All-Island Transmission System Performance Report 2024

April 2025

EirGrid SONI

Revision History		
Revision	**Date**	**Description**
R0	29/04/25	Original issue

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1. Introduction

EirGrid and SONI, as Transmission System Operators (TSOs) for Ireland and Northern Ireland respectively, are pleased to present the annual Transmission System Performance Report for 2024. This report contains transmission system data and performance statistics for the transmission system in Ireland and Northern Ireland for the year 2024 (1 January 2024 – 31 December 2024).

EirGrid is required to publish an annual report on the performance of the TSO business in accordance with Condition 18 of the Transmission System Operator Licence granted to EirGrid by the Commission for Regulation of Utilities (CRU).

Similarly, SONI is required to produce an annual report on the performance of the TSO business in accordance with Condition 20 of the Licence to participate in the Transmission of Electricity granted to SONI Ltd by the Department for the Economy.

Through comparison with previous reports, this report provides a useful resource through which trends can be identified.

This report is structured as follows:

- Section 3 outlines all-island system data, generation availability and outages,
- Section 4 details the performance of the EirGrid TSO business during 2024 against the criteria approved by the CRU,
- Section 5 details the performance of the SONI TSO business during 2024 against the criteria approved by The Utility Regulator in Northern Ireland.

Appendices which provide further detail on the data, results and methodology of relevance are included at the end of this report.

2. Executive Summary

The annual Transmission System Performance Report for 2024 is a comprehensive review of the transmission system through which EirGrid and SONI make available key all-island system operating data from the previous year.

Key statistics detailed in this report include:

- Generation statistics
- Transmission system availability statistics
- Details on system events leading to system minutes lost
- Details of system frequency events

2.1. Key Data

All-island

- All-island peak demand reached 7,148 MW on 27 November 2024 at 17:26. The minimum all-island demand was 3,095 MW and occurred on 9 June 2024 at 05:41.
- The all-island installed capacity of dispatchable generation (including Aggregated Generator Units (AGUs) and excluding batteries) on 31 December 2024 was 8,502 MW.
- In 2024 the system frequency was operated within 49.9 Hz and 50.1 Hz for 98.87% of the time.

Ireland

- In 2024 the availability of the East West Interconnector was 98.7%.
- The weighted-average availability of the Ireland transmission system in 2024 was 95.48%.
- The System Minutes Lost for 2024, attributable to EirGrid, was 0.152166.

Northern Ireland

- The availability of the Moyle Interconnector for 2024 was 98.3%.
- The average availability of the Northern Ireland transmission system in 2024 was 98.13%.
- The System Minutes Lost for 2024, attributable to SONI, was 0.

3. All-Island System Data

3.1. Overview of the All-Island Electricity System

The transmission system in Ireland and Northern Ireland provides the means to transport energy from generators to demand centres across the island. The transmission system is comprised of high-voltage overhead lines and cables that connect power stations, interconnectors and substations. Transformers link different voltage levels and provide a path for power to flow, typically, from higher to lower voltage networks. The transmission system in Ireland is operated at 400 kV, 220 kV and 110 kV. The transmission system in Northern Ireland is operated at 275 kV and 110 kV.

The 400 kV, 275 kV and 220 kV networks form the backbone of the transmission system. They have higher power carrying capacity and lower losses than the 110 kV networks.

The Ireland and Northern Ireland transmission systems are electrically connected by means of a 275 kV double-circuit. This connection is from Louth station in Co. Louth (IE) to Tandragee station in Co. Armagh (NI).

There are also two 110 kV connections:

- Letterkenny station in Co. Donegal (IE) to Strabane station in Co. Tyrone (NI)
- Corraclassy station in Co. Cavan (IE) to Enniskillen station in Co. Fermanagh (NI)

This section contains basic all-island transmission system data. Further information can be found on the EirGrid website: www.eirgrid.ie and the SONI website: https://www.soni.ltd.uk/.

3.2. Total System Production

Total exported energy takes into account energy supplied by all generators that have an export meter, including pumped hydro storage units and batteries. This does not take into account interconnector imports and exports.

Table 1: Total Exported Energy 2020 - 2024

	2020	2021	2022	2023	2024[1]
All-Island Total Exported Energy [GWh]	39,189	38,479	40,889	37,002	37,458
Ireland Total Exported Energy [GWh]	30,738	30,123	32,172	30,026	29,568
Northern Ireland Total Exported Energy [GWh]	8,451	8,356	8,716	6,976	7,890

3.3. System Records

Peak demand is a measure of the maximum demand on the transmission system over a particular period (e.g., annual or seasonal) and is a key measurement for any power system. The transmission system in Ireland and Northern Ireland is a winter peaking system as a result of greater heating and lighting requirements during the winter months. The all-island winter peak in 2024 was 7,148 MW and occurred at 17:26 on 27 November.

In summer, the reduced need for heating and lighting results in a lower demand for electricity. The minimum demand is known as the 'minimum summer night valley' and in 2024 a minimum all-island demand of 3,095 MW was recorded at 05:41 on 9 June.

From the installed wind capacity, a peak all-island wind generation output of 4,631 MW was achieved at 11:27 on 4 March. Table 2 provides a summary of the system records for years 2020 - 2024.

Table 2: System Records 2020 - 2024

	2020	2021	2022	2023	2024
Winter Peak Demand [MW]	6,904	6,826	7,031	6,836	7,148
Minimum Summer Night Valley [MW]	2,395	2,765	2,887	2,914	3,095
Maximum Wind Generation [MW]	4,246	4,489	4,610	4,653	4,631

3.4. Generation Capacity

Generating plant is connected to both the transmission and distribution systems. All generation contributes to meeting system demand. The total generation capacity is calculated as the sum of all fully operational generator capacities connected to both systems (excluding small-scale). Table 3 summarises

[1] Provisional figures for 2024

the key categories of all-island generation capacity. This does not include any import capacity from the Moyle Interconnector or the East West Interconnector.

Table 3: All-Island Generation Capacity as of 31 December 2024

	Ireland	Northern Ireland	All-Island
Dispatchable Generation (including AGUs) (MW)	6,346[2]	2,156	8,502
Batteries (MW)	751 (946 MWh)	212 (110 MWh)	963 (1,056 MWh)
Demand Side Units (MW)	683	126	809
Wind (MW)[3]	4,814	1,196	6,010
Solar (MW)[4]	758	114	872

Appendix 2 provides a list of the dispatchable generating units, including batteries and DSUs, connected to the power system.

[2] This figure includes 435 MW of temporary emergency generation

[3] MEC of operational utility-scale wind farms

[4] MEC of operational utility-scale solar farms

3.5. Generation Availability

Generation Availability is a measure of the capability of a generator to deliver power in a given period to the transmission system. In order for EirGrid and SONI to operate a secure and reliable transmission system in an economic and efficient manner, it is necessary for generators to maintain a high rate of availability.

Generation system availability is calculated on a daily and 365-day rolling average basis[5]. Figure 1 shows the daily and 365-day rolling average availability for 2024.

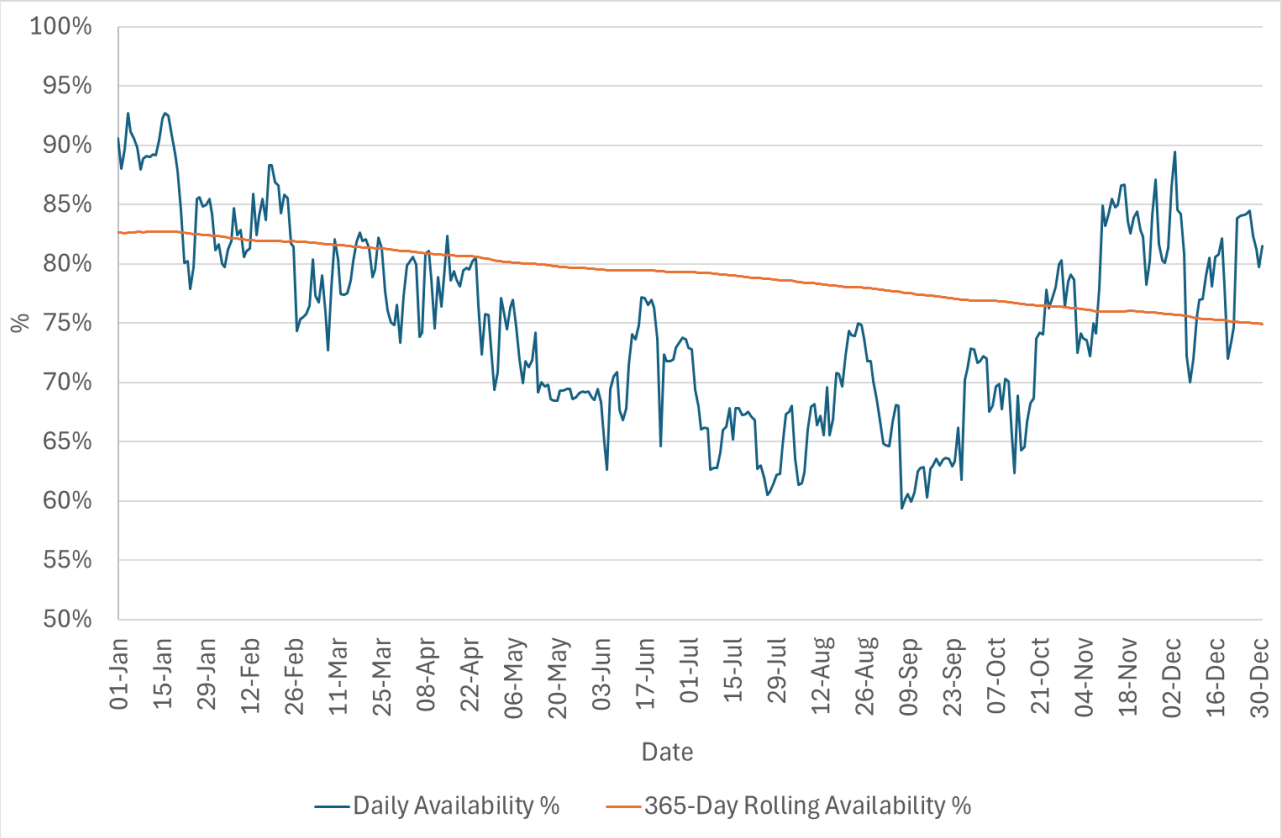

Figure 1: All-Island Dispatchable Conventional Generator (including AGUs) Availability 2024

- The average daily generation availability in 2024 was 75.0%.
- The maximum daily generation availability in 2024 was 92.7%.
- The minimum daily generation availability in 2024 was 59.4%.

[5] 365-day rolling average is a capacity weighted average availability over the previous 365 days.

3.6 Generation Forced Outage %

The generation forced outage % is calculated on a daily and rolling 365-day average basis. The daily forced outage % is a capacity weighted percentage of the time during the day that generation units are unavailable due to unforeseen/unplanned outages. The 365-day rolling forced outage % is the average of the daily forced outage % over the previous 365 days. The daily forced outage % and 365-day rolling forced outage % are shown in Figure 2.

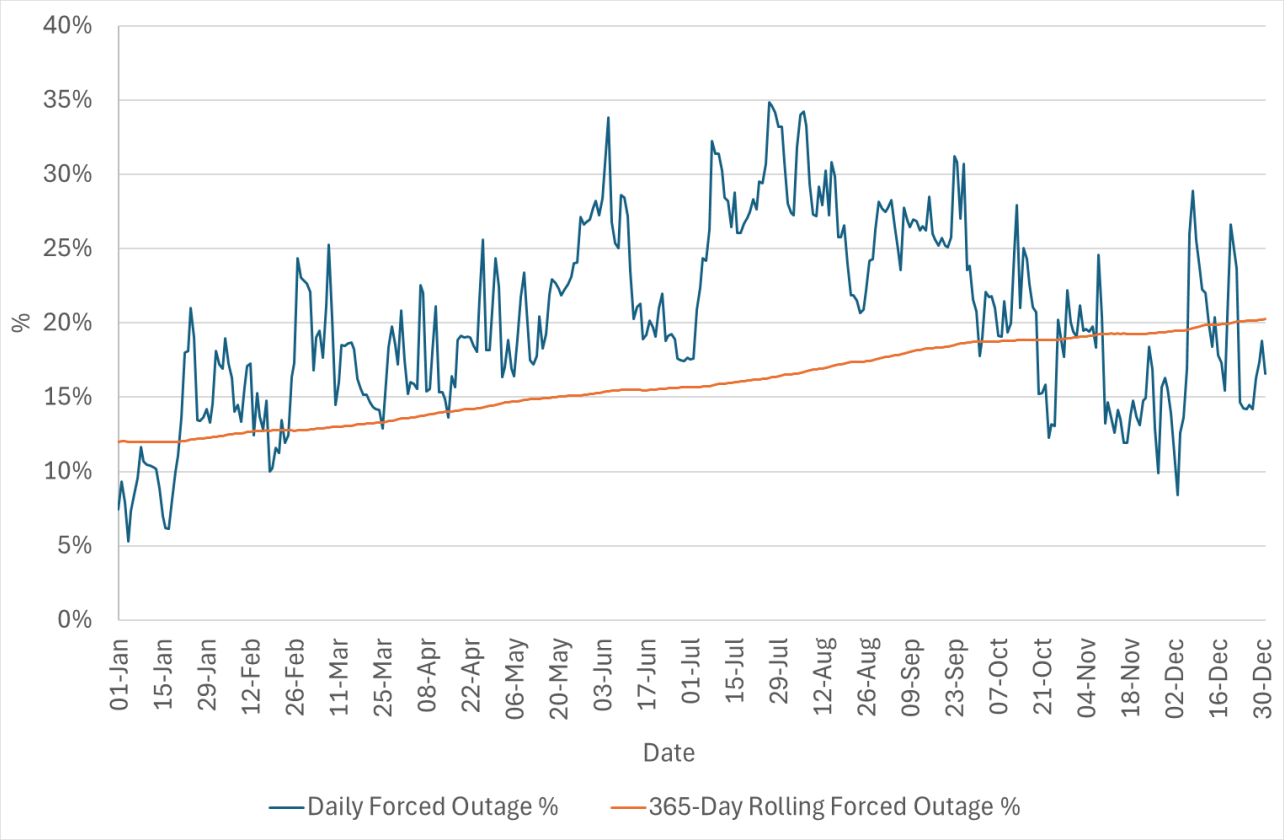

Figure 2: All-Island Dispatchable Conventional Generator (including AGUs) Forced Outage % 2024

- The average daily generation forced outage rate in 2024 was 20.2%.
- The maximum daily generation forced outage rate in 2024 was 34.9%.
- The minimum daily generation forced outage rate in 2024 was 5.3%

3.7 Generation Scheduled Outage %

The generation scheduled outage % can be calculated on a daily and rolling 365-day average basis. The daily scheduled outage % is a capacity weighted percentage of the time during the day that generation units are unavailable due to planned outages. The 365-day rolling scheduled outage % is the average of the daily scheduled outage % over the previous 365 days. The daily scheduled outage % and 365-day rolling scheduled outage % are shown in Figure 3.

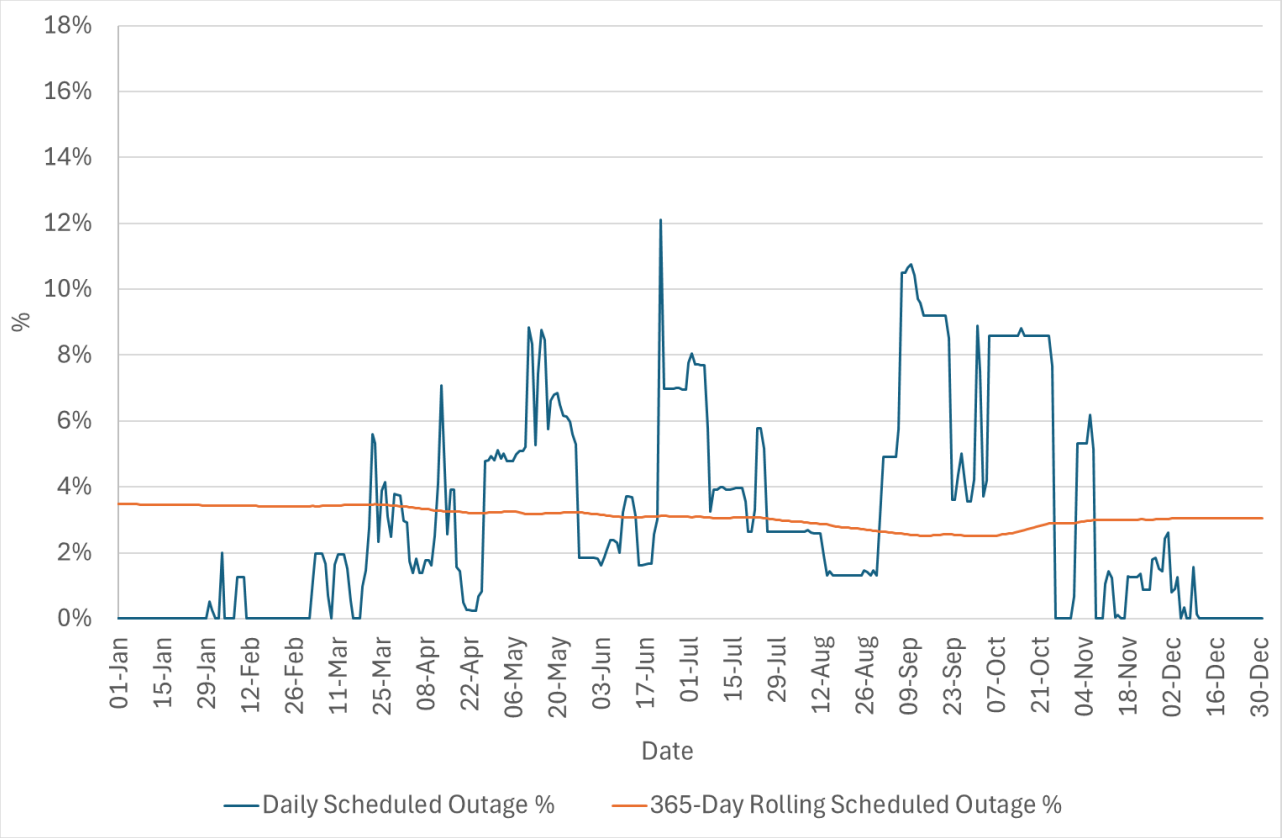

Figure 3: All-Island Dispatchable Conventional Generator (including AGUs) Scheduled Outage Rate 2024

- The average daily generation scheduled outage rate in 2024 was 3.0%.
- The maximum daily generation scheduled outage rate in 2024 was 12.1%.
- The minimum daily generation scheduled outage rate in 2024 was 0%.

3.8 DSU Availability

DSU Availability is a measure of the capability of a Demand Side Unit to deliver demand reduction in a given period to the transmission system. In order for EirGrid and SONI to operate a secure and reliable transmission system in an economic and efficient manner, it is necessary for DSUs to maintain a high rate of availability.

DSU system availability is calculated on a daily and 365-day rolling average basis[6]. Figure 4 shows the daily and 365-day rolling average availability for 2024.

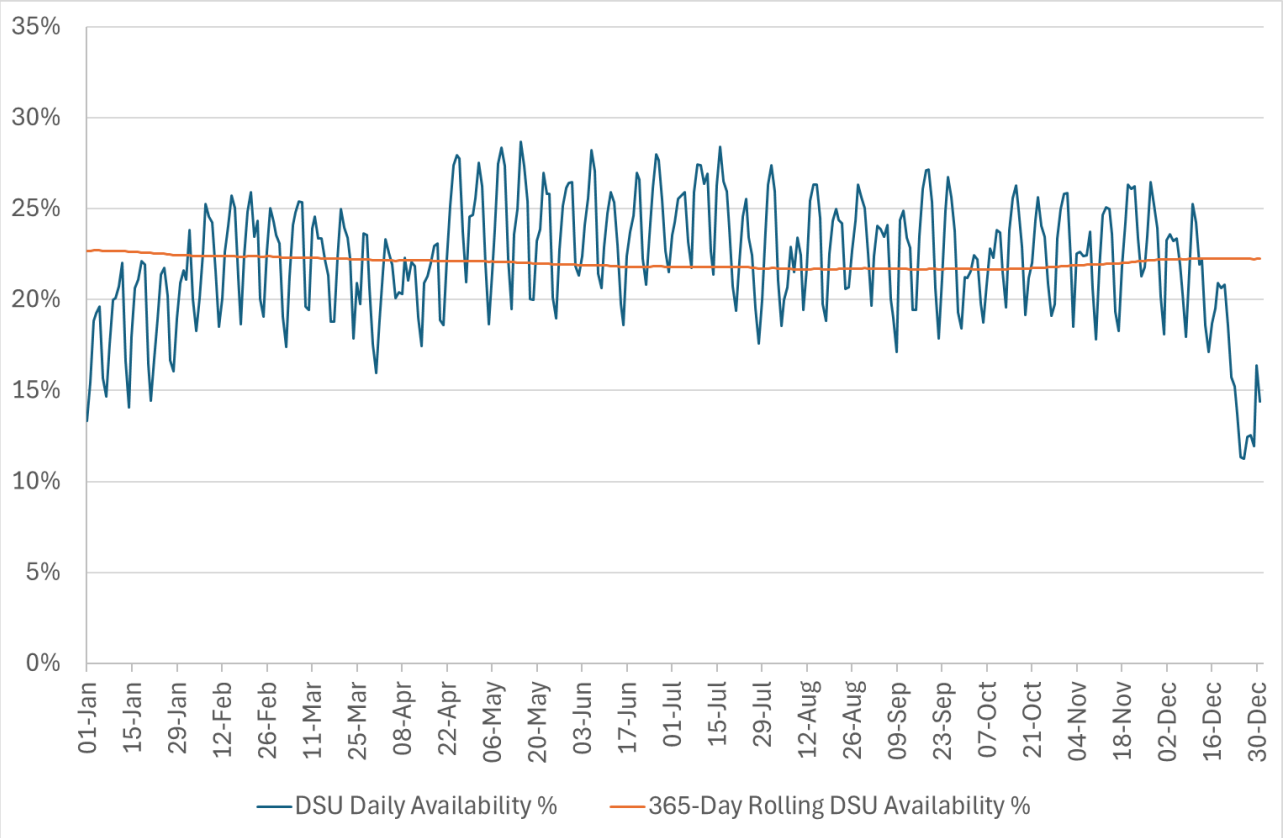

Figure 4: All-Island DSU Availability 2024

- The average daily DSU availability in 2024 was 22.2%.
- The maximum daily DSU availability in 2024 was 28.7%.
- The minimum daily DSU availability in 2024 was 11.2%.

