20.7	-0.4	3.6	-2.1	12.8	1.6	1.1	5.3	9.4
The standard deviation	106	72	107	144	85	51	64	80	72	81	85	78	85
1-percentile	-193	-207	-222	-181	-151	-154	-204	-264	-199	-249	-271	-232	-211
5-percentile	-105	-110	-130	-112	-80	-84	-97	-151	-94	-136	-137	-118	-113
10-percentile	-66	-74	-90	-75	-51	-55	-63	-87	-61	-86	-90	-78	-73
90-percentile	105	82	117	143	93	54	70	83	98	89	91	94	93
95-percentile	184	116	171	291	148	78	109	120	141	131	145	136	147
99-percentile	473	230	380	754	386	149	190	205	223	213	233	221	305
Number of time intervals: average FRCE > Level 1 positive	466	363	604	691	548	271	411	466	575	540	509	572	6016
Number of time intervals: average FRCE < Level 1 negative	315	321	491	344	264	283	345	462	318	469	467	436	4515
Number of time intervals: average FRCE > Level 2 positive	255	129	294	369	246	80	163	193	251	223	237	246	2686
Number of time intervals: average FRCE < Level 2 negative	115	116	191	124	82	92	126	228	116	232	227	183	1832
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	56	58	104	79	55	23	52	70	87	82	93	88	847
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	16	15	26	16	11	4	20	33	13	30	36	26	246

Table 35 LFC Block Performance for Block ESO for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	10.1	33.0	22.7	16.6	2.6	-0.9	3.4	-4.9	4.4	1.0	-4.3	-1.0	6.9
The standard deviation	83	108	83	82	61	56	61	52	48	47	41	40	64
1-percentile	-219	-155	-149	-172	-154	-174	-158	-179	-124	-150	-142	-137	-159
5-percentile	-112	-78	-74	-93	-83	-84	-88	-85	-65	-71	-79	-62	-81
10-percentile	-73	-50	-51	-58	-57	-55	-60	-59	-37	-40	-48	-34	-52
90-percentile	107	123	110	110	63	57	76	49	57	44	32	34	72
95-percentile	157	244	181	170	94	87	109	78	88	70	55	60	116
99-percentile	253	488	343	332	228	170	185	136	176	149	117	127	225
Number of time intervals: average FRCE > Level 1 positive	646	666	654	619	371	327	488	271	307	234	154	179	4916
Number of time intervals: average FRCE < Level 1 negative	436	256	283	331	334	305	362	341	198	219	260	182	3507
Number of time intervals: average FRCE > Level 2 positive	327	372	334	335	132	102	172	80	100	83	43	59	2139
Number of time intervals: average FRCE < Level 2 negative	182	83	80	121	104	108	115	107	59	81	89	68	1197
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	101	81	89	79	33	28	44	22	31	23	16	15	562
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	24	7	7	8	4	7	6	9	1	3	0	3	79

Table 36 LFC Block Performance for Block ESO for Year 2024

Final | 30 September 2025

Germany

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	37.0	39.0	18.0	21.0	17.0	15.0	10.0	-2.0	2.0	9.0	9.0	1.0	14.7
The standard deviation	88	122	98	98	81	119	85	78	83	84	79	83	92
1-percentile	-215	-255	-237	-226	-187	-246	-196	-215	-230	-250	-188	-227	-223
5-percentile	-83	-99	-121	-111	-90	-127	-105	-107	-124	-107	-90	-112	-106
10-percentile	-48	-57	-81	-76	-59	-81	-72	-74	-84	-71	-63	-77	-70
90-percentile	130	150	127	138	104	104	102	74	91	96	84	80	107
95-percentile	179	214	185	194	157	164	162	118	139	142	129	120	159
99-percentile	298	488	329	320	281	551	287	259	259	274	231	234	318
Number of time intervals: average FRCE > Level 1 positive	87	129	89	112	57	98	75	41	45	49	35	34	851
Number of time intervals: average FRCE < Level 1 negative	28	30	35	30	17	41	21	24	31	43	16	29	345
Number of time intervals: average FRCE > Level 2 positive	2	35	8	15	6	46	5	5	2	3	4	3	134
Number of time intervals: average FRCE < Level 2 negative	7	7	5	1	2	1	1	4	3	2	1	7	41
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	3	2	1	1	2	1	6	1	0	2	1	0	20
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	3	2	1	2	1	0	2	0	0	2	2	2	17

Table 37 LFC Block Performance for Block Germany for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	2.9	10.0	20.8	11.6	19.1	6.5	1.1	10.4	10.1	13.4	15.6	5.0	10.5
The standard deviation	88	83	120	96	107	98	81	88	80	69	61	57	86
1-percentile	-249	-231	-261	-264	-216	-255	-221	-239	-212	-172	-129	-124	-214
5-percentile	-135	-111	-126	-118	-109	-119	-113	-103	-101	-61	-78	-81	-104
10-percentile	-86	-70	-81	-78	-67	-74	-78	-63	-60	-34	-55	-61	-67
90-percentile	93	95	125	117	107	88	82	98	87	81	93	76	95
95-percentile	137	139	203	180	156	147	129	155	138	108	108	99	142
99-percentile	249	239	382	300	400	362	257	288	251	229	184	170	276
Number of time intervals: average FRCE > Level 1 positive	48	53	150	107	83	97	62	84	60	41	14	19	818
Number of time intervals: average FRCE < Level 1 negative	57	41	55	59	34	47	35	44	31	18	3	3	427
Number of time intervals: average FRCE > Level 2 positive	7	6	28	10	30	24	9	11	9	5	0	2	141
Number of time intervals: average FRCE < Level 2 negative	4	6	5	10	4	11	2	11	3	6	0	0	62
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	0	0	1	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

Table 38 LFC Block Performance for Block Germany for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

IPTO

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	38.7	24.9	37.3	20.9	26.2	6.0	6.4	6.1	13.4	5.8	27.4	17.9	19.3
The standard deviation	80	68	92	61	58	36	28	36	37	30	56	52	53
1-percentile	-71	-109	-135	-99	-50	-67	-51	-57	-46	-69	-49	-62	-72
5-percentile	-38	-45	-57	-42	-25	-34	-27	-28	-21	-27	-22	-27	-33
10-percentile	-24	-27	-32	-27	-14	-21	-18	-18	-13	-18	-12	-16	-20
90-percentile	140	105	151	92	87	32	31	31	46	30	122	65	78
95-percentile	201	164	218	141	136	56	52	58	86	47	122	113	116
99-percentile	331	287	378	268	257	177	123	163	169	128	232	247	230
Number of time intervals: average FRCE > Level 1 positive	624	399	653	367	417	122	98	128	195	97	506	292	3898
Number of time intervals: average FRCE < Level 1 negative	28	61	114	50	20	31	17	25	11	32	13	27	429
Number of time intervals: average FRCE > Level 2 positive	307	179	351	154	169	54	28	47	74	32	116	123	1634
Number of time intervals: average FRCE < Level 2 negative	2	14	29	14	0	7	2	9	4	4	3	7	95
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	87	77	134	70	69	20	11	15	23	18	42	37	603
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

