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Introduction

1. Introduction

EirGrid Group is pleased to present the annual Transmission System Performance Report for 2013. This report contains transmission system data and performance statistics for the transmission system in Ireland for the year 2013 (1st January 2013 – 31st December 2013). The report has been prepared jointly by EirGrid and SONI TSOs.

EirGrid Group comprises EirGrid as Transmission System Operator in Ireland, SONI as Transmission System Operator in Northern Ireland, SEMO as the all-island Single Electricity Market Operator and the operation and ownership of the East West Interconnector (EWIC).

EirGrid and SONI's role, as the TSOs of Ireland and Northern Ireland is to deliver quality connection, transmission and market services to customers and develop the grid infrastructure required to support the development of Ireland's economy. These objectives are underpinned by a legislative requirement to develop, maintain and operate a safe, secure, reliable, economical and efficient transmission system. EirGrid is regulated by the Commission for Energy Regulation (CER). SONI is regulated by the Northern Ireland Authority for Utility Regulation (NIAUR).

EirGrid and SONI are required to publish the Transmission System Performance Report annually. The report includes both transmission system performance statistics and a number of high level transmission system characteristics, many of which are published elsewhere, but have been collated into one single source for the benefit of industry and external observers.

Background

2. Background

The transmission system is a meshed network of high voltage lines and cables for the transmission of bulk electricity supplies around Ireland. Electricity generated in power plants is transformed to higher voltage levels – 110,000 volts (110 kV); 220,000 volts (220 kV); 275,000 volts (275 kV) and 400,000 volts (400 kV) – and fed into the transmission system, commonly known as the “national grid”. The transmission system also comprises of high voltage stations, where the electricity voltage is reduced for local distribution (at 38 kV, 20 kV and 10 kV in Ireland, and 33 kV, 11kV and 6.6 kV in Northern Ireland). Some large industrial customers also take their power supply directly from the transmission system. The distribution systems in Ireland and Northern Ireland are separately managed by Distribution System Operators (DSOs). The DSO for Ireland is ESB Networks Ltd, and the DSO for Northern Ireland is Northern Ireland Electricity (NIE). These bodies operate the distribution systems and bring power from transmission stations to smaller business units, farms and households.

All-Island Basic System Data

3. All-Island Basic System Data

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

3.1. Total System Production

The total exported energy includes large and small-scale generation and also includes pumped storage units.

	2012	2013
All-Island Total Exported Energy [GWh]	34,639	34,837
ROI Total Exported Energy [GWh]	25,726	25,957
NI Total Exported Energy [GWh]	8,913	8,881

Table 3.1: Total Exported Energy 2012 & 2013

The All-Island total exported energy in 2013 increased by 0.57% from the 2012 figure.

3.2. 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 it is a key measurement for any power system. The Irish system is a winter peaking system as a result of greater heating and lighting requirements during the winter months and this is illustrated in Figure 3.2. The all-island winter peak in 2013 was 6229 MW and occurred at 17:45 on Tuesday 22nd January. This peak demand of 6229 MW is down from a peak demand of 6334 MW in 2012 (-1.7%).

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 2013 a minimum all-island demand of 2217 MW was recorded at 06:00 on Sunday 4th August.

The installed wind capacity continues to increase year-on-year, enabling Ireland to progress towards the target of having 40% of our electricity produced by renewable sources by 2020. In 2013 a maximum all-island wind generation level of 2275 MW was achieved on Tuesday 17th December.

Table 3.2 provides a summary of the system records for 2012 and 2013.

	2012	**2013**
Winter Peak Demand [MW]	6305	6229
Minimum Summer Night Valley [MW]	2176	2217
Maximum Wind Generation [MW]	1864	2275

Table 3.2: System Records 2012 & 2013

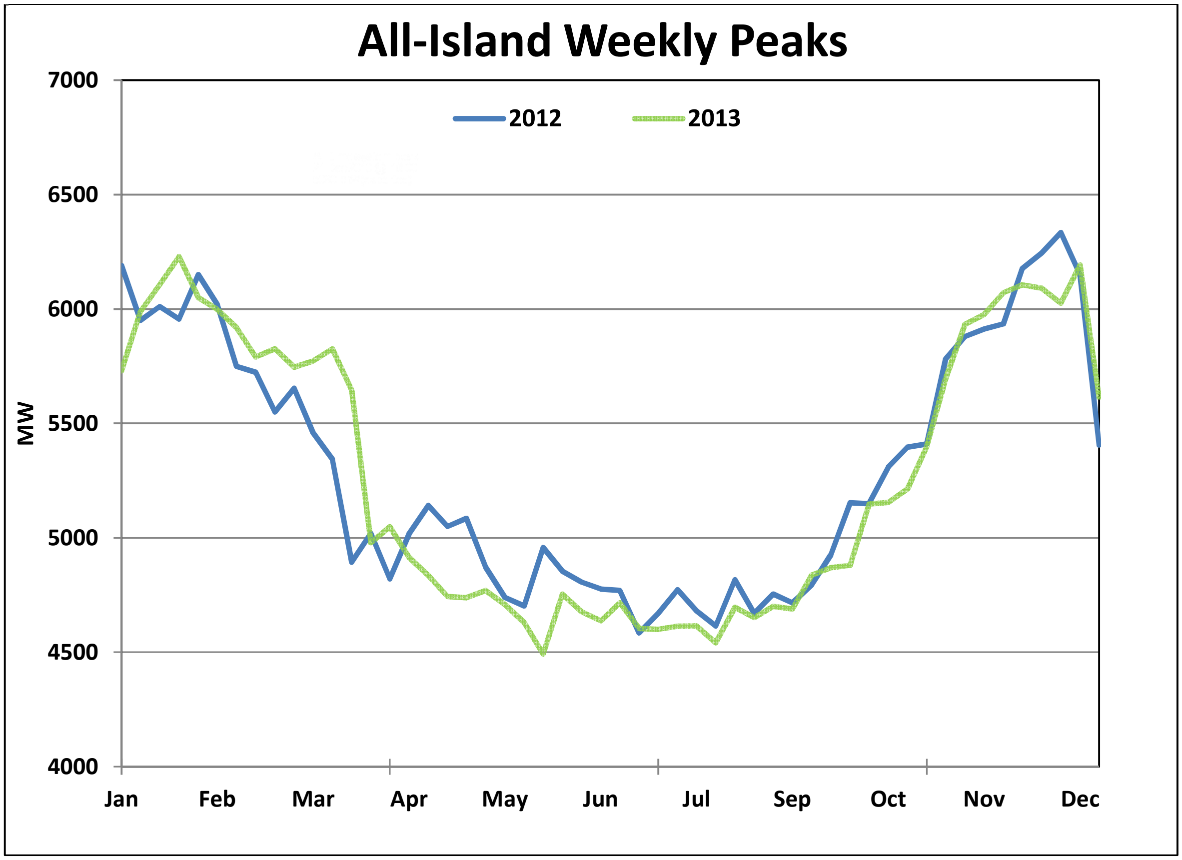


Figure 3.2: Weekly System Demand Peaks for 2012 & 2013

3.3.Operational Generation Capacity

Generation 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*.

The All-Island installed capacity of conventional, dispatchable generation in December 2013 was 9251 MW (6871 MW in Ireland and 2380 MW in Northern Ireland). This does not include any import capacity from the Moyle Interconnector or the East West Interconnector.

The All-island installed capacity of wind generation in December 2013 was 2450 MW (1896 MW in Ireland and 554 MW in Northern Ireland)†.

Appendix 1 provides a list of the fully-dispatchable generating units connected to the transmission system.

* Fully-operational generator capacity is given by the Maximum Export Capacity (MEC) of the generator

† Values from the "All Island Renewable Connection Report 36 (Q4 2013)"

4. All-Island Generation Availability & Outages

4.1. Generation Availability

Generation Availability is a measure of the capability of generators to deliver power to the transmission system. In order for EirGrid to operate a secure and reliable transmission system in an economic, efficient manner, it is necessary for generators to maintain a high rate of availability. Appendix 1 provides a breakdown of availability of fully-dispatchable generation units for 2013.

The EirGrid Monthly Availability Report is published on the EirGrid website (www.eirgrid.com) on a unit-by-unit monthly basis. The availability is broken down into scheduled outages, forced outages and ambient conditions. The report also contains a three-month outlook of unit availability.

Generation system availability is calculated on a daily and 365-day rolling average basis*. Figure 4.1 shows the daily and 365-day rolling average availability for 2013.