[6] 365-day rolling average is a capacity weighted average availability over the previous 365 days.

4 EirGrid Transmission System Performance

This section relates to the performance of EirGrid TSO and the transmission system in Ireland only, unless explicitly stated otherwise. This data has been prepared by EirGrid in accordance with the requirements of Part 5 of Condition 18 of its Transmission System Operator Licence.

4.1 Summary

There were no major incidents in 2024. A major incident is one which results in the loss of greater than or equal to one system minute as a result of a single system disturbance.

The system minutes lost as a result of faults on the main system was 0.152166 in 2024. No system minutes were lost due to the disconnection of normal tariff load customers during Under Frequency Load Shedding (UFLS) disturbances.

EirGrid have a target to operate the system frequency within the range 49.9 Hz to 50.1 Hz for 98% of the time. In 2024, the system frequency was within the agreed limits 98.87% of the time.

4.2 Grid Development and Maintenance

This section provides an overview of grid development activities in 2024.

4.2.1 Completed Capital Projects

- CP0933 - Thurles 110 kV Station - Statcom
- CP1308 - Shannonbridge TEG Phase 1
- CP1307 - Tarbert TEG Phase 1
- CP1129 - Aghada BESS 02
- CP1493 - Huntstown TEG
- CP1103 - Corduff FlexGen
- CP1248 - Harlockstown Solar (Gallanstown Ext)
- CP1414 - Cloncreen Battery Phase 2
- CP1329 - Stonestown 110 kV Station_Derrinlough Wind Farm
- CP0869 - Maynooth - Woodland 220 kV line uprate
- CP1079 - Binbane - Cathaleens Fall 110 kV Line uprate
- CP1437 - Clahane-Tralee 110 kV Circuit Alteration CAR

- CP1145 - Rathnaskilloge Solar Farm
- CP1293 - Tarbert TEG - 2 (Phase 2) (SOS)
- CP0839 - Moy 110 kV Station reconfiguration and busbar uprate
- BF0006 - Hartnetts Cross
- E1887 - New Booltiagh T141
- MC0355 - Ballybeg 110 kV Line Droppers at Arklow 220 kV Station
- MC0377 - Ratrussan Arteche CT Replacement
- MC0378 - Arteche CT replacement in Clonkeen and Coomagearlahy 110 kV Stations
- MC0385 - Uprating of Aghada 1 and 2 220 kV line droppers at Knockraha 220 kV Station

4.2.2 New Connection Offers

Parties seeking a new connection to the transmission system must apply to EirGrid for a connection offer. EirGrid operates within a regulatory approved process for providing connection offers to generators and demand customers seeking direct connection to the transmission system. The process for issuing generation offers was consulted on in 2017 resulting in the Enduring Connection Policy (ECP) which has led to a significant increase in the number of new generation capacity offers issuing between 2019 and 2024. Applications for ECP-2.5 opened in November 2024 and will begin to be processed in Q2 2025.

In order to connect to the transmission system, all demand and generation customers must execute a connection agreement with EirGrid. Table 4: New Capacity Executed Demand & Generation Connection Agreements summarises the total number of new capacity connection agreements executed in 2024 and their associated load or generation capacities. A connection offer which is accepted in one year is unlikely to impact on connected generation capacity in the same year given the lead times associated with construction.

Table 4: New Capacity Executed Demand & Generation Connection Agreements

	Demand	Generation	Autoproducer	Interconnector
Executed Connection Agreements in 2024 [No.]	0	43	1	0
Executed Connection Agreements in 2024 [Capacity]	0.0 MVA	3,774 MW MEC	288 MW MEC	0.0 MW

In addition to issuing connection offers for new generation and demand capacity, EirGrid facilitates existing contracted customers in modifying existing connection agreements.

4.2.3 Connections Energised

When a connection agreement is executed for a new connection, it typically takes a number of years before the demand or generation is connected to the transmission system. This period includes project development, time taken to obtain consents and to construct the connection.

When the transmission connection is energised, it then takes a number of months for the generator to reach commercial operation. This period is generally much shorter for demand customers.

Table 5: Demand & Generation Transmission Connections Energised in 2024 provides an overview of the number of new connections to the transmission system commissioned in 2024.

Table 5: Demand & Generation Transmission Connections Energised in 2024

	Demand	Conventional Generation	PPM[7]	Battery	Interconnector
Connections Energised in 2024 [No.]	1	4	5	1	1
Connections Energised in 2024 [Capacity]	48.2 MVA	523.5 MW	427.4 MW	150 MW	504 MW

4.2.4 Customers Certified Operational

Table 6 provides an overview of customers connected to the transmission system who have been deemed fully operational. It shows customer connections which have completed the testing phase and have received an operational certificate from EirGrid. This includes generators connected to the distribution network. Note that demand customers are not currently certified by EirGrid and are therefore not included in the table.

Following energisation, the unit is required to complete Grid Code Compliance testing, following which Operational Certificates[8] are issued.

[7] PPM: Power Park Modules.

[8] EirGrid issues Operational Certificate Justifications for distribution-connected generation. These are the included in the figures shown.

Table 6: Customers Certified Operational in 2024

	Total number of new units certified operational in 2024	Total new capacity certified operational in 2024 (MW)
PPM	7	272.8
Conventional	4	240.5
Battery	8	330.0
DSU (including existing DSUs with changes in capacity)	26	13.6
Synchronous Condenser	0	N/A

4.3 General System Performance

4.3.1 Under-Frequency Load Shedding

There were no UFLS disturbances in 2024 which resulted in shedding of normal tariff load customers.

The relays to disconnect normal tariff customer load are only activated once the system frequency drops to 48.85 Hz. The lowest system frequency in 2024 was 49.593 Hz.

Figure 5 provides a trend of the number of disturbances since 2015 that involved operation of under-frequency relays to disconnect interruptible and normal tariff end-users. No normal tariff customers have been disconnected due to an under-frequency disturbance since 2014.

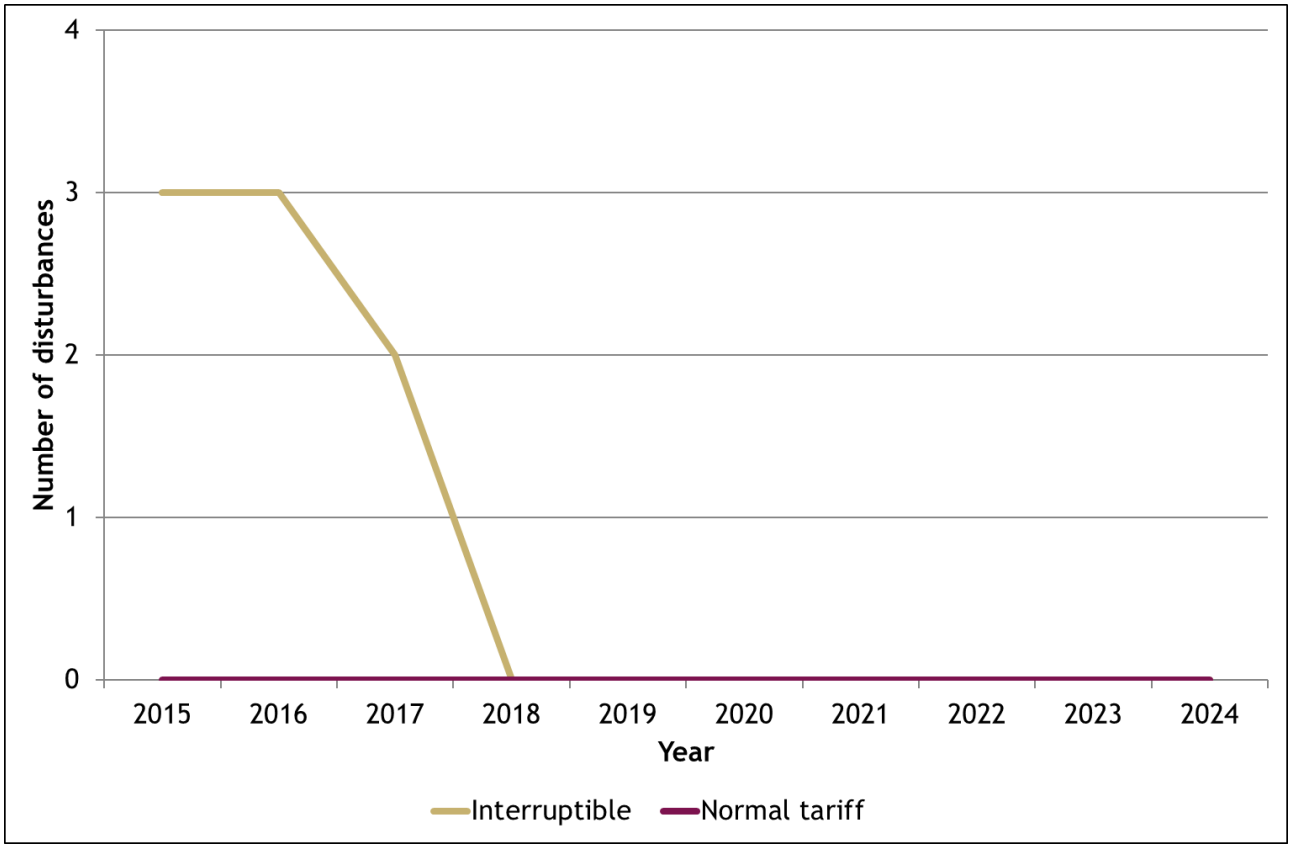

Figure 5: Under frequency disturbances 2015-2024

Figure 6 provides a trend of the lowest system frequency by year since 2014.

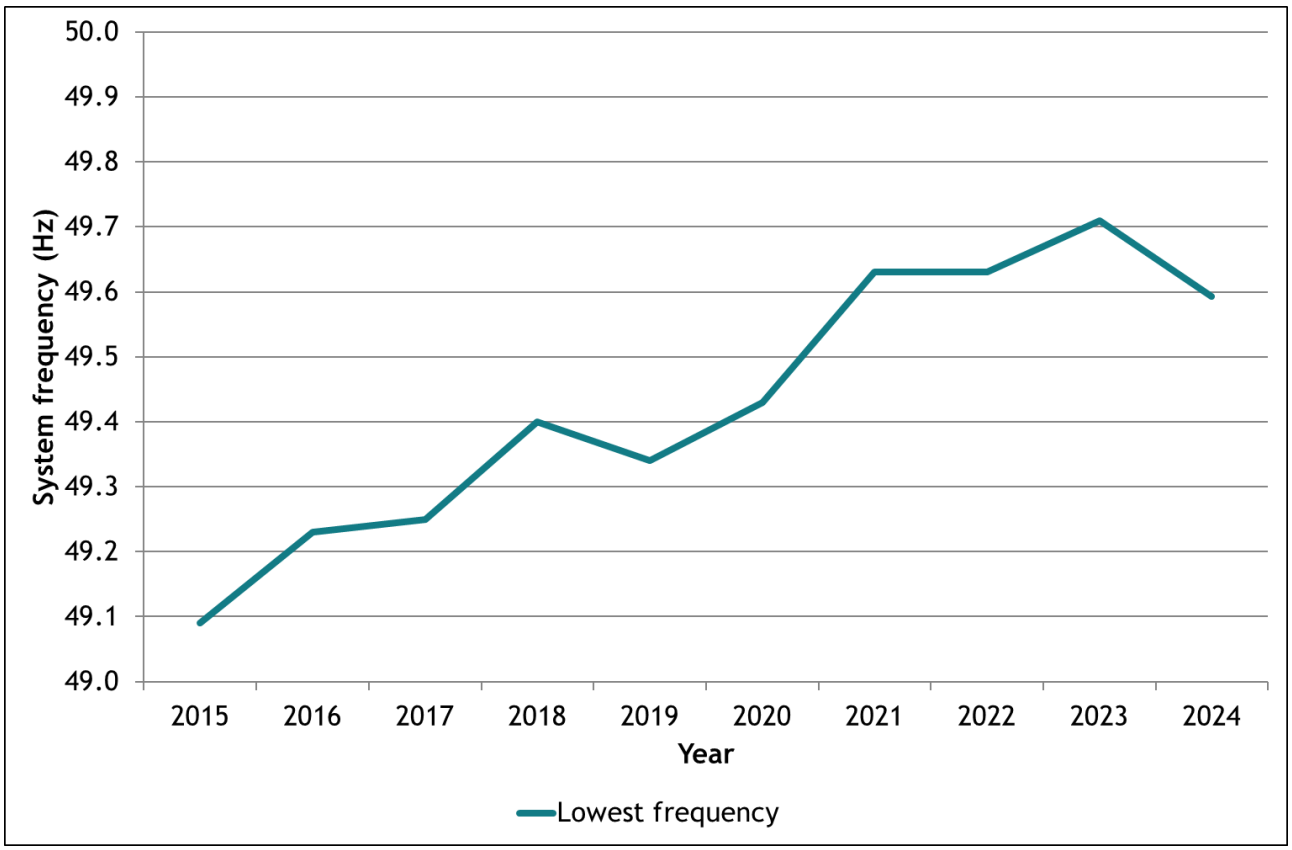

Figure 6: Lowest system frequency 2015-2024

4.3.2 Under-Voltage Load Shedding

There was no incident of Under-Voltage Load Shedding in 2024.

4.4 System Minutes Lost

This section provides information for system minutes lost (SML) attributable to the transmission system operator.

SML is a measure of the energy not supplied for a disturbance. The metric takes account of the load lost (MW), duration of disconnection (minutes) and peak system demand (MW), to allow for historical comparison. For example, if 300 MW were lost for 10 minutes and the system peak was 3000 MW, this would represent one system minute.

$$System\ minutes\ = \frac{(load\ \times\ duration)}{(system\ peak)}\ = \frac{(300\ \times\ 10)}{(3000\ )} = 1$$

The total SML as a result of faults on the main system for 2024, attributable to EirGrid, was 0.152166. There were no under frequency load shedding disturbances which resulted in the disconnection of normal tariff load customers.

The trend of SML since 2015 is shown in Figure 7, with incentive / penalty limits and deadbands as provided by the Commission for Regulation of Utilities. The central target provided until 2020 was replaced in 2021 with a deadband between 0.75 and 2.5 SML, where there is neither penalty nor incentive. One fifth of the incentive amount is awarded for every 0.1 SML below 0.75, down to 0.25 SML. One fifth of the incentive amount is penalised for every 0.1 SML above 2.5, up to 3.0 SML.

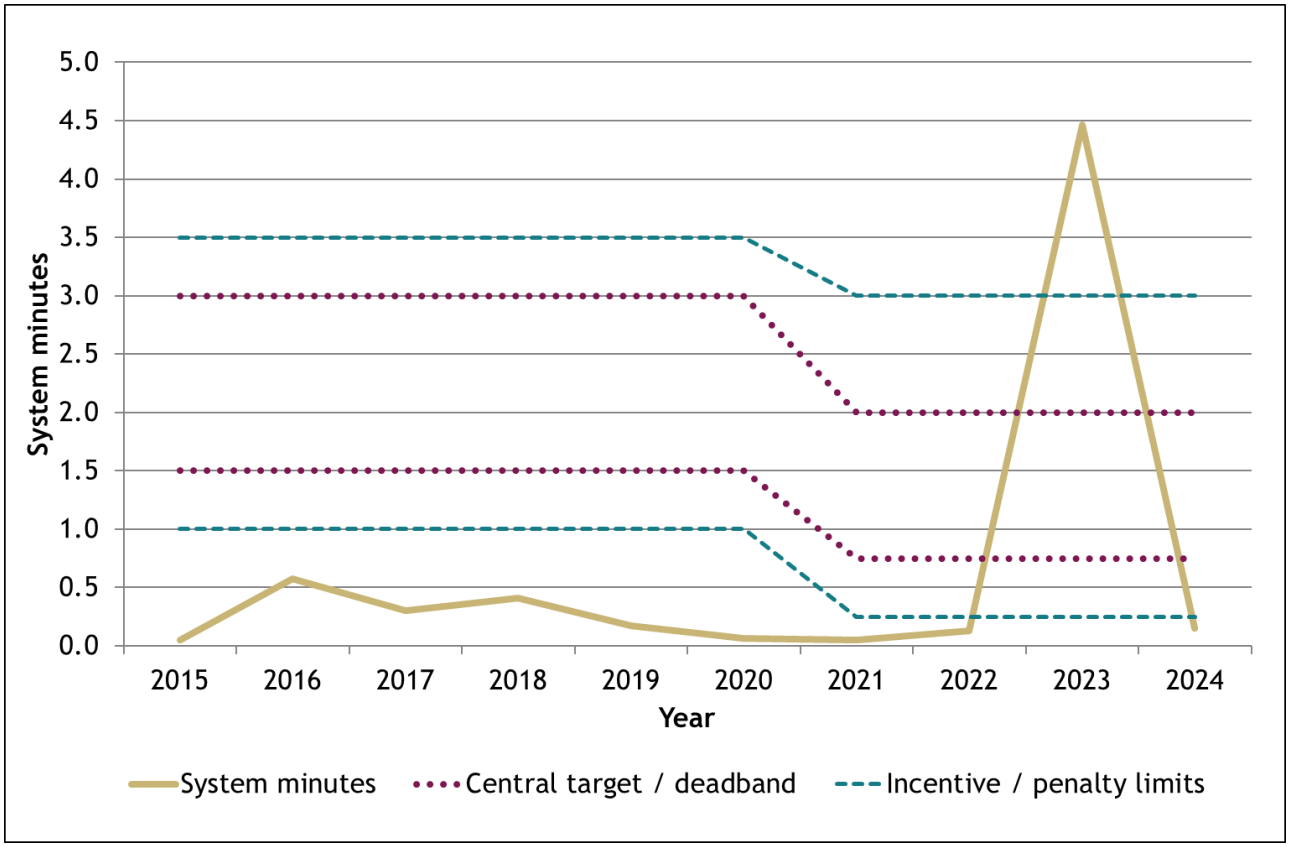

Figure 7: System minutes lost and associated targets: EirGrid 2015-2024

4.5 Zone Clearance Ratio

This section provides details of the short circuit faults on the main system and outside the main system for which main system protection is expected to operate without delay.

Zone clearance ratio (ZCR) is defined as the ratio of the number of short circuit faults, not cleared in zone 1 to the total number of short circuit faults per year cleared by main system protection. See Appendix 1 Glossary, for further definition of Zones and ZCR.

Of the 91 short circuit faults in 2024, the main system protection was expected to operate without delay for 86 of those short circuit faults on the main system. 84 of those faults had zone 1 clearances, giving a zone clearance ration of 0.022. The ZCR trend since 2015 is shown in Figure 8.