Table 39 LFC Block Performance for Block IPTO for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	14.6	14.5	16.9	20.1	10.2	5.0	2.2	1.5	7.5	11.1	6.2	5.8	9.7
The standard deviation	46	51	61	90	54	30	31	31	42	39	34	31	45
1-percentile	-62	-53	-46	-56	-56	-63	-66	-84	-80	-67	-66	-67	-64
5-percentile	-27	-25	-22	-29	-27	-31	-34	-37	-38	-28	-31	-35	-30
10-percentile	-16	-16	-14	-20	-17	-21	-22	-24	-25	-17	-21	-20	-19
90-percentile	53	45	50	51	34	29	24	24	38	47	34	34	39
95-percentile	93	84	109	124	59	47	38	41	71	80	56	56	71
99-percentile	228	252	279	523	215	115	102	110	179	168	127	118	201
Number of time intervals: average FRCE > Level 1 positive	250	200	254	259	138	102	73	77	172	215	124	131	1995
Number of time intervals: average FRCE < Level 1 negative	32	17	10	24	19	33	36	58	56	39	36	39	399
Number of time intervals: average FRCE > Level 2 positive	105	110	138	156	67	27	27	27	72	78	39	34	880
Number of time intervals: average FRCE < Level 2 negative	12	3	3	8	3	7	7	14	11	10	7	9	94
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	26	32	53	25	19	11	7	7	24	22	6	10	242
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	1	1	0	0	0	0	0	0	0	0	2

Table 40 LFC Block Performance for Block IPTO for Year 2024

MAVIR

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1.0	1.8	1.3	1.3	1.0	0.8	0.9	0.4	0.9	0.7	0.3	0.2	0.9
The standard deviation	15	21	24	17	17	20	21	17	16	16	15	15	18
1-percentile	-44	-55	-63	-48	-49	-54	-53	-52	-49	-53	-42	-43	-50
5-percentile	-25	-27	-33	-27	-25	-30	-29	-28	-24	-25	-26	-26	-27
10-percentile	-17	-17	-22	-16	-17	-20	-19	-18	-15	-16	-16	-16	-18
90-percentile	17	19	22	19	17	19	19	17	16	17	16	16	18
95-percentile	26	28	36	27	26	30	27	25	24	25	23	23	27
99-percentile	44	60	68	52	54	59	61	48	47	49	43	40	52
Number of time intervals: average FRCE > Level 1 positive	7	20	35	15	25	31	37	13	11	16	8	10	228
Number of time intervals: average FRCE < Level 1 negative	4	16	28	5	17	20	23	20	19	19	16	6	193
Number of time intervals: average FRCE > Level 2 positive	0	5	7	3	1	4	2	1	0	0	1	0	24
Number of time intervals: average FRCE < Level 2 negative	0	0	1	0	1	4	1	2	2	0	1	0	12
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	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

Table 41 LFC Block Performance for Block MAVIR for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.5	0.8	0.1	0.2	0.7	1.1	-0.2	0.3	0.9	0.5	-1.1	0.6	0.4
The standard deviation	17	16	20	19	19	20	17	20	15	12	21	11	17
1-percentile	-52	-48	-61	-52	-53	-52	-52	-59	-45	-41	-48	-34	-50
5-percentile	-24	-25	-30	-31	-28	-27	-26	-27	-19	-16	-18	-16	-24
10-percentile	-16	-16	-20	-20	-19	-18	-16	-16	-11	-9	-11	-10	-15
90-percentile	17	18	19	18	20	18	15	16	13	11	10	11	15
95-percentile	24	25	28	26	29	27	24	25	20	17	17	16	23
99-percentile	46	45	53	50	51	64	48	59	44	36	36	33	47
Number of time intervals: average FRCE > Level 1 positive	20	15	31	22	28	45	23	39	20	8	6	2	259
Number of time intervals: average FRCE < Level 1 negative	26	22	45	26	31	25	29	41	14	18	24	8	309
Number of time intervals: average FRCE > Level 2 positive	4	1	1	2	5	10	0	8	5	1	0	0	37
Number of time intervals: average FRCE < Level 2 negative	3	1	9	4	1	3	4	9	1	1	7	0	43
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

Table 42 LFC Block Performance for Block MAVIR for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

PSE

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.4	1.6	4.4	6.5	4.1	-1.1	4.6	-2.0	0.9	1.0	0.0	1.3	1.8
The standard deviation	46	54	67	71	70	59	70	62	66	61	50	47	60
1-percentile	-132	-137	-158	-154	-174	-182	-162	-195	-173	-181	-156	-133	-161
5-percentile	-74	-82	-92	-85	-91	-93	-96	-105	-104	-95	-86	-69	-89
10-percentile	-51	-56	-61	-58	-62	-65	-64	-74	-69	-62	-57	-47	-61
90-percentile	49	57	66	71	69	59	73	65	70	60	56	50	62
95-percentile	74	84	100	110	105	89	108	94	101	91	81	74	93
99-percentile	127	151	223	267	239	148	262	146	188	176	137	129	183
Number of time intervals: average FRCE > Level 1 positive	27	45	91	101	112	70	117	75	100	79	53	39	909
Number of time intervals: average FRCE < Level 1 negative	31	31	62	46	75	83	96	121	116	78	69	39	847
Number of time intervals: average FRCE > Level 2 positive	1	12	25	32	33	9	37	4	20	20	2	8	203
Number of time intervals: average FRCE < Level 2 negative	1	3	6	5	10	12	5	15	16	17	2	5	97
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	4	6	12	13	14	6	13	1	7	6	0	4	86
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	1	1	2	1	3	6	2	8	4	7	0	2	37

Table 43 LFC Block Performance for Block PSE for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1.0	1.9	5.2	8.5	0.6	5.2	12.2	4.8	8.6	0.2	0.2	1.2	4.1
The standard deviation	55	55	91	105	121	96	114	77	94	61	42	38	79
1-percentile	-154	-153	-174	-253	-422	-241	-246	-207	-198	-190	-120	-98	-205
5-percentile	-85	-84	-101	-115	-137	-73	-86	-83	-75	-71	-58	-52	-85
10-percentile	-53	-54	-69	-80	-89	-42	-58	-54	-48	-46	-38	-37	-56
90-percentile	55	60	76	91	90	44	72	61	61	48	39	39	61
95-percentile	84	87	113	149	143	88	140	92	100	77	62	60	99
99-percentile	154	163	293	394	363	335	506	307	375	185	122	114	276
Number of time intervals: average FRCE > Level 1 positive	77	70	154	223	224	117	187	116	129	61	35	32	1425
Number of time intervals: average FRCE < Level 1 negative	82	74	114	160	211	81	80	89	71	66	33	18	1079
Number of time intervals: average FRCE > Level 2 positive	11	16	48	84	75	63	99	52	64	24	8	7	551
Number of time intervals: average FRCE < Level 2 negative	10	9	16	38	80	41	35	27	22	26	8	3	315
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	5	5	19	33	25	24	40	19	30	10	0	5	215
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	4	1	4	13	32	21	12	10	14	9	3	1	124