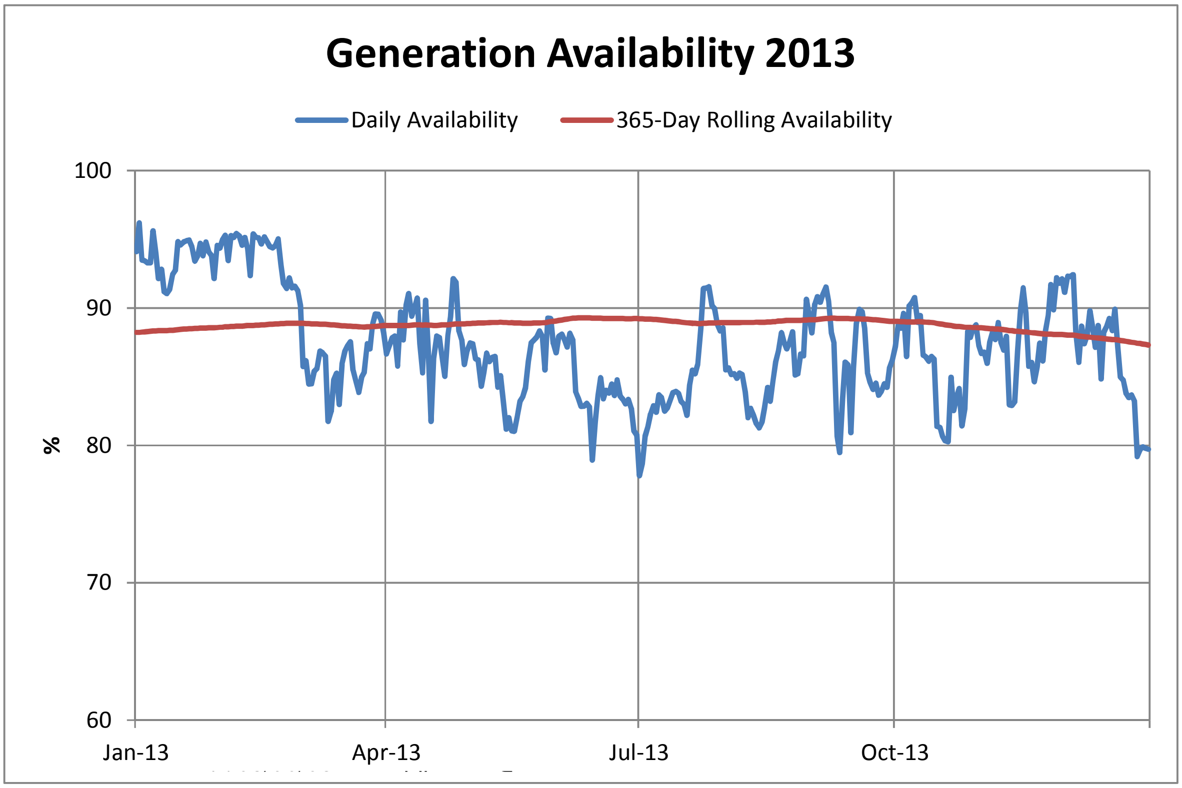


Figure 4.1: Generation System Availability 2013

- The average daily generation system availability in 2013 was 87.31%
- The maximum daily generation system availability in 2013 was 95.87%, occurring on the 24th January 2013
- The minimum daily generation system availability in 2013 was 77.79%, occurring on the 1st July 2013. On this day the following units were unavailable due to outages or testing: Coolkeeragh C30, Aghada AD1, Erne ER1 & ER3 & ER4, Great Island GI1 & GI3, Poolbeg PB6, Edenderry ED1, Tarbert TB3, Sealrock SK4

* 365-day rolling average is a capacity weighted average availability over the previous 365 days

4.2.Generation System Forced Outage Rate

The generation system forced outage rate (FOR) is calculated on a daily and rolling 365-day average basis. The daily FOR 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 FOR is the average of the daily FOR over the previous 365 days.

The daily FOR and 365-day rolling FOR are shown in Figure 4.2.

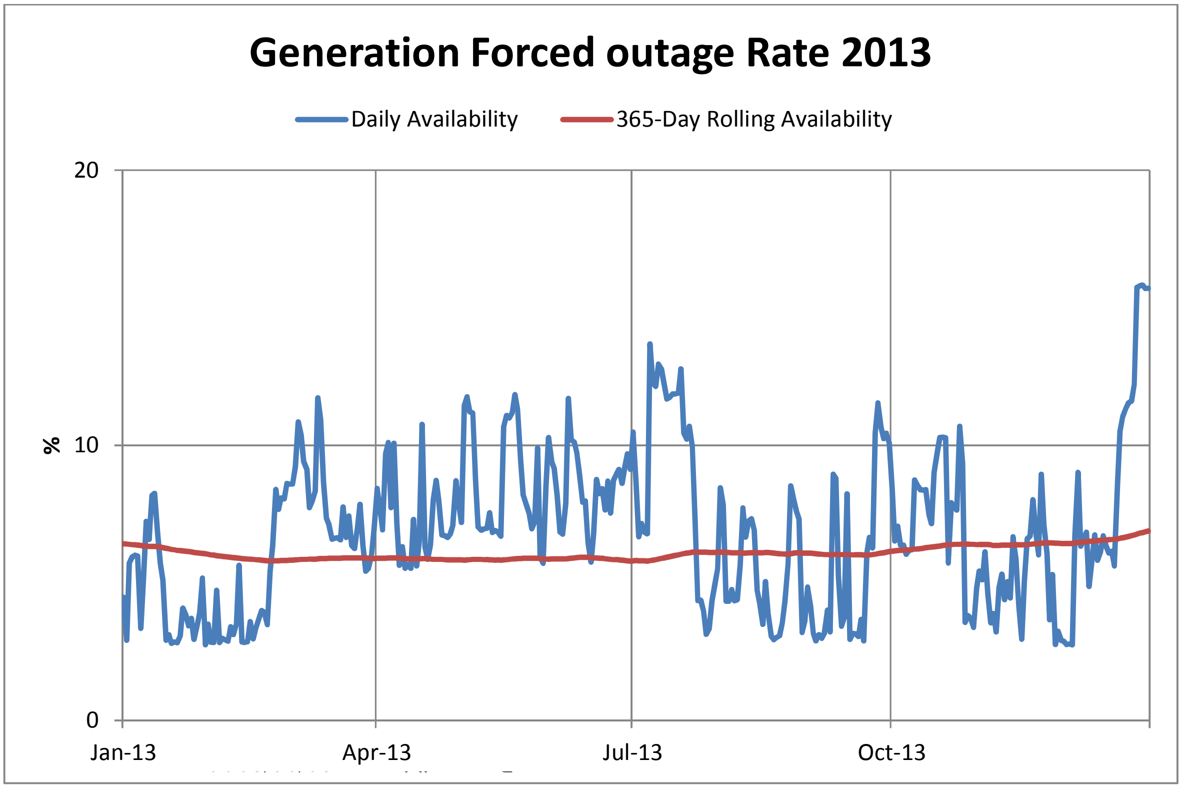


Figure 4.2: Generation System Forced Outage Rate 2013

- The average daily generation system forced outage rate in 2013 was 6.88%.
- The maximum daily generation system forced outage rate in 2013 was 15.82%, occurring on the 29th December 2013. On this date the following units were on forced outage: Whitegate WG1, Aghada AD1 & AT14, Erne ER1 and Moneypoint MP1 & MP2
- The minimum daily generation system forced outage rate in 2013 was 2.75%, which occurred twice: on the 30th January and 4th December 2013.

4.3.Generation System Scheduled Outage Rate

The generation system scheduled outage rate (SOR) can be calculated on a daily and rolling 365-day average basis. The daily SOR is a capacity weighted percentage of the time during the day that generation units are unavailable due to planned outages. The 365-day rolling SOR is the average of the weekly SOR over the previous 365 days.

The daily SOR and 365-day rolling SOR are shown in Figure 4.3.

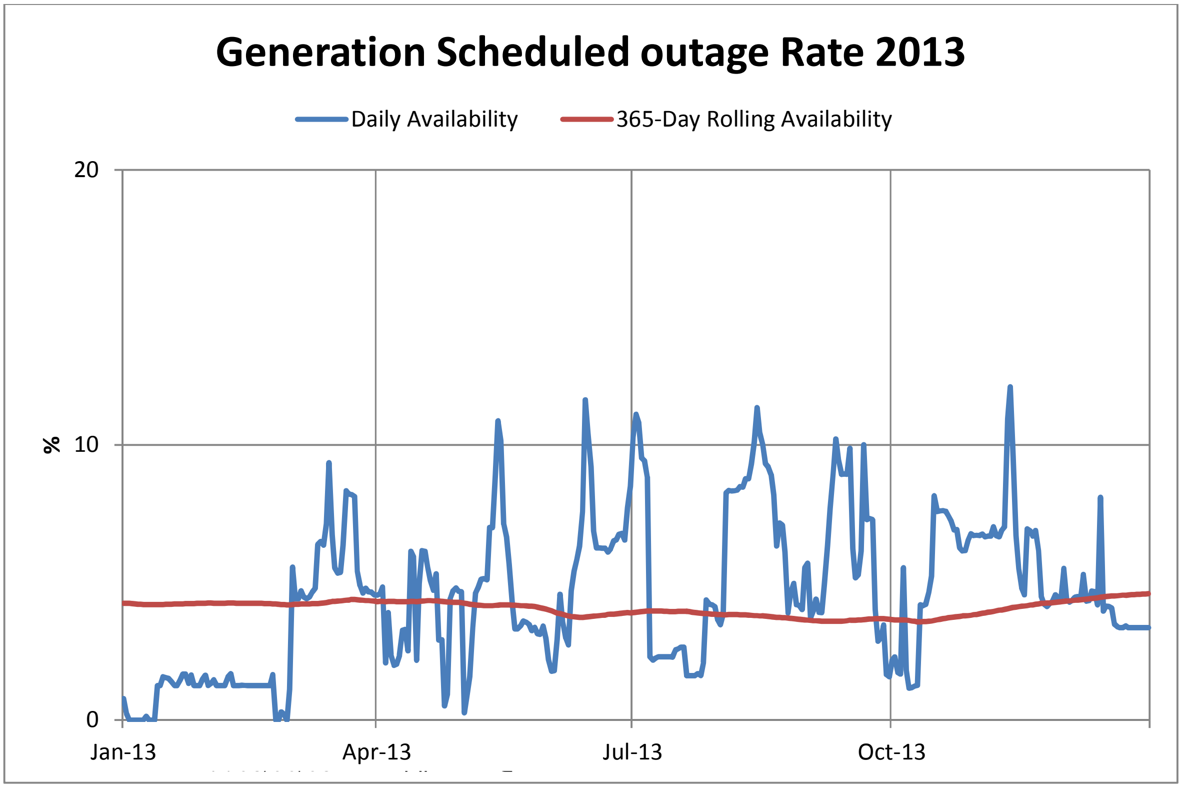


Figure 4.3: Generation System Scheduled Outage Rate 2013

- The average daily generation system scheduled outage rate in 2013 was 4.59%.
- The maximum daily generation system scheduled outage rate in 2013 was 12.12%, occurring on the 12th November 2013. On this date there were scheduled outages of the following units: Ardnacrusha AA3, Erne ER2, Moneypoint MP2, Ballylumford B31 & BGT1 & BGT2, Sealrock SK4, Whitegate WG1
- The minimum daily generation system scheduled outage rate in 2013 was 0.00%, occurring on 11 different days throughout the year.