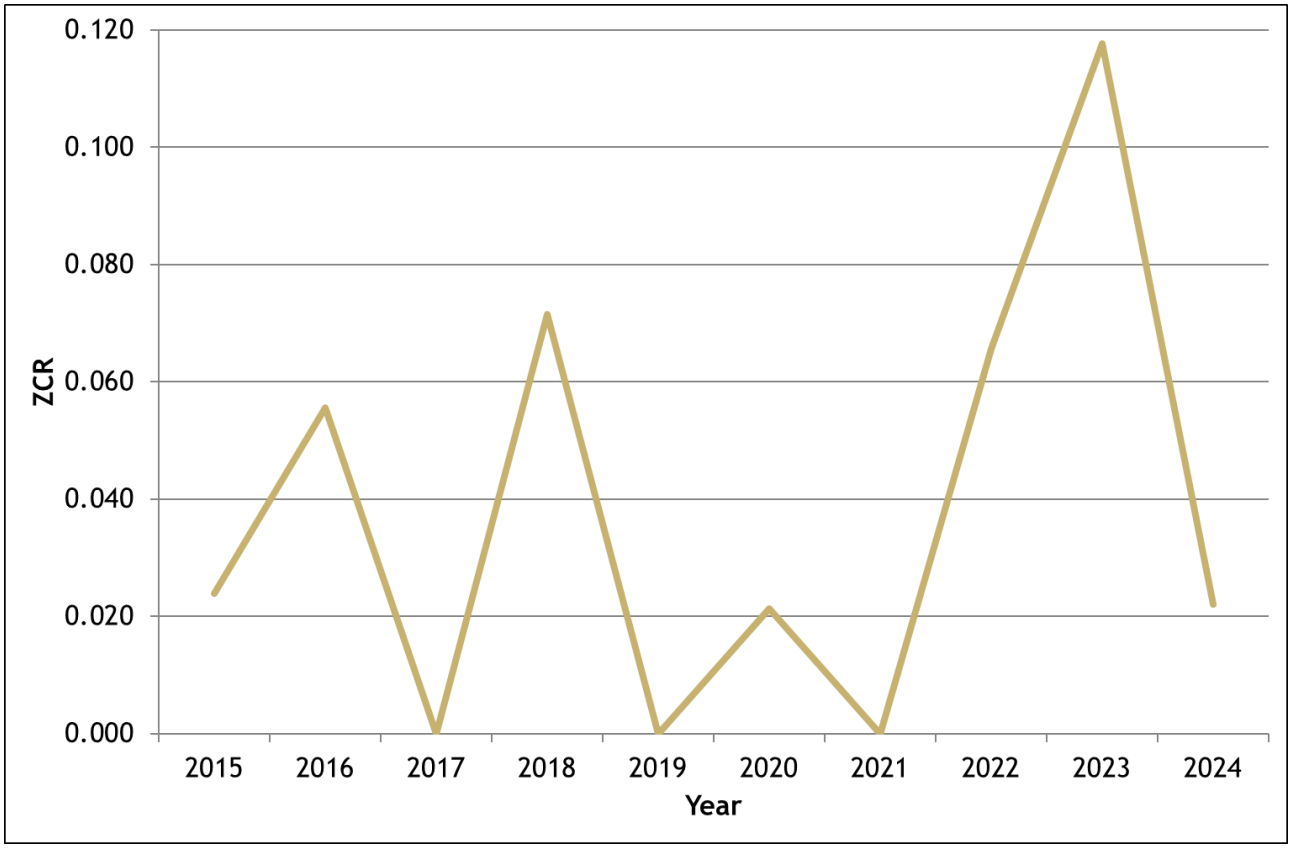

Figure 8: Zone clearance ratio: EirGrid 2015-2024

4.5.1 Frequency Control

In 2024 the system frequency was operated between 49.9 Hz to 50.1 Hz for 98.87% of the time.

4.6 Summary of key disturbances

4.6.1 Loss of load

Date/Time	Plant	Fault Type	Description	Fault Clearance Time	Cause	System Minutes Lost
21/01/2024 19:34	Bellacorick - Castlebar 110 kV circuit	Single-phase to earth (RE)	Circuit tripped at both ends and reclosed in Castlebar. The National Control Centre closed the Castlebar circuit breaker in Bellacorick 110 kV station at 19:38 and the circuit tripped again at 19:39. At 20:21, the line was successfully switched back into service.	60 ms	Storm Isha	0.041465
21/01/2024 21:00	Binbane - Cathaleen's Fall 110 kV circuit	Single-phase to earth (TE)	Circuit tripped.	280 ms	Storm Isha	0.008981
23/02/2024 20:16	Knockearagh - Oughtragh - Tralee 110 kV circuit	Three-phase to earth (RSTE)	Circuit tripped and reclosed.	60 ms	Lightning	0.000039
09/06/2024 17:20	Lenalea - Letterkenny 110 kV circuit	Single-phase to earth (RE)	Circuit tripped. With the Binbane - Cathaleen’s Fall 110 kV circuit out of service for planned works, this resulted in the loss of four 110 kV stations; Lenalea, Tievebrack, Ardnagappary, and Binbane. Supply was restored at 17:30.	40 ms	Heavy rain was recorded in the area	0.028699

Date/Time	Plant	Fault Type	Description	Fault Clearance Time	Cause	System Minutes Lost
					at the time	
11/08/2024 22:21	Lenalea - Tievebrack 110 kV circuit	Single-phase to earth (RE)	Circuit tripped and reclosed in Lenalea. With the Binbane - Cathaleen's Fall 110 kV circuit out of service for planned works, this resulted in the loss of two 110 kV stations; Ardnagappary and Binbane. Supply was restored to Binbane at 22:27 and to Ardnagappary at 22:31.	60 ms	Lightning	0.016211
06/12/2024 23:36	Arigna - Carrick-on-Shannon - Corderry 110 kV circuit	Single-phase to earth (TE)	Circuit tripped, reclosed and tripped again. Supply was restored to Arigna 110 kV station at 23:47	60 ms	Storm Darragh	0.015448
07/12/2024 08:39	Knockearagh - Oughtragh - Tralee 110 kV circuit	single-phase to earth (TE)	Circuit tripped, reclosed and tripped again. Supply was restored to Oughtragh 110 kV station at 08:55.	40 ms	Storm Darragh	0.041323

4.6.2 Under-Frequency Load Shedding

There were no under frequency load shedding disturbances in 2024.

4.6.3 Storms Resulting in Trippings

Between 16:10 and 22:32 on 21/01/2024, there were 25 faults on the transmission network during Storm Isha. Interruptions to end-users occurred at Bellacorick and Binbane 110 kV stations, resulting in 0.050446 system minutes lost. Status Red weather warnings were in operation in counties Galway, Mayo and Donegal.

On 20/10/2024 at 21:07, Great Island - Lodgewood 220 kV circuit tripped and reclosed at one end due to high winds during Storm Ashley. No interruption to end-users occurred. A Status Yellow weather warning was in operation in the area.

Between 06/12/2024 at 20:29 and 07/12/2024 at 09:17, there were 18 faults on the transmission network during Storm Darragh. Interruptions to end-users occurred at Arigna 110 kV and Oughtragh 110 kV stations, resulting in 0.056771 system minutes lost. Status Red weather warnings were in operation in some western and north-western counties.

4.7 Transmission System Availability & Outages

4.7.1 Transmission System Availability

When considering transmission system availability, it is the convention to analyse it in terms of transmission system unavailability. The formula for calculating transmission system unavailability is given in Appendix 4 Formulae. Figure 9 shows the percentage Transmission System Unavailability in each month for 2024.

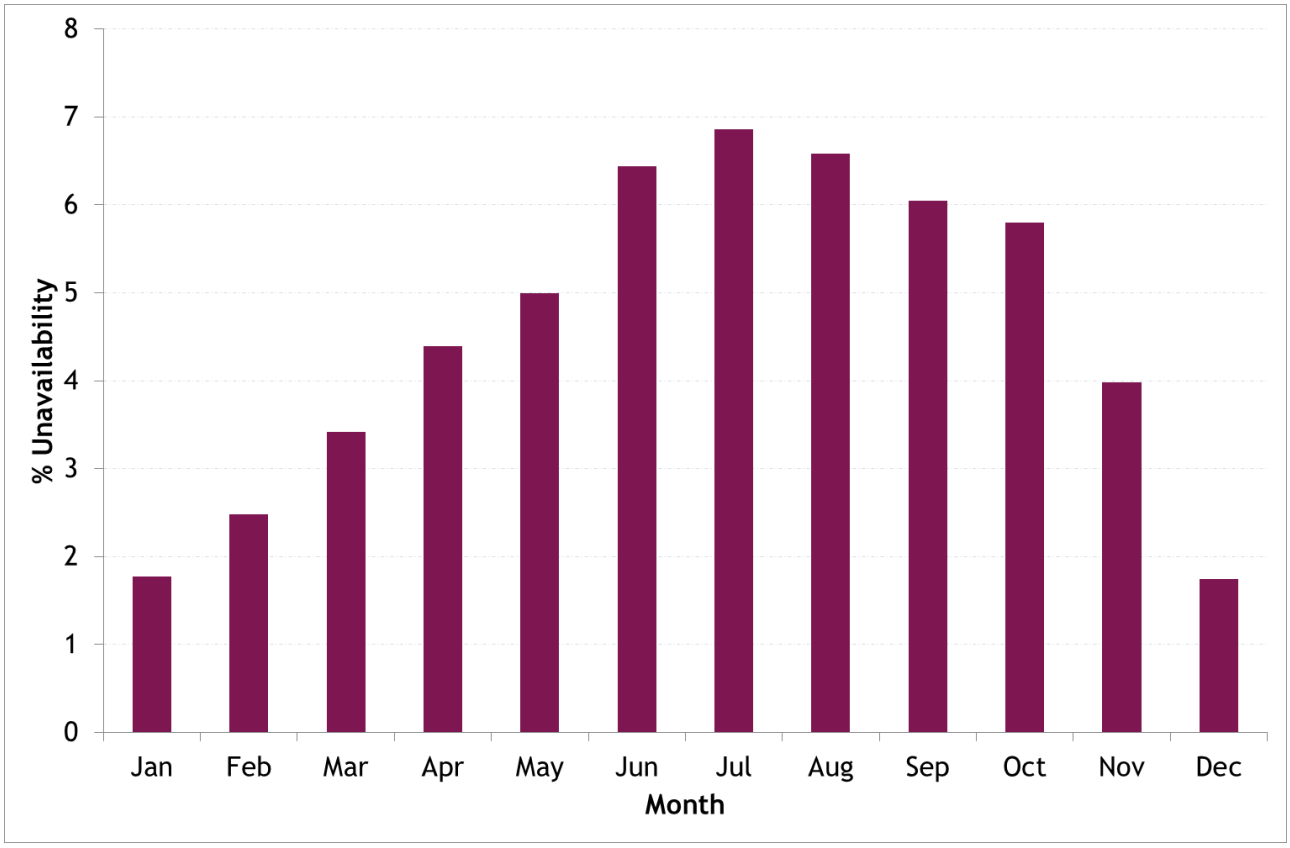

Figure 9: Monthly Variations of Transmission System Unavailability 2024

4.7.2 Transmission Plant Availability

The measure of plant availability is the kilometre-day for feeders and the MVA (megavolt ampere)-day for transformers. The availability figures vary between the different categories of plant. The formulae for calculating transmission plant availability are provided in Appendix 1 Glossary.

Table 7 provides a detailed breakdown of all plant availability figures for 2024.

Table 7: Transmission System Plant Availability 2024

Plant Type	Circuit Length [km]	Number of Outages	Availability (%) 2024
110 kV Circuits	4,695	346	94.45
220 kV Circuits	1,987	74	96.83
275 kV Circuits	97	2	99.01
400 kV Circuits	439	5	99.43
Plant Type	**Transformer Capacity [MVA]**	**Number of Outages**	**Availability (%) 2024**
220 / 110 kV Transformers	11,864	65	97.77
275 / 220 kV Transformers	1,200	4	98.87
400 / 220 kV Transformers	4,050	6	97.17
Total	7,219 km	502	**Weighted Average (%)**
	17,114 MVA		95.48

4.7.3 Cause of Transmission Plant Unavailability

Transmission plant unavailability is classified into the categories outlined in Table 8.

Table 8: Transmission System Plant Unavailability Categories

Category	Description
Forced & Fault	Refers to unplanned outages. An item of plant trips or is urgently removed from service. Usually caused by imminent plant failure. There are three types of forced outage: A) Fault & Reclose B) Fault & Forced C) Forced (No Tripping)
Safety & System Security	**Safety:** Refers to transmission plant outages which are necessary to allow for the safe operation of work to be carried out. **System Security:** Refers to outages which are necessary to avoid the possibility of cascade tripping or voltage collapse as a result of a single contingency. When a line is out for maintenance it may be necessary to take out additional lines for this reason.
New Works	An outage to install new equipment or uprate existing circuits.
Corrective & Preventative Maintenance	**Corrective Maintenance:** Is carried out to repair damaged plant. Repairs are not as urgent as in the case of a forced outage. **Preventative Maintenance:** Is carried out in order to prevent equipment degradation which could lead to plant being forced out over time. Includes line inspections, tests and routine replacements.
Other Reasons	A number of other reasons may be attributed to plant unavailability, such as testing, protection testing and third-party work.

4.7.4 110 kV Circuit Unavailability

Figure 10 provides a breakdown of the causes of unavailability on the 110 kV network in 2024.

The largest contributor to unavailability (54%) on the 110 kV network was attributable to the "New Works" category. This category is for outages to install new equipment or uprate existing circuits.

A further 33% of unavailability on the 110 kV network in 2024 were outages for the purpose of “Corrective and Preventative” maintenance. This type of maintenance includes, amongst others, ordinary services, condition assessments, wood-pole replacement/straightening and general line maintenance.

7% of unavailability was due to forced outages.

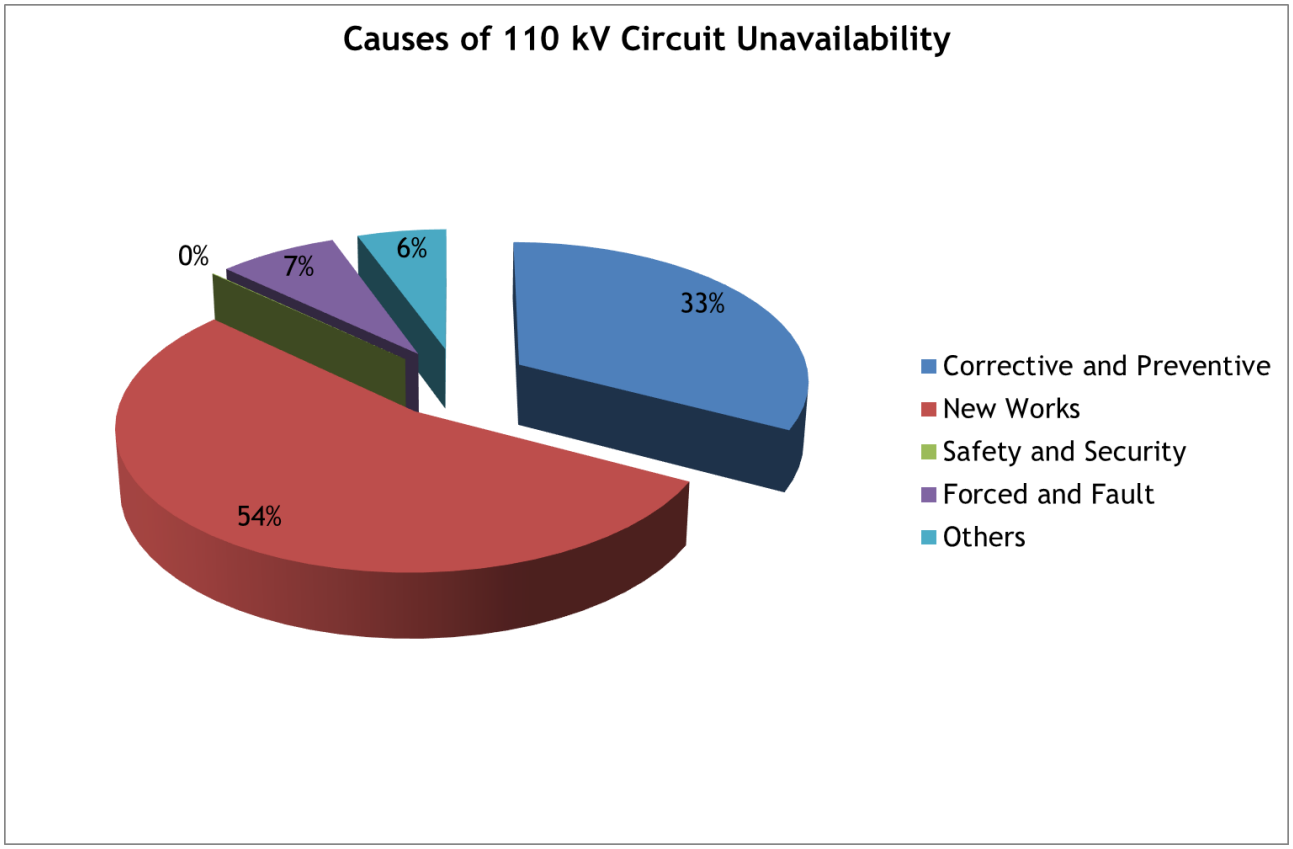

Figure 10: Causes of Unavailability on the 110 kV System in 2024

4.7.5 220 kV Circuit Unavailability

Figure 11 provides a breakdown of the causes of unavailability on the 220 kV network in 2024. The largest contributor to unavailability (52%) on the 220 kV network in 2024 were outages for "New Works" purposes. Approximately 24% of unavailability on the 220 kV network was attributable to “Corrective and Preventative” maintenance. A further 22% of unavailability on the 220 kV network was attributable to forced outages. The forced outage of Prospect – Tarbert 220 kV circuit which was out of service for all of 2024 accounted for 16% of the overall unavailability on the 220 kV system.

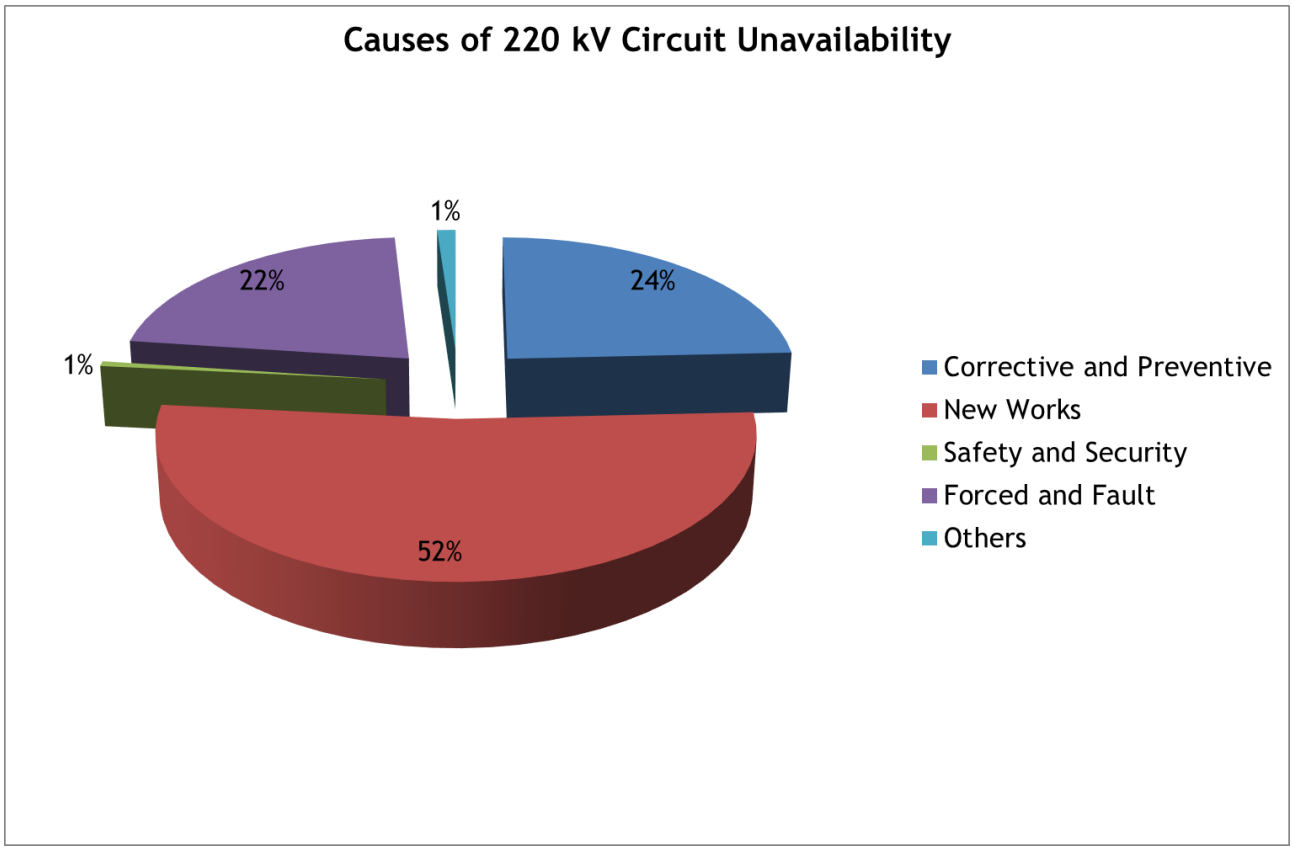

Figure 11: Causes of Unavailability on the 220 kV System in 2024

4.7.6 275 kV Circuit Unavailability

The 275 kV tie-line consists of 48.5 km of 275 kV double-circuit between Louth station and Tandragee station which is situated in County Armagh. All of the unavailability on the 275 kV network in 2024 was due to “Corrective and Preventative” maintenance.