Table 44 LFC Block Performance for Block PSE for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

REE

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	9.8	6.2	11.6	3.1	4.4	4.5	3.0	2.4	8.2	12.2	16.6	12.0	7.8
The standard deviation	50	44	61	56	51	50	56	51	59	60	51	50	53
1-percentile	-115	-115	-130	-148	-141	-142	-150	-138	-144	-131	-112	-123	-132
5-percentile	-62	-62	-60	-73	-67	-60	-58	-63	-68	-62	-48	-54	-62
10-percentile	-38	-40	-36	-46	-42	-38	-38	-40	-40	-36	-28	-31	-38
90-percentile	63	57	61	49	51	51	47	46	59	66	69	64	57
95-percentile	87	78	87	70	72	75	67	66	84	92	90	90	80
99-percentile	160	115	213	124	144	135	130	122	159	164	172	160	150
Number of time intervals: average FRCE > Level 1 positive	14	5	32	11	23	19	20	22	31	34	37	33	281
Number of time intervals: average FRCE < Level 1 negative	6	3	10	18	21	22	28	20	24	20	14	10	196
Number of time intervals: average FRCE > Level 2 positive	1	0	8	3	7	3	5	10	9	7	6	6	65
Number of time intervals: average FRCE < Level 2 negative	0	0	1	4	2	5	6	2	3	2	3	2	30
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	1	1	3	2	1	1	1	3	2	3	0	0	18
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	0	1	0	1	2	0	0	1	0	1	6

Table 45 LFC Block Performance for Block REE for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	15.8	20.7	19.6	19.6	11.1	11.3	7.7	2.0	5.9	3.7	0.2	-1.2	9.7
The standard deviation	53	66	63	74	67	59	61	58	66	64	48	40	60
1-percentile	-126	-142	-150	-157	-186	-133	-170	-163	-173	-206	-178	-119	-158
5-percentile	-51	-58	-53	-68	-67	-62	-75	-85	-74	-74	-61	-47	-64
10-percentile	-31	-30	-29	-36	-39	-40	-44	-54	-50	-45	-38	-32	-39
90-percentile	69	80	80	80	71	68	62	56	65	56	42	28	63
95-percentile	92	105	104	111	99	106	87	80	93	79	61	43	88
99-percentile	162	193	175	251	206	174	166	160	172	163	109	87	168
Number of time intervals: average FRCE > Level 1 positive	37	56	58	77	60	40	34	35	44	36	11	13	501
Number of time intervals: average FRCE < Level 1 negative	18	23	31	36	51	23	49	43	48	51	45	21	439
Number of time intervals: average FRCE > Level 2 positive	5	15	15	23	16	8	8	10	10	14	3	4	131
Number of time intervals: average FRCE < Level 2 negative	5	9	13	7	14	5	11	8	11	14	8	6	111
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	2	2	2	3	1	2	3	0	1	0	0	1	17
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	2	2	2	1	1	1	1	1	1	0	0	12

Table 46 LFC Block Performance for Block REE for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

REN

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	4.2	1.7	3.0	-1.1	1.2	0.3	0.3	-0.5	0.7	2.2	4.8	1.9	1.6
The standard deviation	18	16	18	31	19	17	14	18	20	24	19	18	19
1-percentile	-24	-38	-34	-75	-48	-52	-48	-61	-65	-69	-23	-51	-49
5-percentile	-12	-14	-13	-22	-17	-18	-17	-21	-23	-26	-11	-16	-17
10-percentile	-8	-9	-9	-11	-10	-10	-9	-11	-12	-12	-7	-9	-10
90-percentile	18	14	15	11	12	11	9	10	15	17	18	15	14
95-percentile	33	24	27	21	22	19	17	17	26	37	34	26	25
99-percentile	80	61	71	60	74	56	44	47	63	93	87	66	67
Number of time intervals: average FRCE > Level 1 positive	37	16	24	22	38	18	11	13	28	85	61	35	388
Number of time intervals: average FRCE < Level 1 negative	4	6	2	29	19	22	12	26	30	40	5	17	212
Number of time intervals: average FRCE > Level 2 positive	5	0	4	3	8	6	2	2	4	10	9	6	59
Number of time intervals: average FRCE < Level 2 negative	0	2	0	8	4	3	2	4	6	5	2	4	40
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	25	3	12	8	7	8	8	13	17	18	19	15	153
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	2	4	2	9	18	2	3	3	5	9	0	6	63

Table 47 LFC Block Performance for Block REN for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	3.6	0.8	5.5	4.1	1.6	-0.8	-1.0	-1.4	-0.7	0.7	-0.6	-0.6	0.9
The standard deviation	31	34	20	24	23	28	19	17	19	19	14	21	22
1-percentile	-73	-104	-26	-32	-71	-97	-72	-76	-54	-54	-44	-52	-63
5-percentile	-32	-47	-12	-15	-18	-29	-21	-18	-18	-19	-18	-19	-22
10-percentile	-17	-26	-8	-9	-11	-13	-11	-11	-12	-12	-11	-13	-13
90-percentile	28	29	21	18	14	12	10	9	10	12	11	10	15
95-percentile	52	51	38	30	24	22	15	14	15	21	15	15	26
99-percentile	119	117	95	91	86	79	45	35	43	63	37	44	71
Number of time intervals: average FRCE > Level 1 positive	119	112	81	56	54	44	16	14	21	37	10	18	582
Number of time intervals: average FRCE < Level 1 negative	51	96	3	7	38	71	40	38	27	22	15	23	431
Number of time intervals: average FRCE > Level 2 positive	40	31	18	21	15	17	1	1	9	7	1	10	171
Number of time intervals: average FRCE < Level 2 negative	10	24	1	4	11	23	13	13	6	4	3	7	119
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	47	26	27	17	17	28	8	4	8	2	3	5	192
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	13	10	1	0	8	7	5	4	0	4	4	4	60

Table 48 LFC Block Performance for Block REN for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