EirGrid Transmission System Performance

5. EirGrid Summary

- The system was operated at all times within acceptable international standards for safety, security and reliability of customer supplies. All security of supply Key Performance Indicators (KPIs) were achieved throughout the year
- Four new 110kV stations and six new 110kV lines were complete in 2013
- The total number of system minutes lost (SM) on the ROI Transmission System in 2013 was 0.357 SM, all of which were due to Transmission System faults
- The new GI4 CCGT unit at Great Island was the only new conventional generator connection provided in 2013, and is due to become commercially operational in late 2014. There were also a number of wind farms connected throughout the year
- East West Interconnector went through its first year of full operation
- Extensive maintenance of the transmission system was carried out throughout the year, including 9,932 km of overhead line patrols
- One of the key measures of transmission system performance is availability: the average daily generation system availability in 2013 was 87.31%
- There was no load shedding (0 SM) of Normal Tariff customers in 2013

5.1.Transmission Infrastructure

The transmission system is a meshed network of high voltage lines and cables (110 kV, 220 kV, 275 kV and 400 kV) for the transmission of bulk electricity supplies around Ireland. This excludes the Dublin 110 kV network and some other specific 110 kV circuits which are treated as part of the distribution system. Table 5.1 provides a summary of transmission system infrastructure for 2013 and 2012.

	2012		2013	
Plant Type	**No. of Items**	**Circuit Length [km]**	**No. of Items**	**Circuit Length [km]**
110 kV Circuits	**193**	4174	**197**	4200
220 kV Circuits	**55**	1917	**55**	1917
275 kV Circuits	**2**	97	**2**	97
400 kV Circuits	**4**	439	**4**	439
Circuit Total	254	6606	258	6653
Plant Type	**No. of Items**	**Transformer Capacity [MVA]**	**No. of Items**	**Transformer Capacity [MVA]**
220 / 110 kV Transformers	46	8739	46	8739
275 / 220 kV Transformers	3	1200	3	1200
400 / 220 kV Transformers	5	2550	6	3050
Transformer Total	54	12489	55	12989
Total No. of Substions	148		152	

Figure 5.1: Transmission System Infrastructure 2012 & 2013

5.2.Grid Development and Maintenance

This section provides an overview of grid development activities in 2013. Grid development includes new or amended customer connection offers issued, offers accepted and connections energised at year end. This section also provides an overview of the total connected transmission system generating capacity and the level of maintenance activities carried out throughout the year.

5.2.1. Grid 25

Grid25 is EirGrid's programme for the long-term development of Ireland's transmission system. This includes the construction of 800km of new circuit at various high voltages and the upgrading of over 2000km of existing transmission circuits using new and existing conductor technologies.

In 2013 a significant number of circuit and station upratings and refurbishments were completed. Over the course of 2013 260km of existing transmission circuits were uprated and 170km of transmission circuits were refurbished. Thirteen Associated Transmission Reinforcement (ATR) projects were completed in 2013 leading to the provision of an additional 115MW of Firm Access Quantity (FAQ) being made available to generators.

Over the course of 2013 the following customer connection projects were completed:

- Connection of Athea 110kV station;
- Connection of Cloghran 110kV station;
- Connection of Reamore 110kV station;
- Connection of Mountlucas 110kV station;
- Connection of new Great Island CCGT.

Station and circuit upratings were completed for the following existing transmission assets:

- Uprating of Bellacorick 110kV busbar;
- Uprating of Butlerstown 110kV busbar;
- Uprating of Cushaling 110kV busbar;
- Uprating of Ennis 110kV busbar;
- Uprating of half of Cathaleen's Fall 110kV busbar;
- Uprating of half of Thurles 110kV busbar;
- Uprating of Ballydine-Doon 110kV circuit;
- Uprating of Butlerstown-Killoteran 110kV circuit;
- Uprating of Butlerstown-Cullenagh 110kV circuit;
- Uprating of Cathaleen's Fall-Drumkeen 110kV circuit;
- Uprating of Clashavoon-Knockraha 220kV circuit;
- Uprating of Cullenagh-Dungarvan 110kV circuit;
- Uprating of Inchicore-Maynooth 220kV circuits 1 & 2;
- Uprating of Inniscarra-Macroom 110kV circuit;
- Uprating of Marina-Trabeg 110kV circuits 1 & 2.

Planning permission was granted by the statutory planning authorities for the development of the following projects during 2013:

- Belcamp 220kV project - new 220kV station
- Finglas 220kV station busbar reconfiguration
- Killonan 220kV station refurbishment
- Kinnegad - Mullingar 110kV new circuit
- Raffeen -Trabeg no. 1 110kV line uprate
- Tarbert 220kV station refurbishment
- West Galway 110kV - new 110kV station

Following feedback received from public consultation on a number of major transmission projects in 2013 EirGrid will progress a number of measures to respond to the themes raised, in consultation with the Minister for Energy Minister for Energy, Pat Rabbitte TD and his Department. These measures will include a comprehensive underground analysis for the Grid Link and Grid West projects and the introduction of a Community Gain Fund for localities and residences located close to new pylons and stations.

EirGrid will work with the Government-appointed Independent Expert Panel to review underground and overhead options before proceeding to the next stages of project development and will review the consultation process to enhance future public engagement. These measures will be progressed during 2014.

5.3.Connection Offers Issued

Parties seeking a new connection to the transmission system or to amend an existing Connection Agreement must apply to EirGrid for a connection offer. EirGrid operates a standard regulatory approved process for providing Connection Offers to generators and demand customers seeking direct connection to the transmission system. Table 5.3 details the number of connection offers made by EirGrid in 2013.

	Demand	Generation
New Connection Offers Issued in 2013 [No.][*]	3	0
New Connection Offers Issued in 2013 [MW Capacity]	-31 MVA[†]	0 MW

Table 5.3: Demand & Generation Connection Offers Issued 2013

5.4.Connection Offers Accepted

In order to connect to the transmission system, all demand and generation customers must execute a Connection Agreement with EirGrid. Table 5.4 summarises the total number of executed Connection Agreements in 2013 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.

	Demand	Generation
Executed Connection Offer Agreements in 2013 [No.]	3	6
Executed Connection Offer Agreements in 2013 [Capacity]	-31 MVA[4]	503.38 MW

Table 5.4: Executed Demand & Generation Connection Agreements in 2013

5.5.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 5.5 provides an overview of the number of new connections to the transmission system commissioned in 2013.

	Demand	Generation
Connections Energised in 2013 [No.]	0	5
Connections Energised in 2013 [Capacity]	0 MVA	173.05 MW

Table 5.5: Demand & Generation Connections Energised in 2013

5.6.Customers Certified Operational

Table 5.6 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. Note that demand customers are not currently certified by EirGrid and are therefore not included in the table.

	New in 2013		System Total	
	Generation	Interconnector	Generation	Interconnector
Customers Certified Operational [Total No. of sites]	1	0	76	1
Customers Certified Operational [MW Capacity]	22	0	7253	530

Table 5.6: Customers Certified Operational in 2013

[*] These figures do not include non-capacity connection offers

[†] Negative value indicates net reduction in connected customer demand in 2013; due to termination of a TSO Customer and new Connection Agreements with reduced MIC for two TSO Customers. Total Customer Demand in 2013 = 364 MVA

5.7.Maintenance Works Completed

Transmission maintenance is undertaken in accordance with EirGrid's maintenance policy to ensure that the transmission system can operate in a safe, secure and reliable manner. The policy comprises continuous and cyclical condition monitoring, preventive maintenance on critical items of plant and the implementation of corrective maintenance tasks. The maintenance policy is kept under review to ensure that it continues to meet the requirements of the system and best international practice. On an annual basis, transmission maintenance activities dictated by policy, work identified from analysis of plant condition and work carried over from previous years provide the total volume of maintenance requirements for the year (refer to Table 5.7).

During the relevant year, due to a variety of reasons not anticipated at the start of that year (including resource limitations, outage restrictions, material availability, system conditions, etc), it may be necessary to defer programmed maintenance activities. While a degree of this is appropriate, the deferrals are kept under review, as any increase in backlog could have a negative impact on the reliability and performance of the transmission system.