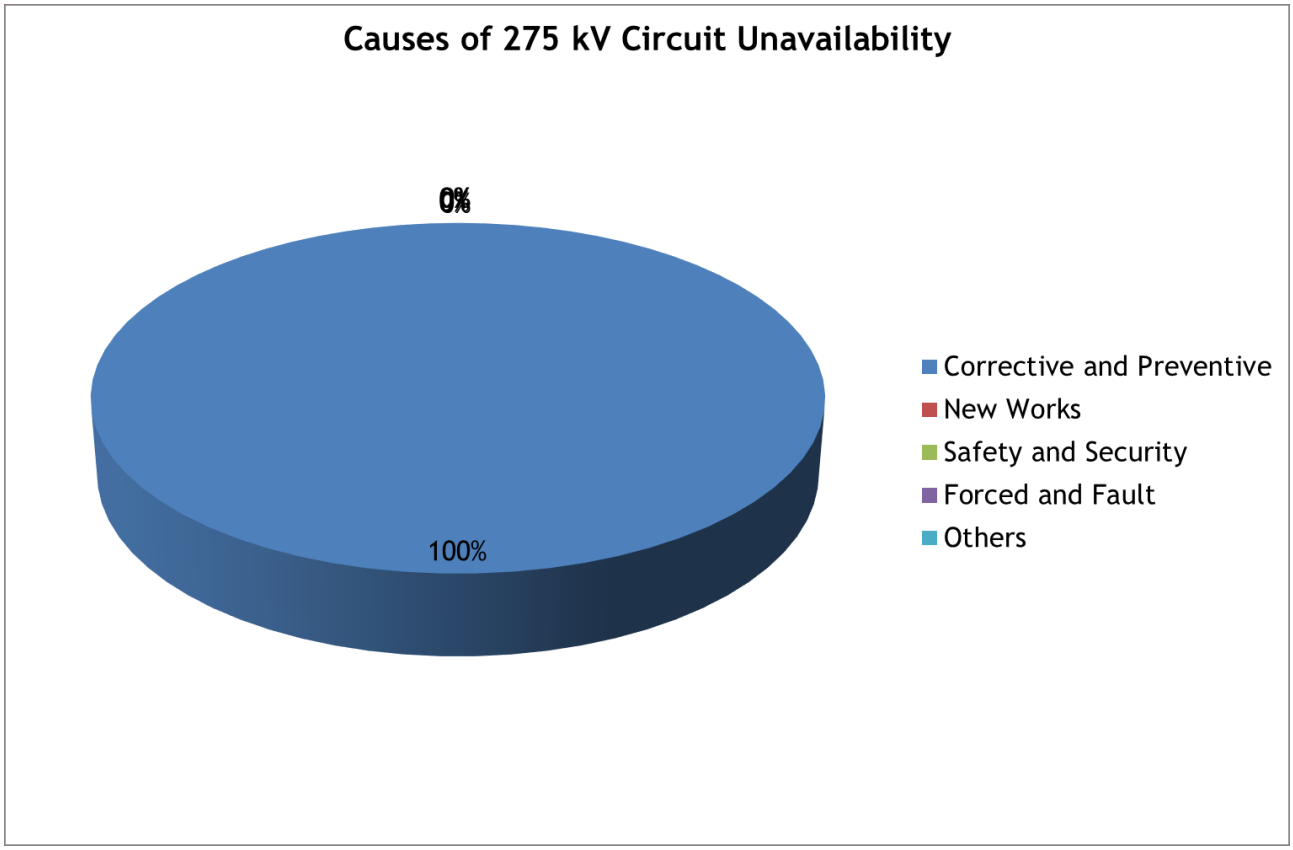

Figure 12: Causes of Unavailability on the 275 kV System in 2024

4.7.7 400 kV Circuit Unavailability

Figure 13 provides a breakdown of the causes of unavailability on the 400 kV network in 2024. There were 9 days of outages on the 400 kV network in 2024 with the largest contributor being “Corrective and Preventive”.

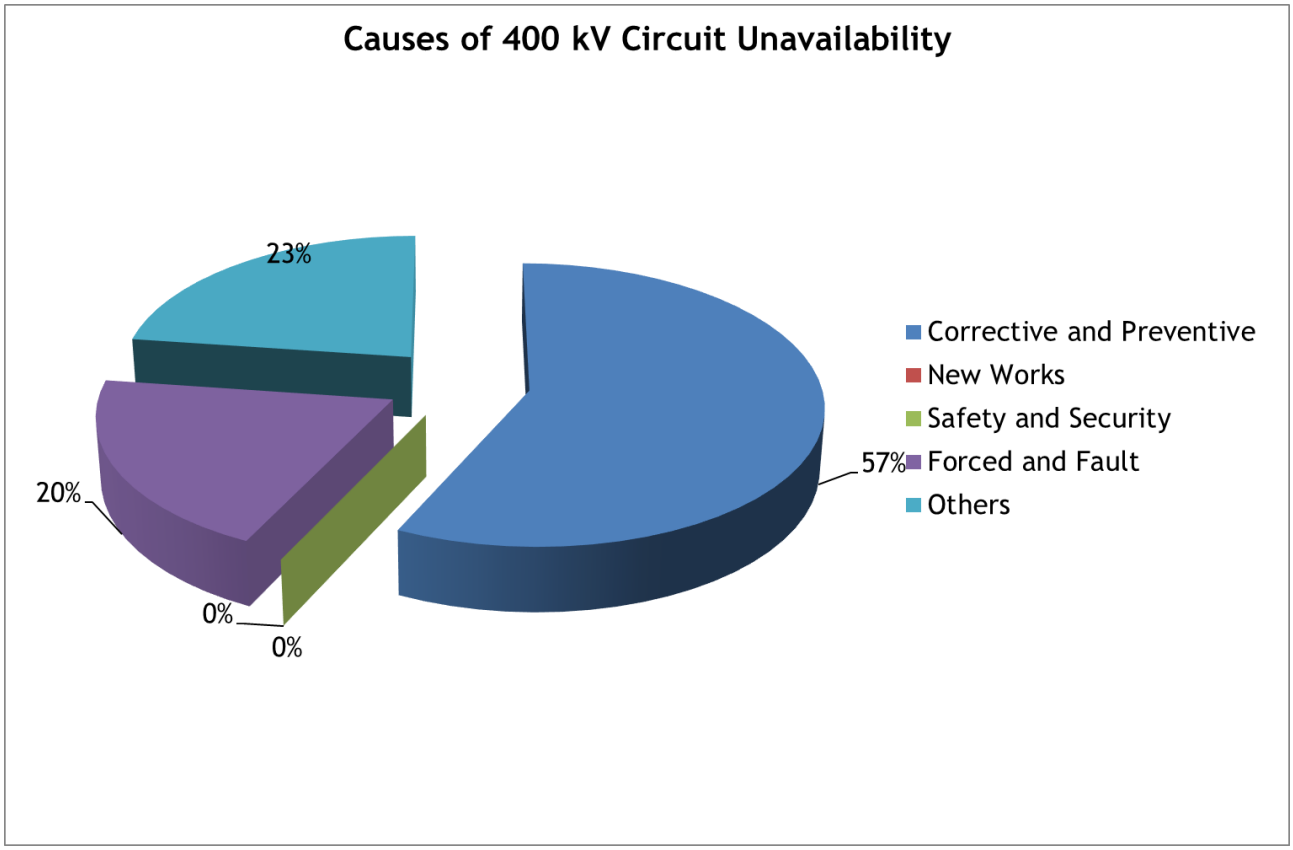

Figure 13: Causes of Unavailability on the 400kV System in 2024

Table 9 provides a breakdown of the transmission system outages that occurred in 2024 by plant type.

Table 9: Transmission System Plant Outage 2024

Plant Type	No. of Items	Circuit Length	Forced & Fault	Safety & System Security	New Works	Corrective & Preventive Maintenance	Other	Total No. of Outages
110 kV Circuits	271	4,695	39	3	109	172	23	346
220 kV Circuits	76	1,987	16	1	29	25	3	74
275 kV Circuits	2	97	0	0	0	2	0	2
400 kV Circuits	4	439	1	0	0	3	1	5
Total	353	7,219	56	4	138	202	27	427
Plant Type	**No. of Items**	**Transformer Capacity**	**Forced & Fault**	**Safety & System Security**	**New Works**	**Corrective & Preventive Maintenance**	**Other**	**Total No. of Outages**
220 / 110 kV Trafos	58	11,864	11	1	21	25	7	65
275 / 220 kV Trafos	3	1,200	0	0	0	4	0	4
400 / 220 kV Trafos	8	4,050	0	0	0	4	2	6
Total	69	17,114	11	1	21	33	9	75

4.7.8 East West Interconnector

The East West Interconnector (EWIC) is a high-voltage direct current (HVDC) scheme which links the power systems of Ireland and Great Britain. It has a power rating of 500 MW. EWIC is a fully regulated interconnector which was developed and is owned by EirGrid Interconnector DAC (EIDAC) which is part of the EirGrid Group. The scheme consists of two Converter Stations located in Meath, Ireland and Deeside, Wales connected by 264 km of HV cable, 185 km of which is submarine.

4.7.9 East West Interconnector Availability

In 2024 the availability of the East West Interconnector (EWIC) was 98.7%. EWIC unavailability was as a result of a planned maintenance outage and a number of short forced outages.

4.7.10 Transmission Outage Duration

The duration of transmission outages is useful for assessing transmission system performance. Transmission outages are broken into eight time classifications ranging from less than 10 minutes to greater than four weeks. The total number of outages in each time classification is shown in Figure 14.

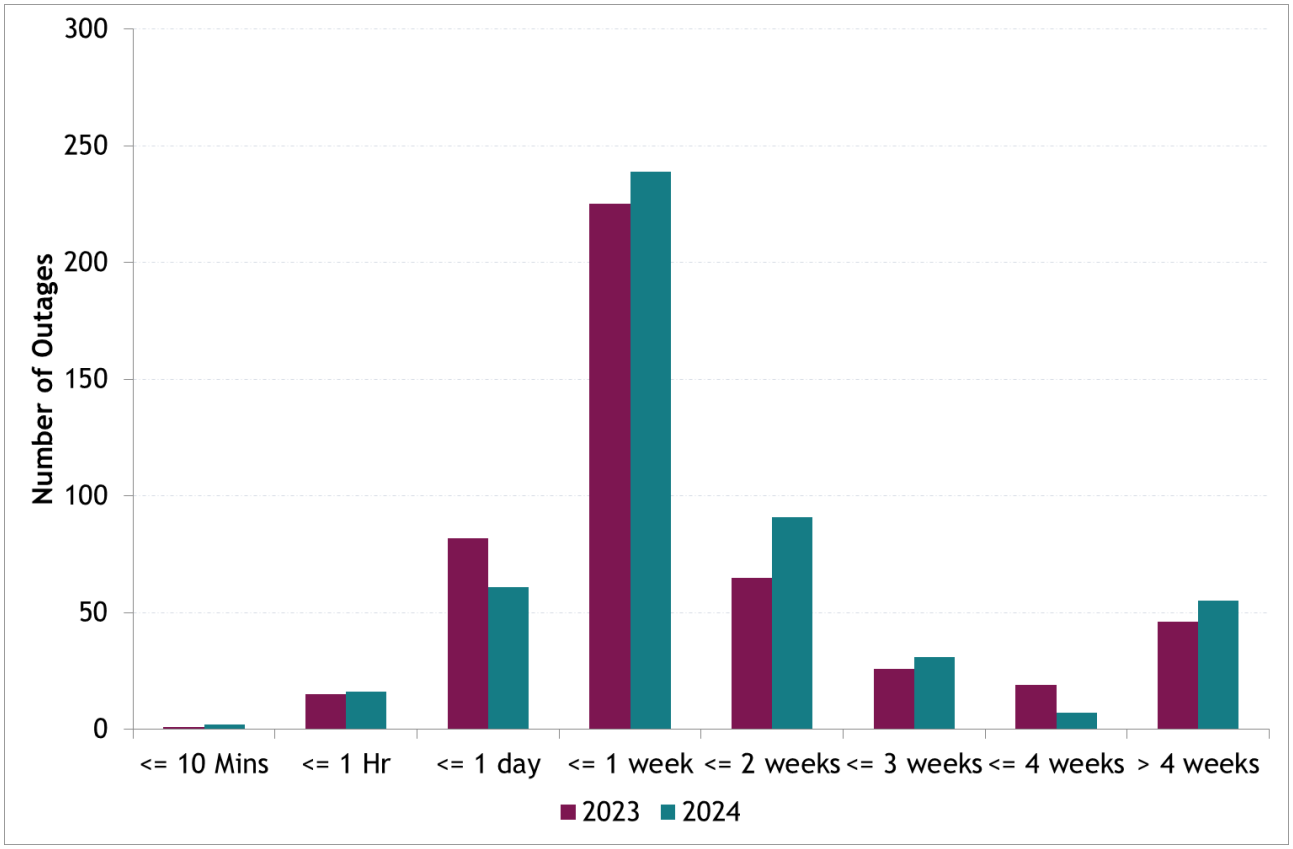

Figure 14: Duration of Outages in 2023 & 2024

The majority of the outage durations are concentrated between one day and 2 weeks with the peak occurring between one day and 1 week. In the category of one hour to one day, outages can be arranged to avoid peak load times and thereby reduce the impact on the system, while one-week outages for annual maintenance are commonplace during the outage season.

4.7.11 Timing of Transmission Outages

Figure 15 shows the percentage unavailability of the transmission system in each month. The March-November period sees the highest rates of unavailability during the year, when decreased system load is taken advantage of to carry out extensive maintenance outages. Figure 16 shows the average duration in days of the transmission outages in each month in 2024.

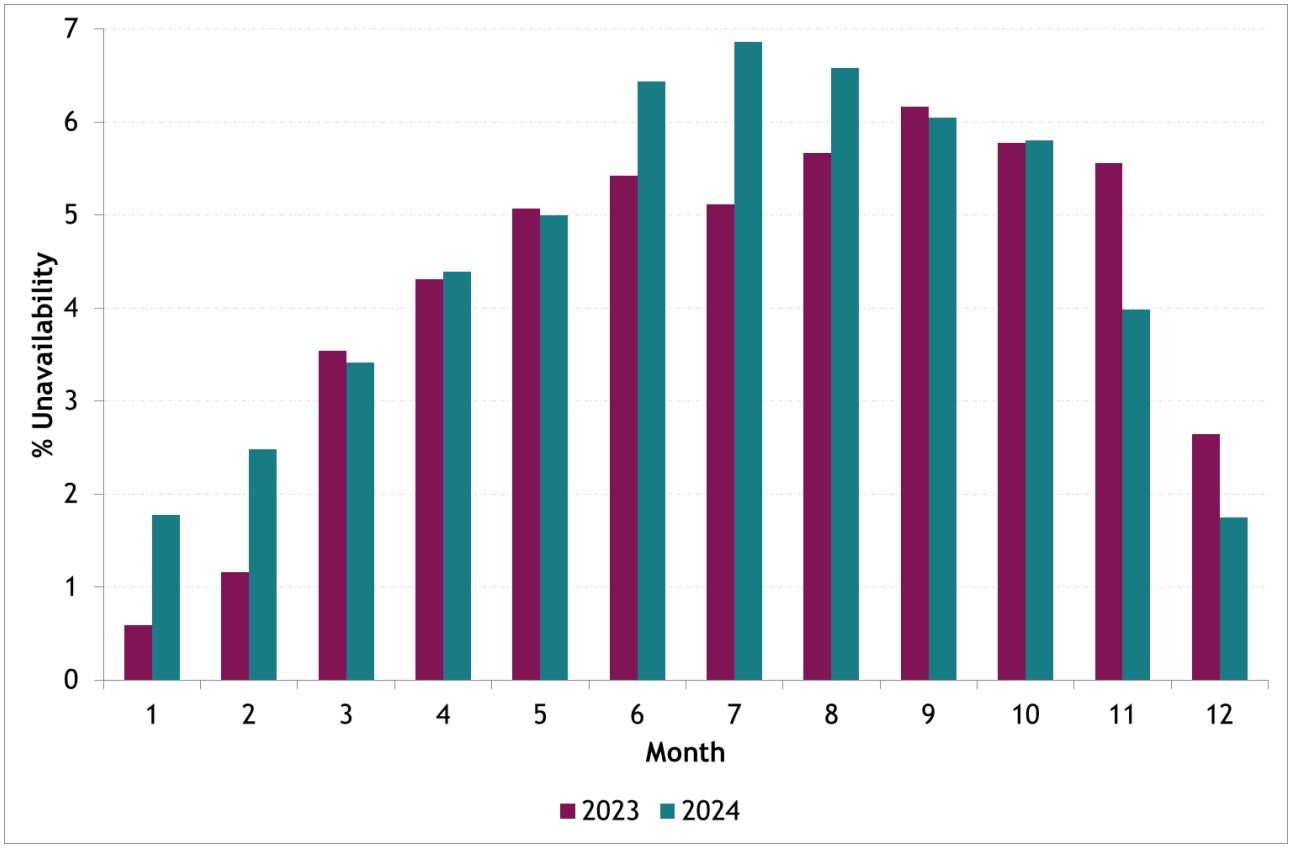

Figure 15: Percentage unavailability in each month of 2023 & 2024

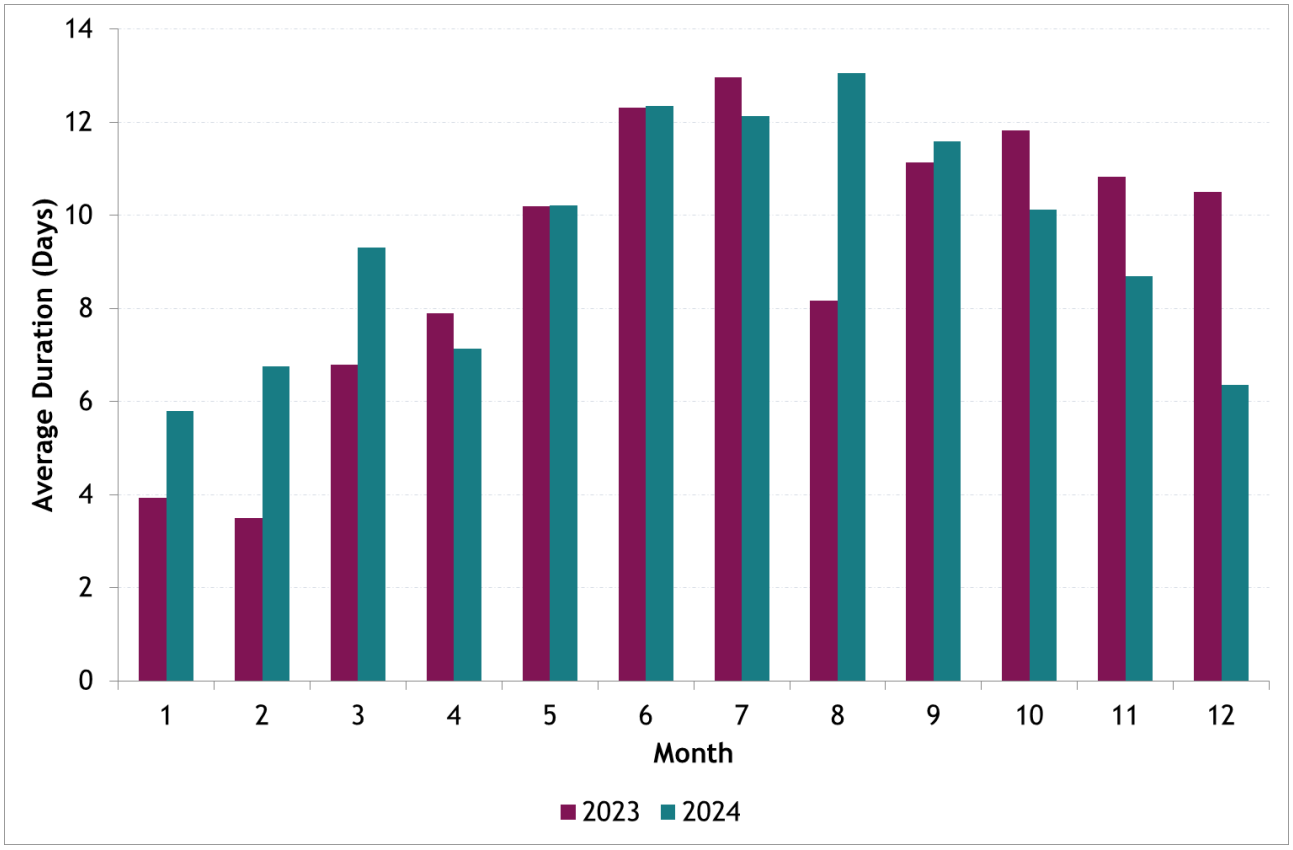

Figure 16: Average duration of outages 2023 & 2024

4.7.12 Forced Outages

There are two main outage classifications, voluntary outages and forced outages. The majority of outages are voluntary outages that are scheduled by EirGrid. Forced outages are not scheduled and cause the most disruption to the transmission system. Due to their disruptive nature, forced outages merit further analysis.

4.7.13 Forced Outages per km

The measure used for analysing the forced outages of lines and cables is the number of forced outages per kilometre of feeder and is shown in Figure 17.