RTE

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-10.4	-7.5	23.7	1.4	18.2	55.9	10.2	7.8	20.4	10.2	0.7	9.3	11.7
The standard deviation	141	142	259	192	175	559	174	171	227	175	160	160	211
1-percentile	-545	-528	-734	-569	-428	-477	-473	-493	-665	-478	-553	-497	-536
5-percentile	-236	-228	-337	-262	-198	-185	-209	-198	-212	-213	-212	-196	-224
10-percentile	-136	-142	-185	-154	-120	-113	-128	-136	-150	-145	-134	-128	-139
90-percentile	104	115	218	130	144	122	133	134	172	154	130	144	142
95-percentile	149	156	433	216	259	236	233	217	338	244	192	227	242
99-percentile	347	380	973	705	725	1521	650	593	866	615	546	533	705
Number of time intervals: average FRCE > Level 1 positive	63	72	289	133	183	162	177	157	236	190	133	173	1968
Number of time intervals: average FRCE < Level 1 negative	152	131	212	172	135	120	150	141	152	157	152	136	1810
Number of time intervals: average FRCE > Level 2 positive	14	17	147	60	94	93	86	69	122	84	50	60	896
Number of time intervals: average FRCE < Level 2 negative	49	40	93	60	37	41	51	56	78	50	63	50	668
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	23	24	101	44	67	42	53	48	77	63	45	62	649
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	7	4	17	10	4	2	8	4	15	3	6	6	86

Table 49 LFC Block Performance for Block RTE for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1.8	4.0	15.2	17.2	25.5	20.3	21.0	21.6	16.8	17.5	11.2	7.5	15.0
The standard deviation	163	135	156	205	181	170	155	146	186	158	126	137	160
1-percentile	-538	-451	-386	-554	-418	-422	-352	-364	-522	-434	-346	-424	-434
5-percentile	-219	-191	-171	-228	-178	-171	-163	-149	-187	-170	-154	-186	-181
10-percentile	-140	-120	-98	-140	-115	-118	-112	-101	-124	-110	-106	-124	-117
90-percentile	140	129	132	182	171	157	155	148	152	145	128	130	147
95-percentile	205	185	211	306	315	262	254	257	259	241	195	201	241
99-percentile	533	429	551	670	710	698	666	574	707	587	421	443	582
Number of time intervals: average FRCE > Level 1 positive	175	141	181	280	271	217	228	227	215	206	159	172	2472
Number of time intervals: average FRCE < Level 1 negative	193	142	127	195	139	114	114	94	148	120	91	150	1627
Number of time intervals: average FRCE > Level 2 positive	64	45	82	122	138	103	90	95	110	86	49	57	1041
Number of time intervals: average FRCE < Level 2 negative	77	37	37	68	42	39	29	30	49	44	25	48	525
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	50	29	49	82	85	66	72	76	69	74	37	45	734
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	6	4	3	11	5	3	3	1	6	5	2	3	52

Table 50 LFC Block Performance for Block RTE for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

SEPS

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.3	0.1	-0.1	1.4	1.7	-0.3	0.2	0.3	0.4	0.2	0.0	0.4	0.3
The standard deviation	12	8	8	22	17	8	7	6	8	8	7	8	10
1-percentile	-31	-23	-22	-25	-16	-21	-18	-17	-20	-20	-22	-21	-21
5-percentile	-13	-10	-10	-12	-7	-9	-9	-8	-11	-11	-11	-10	-10
10-percentile	-8	-6	-7	-8	-5	-5	-6	-5	-8	-7	-7	-7	-7
90-percentile	7	7	6	7	6	5	6	6	8	7	7	8	7
95-percentile	11	10	10	12	9	8	9	8	11	11	10	11	10
99-percentile	23	20	20	51	48	17	18	16	21	20	19	27	25
Number of time intervals: average FRCE > Level 1 positive	3	4	2	30	30	1	6	2	2	2	3	8	93
Number of time intervals: average FRCE < Level 1 negative	7	2	3	4	1	10	1	3	4	1	2	2	40
Number of time intervals: average FRCE > Level 2 positive	1	1	1	15	21	0	0	0	0	1	0	0	40
Number of time intervals: average FRCE < Level 2 negative	3	0	0	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	9	5	0	0	0	0	0	0	0	14
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

Table 51 LFC Block Performance for Block SEPS for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.1	0.4	0.3	0.6	0.1	0.2	0.2	-0.5	0.8	-0.1	-0.5	-0.2	0.1
The standard deviation	7	7	8	11	11	8	10	7	11	7	9	6	8
1-percentile	-21	-18	-21	-27	-34	-24	-27	-22	-26	-21	-32	-17	-24
5-percentile	-10	-10	-11	-11	-13	-11	-12	-11	-11	-10	-12	-8	-11
10-percentile	-7	-6	-7	-7	-9	-8	-8	-8	-7	-7	-7	-5	-7
90-percentile	7	7	7	8	9	8	8	6	9	7	6	5	7
95-percentile	9	10	10	13	13	12	12	10	14	10	10	7	11
99-percentile	16	19	20	38	34	21	33	20	43	19	21	14	25
Number of time intervals: average FRCE > Level 1 positive	0	3	9	26	18	6	15	2	27	3	1	3	113
Number of time intervals: average FRCE < Level 1 negative	2	0	3	5	10	5	6	6	5	0	14	1	57
Number of time intervals: average FRCE > Level 2 positive	0	0	0	3	2	0	3	0	3	1	0	0	12
Number of time intervals: average FRCE < Level 2 negative	1	0	0	0	0	0	0	0	0	0	4	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