For clarity, it should be noted that physical maintenance works are carried out by ESB, as Transmission Asset Owner (TAO), in accordance with its obligations under Regulation 19(a) of S.I. 445/2000.

Table 5.7 provides, in volume terms, a summary of transmission maintenance requirements, maintenance programmed and maintenance completed in 2013 for overhead lines, underground cables and transmission stations.

Volume of Transmission Maintenance by Activity	**Maintenance Requirements**	**Maintenance Programmed***	**Maintenance Completed**
		Year End	
Patrols (incl. helicopter, climbing & bolt) [km]	9901	10365	9932
Timber Cutting [km]	91.8	92.6	82.6
Structure Painting [Number]†	152	0	0
Structure & Hardware Replacement [Number]	1	4	3
Insulator & Hardware Replacement [Number]	39	28	24
Underground Cables Maintenance			
Check/Alarms [Number]	687	679	631
Station Maintenance			
Detailed Service [Number]	0	1	1
Ordinary Service [Number]	405	184	126
Operational Tests [Number]	898	1060	818
Tap changes inspection [Number]	18	8	5
Corrective Maintenance [Number]	521	630	396
Condition Assessment of switchgear [Number]	104	112	81

Table 5.7: Transmission System Maintenance 2013

Appendix 3 provides a full explanation of the main terms and activities in the asset maintenance policy as operated by EirGrid.

The year 2013 saw a slight decrease of approximately 4% in maintenance completions over 2012. The decrease in the completion rate of maintenance requirements is believed to be due to reprioritisation of maintenance requirements and resources due to other faults/system requirements.

* This excludes work that is not programmed due to outage difficulties, access issues or extreme weather events

† All Tower Painting requirements were transferred to the CAPEX programme

6. Transmission System Availability & Outages

6.1. 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 4.1. Figure 6.1 shows the percentage of the total number of maintenance outages which occurred in each month for 2012 and 2013.

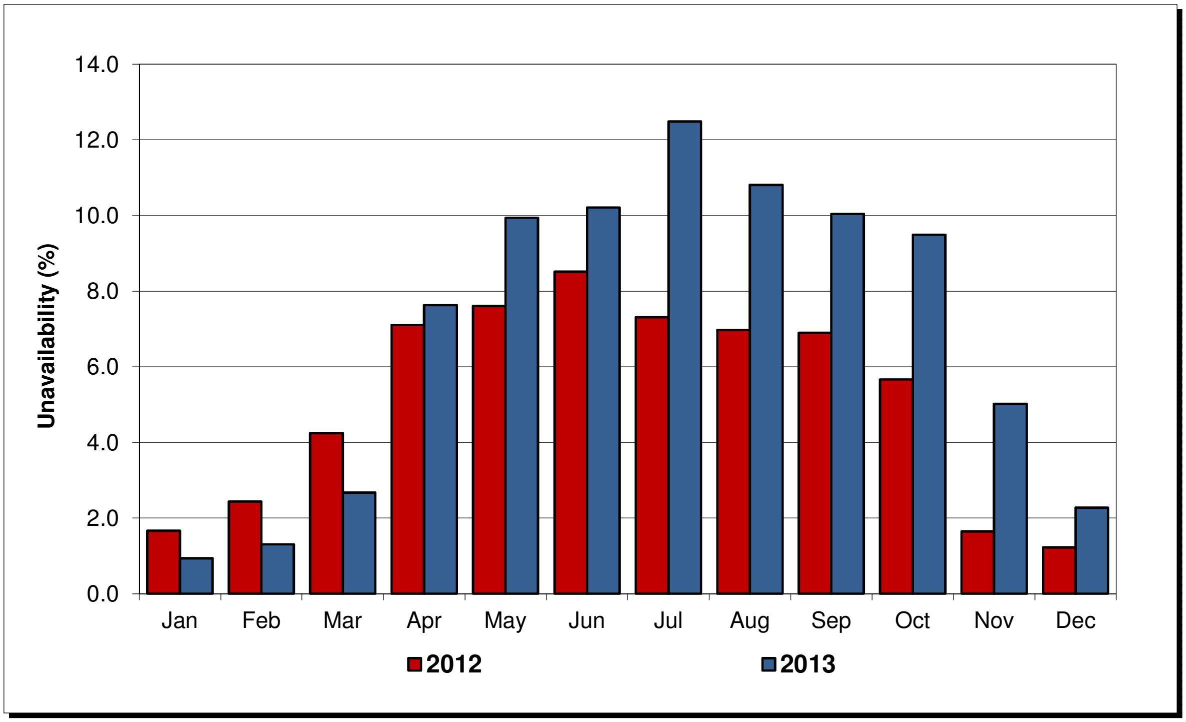


Figure 6.1: Monthly Variations of System Unavailability 2012 & 2013

6.2. Transmission Plant Availability

The measure of plant availability is the kilometre-day for feeders and the MVA-day for transformers. The availability figures vary between the different categories of plant. The formulae for calculating transmission plant availability are provided in Appendix 4.1.

Table 6.2 provides a detailed breakdown of all plant availability figures for 2013 and 2012.

Plant Type	No. of Items	Circuit Length [km]	Number of Outages	Availability (%) 2013	Availability (%) 2012
110 kV Circuits	197	4200	460	92.88	96.17
220 kV Circuits	55	1917	131	93.41	94.07
275 kV Circuits	2	97	5	96.08	99.55
400 kV Circuits	4	439	4	90.58	98.13
Plant Type	**No. of Items**	**Transformer Capacity [MVA]**	**Number of Outages**	**Availability (%) 2013**	**Availability (%) 2012**
220 / 110 kV Transformers	46	8739	108	93.77	96.15
275 / 220 kV Transformers	3	1200	11	85.91	98.43
400 / 220 kV Transformers	6	3050	18	93.41	98.12
Total	313	6653 km 12989 MVA	737	92.29	97.23

Table 6.2: Transmission System Plant Availability 2012 & 2013

In 2013:

- The average plant availability was 92.29%;
- The maximum availability by plant type was 96.08%, which occurred on the 275kV tie lines; and
- The minimum availability by plant type was 85.91%, which occurred on the 275/220kV Transformers.

The decrease in plant availability from 97.23% in 2012 to 92.29% in 2013 can in part be attributed to the significant decreases in availability of the 400kV Lines and the 275/220kV transformers. The reduced availability of 400kV lines is due to a several forced outages in 2013 for minor issues (such as SF6 gas leaks and low coolant levels), while the reduced 275/220 kV transformer availability is mainly due to a long term outage (6+ months) of Louth AT1 transformer.

6.3.Cause of Transmission Plant Unavailability

Transmission plant unavailability is classified into the categories outlined in Table 6.3.

Category	Category
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) The above forced outages are explained in detail in Section 6.6.
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.

Table 6.3: Transmission System Plant Unavailability Categories

6.3.1. 110kV Plant Unavailability

Figure 6.3.1 provides a breakdown of the causes of unavailability on the 110 kV network in 2013.

The largest contributor to unavailability (51%) on the 110 kV network in 2013 were outages for the purpose of Corrective and Preventive Maintenance. This type of maintenance includes, amongst others, Ordinary Services, Condition Assessments, wood-pole replacement/straightening and general line maintenance. The most significant of these outages was the refurbishment of the Charleville - Mallow 110kV Circuit, which lasted 158 days.

A further 37% of unavailability on the 110 kV network was attributable to the "Other Reasons" category. This category consists mainly of outages for protection testing and various inspections. The most significant of these was a simultaneous outage of the Gorman - Navan 3 and Knockumber - Navan 110 kV lines. This outage started in January 2013 and lasted 1 year.

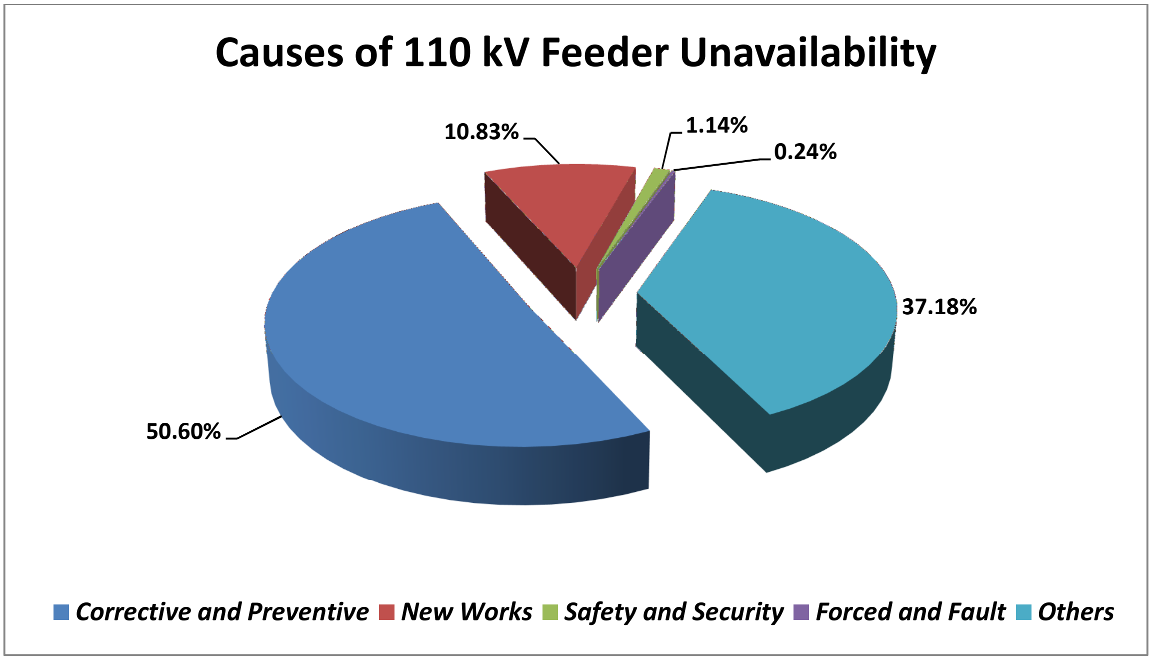


Figure 6.3.1: Causes of Unavailability on the 110kV System in 2013

6.3.2. 220kV Plant Unavailability

Figure 6.3.2 provides a breakdown of the causes of unavailability on the 220 kV network in 2013.