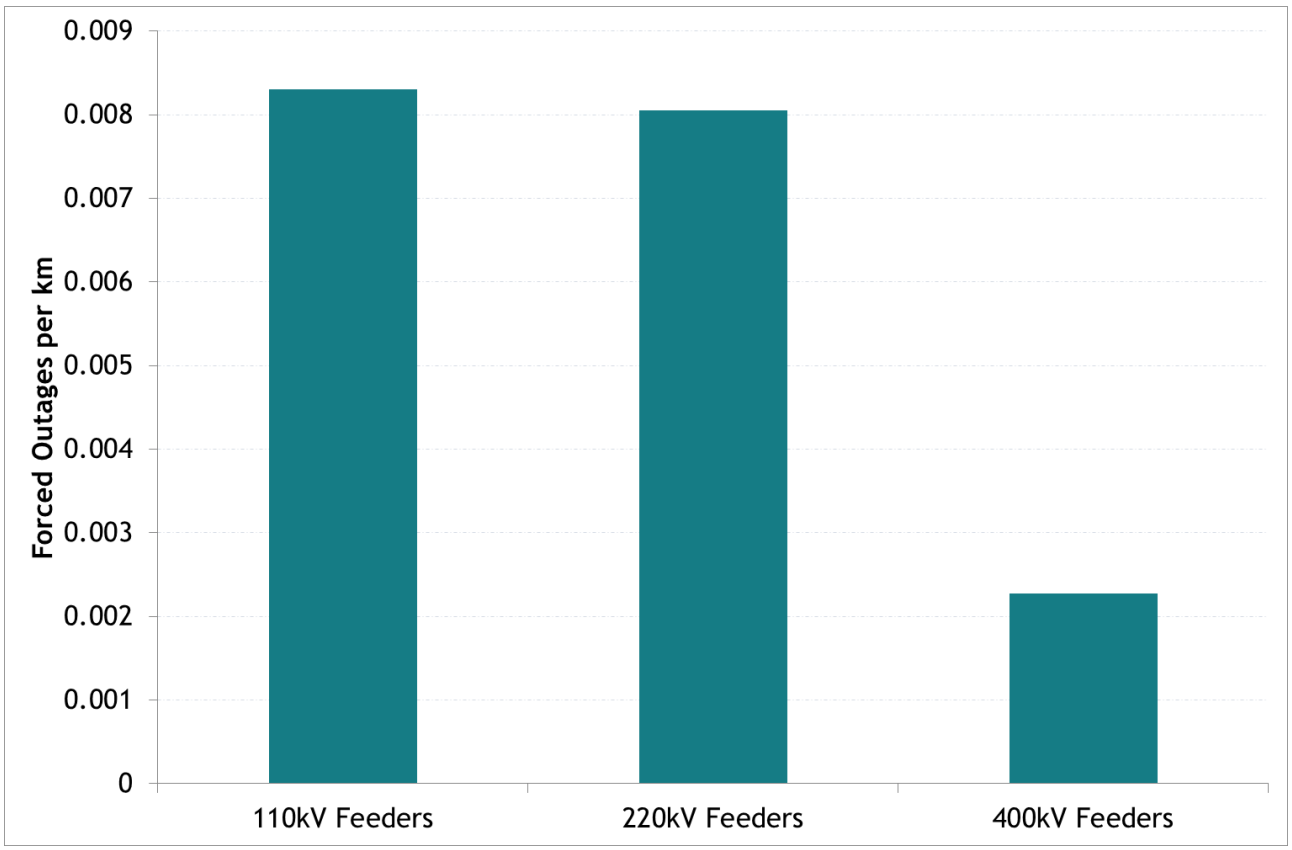

Figure 17: Forced Outages of lines and cables per km in 2024.

4.7.14 Forced Outages per MVA

The measure used for analysing the forced outages of transformers is the number of forced outages per MVA capacity, which can be seen in Figure 18.

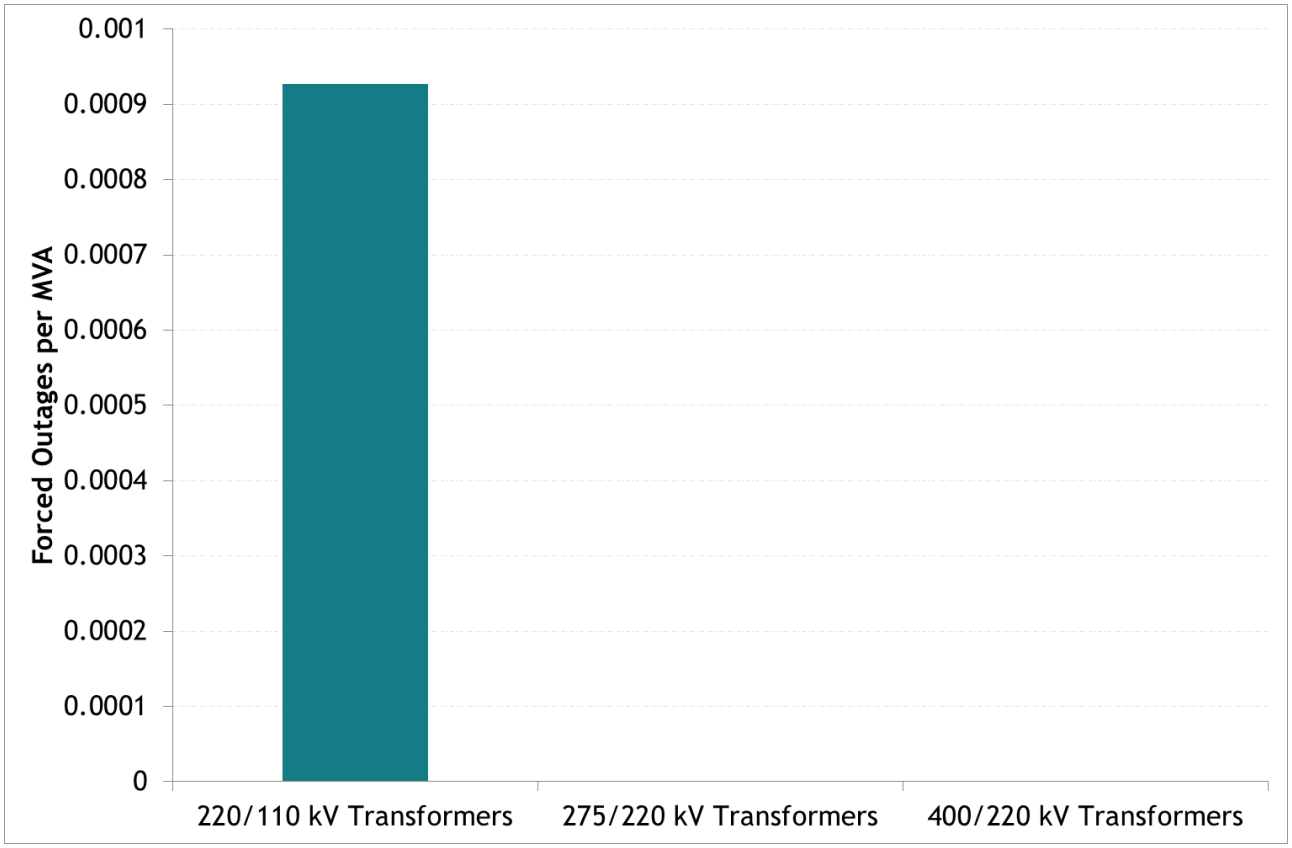

Figure 18: Forced Outage per MVA in 2024

5 SONI Transmission System Performance

This section details the performance of the transmission system in Northern Ireland, unless explicitly stated otherwise. This data has been prepared by SONI in accordance with Condition 20 of the 'Licence to participate in the Transmission of Electricity.

5.1 Summary

SONI is responsible for the safe, secure, efficient and reliable operation of the Northern Ireland transmission network. The transmission network is operated at 275 kV and 110 kV and is made up of 116 circuits covering a total length of approximately 2,311 km. The primary purpose of the transmission system is to transport power from generators and interconnectors to bulk supply points which connect the transmission system to the distribution system.

Availability is a key measure of power system performance. In this report availability refers to the proportion of time a transmission circuit or interconnector was available.

- The annual system availability for 2024 was 98.13%
- The annual availability of the Moyle Interconnector for 2024 was 98.32%.
- The North-South 275 kV tie line, connecting Louth in Ireland and Tandragee in Northern Ireland had an availability of 99.02% in 2024.
- The annual availability of the Strabane – Letterkenny and Enniskillen – Corraclassy 110 kV tie lines were 44.60% and 89.80%, respectively, in 2024.

The Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012 set out the statutory obligations in relation to managing both frequency and voltage for Northern Ireland. Under the regulations SONI is required to report incidents, which have caused interruptions to supply to customers, to the transmission asset owner, NIE Networks. Part 8, provision 33 of the regulation contains details of the requirements for the reporting of incidents.

In 2024, there were no transmission incidents leading to customers being off supply.

Quality of service is measured by the number of voltage excursions which fall outside statutory limits. There were no voltage excursions in 2024 outside the statutory limits.

5.2 Transmission System Availability

5.2.1 System Availability

Transmission system availability is the proportion of time a transmission circuit was available during the calendar year. A circuit is defined as the overhead line, cable, transformer or any combination of these that connects two busbars together or connects the transmission system to another system. Transmission system availability is reduced when a circuit is taken out of service, either for planned or unplanned purposes.

Planned outages are necessary to facilitate new user connections, network development and maintenance of network assets necessary to deliver acceptable levels of system security and reliability. These are outages planned with at least seven days' notice.

Unplanned outages can be a result of equipment failure, or a fault caused by adverse weather etc. These are outages required immediately or planned with less than seven days' notice.

System Availability is calculated using the formula:

$$\text{Sytem Availability (\%)} = \frac{\sum \text{Hours each circuit is available}}{(\text{No. of Circuits}) * (\text{Total No. Hours in Period})}$$

In 2024, the analysis of the transmission system availability data has produced the following results:

- The average availability of the Northern Ireland transmission system was in 2024 was 98.13%
- The average winter system availability (for the winter months January, February, November and December 2024) was 98.83%.

Figure 19 below shows the month-by-month variation in Transmission System Availability in Northern Ireland.

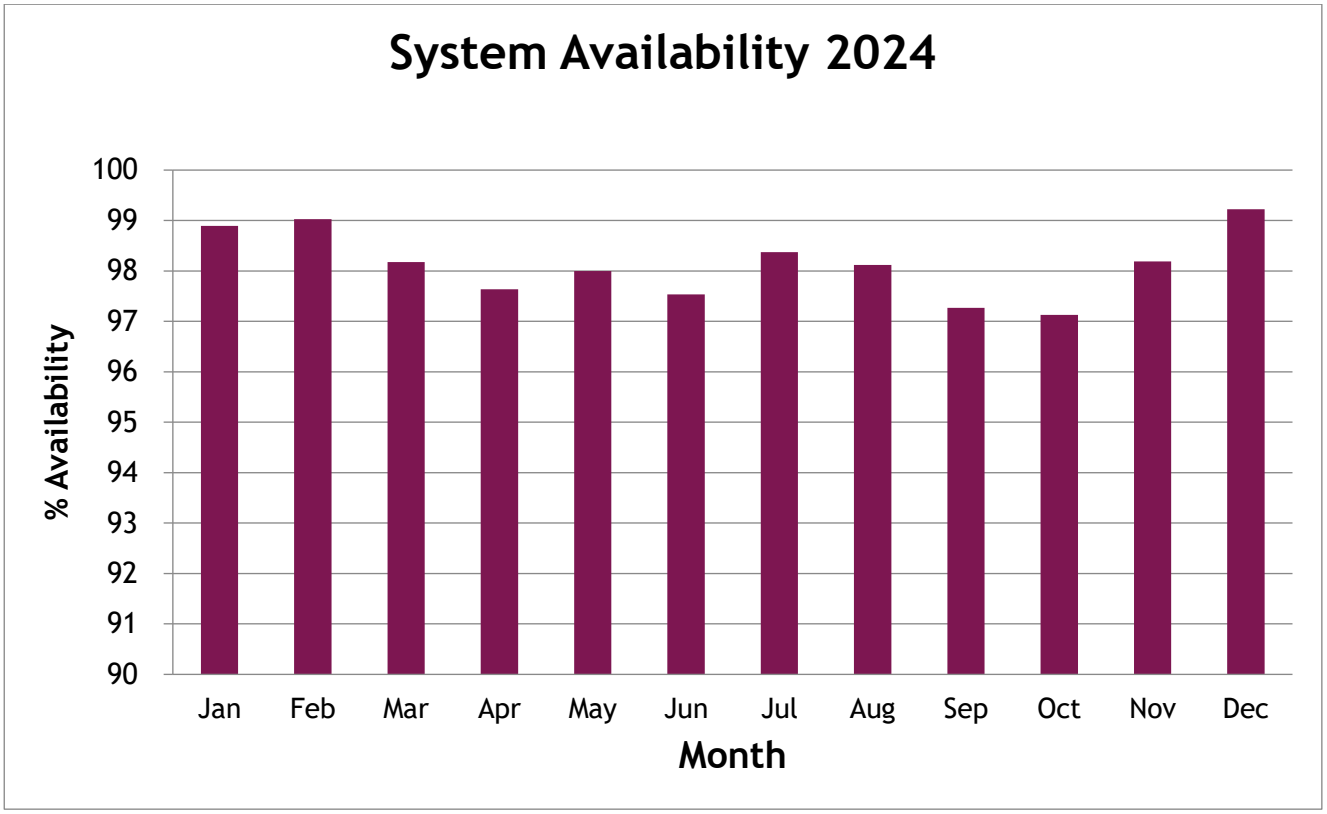

Figure 19: Transmission System Availability 2024

Overall, the availability of the system is high, particularly over the winter months, such as January and December, where maintenance is avoided due to the higher electrical demand and potential adverse weather conditions. The preference is for maintenance to take place over the summer months when network loading is generally lower to mitigate the risk of affecting the supply to customers.

5.2.2 System Unavailability

Figure 20 below shows the month-by-month variation in planned and unplanned system unavailability.

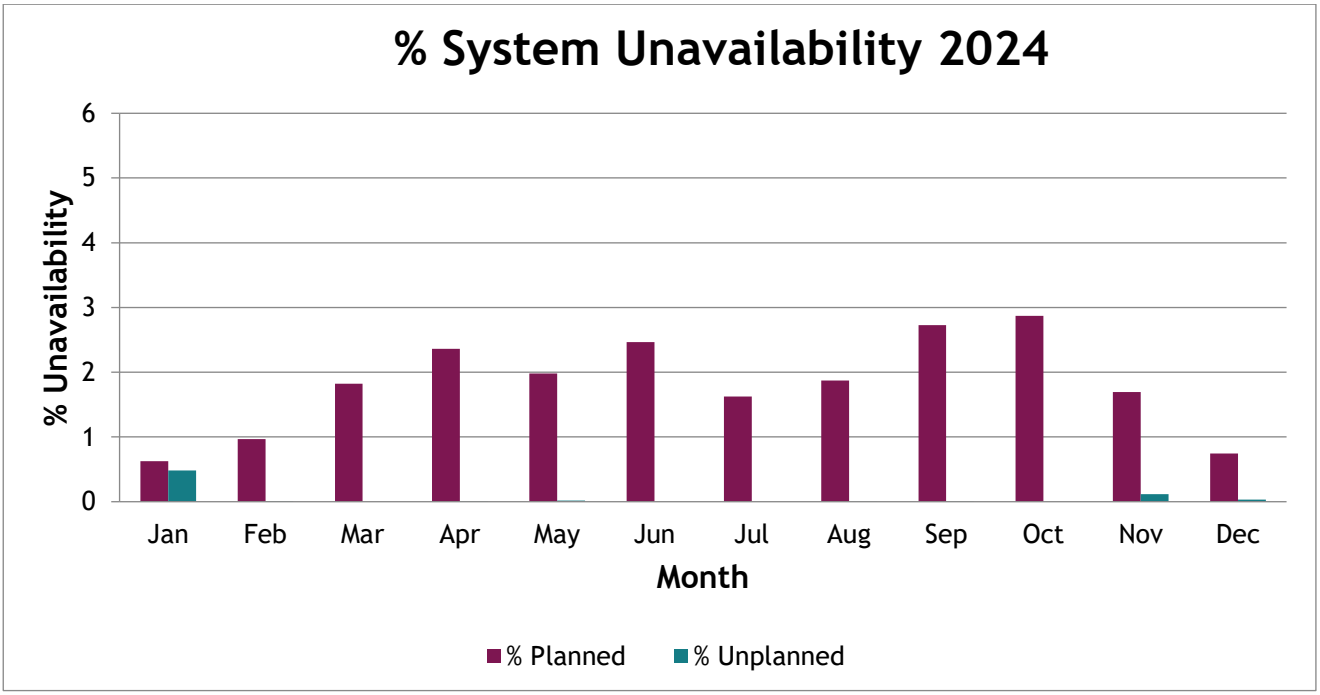

Figure 20: Transmission System Unavailability 2024

Transmission outages are planned during the spring/summer/autumn months where possible. This is to take advantage of periods when the Northern Ireland demand is lower and hence power flows around the transmission system are reduced. During the winter months when demand is higher, only urgent outages or outages that will not reduce the reliability of the transmission system can be accommodated. This is to ensure the resilience of the transmission system is maintained.

5.2.3 System Historical Availability Performance

Figure 21 shows the historic variation in system availability from 2014 to 2024 for the transmission network in Northern Ireland.

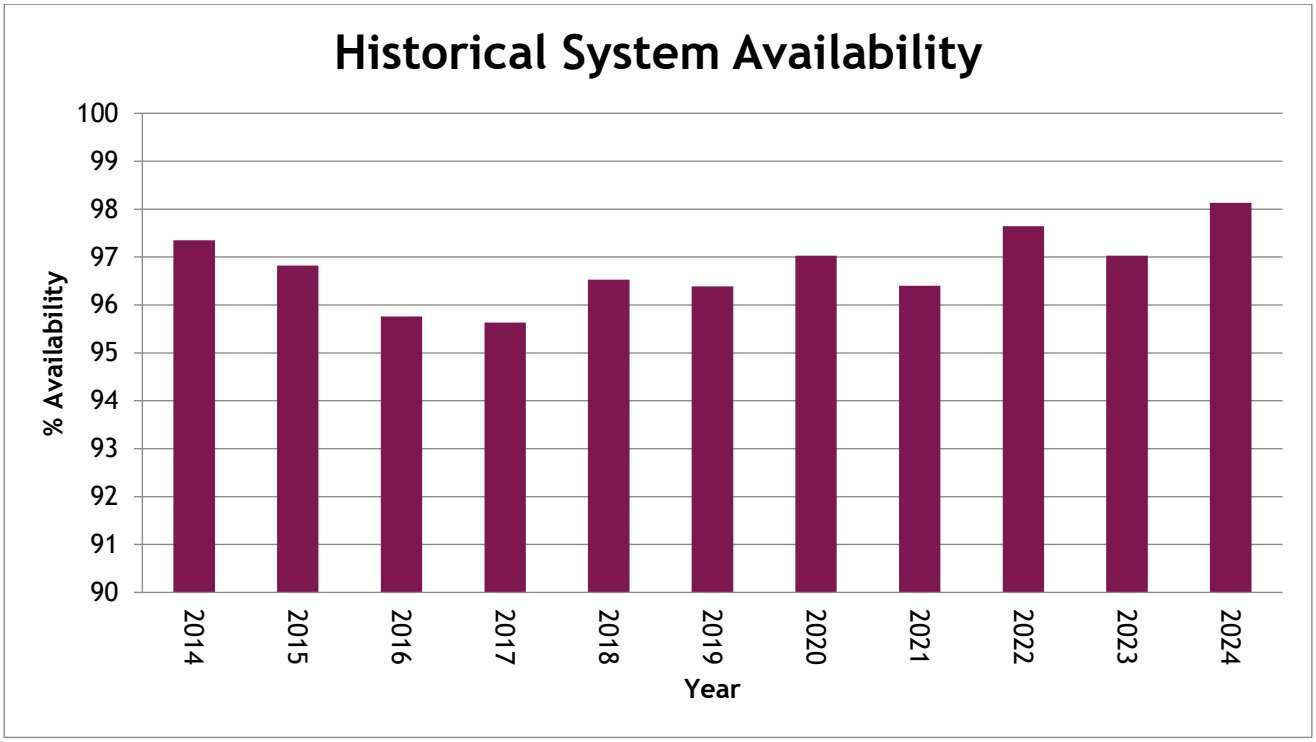

Figure 21: Historical System Availability 2014 to 2024

5.2.4 System Historical Unavailability Performance

Figure 22 below shows the breakdown of the system unavailability from 2014 to 2024.