Table 52 LFC Block Performance for Block SEPS for Year 2024

Final | 30 September 2025

SG

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-0.1	0.7	0.0	0.0	-0.1	0.0	-0.2	-0.3	-0.2	0.0	0.0	0.1	0.0
The standard deviation	6	23	7	6	5	10	6	6	6	6	6	6	8
1-percentile	-20	-18	-20	-20	-17	-17	-17	-19	-20	-19	-17	-17	-18
5-percentile	-11	-11	-12	-11	-10	-9	-10	-11	-11	-10	-10	-10	-11
10-percentile	-7	-7	-8	-8	-6	-6	-6	-7	-8	-7	-6	-6	-7
90-percentile	7	7	7	7	6	5	6	6	7	6	6	6	6
95-percentile	9	9	10	10	8	7	8	9	10	9	8	8	9
99-percentile	16	15	17	16	13	13	13	15	15	14	13	14	14
Number of time intervals: average FRCE > Level 1 positive	0	3	0	0	0	2	0	0	0	0	0	1	6
Number of time intervals: average FRCE < Level 1 negative	0	0	0	0	0	1	0	1	0	0	1	0	3
Number of time intervals: average FRCE > Level 2 positive	0	3	0	0	0	2	0	0	0	0	0	1	6
Number of time intervals: average FRCE < Level 2 negative	0	0	0	0	0	1	0	0	0	0	0	0	1
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	1	0	0	0	1	0	0	0	0	0	0	2
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 53 LFC Block Performance for Block SG for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	0.1	0.1	0.1	0.1	0.0	-0.2	4.0	-0.2	-0.1	-0.1	0.0	-0.1	0.3
The standard deviation	6	6	8	6	6	6	108	5	5	5	5	6	14
1-percentile	-18	-17	-17	-18	-17	-18	-19	-15	-16	-16	-14	-16	-17
5-percentile	-10	-11	-11	-11	-10	-10	-11	-9	-10	-9	-8	-9	-10
10-percentile	-7	-7	-7	-7	-6	-7	-8	-6	-7	-6	-6	-6	-7
90-percentile	6	7	7	7	6	6	7	6	6	6	5	6	6
95-percentile	9	9	10	10	9	9	10	8	9	8	7	8	9
99-percentile	14	15	17	16	15	14	20	13	14	13	12	12	15
Number of time intervals: average FRCE > Level 1 positive	0	0	2	0	0	0	12	0	0	0	0	0	14
Number of time intervals: average FRCE < Level 1 negative	0	0	0	0	0	1	1	0	0	0	0	2	4
Number of time intervals: average FRCE > Level 2 positive	0	0	2	0	0	0	6	0	0	0	0	0	8
Number of time intervals: average FRCE < Level 2 negative	0	0	0	0	0	0	0	0	0	0	0	1	1
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	0	0	0	0	2	2	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

Table 54 LFC Block Performance for Block SG for Year 2024

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SHB

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	3.6	6.6	9.2	9.1	7.4	7.3	10.3	0.2	4.9	2.0	9.0	10.9	6.7
The standard deviation	30	26	28	32	29	29	32	29	25	27	29	26	28
1-percentile	-98	-58	-80	-78	-80	-73	-87	-92	-64	-80	-93	-68	-79
5-percentile	-43	-30	-30	-32	-30	-26	-26	-43	-31	-41	-36	-27	-33
10-percentile	-27	-17	-16	-18	-16	-13	-13	-26	-19	-28	-20	-13	-19
90-percentile	35	29	37	38	36	30	38	24	28	28	38	39	33
95-percentile	50	43	52	57	52	42	54	42	44	42	50	50	48
99-percentile	86	84	88	107	94	94	113	94	87	75	79	83	90
Number of time intervals: average FRCE > Level 1 positive	51	38	65	92	106	59	118	83	71	57	86	80	906
Number of time intervals: average FRCE < Level 1 negative	53	16	45	33	48	34	50	76	33	64	60	45	557
Number of time intervals: average FRCE > Level 2 positive	7	8	3	18	15	21	29	20	8	6	11	9	155
Number of time intervals: average FRCE < Level 2 negative	4	3	6	8	10	10	12	10	5	9	9	7	93
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	3	1	0	5	5	2	2	0	0	0	0	0	18
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

Table 55 LFC Block Performance for Block SHB for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	5.8	8.2	0.4	5.8	8.7	-0.8	4.0	-2.3	5.0	3.4	-6.4	-9.8	1.8
The standard deviation	26	27	29	32	30	86	35	40	46	30	38	36	38
1-percentile	-65	-75	-88	-103	-80	-313	-85	-120	-122	-96	-132	-124	-117
5-percentile	-33	-29	-42	-39	-37	-57	-38	-61	-62	-44	-71	-72	-49
10-percentile	-18	-14	-25	-23	-20	-35	-25	-40	-41	-26	-49	-51	-31
90-percentile	31	36	24	36	40	39	31	30	55	30	28	23	34
95-percentile	43	49	40	50	56	60	48	43	79	45	43	36	49
99-percentile	90	96	91	99	102	135	122	100	147	96	84	71	103
Number of time intervals: average FRCE > Level 1 positive	101	108	87	116	164	160	128	103	288	100	81	65	1501
Number of time intervals: average FRCE < Level 1 negative	52	53	87	88	69	160	68	184	180	107	241	265	1554
Number of time intervals: average FRCE > Level 2 positive	19	18	21	26	26	46	40	27	73	17	13	7	333
Number of time intervals: average FRCE < Level 2 negative	14	6	21	28	13	68	21	47	44	22	51	54	389
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	1	3	4	2	7	6	2	9	1	1	1	37
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	0	0	0	2	0	0	0	0	0	0	2

Table 56 LFC Block Performance for Block SHB for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

SMM

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-11.2	-15.1	-0.6	-9.0	3.6	0.9	2.3	0.9	7.8	3.2	-15.6	2.4	-2.5
The standard deviation	59	48	42	56	61	52	44	31	34	34	66	68	50
1-percentile	-162	-167	-117	-148	-97	-218	-91	-83	-72	-76	-301	-148	-140
5-percentile	-105	-90	-62	-79	-59	-64	-49	-47	-45	-45	-110	-81	-70
10-percentile	-80	-59	-43	-61	-45	-39	-35	-33	-31	-32	-70	-58	-49
90-percentile	53	29	45	36	68	50	45	36	51	43	40	63	47
95-percentile	83	46	69	55	93	74	65	51	64	64	62	87	68
99-percentile	154	91	131	80	140	126	113	90	101	105	105	176	118
Number of time intervals: average FRCE > Level 1 positive	195	60	147	157	348	192	172	95	171	168	153	314	2172
Number of time intervals: average FRCE < Level 1 negative	358	208	117	201	137	133	85	81	51	65	349	276	2061
Number of time intervals: average FRCE > Level 2 positive	50	3	29	33	72	39	26	11	18	18	24	82	405
Number of time intervals: average FRCE < Level 2 negative	62	56	18	39	13	54	26	6	7	6	133	63	483
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	4	1	5	5	4	9	4	2	0	6	7	8	55
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	2	7	2	2	1	3	4	0	0	0	3	1	25

Table 57 LFC Block Performance for Block SMM for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	8.2	3.6	9.8	10.0	8.2	-7.6	-2.7	-2.2	1.5	-13.3	-2.2	0.4	1.1
The standard deviation	47	42	47	55	52	53	58	50	58	66	67	49	54
1-percentile	-102	-96	-100	-137	-166	-148	-176	-161	-158	-292	-278	-159	-164
5-percentile	-59	-62	-56	-73	-67	-91	-106	-90	-94	-116	-107	-76	-83
10-percentile	-42	-46	-41	-53	-46	-67	-70	-61	-64	-81	-61	-53	-57
90-percentile	64	34	68	67	68	42	63	55	57	49	64	56	57
95-percentile	86	42	92	85	89	58	83	72	73	70	84	76	76
99-percentile	134	50	157	104	132	75	127	109	92	118	151	123	114
Number of time intervals: average FRCE > Level 1 positive	382	246	422	520	417	249	370	281	398	233	359	294	4171
Number of time intervals: average FRCE < Level 1 negative	174	174	153	264	206	413	408	341	361	474	328	263	3559
Number of time intervals: average FRCE > Level 2 positive	79	36	112	116	74	49	58	37	69	49	82	55	816
Number of time intervals: average FRCE < Level 2 negative	26	16	25	53	60	93	145	104	110	183	148	80	1043
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	6	3	8	6	3	3	5	1	5	2	5	2	49
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	1	1	0	2	0	3	1	1	2	6	1	0	18