The largest contributor to unavailability (58%) on the 220 kV network in 2013 were also outages for the purpose of Corrective and Preventive Maintenance. The most significant of these was for the refurbishment of the Inchicore - Maynooth 2 (TWO) 220kv Line which lasted for 181 days.

Approximately 32% of unavailability on the 220 kV network was attributable to New Works. The most significant of these outages included the uprating of the Clashavoon - Knockraha 220 kV line which lasted 227 days.

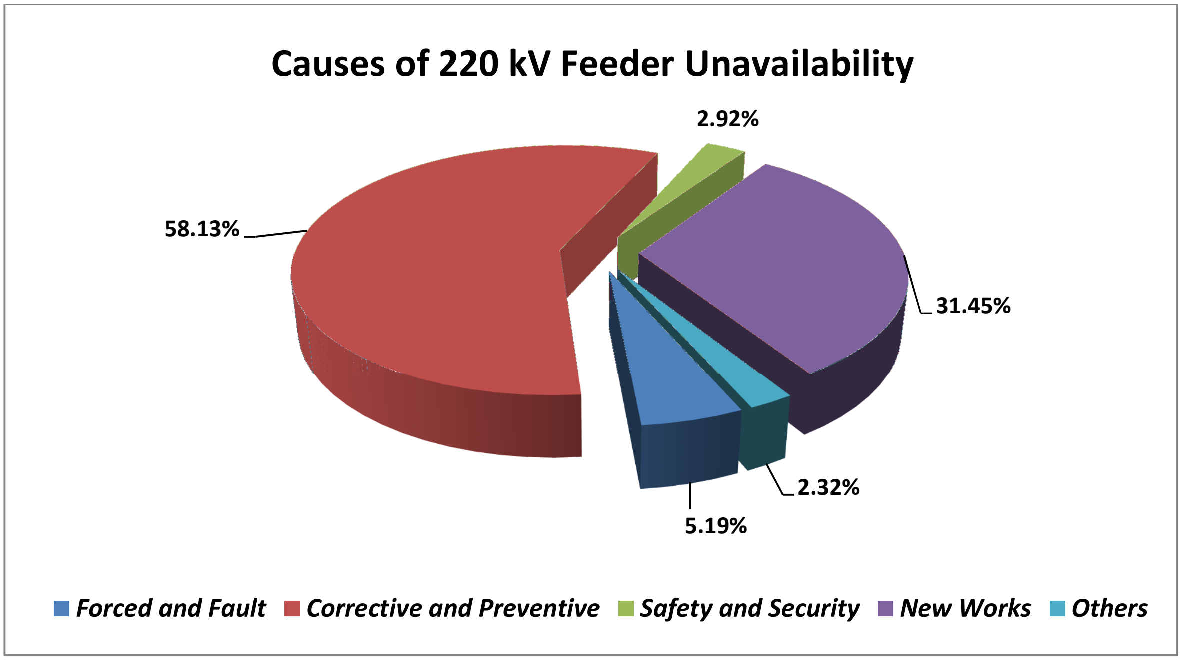


Figure 6.3.2: Causes of Unavailability on the 220kV System in 2013

6.3.3. 275kV Plant 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. In 2013 there were only 4 outages of 275 kV tie-lines, all of which were for corrective and preventative maintenance. The longest of these was a 13 day outage of Louth - Tanderagee 1 (ONE) 275 kV Line to facilitate a climbing patrol.

6.3.4. 400kV Plant Unavailability

Figure 6.3.4 provides a breakdown of the causes of unavailability on the 400 kV network in 2013.

The largest contributor to unavailability (71%) on the 400 kV network in 2013 were Forced and Fault outages. The most significant of these was due to a tripping of the Dunstown - Moneypoint 400kV line which as a result remained on forced outage for 44 days.

The second largest portion (22%) of unavailability on the 400kV Network in 2013 was attributable to Corrective and Preventive Maintenance. The most significant of these outages was the refurbishment of the Dunstown - Moneypoint 400kV Circuit which lasted 16 days.

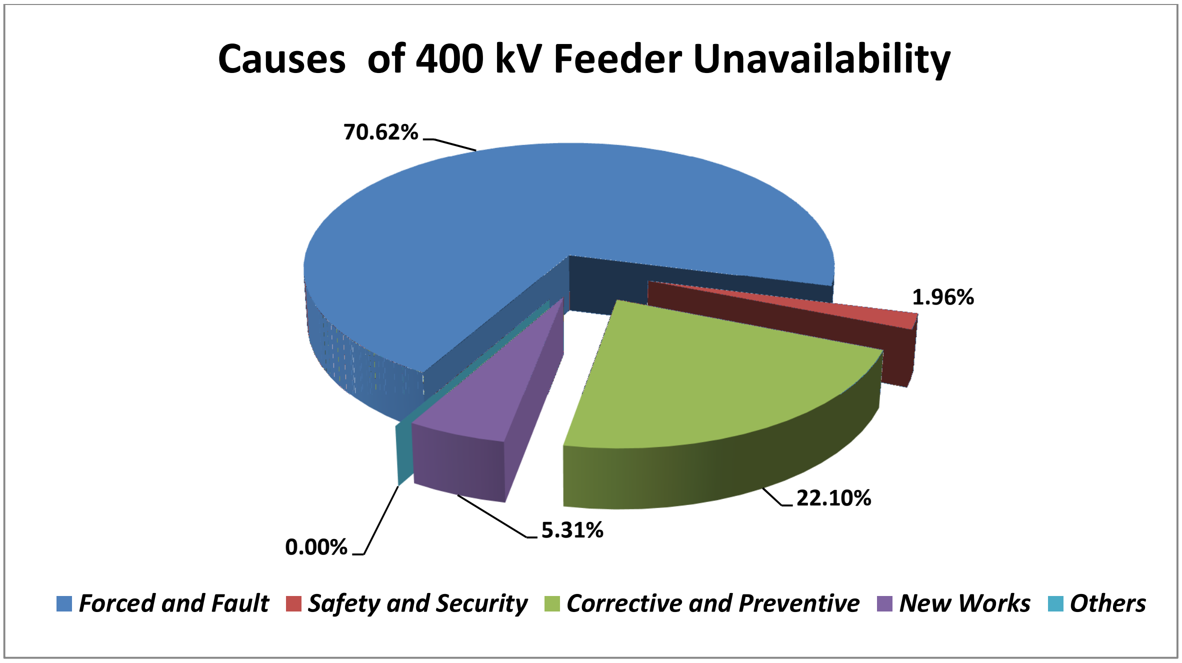


Figure 6.3.4: Causes of Unavailability on the 400kV System in 2013

Table 6.3.4 provides a breakdown of the transmission system outages that occurred in 2012 by plant type.

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	**197**	4200	28	30	104	233	65	460
220 kV Circuits	**55**	1917	13	15	27	61	15	131
275 kV Circuits	**2**	97	0	0	0	4	0	4
400 kV Circuits	**4**	439	11	1	1	3	2	18
Total	258	6653	52	46	132	301	82	613
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 Transformers	46	8739	17	6	16	54	15	108
275 / 220 kV Transformers	3	1200	4	0	0	4	3	11
400 / 220 kV Transformers	6	3050	7	1	3	7	0	18
Total	55	12989	28	7	19	65	18	137