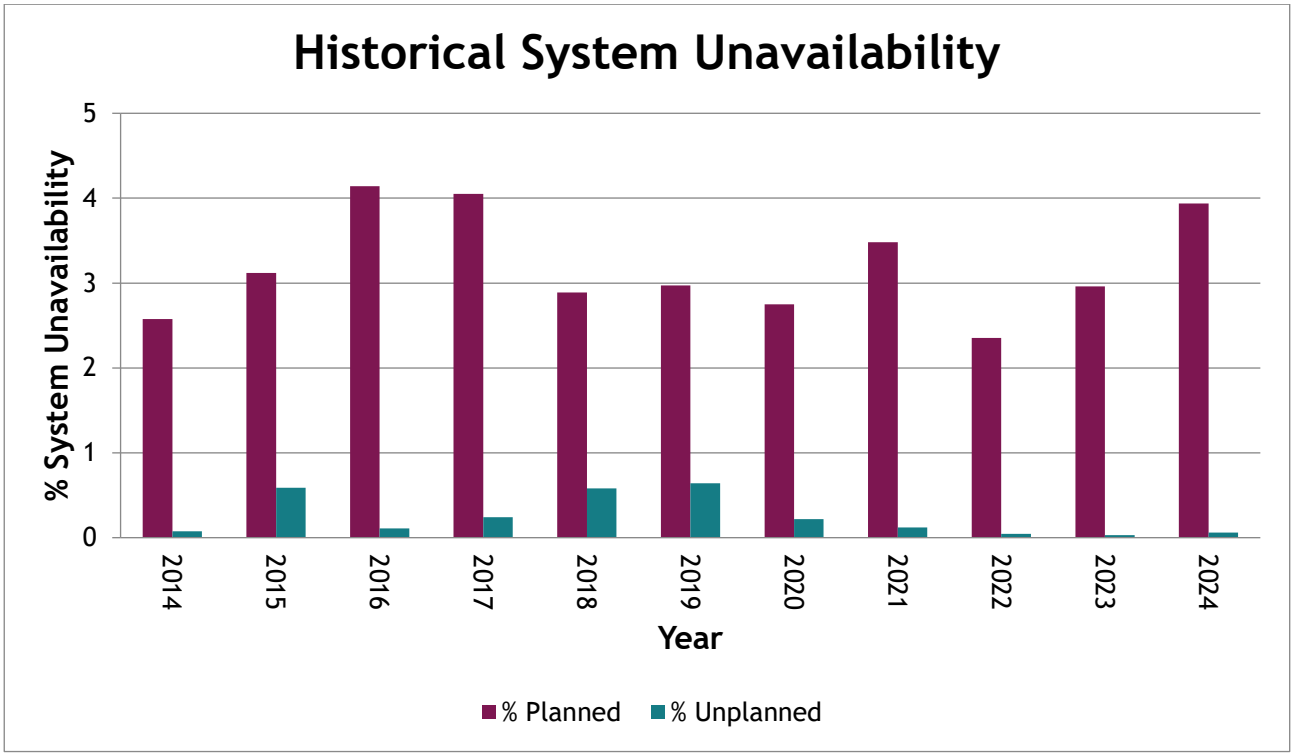

Figure 22: Historical System Unavailability 2014 to 2024

5.2.5 Moyle Interconnector

The Moyle interconnector, owned by Mutual Energy, connects the power systems of Northern Ireland and Scotland. The interconnector is a High Voltage Direct Current (HVDC) system; consisting of two submarine power cables and two HVDC-AC converter stations; one located at Islandmagee in Northern Ireland and the other at Auchencrosh in Scotland.

The interconnector has an operational import capacity of 441 MW and an operational export capacity of a maximum 410 MW (values with reference to the NI system). The interconnector is operated by SONI, and the performance of the interconnector is detailed in this report.

5.2.6 Moyle Interconnector Historical Availability

The Annual Availability of the Moyle Interconnector for 2024 was 98.32%.

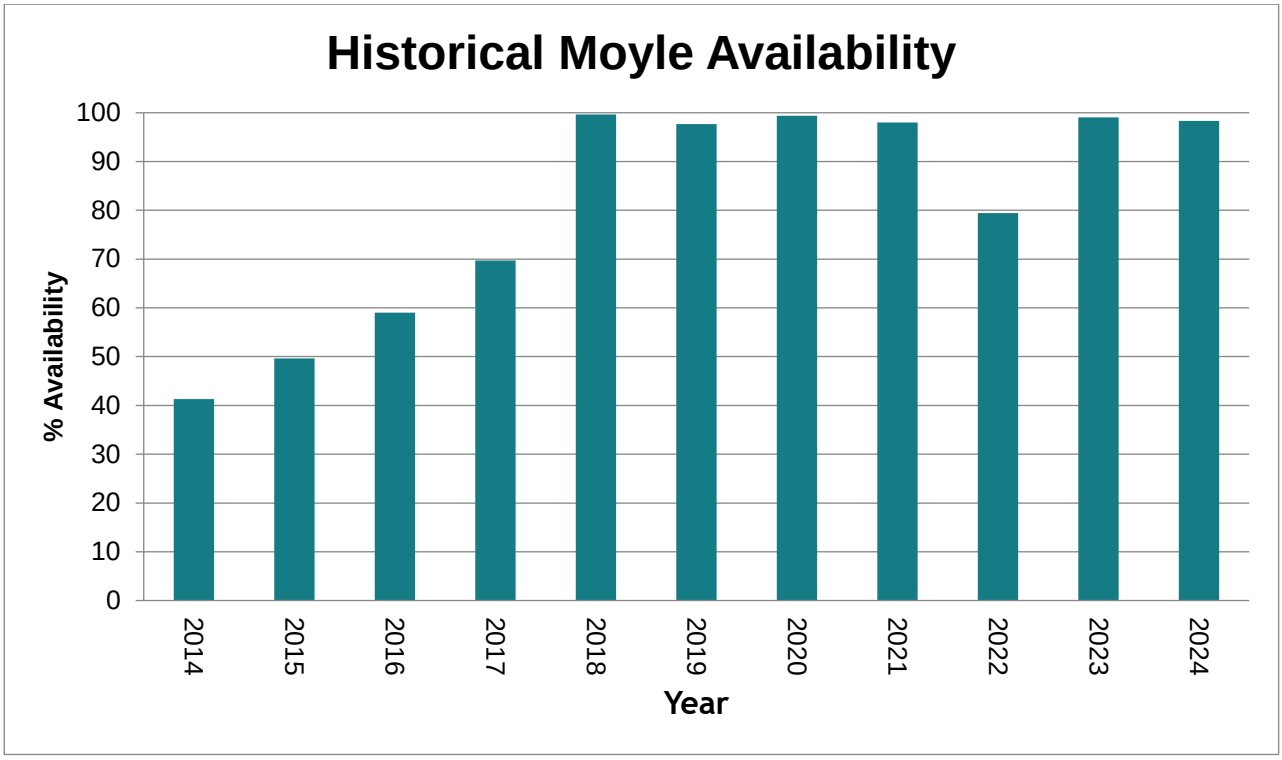

Figure 23: Historical Moyle Interconnector Availability 2014 to 2024

5.2.7 Moyle Interconnector Historical Unavailability

The 2024 Annual Unavailability of the Moyle Interconnector was 1.68%.

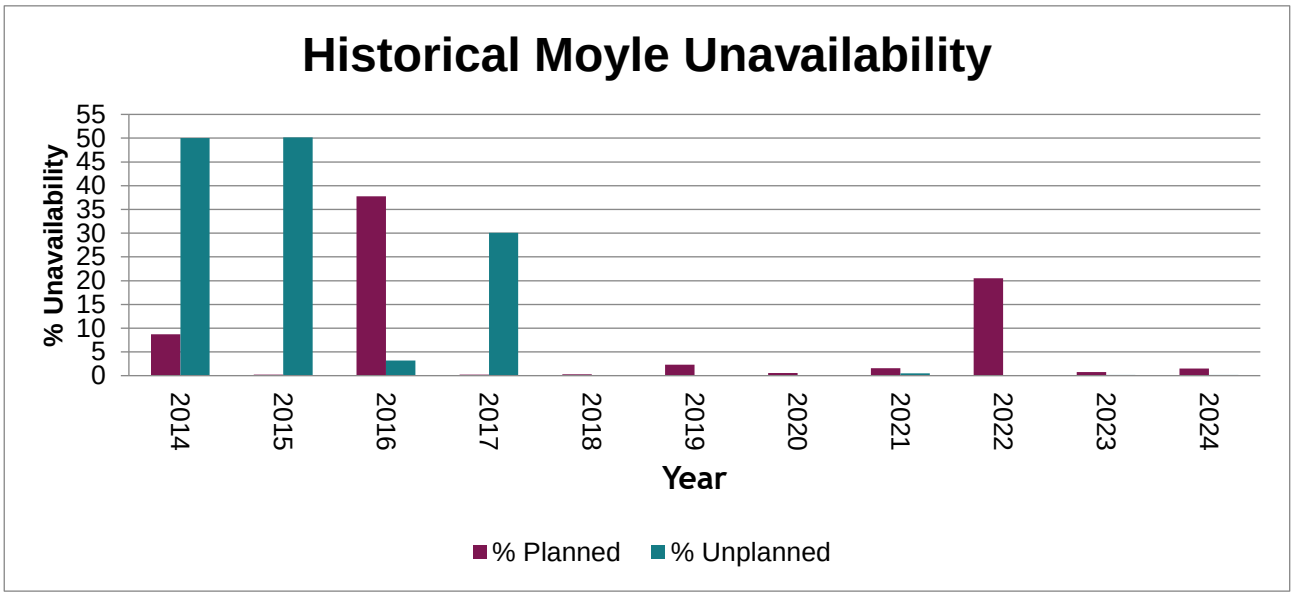

Figure 24: Historical Moyle Interconnector Unavailability 2014 to 2024

5.2.8 Moyle Interconnector Monthly Unavailability

Figure 25 below shows the month-by-month variation of unavailability of the interconnector.

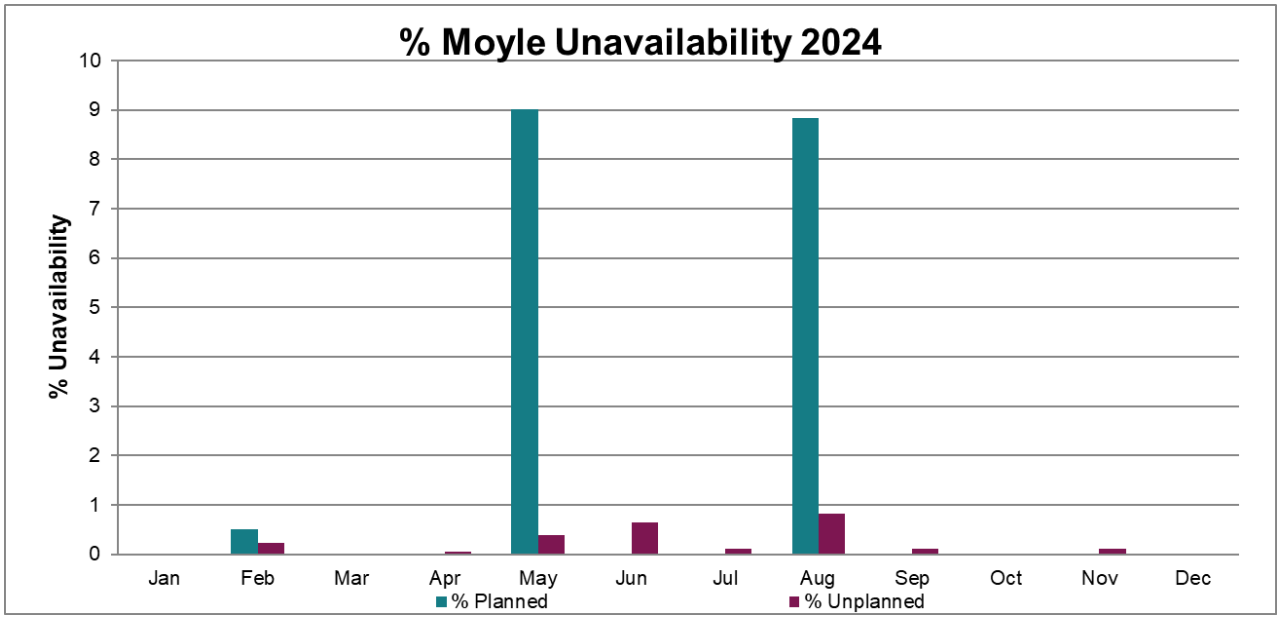

Figure 25: Moyle Interconnector Monthly Unavailability 2024

Figure 25 shows there were scheduled outages of the interconnector primarily throughout May and August. In May there were two separate outages one lasting a single day to replace a faulted cooling pump on Pole 2 and the other lasting 5 days to accommodate fire control replacement and transformer condition assessment on Pole 2. Fire control replacement on Pole 1 took place in August lasting 6 days. Outside of these there were two small outages in February only lasting a few hours each to update the software for each pole. There were forced outages of the interconnector in February, April, May, June, July and August, September and November 2024.

5.2.9 275 kV Tie Line

The connections between Ireland and Northern Ireland are referred to as 'Tie Lines'.

The Northern Ireland transmission system is connected to the transmission system in Ireland by means of one 275 kV double-circuit connection from Tandragee 275 kV substation in Co. Armagh to Louth 275 kV substation in Co. Louth.

The 275 kV double-circuit tie line is used as the method for synchronising the Northern Ireland and Ireland power systems together. Energy can flow freely between both jurisdictions, depending on the operating requirements and generating plant being utilised on the all-island power system.

The annual average availability of the 275 kV North-South Tie Line in 2024 was 99.02%.

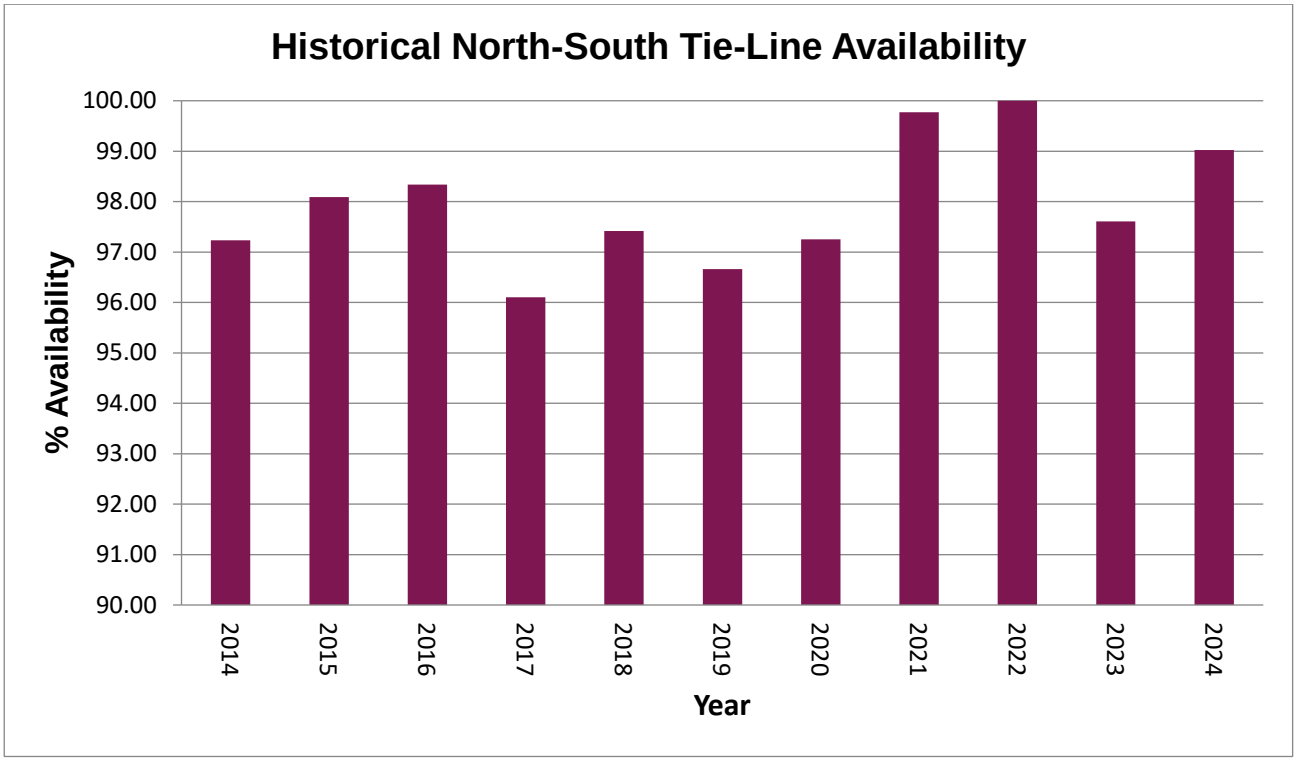

Figure 26: Historical North-South Tie Line Availability 2014 to 2024

A breakdown of 275 kV tie line unavailability is shown in Figure 27 below.

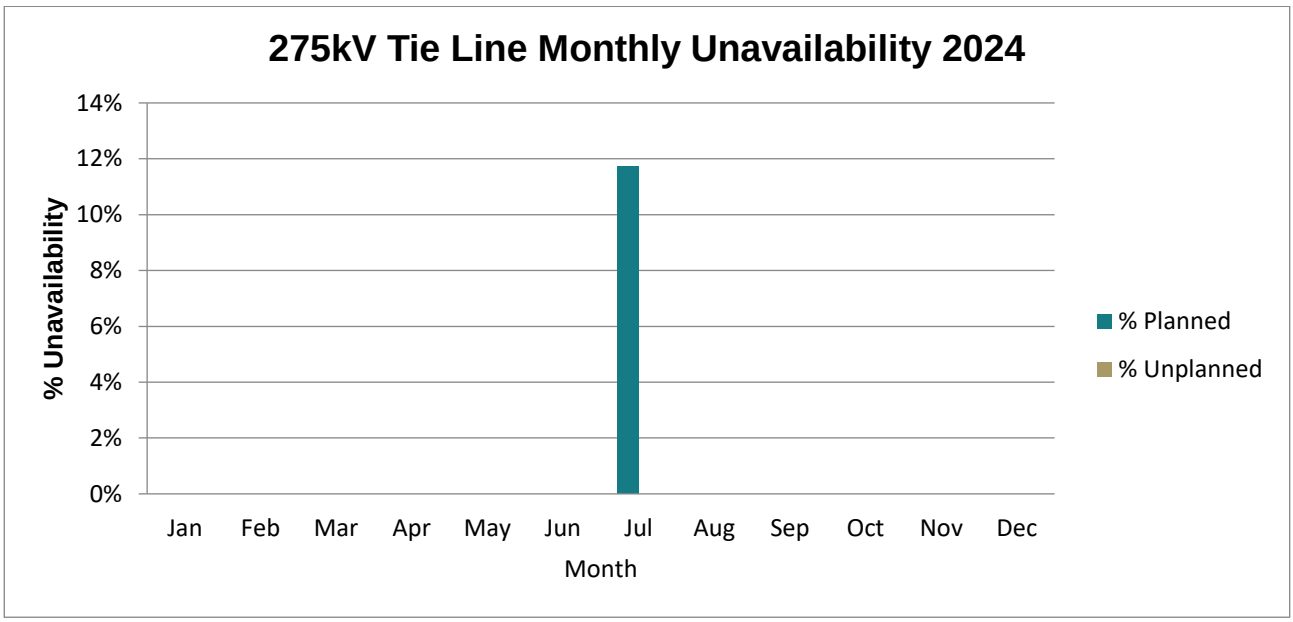

Figure 27: 275kV Tie Line Unavailability 2024

5.2.10 110 kV Tie lines

There are two 110 kV connections between Ireland and Northern Ireland:

- Strabane – Letterkenny 110 kV circuit
- Enniskillen – Corraclassy 110 kV circuit

These 110 kV tie lines provide an AC connection between the two transmission systems, which allows emergency flows of active and reactive power for frequency and voltage support, increasing system stability.

Phase Shifting Transformers (PSTs), designed for energy to flow in two directions, are installed at Strabane and Enniskillen and control the flow of energy between Ireland and Northern Ireland. These PSTs are rated at 125 MW each and are, in normal operation, operated to maintain a 0 MW flow between both jurisdictions.

To negate any potential system abnormalities as a result of transmission outages, either scheduled or unplanned, a controlled flow can be allowed, to support system operation in both jurisdictions. Also, in times of high wind, the Strabane-Letterkenny tie line is used to import excess wind energy being produced in the north-west of Ireland.

The availability of the 110 kV Tie Lines was 67.20% in 2024.

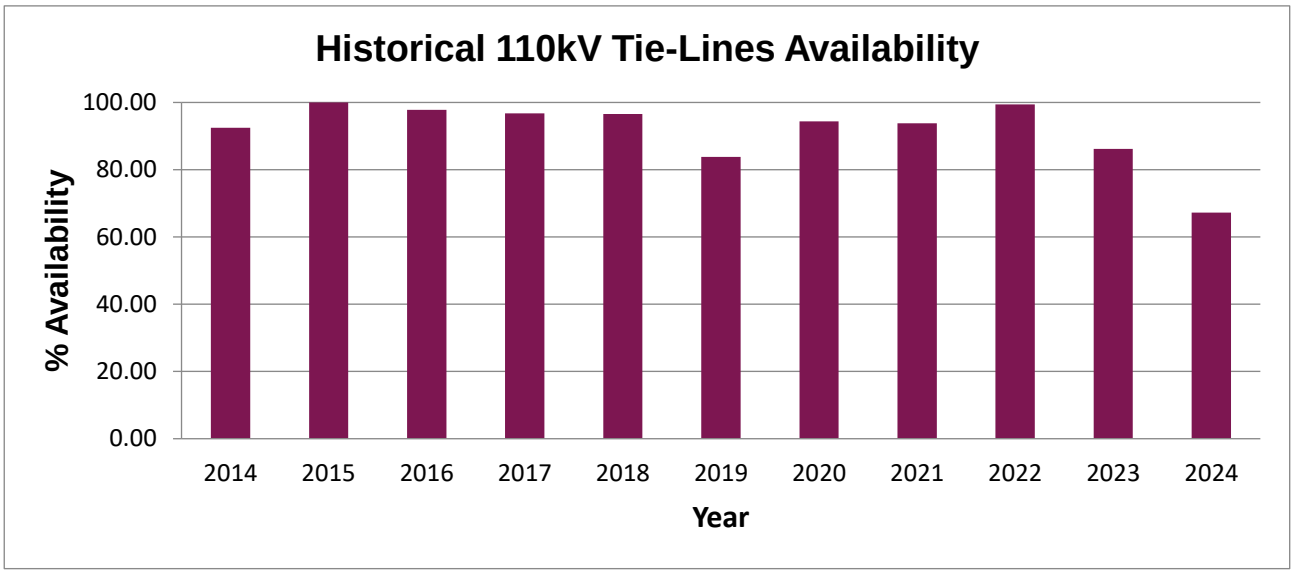

Figure 28: North-South 110Kv Tie Line Availability 2014 to 2024

A breakdown of 110 kV tie line unavailability is shown in Figure 29 below.