Table 58 LFC Block Performance for Block SMM for Year 2024

LFC ANNUAL REPORT 2024



Final | 30 September 2025

TEIAS

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	2.0	-9.4	-9.4	-10.1	-7.6	-9.7	-13.9	-11.2	-13.6	-11.2	-11.2	-9.7	-9.6
The standard deviation	37	37	36	46	36	37	39	38	31	35	41	36	37
1-percentile	-110	-130	-120	-164	-109	-116	-123	-144	-106	-104	-138	-108	-123
5-percentile	-47	-59	-61	-67	-59	-62	-64	-64	-58	-60	-65	-61	-61
10-percentile	-33	-44	-46	-49	-45	-48	-52	-49	-45	-47	-49	-48	-46
90-percentile	37	27	29	34	32	32	27	29	21	27	31	31	30
95-percentile	47	38	41	48	44	42	38	40	32	41	44	44	42
99-percentile	75	82	70	88	66	67	60	70	59	78	85	69	72
Number of time intervals: average FRCE > Level 1 positive	5	4	3	3	2	1	2	0	0	5	9	2	36
Number of time intervals: average FRCE < Level 1 negative	9	10	8	21	8	14	10	23	10	9	18	13	153
Number of time intervals: average FRCE > Level 2 positive	0	0	0	2	0	1	1	0	0	0	0	0	4
Number of time intervals: average FRCE < Level 2 negative	1	2	1	4	2	3	1	1	0	0	4	0	19
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	1	0	0	0	0	1	2	0	0	0	0	4
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

Table 59 LFC Block Performance for Block TEIAS for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-12.7	-12.1	-7.2	-4.5	-13.1	-7.4	-10.5	-13.0	-14.2	-13.4	-15.3	-16.3	-11.6
The standard deviation	37	43	42	43	43	45	37	34	42	41	39	35	40
1-percentile	-115	-140	-132	-132	-159	-126	-97	-114	-120	-121	-92	-96	-120
5-percentile	-65	-73	-64	-64	-70	-60	-59	-60	-67	-64	-61	-60	-64
10-percentile	-52	-56	-50	-46	-53	-48	-47	-48	-52	-51	-50	-50	-50
90-percentile	29	35	36	41	32	38	28	26	29	30	22	19	30
95-percentile	40	46	49	55	46	54	41	36	42	45	39	32	44
99-percentile	70	97	91	105	84	117	83	68	83	101	105	79	90
Number of time intervals: average FRCE > Level 1 positive	2	7	3	6	7	15	10	2	10	12	11	7	92
Number of time intervals: average FRCE < Level 1 negative	7	9	8	13	23	22	8	10	13	15	9	9	146
Number of time intervals: average FRCE > Level 2 positive	0	0	1	0	0	0	1	0	2	2	3	1	10
Number of time intervals: average FRCE < Level 2 negative	1	1	1	5	4	4	0	0	1	0	2	1	20
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	1	0	0	0	0	1	2	0	0	0	1	0	5
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	0	1	0	0	0	1	0	1	0	0	3

Table 60 LFC Block Performance for Block TEIAS for Year 2024

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TEL

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	5.8	3.7	9.0	8.6	10.0	5.2	6.4	2.3	6.3	2.6	2.0	2.6	5.4
The standard deviation	34	26	48	42	47	29	48	32	33	29	30	37	36
1-percentile	-68	-44	-97	-71	-41	-42	-40	-74	-35	-55	-80	-110	-63
5-percentile	-21	-21	-21	-18	-17	-17	-20	-23	-20	-20	-24	-22	-20
10-percentile	-13	-14	-13	-12	-12	-11	-13	-14	-13	-13	-14	-13	-13
90-percentile	26	19	36	29	28	20	18	16	20	15	16	15	21
95-percentile	54	32	82	74	77	45	37	30	48	24	30	32	47
99-percentile	144	126	191	196	207	135	200	125	160	124	138	144	157
Number of time intervals: average FRCE > Level 1 positive	89	57	156	138	161	86	86	63	114	61	70	77	1158
Number of time intervals: average FRCE < Level 1 negative	23	9	36	26	14	11	16	33	10	19	38	47	282
Number of time intervals: average FRCE > Level 2 positive	30	15	60	57	75	30	51	29	46	23	33	33	482
Number of time intervals: average FRCE < Level 2 negative	9	2	15	6	7	5	5	12	0	8	11	20	100
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

Table 61 LFC Block Performance for Block TEL for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1.5	6.8	6.8	4.6	2.0	-3.9	-0.8	0.2	-0.4	0.5	-4.1	-0.7	1.0
The standard deviation	32	37	40	49	41	49	58	40	42	34	28	23	39
1-percentile	-92	-43	-59	-141	-140	-197	-202	-125	-179	-123	-143	-77	-127
5-percentile	-22	-17	-18	-36	-30	-53	-46	-29	-31	-26	-28	-26	-30
10-percentile	-13	-11	-12	-17	-16	-19	-21	-16	-16	-16	-18	-17	-16
90-percentile	14	21	21	24	18	13	21	16	17	16	12	14	17
95-percentile	24	54	50	65	42	23	45	26	34	27	16	21	36
99-percentile	123	184	179	209	161	137	162	145	136	128	30	43	136
Number of time intervals: average FRCE > Level 1 positive	65	119	136	150	106	69	103	84	93	74	7	22	1028
Number of time intervals: average FRCE < Level 1 negative	50	21	28	89	84	121	118	80	93	67	76	44	871
Number of time intervals: average FRCE > Level 2 positive	31	57	77	72	51	33	50	40	37	34	2	10	494
Number of time intervals: average FRCE < Level 2 negative	18	8	11	37	35	55	58	32	53	31	39	14	391
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

Table 62 LFC Block Performance for Block TEL for Year 2024

TERNA

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-8.6	-16.6	-15.6	-5.0	-1.1	-2.2	0.7	-9.6	-2.9	-4.3	-15.7	-8.3	-7.4
The standard deviation	127	136	150	143	123	123	135	145	127	147	126	141	135
1-percentile	-489	-515	-561	-496	-424	-440	-455	-531	-422	-520	-509	-540	-492
5-percentile	-208	-241	-271	-235	-177	-158	-187	-241	-204	-233	-232	-203	-216
10-percentile	-115	-142	-149	-125	-103	-96	-106	-120	-121	-129	-123	-101	-119
90-percentile	87	94	100	111	92	86	109	86	104	104	79	77	94
95-percentile	131	139	149	176	151	141	178	146	157	185	109	120	149
99-percentile	393	339	412	431	397	409	490	440	420	493	300	417	412
Number of time intervals: average FRCE > Level 1 positive	87	82	115	141	143	122	170	138	144	187	70	106	1505
Number of time intervals: average FRCE < Level 1 negative	178	206	247	196	180	144	185	236	213	242	221	205	2453
Number of time intervals: average FRCE > Level 2 positive	36	27	42	49	59	59	64	62	60	77	29	56	620
Number of time intervals: average FRCE < Level 2 negative	64	81	105	75	65	65	76	111	77	106	100	94	1019
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

Table 63 LFC Block Performance for Block TERNA for Year 2023

*Data to be updated due to internal issues occurred in the generation of the input data.