Table 6.3.4: Transmission System Plant Outage 2013

6.3.5. East West Interconnector Unavailability

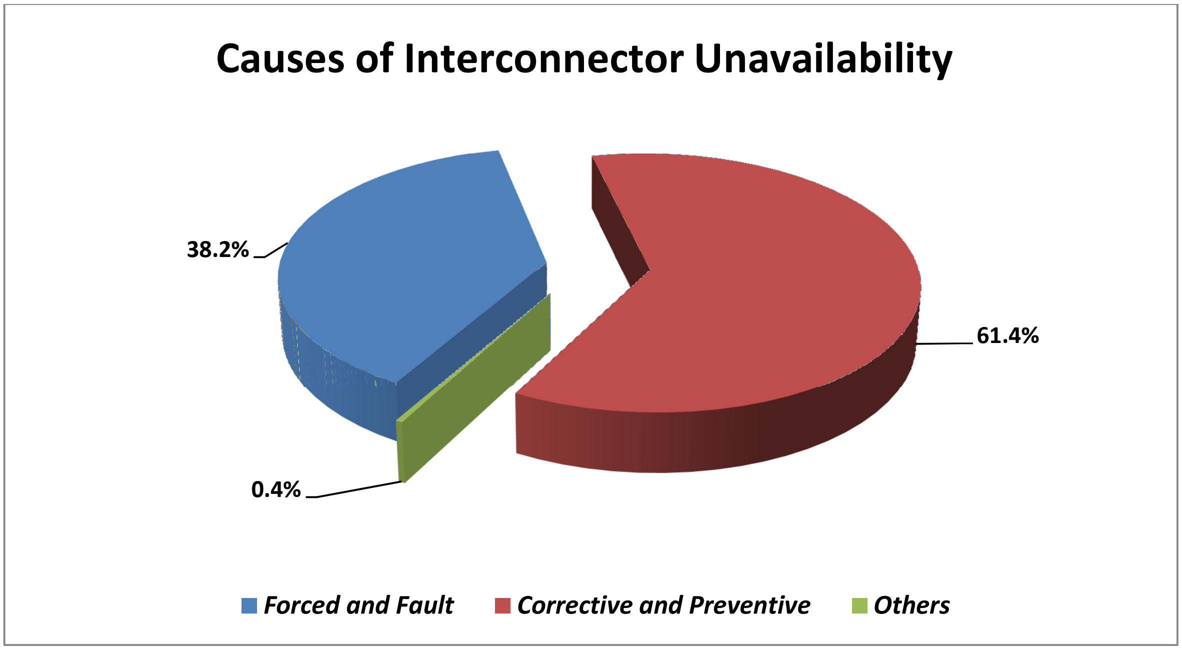


Figure 6.3.5: Causes of East West Interconnector Unavailability in 2013

During its first full year of operation, the availability of the East West Interconnector in 2013 was 90.72%. Of the outages contributing to EWIC unavailability, Corrective & Preventative maintenance represented the largest portion (61%), the longest of which was an eleven day outage to perform several timing tests and replace dampers on a circuit breaker at Shotton convertor station.

Forced and Fault outages accounted for another 38%, while there was one outage which fell under the "Others" category.

6.4. 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 6.4.

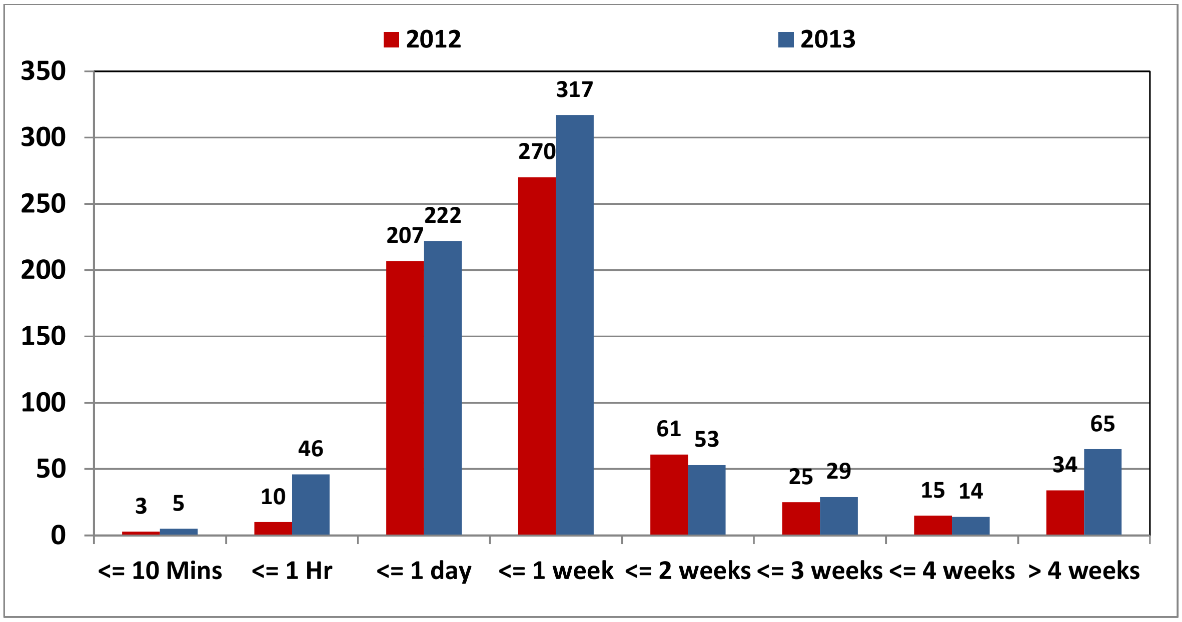


Figure 6.4: Duration of Outages in 2012 & 2013

The two most frequent transmission system outage periods occur between one hour and one day and between one day and one 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.

6.5.Timing of Transmission Outages

Transmission outages are scheduled, where possible, during periods of low load in the summertime (however, this can be limited by a number of factors such as personnel availability and shortage of hydro-power support in some areas). The seasonal nature of transmission outages is apparent in Figure 6.5.1 which shows the percentage of the total number of maintenance outages which occurred in each month. The April-October period (known as the Outage Season) sees the highest rates of unavailability during the year, when decreased system load is taken advantage of to carry out extensive maintenance outages such as the 227 day outage to uprate the Clashavoon – Knockraha 220kV Line and the 181 day outage for the refurbishment of the Inchicore - Maynooth 2 (TWO) 220kv Line.

The increased volume of work undertaken in 2013 is highlighted by the increased unavailability in most months of 2013. Figure 6.5.2 also highlights this, showing an increase in the average duration of outages in most months of 2013 compared to 2012.