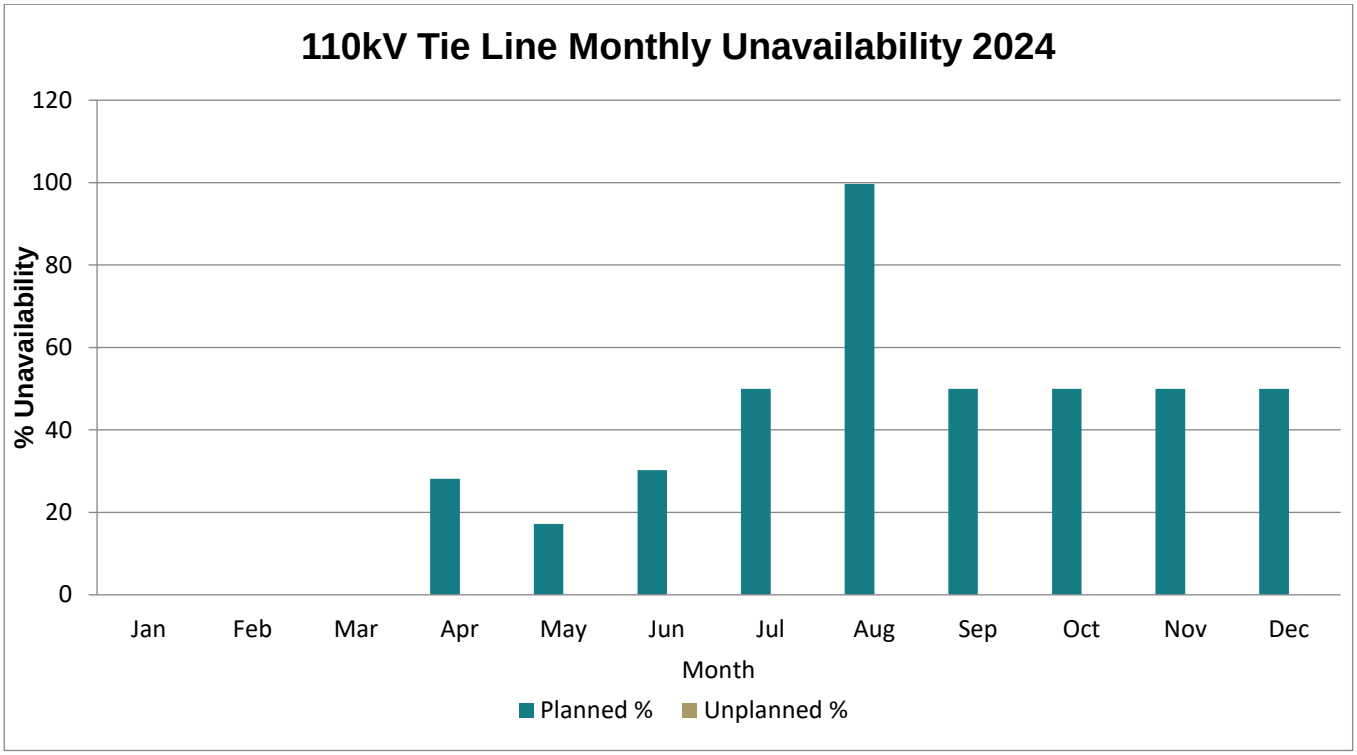

Figure 29: 110kV Tie Line Unavailability 2024

5.3 Transmission System Security

An incident is a system event that results in loss of supply. In this section incidents resulting from issues on the Northern Ireland Transmission system are described individually. The following sections detail the nature, location and duration of the incidents with an estimate of energy unsupplied.

5.3.1 Incidents for 2024

The criterion for the reporting of incidents is specified in Part 8, paragraph 33, of 'The Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012'. An incident shall be reported if there has been:

- any single interruption of supply, to any demand of 20 MW or more at the time of the interruption, for a period of three minutes or longer; or
- any single interruption of supply, to any demand of 5 MW or more at the time of the interruption, for a period of one hour or longer; or
- any single interruption of supply to 5,000 or more consumer's installations for a period of one hour or longer.

5.3.2 Number of Incidents and Estimated Unsupplied Energy

In 2024, there were no system events in Northern Ireland that resulted in the loss of supply to customers.

5.3.3 Incident Analysis

Figure 30 details the incidents that have occurred historically in Northern Ireland.

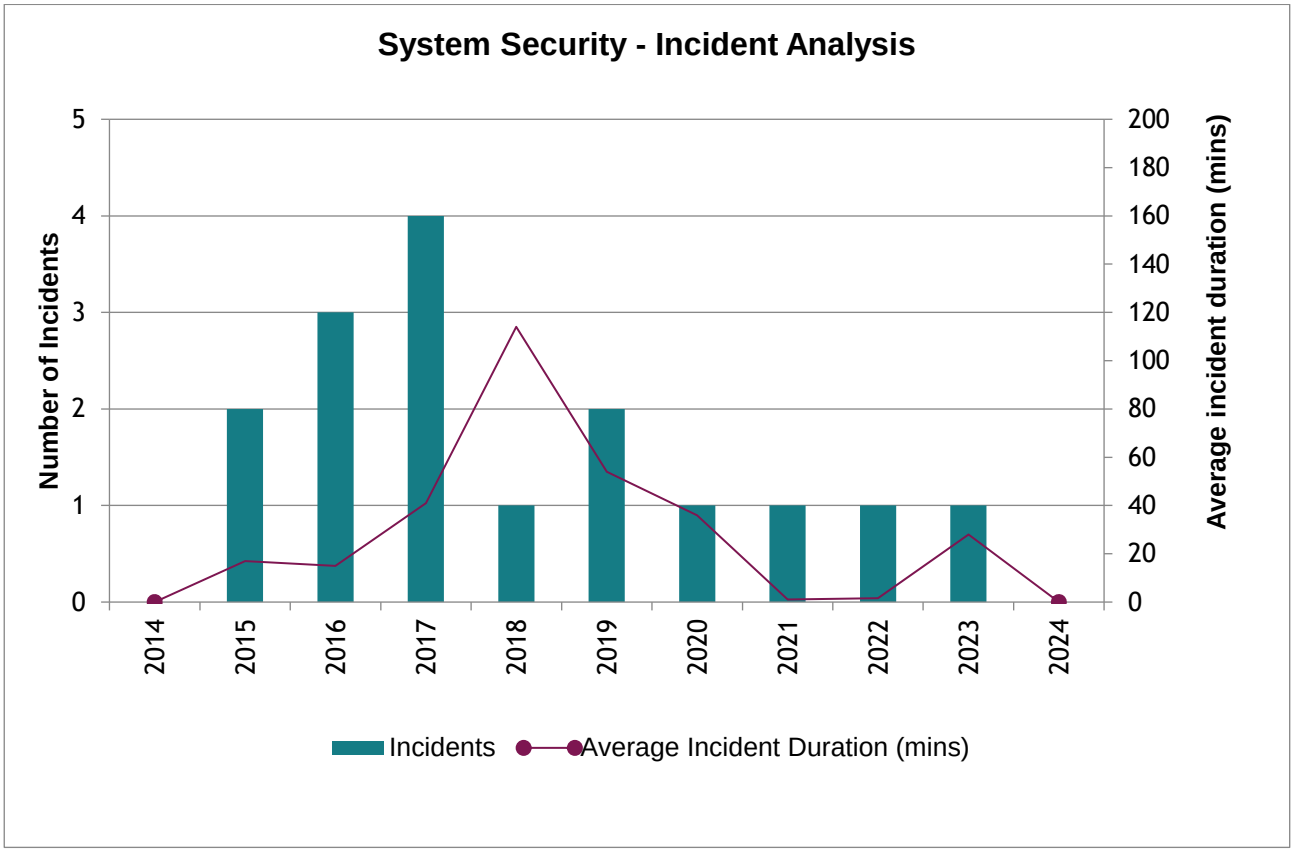

Figure 30: Historical System Security 2014 to 2024

5.3.4 Unsupplied Energy

Figure 31 below shows the historical amount of unsupplied energy to Northern Ireland customers.

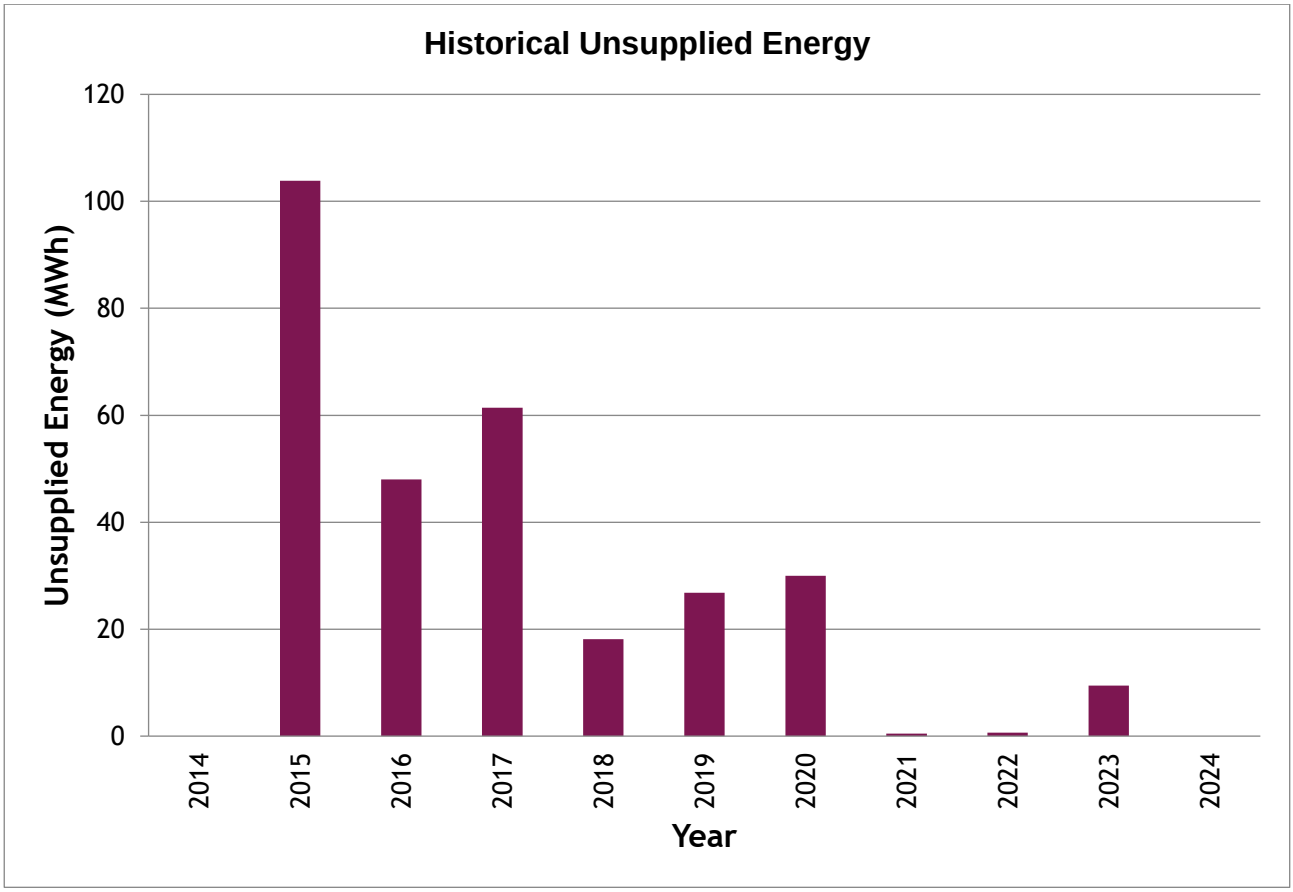

Figure 31: Historical Unsupplied Energy 2014 to 2024

5.3.5 System minutes lost

The total system minutes lost for 2024, attributable to SONI, was 0. The trend of system minutes lost since 2014 is shown in Figure 32.

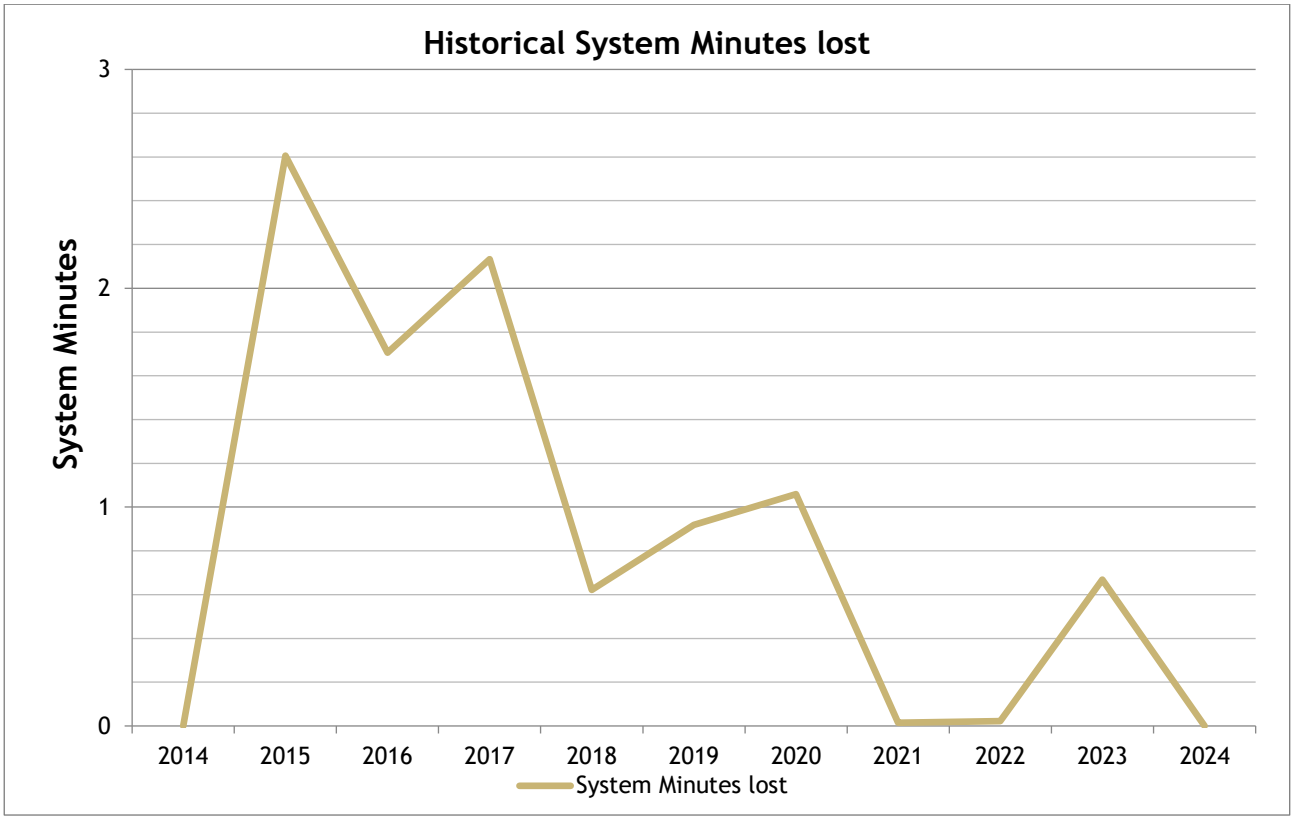

Figure 32: System minutes lost 2014 - 2024

5.3.6 Zone Clearance Ratio

The Zone Clearance Ratio (ZCR) is defined as the ratio of the number of short circuit system faults not cleared in Zone 1 to the total number of short circuit faults per year cleared by Main System protection. See " Zones of Protection" for further definition of Zones and ZCR.

In 2024, the ZCR was 0. Of the 8 short circuit faults in 2024, the main system protection was expected to operate without delay for all 8 of those short circuit faults on the main system. All 8 of the aforementioned faults were cleared in Zone 1, giving a zone clearance ratio of 0.

5.4 Quality of Service

Quality of service is measured with reference to system voltage and frequency.

5.4.1 Voltage

The Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012 details the requirements for the management of voltage in Northern Ireland.

Part 7, paragraph 28 permit variations not exceeding 10% for operating voltages of 110 kV or higher. As well as adhering to legislation, SONI also operates the transmission system in such a way as to comply with the Operating Security Standards[9], acceptable step changes in voltages are detailed in Table 10.

Table 10: Voltage step change limits in operational timescales

Transmission System secured events or switching event	Voltage fall	Voltage rise
Following loss of single circuit	-6%	+6%
Following loss of double circuit overhead line	-10%	+6%

5.4.2 Voltage Excursions

There were no voltage excursions exceeding these limits in 2024.

5.4.3 Frequency

SONI is required to manage the frequency of the power system. Power system frequency is a measure of balance between the electrical demand on the network and the amount of energy being generated. The Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012 details the requirements for the management of Frequency in Northern Ireland.

Part 7, paragraph 28 of the regulations permits a frequency variation of up to 0.5 Hz above or below 50 Hz. There was one reportable frequency excursions in Northern Ireland in 2024.

[9] SONI Operating Security Standards

5.4.4 Frequency Excursions

There was one reportable frequency excursion in Northern Ireland in 2024. On 14/02/2024 EWIC tripped, and the frequency reduced to around 49.7 and 22 seconds later Moyle tripped and the Frequency went down to 49.582Hz.

5.4.5 Historical Frequency Excursions

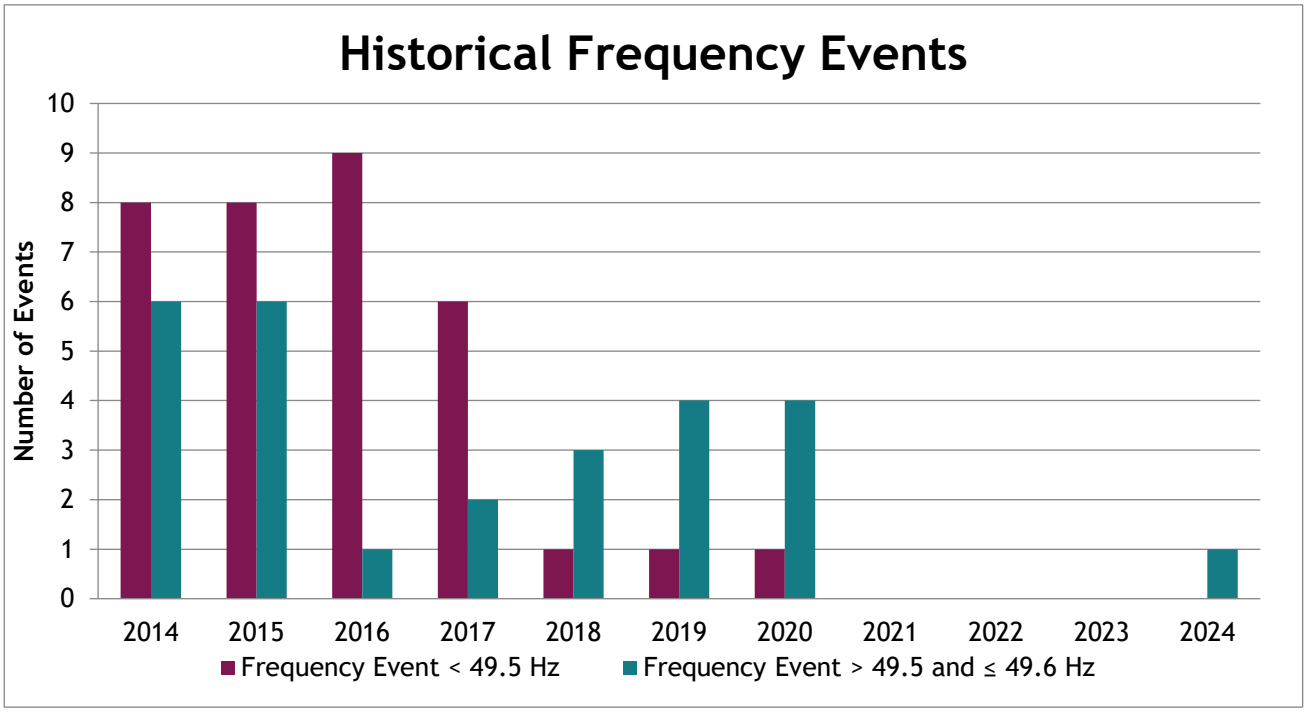

Figure 33: Historic Frequency Excursions 2014-2024

6 Appendix 1 Glossary

6.1 DCEF

Directional comparison earth fault. A teleprotection scheme that allows accelerated tripping by exchanging permit and receive signals for earth faults in a relay's forward direction.

6.2 Disturbance

A system disturbance is defined as one or more related faults and their consequences which occur either simultaneously or over a period of time. These incidents are grouped in a single system disturbance report under the highest voltage involved.

6.3 Fault

Any abnormal event causing or requiring the tripping of a Main System circuit breaker automatically within the Main System. Any abnormal event causing or requiring the closing of a Main System circuit breaker automatically within the Main System. Any abnormal event causing or requiring the tripping of an MV circuit breaker automatically by under frequency relay operation.