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-12.0	-33.0	-13.0	-4.0	-7.0	-15.0	0.0	0.0	-4.0	-7.0	-13.0	-7.0	-9.6
The standard deviation	126	134	131	133	146	145	112	106	120	120	122	129	127
1-percentile	-501	-596	-463	-464	-504	-547	-367	-351	-384	-426	-501	-416	-460
5-percentile	-215	-290	-242	-200	-221	-242	-154	-157	-194	-178	-203	-197	-208
10-percentile	-103	-169	-136	-118	-127	-134	-105	-103	-116	-106	-117	-124	-122
90-percentile	63	65	90	103	107	96	103	101	110	93	90	105	94
95-percentile	111	92	137	175	171	146	151	142	158	134	131	156	142
99-percentile	346	205	380	405	462	420	347	299	349	324	295	372	350
Number of time intervals: average FRCE > Level 1 positive	106	51	131	178	196	143	158	139	169	122	114	166	1673
Number of time intervals: average FRCE < Level 1 negative	220	307	276	220	251	268	157	168	210	196	216	240	2729
Number of time intervals: average FRCE > Level 2 positive	41	16	61	77	72	59	52	39	47	38	35	50	587
Number of time intervals: average FRCE < Level 2 negative	98	145	117	93	115	121	53	51	69	82	95	78	1117
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

Table 64 LFC Block Performance for Block TERNA for Year 2024

* Data to be updated due to internal issues occurred in the generation of the input data.

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TTB

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	1.0	0.5	1.1	4.5	3.4	3.9	18.2	19.2	12.6	17.9	12.7	13.5	9.0
The standard deviation	38	35	54	65	53	54	75	76	67	77	57	56	59
1-percentile	-111	-107	-154	-132	-150	-123	-150	-135	-132	-149	-117	-121	-132
5-percentile	-50	-55	-67	-66	-58	-69	-76	-70	-71	-72	-61	-64	-65
10-percentile	-35	-36	-44	-43	-38	-46	-47	-49	-47	-43	-38	-40	-42
90-percentile	37	39	47	50	51	54	98	106	79	90	71	81	67
95-percentile	53	52	71	71	70	86	156	161	131	145	114	119	102
99-percentile	95	84	123	123	118	207	282	302	256	317	217	201	194
Number of time intervals: average FRCE > Level 1 positive	17	10	37	38	67	121	318	344	229	275	201	239	1896
Number of time intervals: average FRCE < Level 1 negative	29	24	53	46	65	62	101	84	79	88	55	54	740
Number of time intervals: average FRCE > Level 2 positive	4	2	5	17	6	41	128	119	70	97	62	41	592
Number of time intervals: average FRCE < Level 2 negative	8	1	16	13	23	11	16	12	14	23	2	5	144
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	1	0	2	5	1	0	0	1	0	1	0	0	11
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	7	1	20	10	15	5	9	7	8	10	1	0	93

Table 65 LFC Block Performance for Block TTB for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	2.7	1.7	7.8	12.5	8.3	4.9	4.6	5.1	6.4	1.2	-4.8	-2.1	4.0
The standard deviation	38	33	47	67	55	51	53	49	45	50	54	61	50
1-percentile	-102	-89	-113	-140	-144	-136	-133	-116	-123	-146	-149	-173	-130
5-percentile	-59	-51	-62	-75	-69	-62	-57	-58	-59	-78	-78	-101	-67
10-percentile	-39	-35	-40	-45	-47	-42	-37	-38	-39	-54	-58	-73	-46
90-percentile	47	38	59	77	69	54	51	54	56	57	48	69	57
95-percentile	65	53	82	110	100	76	69	74	78	78	69	95	79
99-percentile	110	88	147	212	171	136	121	140	129	124	120	154	138
Number of time intervals: average FRCE > Level 1 positive	217	128	336	479	440	282	263	283	301	313	232	403	3677
Number of time intervals: average FRCE < Level 1 negative	170	103	186	235	230	183	155	167	164	294	321	476	2684
Number of time intervals: average FRCE > Level 2 positive	20	7	60	121	98	43	35	56	42	45	33	91	651
Number of time intervals: average FRCE < Level 2 negative	19	15	27	52	49	37	37	28	34	53	53	97	501
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	0	0	0	1	4	3	8	6	1	2	2	3	30
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	1	2	1	2	0	0	0	0	0	0	6

Table 66 LFC Block Performance for Block TTB for Year 2024

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UAMD

2023

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	-27.7	21.1	50.1	27.4	5.1	2.3	2.7	-25.7	8.8	7.8	-0.1	10.3	6.8
The standard deviation	111	88	94	104	115	66	80	76	89	83	72	78	88
1-percentile	-306	-233	-171	-233	-243	-173	-189	-232	-213	-199	-169	-180	-212
5-percentile	-209	-112	-83	-132	-157	-98	-128	-158	-132	-124	-112	-118	-130
10-percentile	-165	-64	-40	-85	-118	-67	-91	-121	-92	-88	-82	-78	-91
90-percentile	98	130	183	162	122	79	104	64	124	107	87	108	114
95-percentile	145	175	224	210	157	117	150	97	170	150	133	155	157
99-percentile	301	275	305	307	244	211	219	171	244	253	220	248	250
Number of time intervals: average FRCE > Level 1 positive	208	308	615	492	546	282	424	204	509	425	305	428	4746
Number of time intervals: average FRCE < Level 1 negative	525	123	73	176	474	216	349	592	324	326	290	286	3754
Number of time intervals: average FRCE > Level 2 positive	54	47	132	99	154	73	134	43	174	136	103	147	1296
Number of time intervals: average FRCE < Level 2 negative	111	27	13	32	153	46	66	155	93	70	42	60	868
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	612	305	1051	742	244	91	163	16	286	362	199	259	4330
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	9	0	0	0	0	0	0	0	0	0	0	9