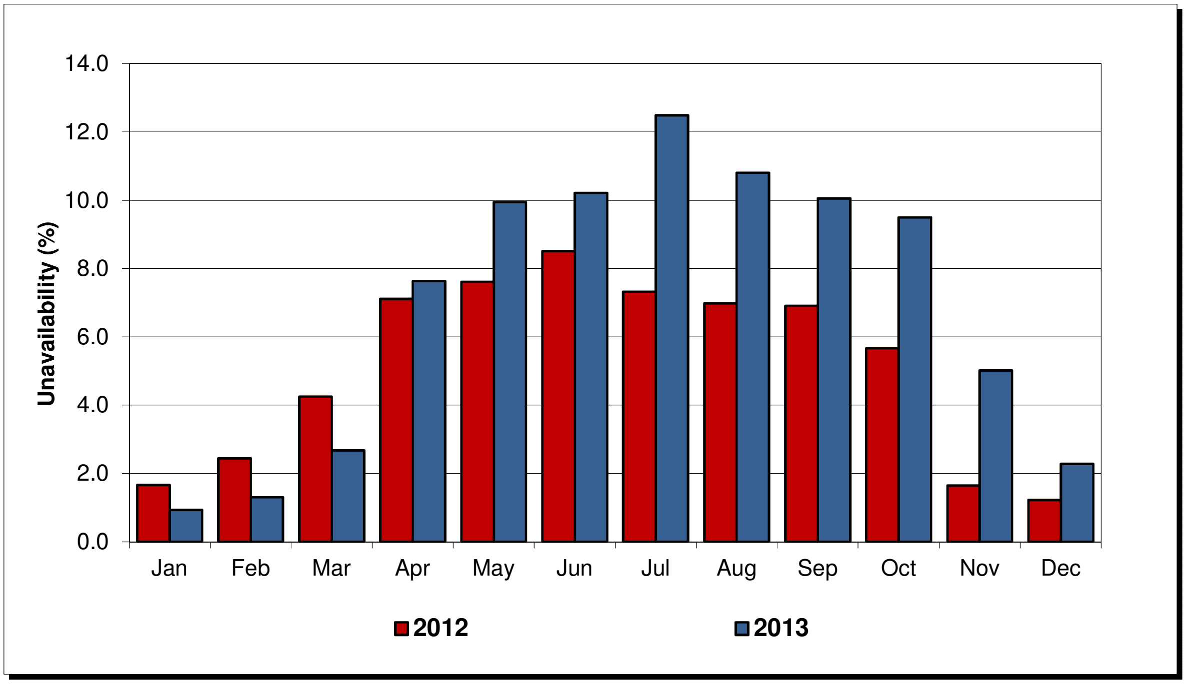


Figure 6.5.1: Percentage unavailability in each month of 2012 & 2013

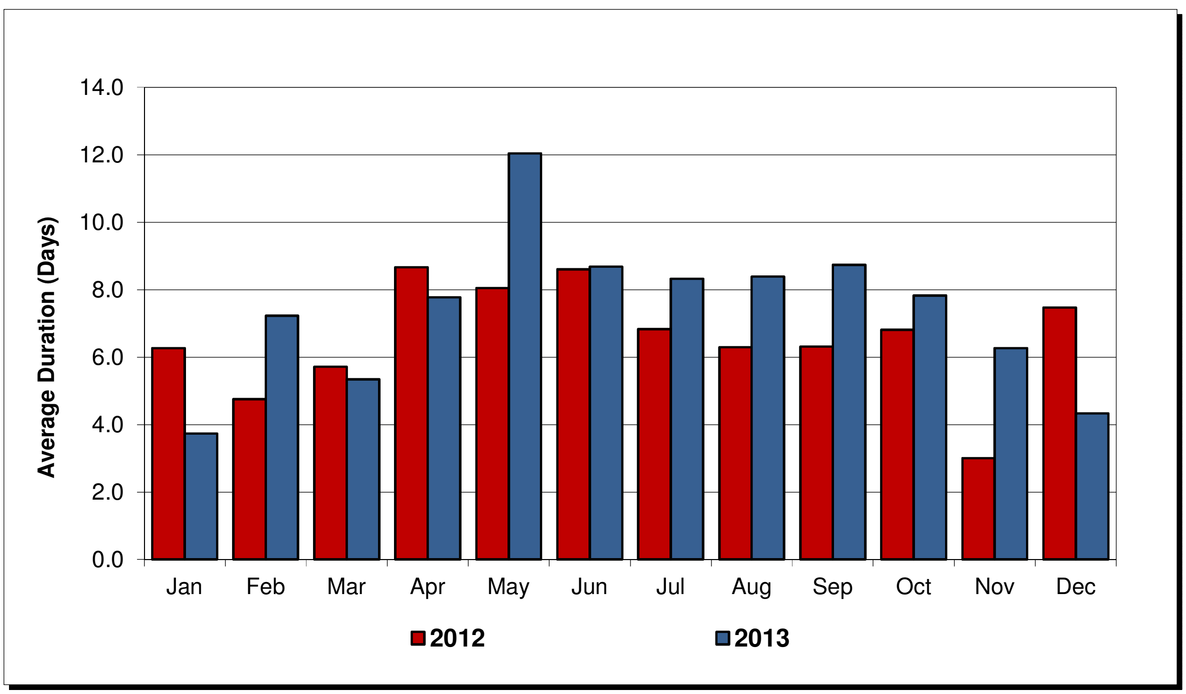


Figure 6.5.2: Average duration of outages 2012 & 2013

6.6. 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. There are three types of forced outages:

A) Fault & Reclose

This type of outage occurs when a fault is detected by the protection equipment; the transmission plant is disconnected and successfully reconnected immediately, thus re-energising the circuit. These represent temporary faults, which, in general, do not cause major disruption to the system or customer. Lightning is a typical cause of this type of outage.

B) Fault & Forced

This occurs when an item of plant is tripped by protection and does not return to service within ten minutes. This typically signifies plant damage, which requires maintenance.

C) Forced (No Tripping)

This type of outage occurs when an item of plant is not tripped by protection, but is removed from the system urgently (i.e. there is no opportunity for scheduling). This may be necessary to avoid imminent failure or danger to plant and/or personnel. A typical cause of this outage would be the discovery of a fault during a maintenance inspection which is deemed to be sufficiently severe as to warrant the removal of the plant from service until the plant can be repaired or replaced.

6.6.1. 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. This is shown in Figure 6.6.1. Fault & Reclose forced outages are excluded due to their relatively low level of disruption. The large level of Forced Outages per km on the 400kV network in 2013 is due to several forced outages for minor issues (such as SF6 gas leaks and low coolant levels).

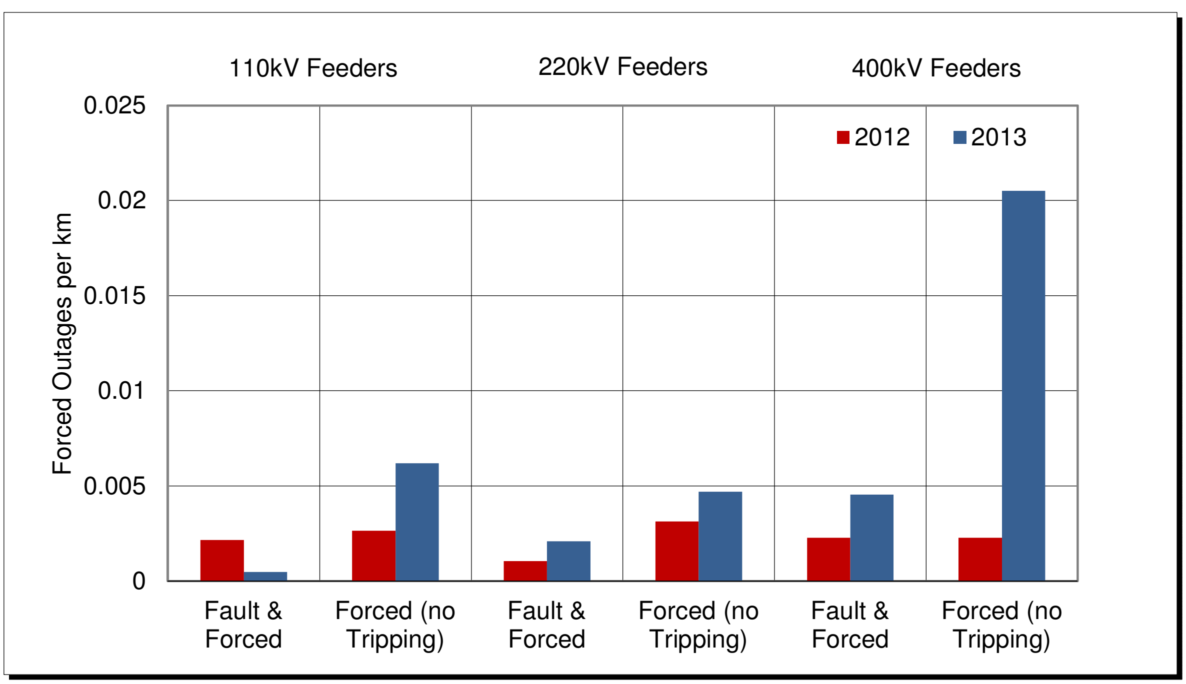


Figure 6.6.1: Nature of Feeder Forced Outages 2012 & 2013

6.6.2. 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 6.6.2.

There was a significant increase in 400/220 kV transformer forced outages in 2013. This is largely due to the Dunstown T4201 Transformer which accounted for five out of seven 400/220 kV transformer forced outages in 2013 for minor issues such as SF6 gas top ups and oil leak investigation.

The large Forced Outage per MVA for 275/220 kV transformers in 2013 is due to a forced outage of all three Louth transformers during a separation of the Northern Ireland and Republic of Ireland systems and then a long-term outage of Louth AT1 Transformer.

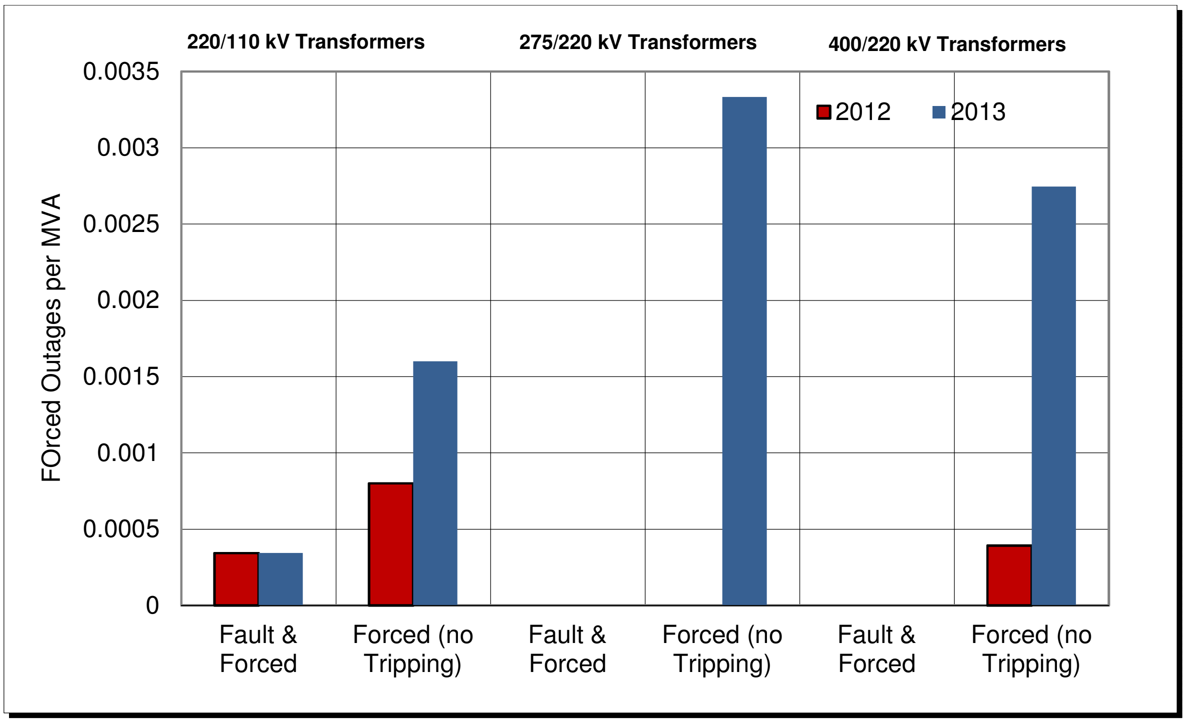


Figure 6.6.2: Nature of Transformer Forced Outages 2012 & 2013

7. General System Performance

7.1.System Frequency and Frequency Deviation

The National Control Centre aims to maintain the frequency within a target operating range of 50 ±0.1 Hz*.

The frequency, however, may deviate outside the normal operating range under fault or abnormal operating conditions. In 2013, the frequency was maintained within the target operating limits of 50 ±0.1 Hz for 99.3% of the time.

Mean Frequency (Hz)	50
Minimum Frequency (Hz)	49.222
Maximum Frequency (Hz)	50.510

Table 7.1: System Frequency & Frequency Deviation 2013

7.2.System Alerts

The system may enter an alert state at any time and the number of occasions that this occurs is recorded by the number of amber or red alerts issued by the National Control Centre.