6.4 Main system: EirGrid

The main transmission system includes: the 400 kV, 220 kV and 110 kV overhead line (OHL) and underground cable (UGC) network, the 400 kV, 220 kV and 110 kV busbars and couplers, the 400/220 kV and 220/110 kV coupling transformers (with the exception of those feeding the Dublin city 110 kV network). It also includes the 275 kV ESB/NIE Networks interconnector as far as the border with Northern Ireland, and the associated 275/220 kV transformers. The main transmission system does not include the Dublin city 110 kV network or the 220/110 kV coupling transformers at Carrickmines, Inchicore and Poolbeg. The HV circuit breakers of tail connected lines and directly connected transformers (DSO load, directly connected industrial customer load, generator and HVDC interconnector transformers) are part of the main transmission system thus faults on these lines and transformers, which cause transmission system circuit breakers to be tripped, are reported.

6.5 Main system: SONI

The main transmission system includes: the 275 kV and 110 kV OHL and UGC network, the 275 kV and 110 kV busbars and couplers, the 275/110 kV interbus transformers, and all 110/33 kV transformers (aka main transformers). It also includes the 275 kV ESB/NIE Networks interconnector as far as the border with Ireland. The HV circuit breakers of directly connected transformers (generator and HVDC interconnector transformers) are part of the main transmission system thus faults on these transformers, which cause transmission system circuit breakers to be tripped, are reported.

6.6 Major incident

A major incident is one which results in the loss of greater than or equal to one system minute as a result of a single system disturbance.

6.7 MVA Minute Lost

Amount of Power (Mega Volt-Amp) not supplied during an interruption of one minute.

6.8 Non main system/outside the main system: EirGrid

All HV plant on the Irish electricity network that does not form part of the main system: the Dublin 110 kV network (controlled by the DSO at the northern distribution control centre (NDCC). The MV system in Ireland is controlled by the NDCC in Leopardstown), all DSO and industrial customer load transformers, all Independent Power Producer (IPP) generator transformers, and all plant on the NIE Networks owned, SONI controlled, HV system in Northern Ireland.

6.9 Non main system/outside the main system: SONI

All HV plant connected to the Northern Irish electricity network that does not form part of the main system: all IPP generator transformers, HVDC interconnector transformers, and all plant on the ESB owned, EirGrid controlled, HV system in Ireland.

6.10 Non-System Fault

Any unplanned circuit breaker operation resulting from a cause other than a system fault or incorrect manual operation from a control point.

6.11 Permanent Fault

A fault is permanent if the component or unit is damaged and cannot be restored to service until repair or replacement is completed. An overhead line trips and stays out of service due to the absence or outage of reclosing facilities; the fault is permanent if maintenance staff must carry out equipment repairs or replacement before the line is returned to service. A protection setting change is required on the piece of plant before or after it is switched in following a fault.

6.12 POTT

Permissive Overreach Transfer Trip. A distance teleprotection scheme that allows accelerated tripping by exchanging permit and receive signals for faults in a relay's zone 2.

6.13 Protection - Correct Operation

The operation is correct if a fault is cleared by the protection (in any time step) such that the correct circuit breakers open and no other circuit breaker opens.

6.14 Protection - Incorrect Operation

The operation is incorrect if, while a fault is being cleared, a circuit breaker is opened which should not have opened or a circuit breaker remains closed which should have opened.

6.15 PUTT

Permissive Underreach Transfer Trip. A distance teleprotection scheme that allows accelerated tripping by receiving a signal for a fault in a relay's forward direction.

6.16 Sustained Interruption

A sustained interruption is one which lasts for more than one minute.

6.17 System Fault

Any fault or system abnormality which involves or is the result of failure of primary electrical apparatus and which requires the disconnection of the affected equipment from the system by the automatic tripping of the associated circuit breaker.

6.18 System Minute

A measure of the energy not supplied for a disturbance. The metric takes account of the load lost (MW), duration of disconnection (Minutes) and peak system demand (MW), to allow for historical comparison. For example, if 300 MW were lost for 10 minutes and the system peak was 3000 MW, this would represent one System Minute.

$$System\ Minutes\ = \frac{(Load\ MW\ \times\ Duration\ mins)}{(System\ Peak\ MW)}\ = \frac{(300\ \times\ 10)}{3000}\ =\ 1$$

6.19 Transient Fault

A fault is transient if the unit or component is undamaged and is restored to service through manual switching operations, or rapid automatic reclosure on overhead lines, without repair being performed, but possibly with on-site inspection.

6.20 Zone Clearance Ratio

The Zone Clearance Ratio is defined as the ratio of the number of short circuit faults not cleared in Zone 1 to the total number of short circuit faults per year. The more faults cleared in Zone 1, the quicker they are taken off the power system which reduces the risk of system instability, plant damage and injury to personnel.

6.21 Zones of Protection

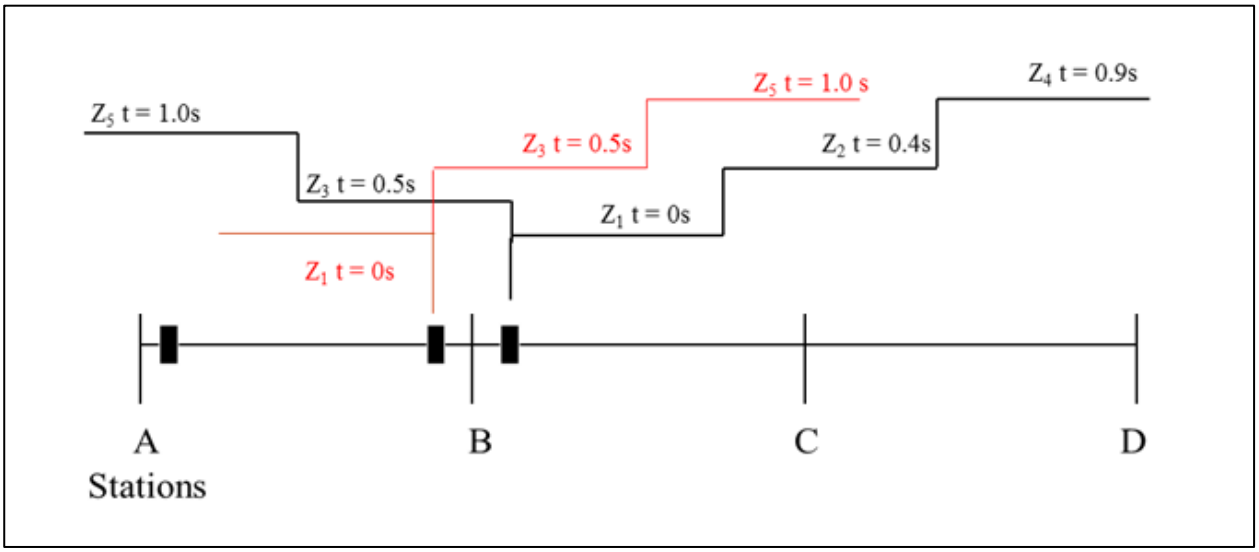

Figure 34: Zones of Protection

Zone 1 on an impedance (distance) relay is the primary protection zone and in the case of an overhead line is set to 70 - 85% of the circuit length depending on the location of the circuit in the transmission network. There is no time delay for the relay to pick up when a fault occurs within the Zone 1 reach, as shown in Figure 34. Typical Zone 1 clearance times are 50 to 150 ms.

Zone 2 on an impedance relay is used as a backup protection zone and is set to 100% of the circuit length plus 20 - 50% of the length of the shortest feeder at the remote end of the protected circuit. A delay of approximately 400 ms is applied in Zone 2 settings and so typical Zone 2 fault clearance times are 450 to 550 ms.

Zone 3 on an impedance relay is used as a backup protection zone and is set to 20 - 50% of the length of the shortest feeder in the reverse direction. A delay of approximately 500 ms is applied in Zone 3 settings and so typical Zone 3 fault clearance times are 550 to 650 ms.

Zone 4 is the third forward step of a distance scheme with a time delay of approximately 900 ms.

Zone 5 is the second reverse step of a distance protection scheme with a time delay of approximately 1.1 seconds.

7 Appendix 2 All Island Dispatchable Generation Plant

Table 11: All Island Dispatchable Generation Plant

Company	Unit	Capacity (MW)	Fuel	365-day Rolling Availability %
AC Automation	ACA	7.625	DSU	75.0
Enel X	AE1	80.197	DSU	12.2
	AE2	12.407	DSU	22.0
	AE3	13.969	DSU	47.9
	AE4	15.096	DSU	1.6
	AE5	15.300	DSU	0.0
	EN1	15.451	DSU	0.7
	EN2	16.980	DSU	0.0
	EN3	16.330	DSU	41.4
	EN4	15.700	DSU	44.1
	EN5	5.359	DSU	0.0
	EN6	30.012	DSU	21.5
	EN8	23.350	DSU	26.6
	EN9	15.918	DSU	31.4
	EX1	20.200	DSU	0.0
Activation Energy Ltd (NI)	AEA	1.561	DSU	0.0
EPUK	Ballylumford - B10	101.000	Gas / Distillate Oil	57.4
	Ballylumford – B31	247.000	Gas / Distillate Oil	59.9

Company	Unit	Capacity (MW)	Fuel	365-day Rolling Availability %
	Ballylumford – B32	247.000	Gas / Distillate Oil	86.3
	Ballylumford - BGT1	58.000	Distillate Oil	97.8
	Ballylumford - BGT2	58.000	Distillate Oil	98.7
	Kilroot - KGT1	29.000	Distillate Oil	93.8
	Kilroot - KGT2	29.000	Distillate Oil	87.6
	Kilroot - KGT3	42.000	Distillate Oil	93.9
	Kilroot - KGT4	42.000	Distillate Oil	94.8
	Kilroot – KGT6	350.000	Gas	72.0
	Kilroot – KGT7	350.000	Gas	53.4
Aughinish Alumina Ltd	Seal Rock - SK3	83.000	Gas / Distillate Oil	89.7
	Seal Rock - SK4	83.000	Gas / Distillate Oil	76.0
	EB1	25.000	DSU	3.0
Bord Gáis	Whitegate - WG1	444.000	Gas / Distillate Oil	90.2
Carmeen	CMN	20.000	Distillate Oil	83.1
Contour Global	CGA	12.084	Gas	54.0
Coolkeeragh ESB	Coolkeeragh - C30	425.000	Gas / Distillate Oil	87.9
	Coolkeeragh - CG8	53.000	Distillate Oil	71.0
DAE Virtual Power Plant	DP1	8.067	DSU	37.2
	DP2	21.156	DSU	37.1
	DP3	8.413	DSU	13.5
Dublin Waste to Energy	Dublin Waste - DW1	62.000	Waste	82.4
Edenderry Power Ltd	Edenderry - ED1	118.000	Biomass	58.3

Company	Unit	Capacity (MW)	Fuel	365-day Rolling Availability %
	Edenderry - ED3	58.000	Distillate Oil	99.7
	Edenderry - ED5	58.000	Distillate Oil	99.8
Electricity Exchange NI	VN1	7.547	DSU	10.1
VIOTAS	EE1	58.687	DSU	17.9
	EE2	25.211	DSU	21.4
	EE3	12.958	DSU	10.5
	EE4	15.305	DSU	9.5
	EE5	21.748	DSU	51.3
	EE6	13.718	DSU	42.9
	EE7	36.007	DSU	31.3
	EE8	4.098	DSU	37.1
	EE9	4.898	DSU	26.8
	VS1	4.168	DSU	17.9
	VS2	6.006	DSU	21.9
Empower	EMP	12.755	Distillate Oil	100.0
Endeco Technologies	EC1	52.616	DSU	20.9
	EC2	12.750	DSU	25.7
	EC3	5.194	DSU	37.8
	EC4	4.820	DSU	48.3
	EC5	17.197	DSU	17.6
	EC6	4.105	DSU	N/A
	ECA	24.305	DSU	32.7
	ECB	8.867	DSU	58.3
Energy Trading Ireland	ETB	5.542	DSU	3.8

Company	Unit	Capacity (MW)	Fuel	365-day Rolling Availability %
	ETC	4.039	DSU	0.0
	ETD	6.087	DSU	1.8
	ETE	5.031	DSU	17.1
	ETF	5.053	DSU	16.3
	ETR	4.037	DSU	5.3
Evermore Renewable Energy	Lisahally - LPS	18.000	Biomass	80.0
Indaver	IW1	17.000	Waste	92.6
IPOWER	AGU	62.606	Distillate Oil	72.1
	ID1	4.334	DSU	19.2
	ID2	5.400	DSU	33.9
	ID3	9.852	DSU	49.4
	IR1	6.277	DSU	N/A
Kelwin	KZ3	2.000	Diesel / Ultra-Capacitor	97.3
Powerhouse Generation Ltd.	PG1	10.226	DSU	22.8
	PG2	4.062	DSU	N/A
	PG6	4.009	DSU	N/A
Powerhouse Generation Ltd. (NI)	PH1	13.283	DSU	7.6
	PH2	13.925	DSU	29.5
SSE Generation Ireland	Great Island - GI4	464.000	Gas / Distillate Oil	75.8
	Rhode - RP1	52.000	Distillate Oil	85.6
	Rhode - RP2	52.000	Distillate Oil	87.4
	Tawnaghmore - TP1	52.000	Distillate Oil	82.4
	Tawnaghmore - TP3	52.000	Distillate Oil	96.1

Company	Unit	Capacity (MW)	Fuel	365-day Rolling Availability %
Synergen	Dublin Bay - DB1	415.000	Gas / Distillate Oil	81.7
Tynagh Energy Ltd	Tynagh - TYC	404.000	Gas / Distillate Oil	72.1
Viridian Power and Energy	Huntstown - HN2	402.000	Gas / Distillate Oil	89.6
	Huntstown - HNC	342.000	Gas / Distillate Oil	89.5
	Huntstown Temporary Emergency Generation – DG1	50.000	Gas	N/A
ESB Power Generation	Ardnacrusha - AA1	21.000	Hydro	41.5
	Ardnacrusha - AA2	22.000	Hydro	96.9
	Ardnacrusha - AA3	19.000	Hydro	95.6
	Ardnacrusha - AA4	24.000	Hydro	93.9
	Aghada - AD2	449.000	Gas / Distillate Oil	39.9
	Aghada - AT11	90.000	Gas / Distillate Oil	92.3
	Aghada - AT12	90.000	Gas / Distillate Oil	62.3
	Aghada - AT14	90.000	Gas / Distillate Oil	68.9
	Corduff – FG2	64.000	Gas	N/A
	Erne - ER1	10.000	Hydro	98.2
	Erne - ER2	10.000	Hydro	89.8
	Erne - ER3	23.000	Hydro	98.3
	Erne - ER4	23.000	Hydro	12.7
	Irishtown – IS3	64.000	Gas	N/A
	Lee - LE1	15.000	Hydro	93.8

Company	Unit	Capacity (MW)	Fuel	365-day Rolling Availability %
	Lee - LE2	4.000	Hydro	89.1
	Lee - LE3	8.000	Hydro	94.1
	Liffey - LI1	15.000	Hydro	87.6
	Liffey - LI2	15.000	Hydro	89.7
	Liffey - LI4	4.000	Hydro	17.1
	Liffey - LI5	4.000	Hydro	46.9
	Moneypoint - MP1	285.000	Coal / Heavy Fuel Oil	63.9
	Moneypoint - MP2	285.000	Heavy Fuel Oil	60.6
	Moneypoint - MP3	285.000	Coal / Heavy Fuel Oil	40.1
	Poolbeg - PBA	240.000	Gas / Distillate Oil	91.3
	Poolbeg - PBB	236.000	Gas / Distillate Oil	84.9
	Poolbeg – PB7	64.000	Gas	N/A
	Turlough Hill - TH1	73.000	Hydro - Pumped Storage	98.2
	Turlough Hill - TH2	73.000	Hydro - Pumped Storage	96.2
	Turlough Hill - TH3	73.000	Hydro - Pumped Storage	97.2
	Turlough Hill - TH4	73.000	Hydro - Pumped Storage	97.0
	Northwall Temporary Emergency Generation - NW8	193.000	Gas	94.5
	Shannonbridge Temporary Emergency Generation – SQ1	192.000	Distillate	N/A

Company	Unit	Capacity (MW)	Fuel	365-day Rolling Availability %
Low Carbon	Ballydown- BLD	12.200 (24.000 MWh)	Battery	92.3
	Drumkee - DK1	50.000 (21.600 MWh)	Battery	83.7
	Mullavilly - MZ1	50.000 (21.600 MWh)	Battery	95.9
	Connor - KEB	50.000 (21.600 MWh)	Battery	99.1
	Lisnabreeny - CSB	50.000 (21.600 MWh)	Battery	97.7
	Porterstown - PN1	30.000 (27.000 MWh)	Battery	97.9
Statkraft	Beenanaspuck and Tobertoreen – XT2	11.000 (5.660 MWh)	Battery	96.3
	Kelwin – KZ4	26.600 (13.400 MWh)	Battery	99.2
Lumcloon Energy	Lumcloon – LU1	50.000 (30.000 MWh)	Battery	N/A
	Lumcloon – LU2	50.000 (30.000 MWh)	Battery	N/A
	Shannonbridge – SI1	50.000 (30.000 MWh)	Battery	N/A
	Shannonbridge – SI2	50.000 (30.000 MWh)	Battery	N/A
NTR	Gorey – OD1	9.000 (4.500 MWh)	Battery	N/A
Killala Community Wind Farm	Killala – KF2	10.800 (10.800 MWh)	Battery	88.9
ESB	Aghada – AD3	19.000 (37.100 MWh)	Battery	97.6
	Hadwell – AD4	75.000 (150.000 MWh)	Battery	N/A
	Hadwell – AD5	75.000 (150.000 MWh)	Battery	N/A

Company	Unit	Capacity (MW)	Fuel	365-day Rolling Availability %
	Kylemore – IH1	30.000 (60.000 MWh)	Battery	95.9
	Poolbeg - PB8	75.000 (150.000 MWh)	Battery	94.2
	Irishtown – IS2	30.000 (61.350 MWh)	Battery	N/A
Scottish Power	Gorman - GF1	50.000 (32.200 MWh)	Battery	96.6
Innogy/RWE	Lisdrumdoagh - LF1	60.000 (26.280 MWh)	Battery	80.7
	Gardnershill – GP1	8.500 (9.580 MWh)	Battery	97.2
NTR	Avonbeg – AV1	16.000 (9.220 MWh)	Battery	N/A
Bord na Móna	Cloncreen - OE2	25.000 (79.230 MWh)	Battery	N/A

8 Appendix 3 EirGrid Maintenance Policy Terms

The following summarises the main terms and activities in the asset maintenance policy as operated by EirGrid[10]. The overall objective of maintenance is to ensure that the assets continue to meet their service and performance requirements including safety, environmental and output parameters[11] . Maintenance activities help to realise expected lifetime of an asset.

There are four primary maintenance categories:

1. Preventative/Routine: Preventive/routine maintenance is planned at predetermined intervals to reduce the likelihood of equipment degradation which could lead to plant failure e.g., condition assessment. This type of maintenance is planned in advance and the frequencies of these activities are pre-determined by the EirGrid Asset Maintenance Policy
2. Corrective: Corrective maintenance may consist of repair, restoration, or replacement of equipment before functional failure. Corrective maintenance requirements are identified through regular inspections. The aim of routine inspections is to identify the potential for failure in time for the solution to be planned and scheduled and then performed during the next available outage.
3. Fault: Fault maintenance includes activities arising from unexpected equipment failure in service.
4. Statutory Maintenance: Maintenance which is carried out to facilitate statutory requirements e.g., Pressure Vessel Inspections, bund inspections.

Please refer to the 'Guide to Transmission Equipment Maintenance' which is published on the EirGrid website for further information[12].

[10] In Northern Ireland maintenance policy for the transmission system is the responsibility of NIE Networks as licenced Transmission Owner.

[11] An anatomy of Asset Management – Institute of Asset Management Version 2 (July 2014)

[12] Guide-to-Transmission-Equipment-Maintenance-March-2018.pdf

9 Appendix 4 Formulae

9.1 Ireland Availability & Unavailability Formula

Availability of 110kV, 220 kV, 275 kV and 400 kV lines:

$$\text{System Availability} = 1 - \frac{\sum_{i=1}^{i=n} \text{Duration of Outage (i)} * \text{Length of Line (i)}}{\sum_{j=1}^{j=m} \text{Length of Line (j)} * \text{Days in a Year}}$$

Where: n = The total number of lines (at that voltage level) for which outages occurred

m = The total number of lines at that voltage level

Availability of 220 kV/110 kV, 275 kV/220 kV and 400 kV/220 kV transformers:

$$\text{System Availability} = 1 - \frac{\sum_{i=1}^{i=n} \text{Duration of Outage (i)} * \text{MVA of Transformer (i)}}{\sum_{j=1}^{j=m} \text{MVA of Transformer (j)} * \text{Days in a Year}}$$

Where: n = The total number of transformers for which outages occurred

m = The total number of transformers at that voltage level

System Unavailability:

$$\text{System Unavailability} = 1 - \frac{\sum \text{Hours each Circuit is Available}}{\text{Number of Circuits} * \text{Hours in Period}}$$

The equation above is the same as that used by OFGEM (The Office of Gas and Electricity Markets) in the UK.

9.2 System Minute Formula

System Minutes:

$$\text{System Minutes} = \frac{\text{Energy not supplied MW Minutes}}{\text{Power at System Peak}}$$

$$\text{System Minutes} = \frac{(\text{MVA Minutes}) * (\text{Power Factor})}{\text{System Peak to Date}}$$

Where Power Factor = 0.9.