Table 67 LFC Block Performance for Block UAMD for Year 2023

2024

Data item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yr.
The mean value	2.0	14.5	1.8	5.9	-5.6	5.2	0.2	0.2	9.4	10.7	5.9	18.1	5.7
The standard deviation	57	51	73	81	95	97	97	103	101	82	98	96	86
1-percentile	-152	-120	-185	-178	-242	-225	-217	-228	-205	-164	-217	-191	-194
5-percentile	-95	-52	-119	-129	-152	-149	-151	-155	-146	-125	-143	-131	-129
10-percentile	-64	-30	-85	-100	-119	-114	-117	-125	-113	-97	-116	-99	-98
90-percentile	68	75	92	112	109	124	122	129	136	116	128	140	113
95-percentile	101	111	127	141	146	169	163	179	175	143	158	176	149
99-percentile	163	170	192	197	226	260	254	276	277	204	238	266	227
Number of time intervals: average FRCE > Level 1 positive	205	227	333	474	451	498	532	547	616	549	580	666	5678
Number of time intervals: average FRCE < Level 1 negative	184	65	288	359	535	436	526	565	468	371	487	376	4660
Number of time intervals: average FRCE > Level 2 positive	29	34	61	85	101	158	152	177	182	85	128	185	1377
Number of time intervals: average FRCE < Level 2 negative	21	7	60	49	118	107	100	120	93	32	92	68	867
Number of events: FRCE > 60 % FRR capacity - and not < 15 % FRR capacity - within 15 min	17	42	74	71	156	456	271	537	356	117	276	503	2876
Number of events: FRCE < -60 % FRR capacity + and not > - 15 % FRR capacity + within 15 min	0	0	0	0	23	0	0	0	2	0	2	0	27

Table 68 LFC Block Performance for Block UAMD for Year 2024

Ireland/Northern Ireland

2023

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 69 IE/Ni LFC FRCE Statistic for Year 2023

2024

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 70 IE/Ni LFC FRCE Statistic for Year 2024

Additionally, the synchronous area of IE/Ni requires to report the number of time intervals outside Level 1 and Level 2 FRCE ranges over the course of one year. The time intervals are aligned with Annex III, Table 1 of the SOGL. 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 $35\,040 \text{ (periods)} \times 0.03 = 1\,051$ periods.
4. The Level 2 FRCE target parameter = 1%, which is $525\,600 \text{ (periods)} \times 0.01 = 5\,256$ 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.

Data item	2023	2024
Number of time intervals frequency deviates outside +/- 200 mHz	0	0
Number of time intervals frequency deviates outside +/- 500 mHz	0	0

Table 71 IE/NI LFC Number of Time Intervals Outside Range for Years 2023 and 2024

Nordic

The Nordic LFC block performance is presented in the following tables. 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 72.

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

Table 72 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 the calculation of these target parameters is as defined in the Nordic Synchronous Area Operational Agreement. FRCE values are calculated on a basis of 15-minute frequency data. The percentages in Table 72 refer to 30% or 5% of the time intervals of the year. Additionally, events which indicate where FRCE exceeds 60% of FRR used and is not returned to 15% of FRR during a 15-minute time period are reported.

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Nordic LFC Block Performance

2023

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	50.00006	50.00006	50.00004	49.99998	49.99991	50.00011	50.00007	50.00001	49.99985	49.99993	50.00004	49.99998	50.00000
The standard deviation	0.0401	0.0395	0.0402	0.0422	0.0441	0.0415	0.0376	0.0400	0.0428	0.0392	0.0388	0.0368	0.0402
1-percentile	49.904	49.904	49.901	49.900	49.893	49.900	49.912	49.902	49.901	49.905	49.905	49.910	49.903
5-percentile	49.936	49.937	49.934	49.932	49.928	49.933	49.940	49.935	49.932	49.937	49.939	49.942	49.935
10-percentile	49.951	49.952	49.950	49.948	49.945	49.949	49.953	49.951	49.947	49.951	49.953	49.956	49.951
90-percentile	50.050	50.050	50.050	50.053	50.056	50.052	50.047	50.050	50.054	50.049	50.047	50.045	50.050
95-percentile	50.067	50.066	50.067	50.071	50.073	50.068	50.062	50.066	50.071	50.065	50.063	50.061	50.067
99-percentile	50.101	50.097	50.099	50.106	50.106	50.101	50.094	50.096	50.108	50.096	50.102	50.095	50.100
Number of time intervals: average FRCE > Level 1 positive	305	279	287	292	291	258	227	283	284	246	232	243	3227
Number of time intervals: average FRCE < Level 1 negative	232	208	247	259	245	190	147	202	223	204	201	171	2529
Number of time intervals: average FRCE > Level 2 positive	58	45	60	65	58	40	32	35	60	35	52	42	582
Number of time intervals: average FRCE < Level 2 negative	32	36	43	32	36	32	12	41	22	25	26	28	365
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	608	0	0	439	22	876	0	0	0	0	0	0	1945

Table 73 Nordic LFC Block Performance for Year 2023

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2024

Data item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
The mean value	49.99997	50.00008	50.00018	49.99988	49.99985	50.00018	49.99986	49.99993	50.00020	49.99984	50.00010	50.00014	50.00002
The standard deviation	0.0394	0.0398	0.0391	0.0441	0.0443	0.0439	0.0375	0.0412	0.0399	0.0377	0.0363	0.0343	0.0398
1-percentile	49.905	49.905	49.906	49.889	49.892	49.894	49.910	49.898	49.905	49.905	49.910	49.916	49.903
5-percentile	49.937	49.936	49.937	49.929	49.928	49.929	49.940	49.934	49.938	49.939	49.943	49.946	49.936
10-percentile	49.952	49.951	49.952	49.947	49.945	49.946	49.954	49.950	49.953	49.954	49.957	49.959	49.952
90-percentile	50.049	50.049	50.049	50.054	50.055	50.055	50.046	50.051	50.050	50.046	50.045	50.042	50.049
95-percentile	50.065	50.065	50.065	50.073	50.073	50.072	50.062	50.069	50.068	50.062	50.061	50.057	50.066
99-percentile	50.099	50.102	50.098	50.112	50.108	50.107	50.096	50.105	50.106	50.096	50.095	50.092	50.101
Number of time intervals: average FRCE > Level 1 positive	348	275	303	325	327	323	212	276	301	249	266	241	3446
Number of time intervals: average FRCE < Level 1 negative	267	232	229	271	289	230	157	201	193	204	195	174	2642
Number of time intervals: average FRCE > Level 2 positive	53	55	51	76	76	53	34	60	56	41	56	41	652
Number of time intervals: average FRCE < Level 2 negative	34	25	35	61	49	42	17	29	27	37	29	26	411
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	138	0	138
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

Table 74 Nordic LFC Block Performance for Year 2024