Red alerts are generally issued when:

1. The system frequency deviates significantly from normal i.e. < 49.3Hz for a sustained period of time; and/or
2. System voltages have deviated significantly from normal i.e. a group of stations have 110kV voltages less than 95kV; and/or
3. Significant consumer load has been shed; and/or
4. In the period immediately ahead there is a high risk of failing to meet System Demand or maintaining normal Voltage and Frequency;

Amber alerts are generally issued when:

1. The system margin is such as the tripping of the largest infeed (generator or Interconnector), would give rise to a reasonable possibility of:
    a. Failure to meet the System Demand; and/or
    b. Frequency or voltage departing significantly from normal; and/or
2. When multiple contingencies are probable because of thunderstorm or high wind activity;

Figure 7.2 shows the number of major alerts on the system over the past five years.

* The Grid Code defines the normal operating range as 50 ±0.2 Hz. The Grid Code can be found on the EirGrid website (www.eirgrid.com)

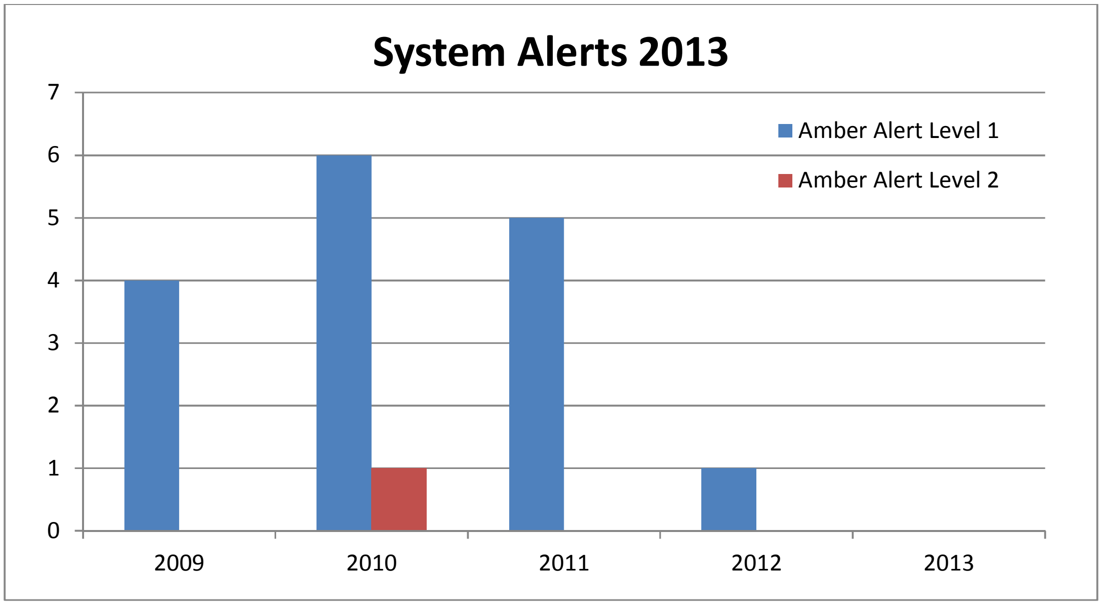


Table 7.2: Number of Alerts in the National Control Centre from 2009 – 2013

7.3.Load Shedding of Customers

7.3.1. Under Frequency Load Shedding

There was one incident of Under Frequency Load Shedding (UFLS) in 2013, due to a trip of the East West Interconnector. Short Term Active Response customers were disconnected during the disturbance. System frequency dropped to 49.27 Hz on another occasion due to the trip of a generator from 386 MW, however, as this occurred between midnight and 07:00 hours, the STAR scheme was not required to act.

No frequency excursion resulted in load shedding of Normal Tariff customers in 2013.

Table 7.3.1 provides a summary of each UFLS event. Normal Tariff System Minutes are normal customer System Minutes which were disconnected for frequency excursions below 48.85 Hz. The time to recover to 49.9 Hz starts from 49.3 Hz, the point at which the STAR under frequency relays are activated.

The lowest system frequency in 2013 was 49.22 Hz; during the UFLS disturbance in May.

SDR No.	Date	Cause	Frequency Nadir, Hz	Minutes to Recover to 49.9 Hz	MVA Minutes	STAR SM	Normal Tariff SM
T028/2013	10/05/2013	EWIC tripped from 530 MW import.	49.22	3.3	127.9	0.021806	0

Table 7.3.1: Summary of UFLS disturbances in 2013

The target for activation of STAR schemes is 16 events or lower for the year. The number of STAR events each year since 2004 is presented in Figure 7.3.1. The average over this period was 2.9 ± 1.7 events per year.

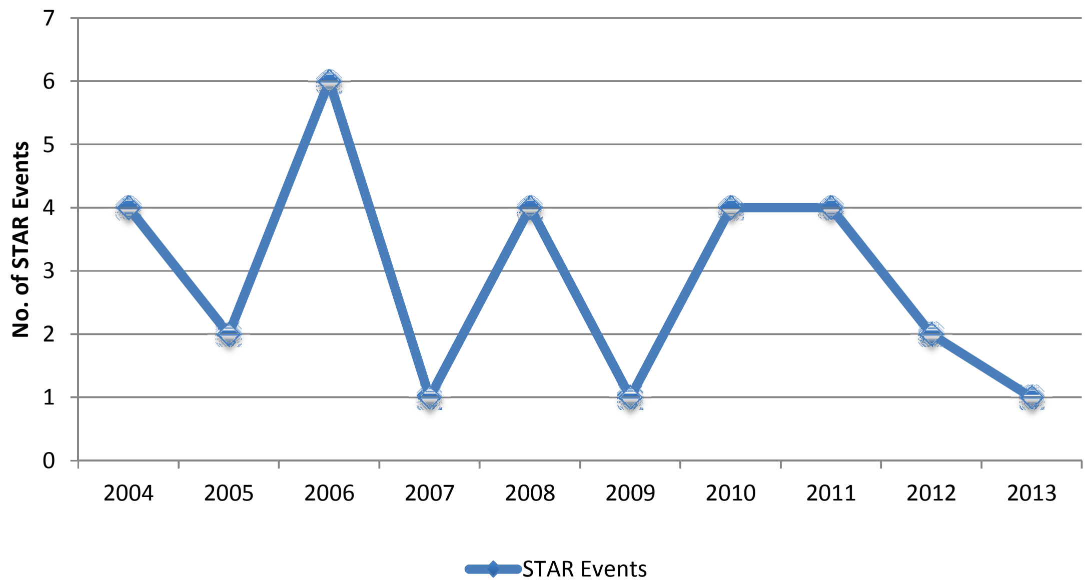


Figure 7.3.1: Number of STAR events 2004 – 2013

7.3.2. Under Voltage Load Shedding

There was no incident of Under Voltage Load Shedding (UVLS) in 2013.

7.4. System Minutes Lost

The total System Minutes lost for 2013, attributable to EirGrid, was 0.357.

The trend of System Minutes lost since 2006 is shown in Figure 2.

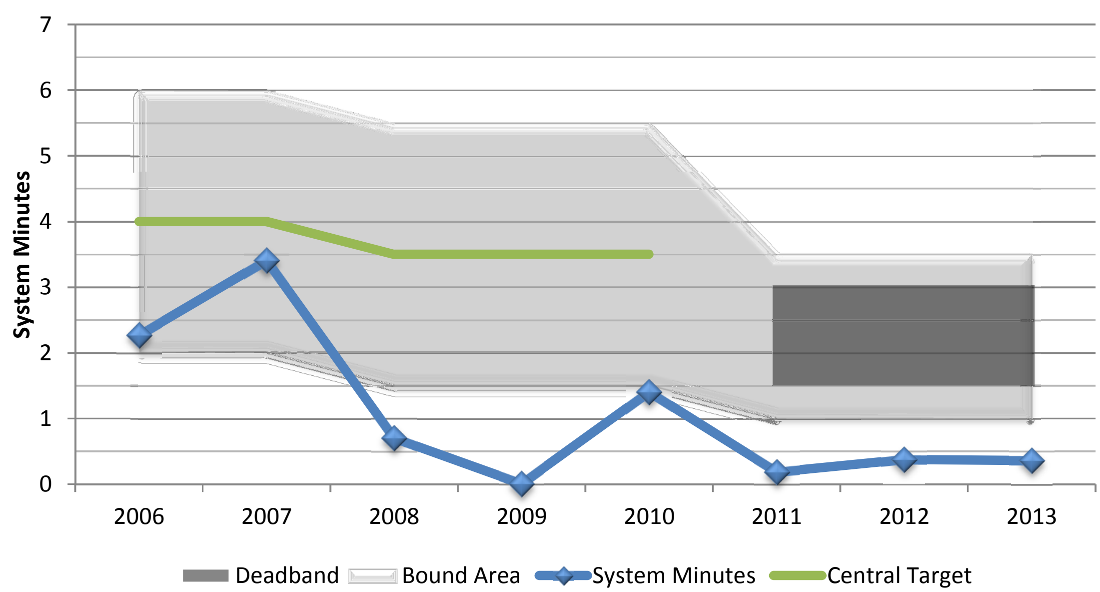


Figure 7.4.1: System Minutes attributable to EirGrid and associated targets 2006 – 2013

7.5. Zone Clearance Ratio

The Zone Clearance Ratio 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 Appendix A for further definition of Zones and ZCR.

In 2013, the ZCR was 0.074. The ZCR trend since 2004 is shown in Figure 7.4.2.

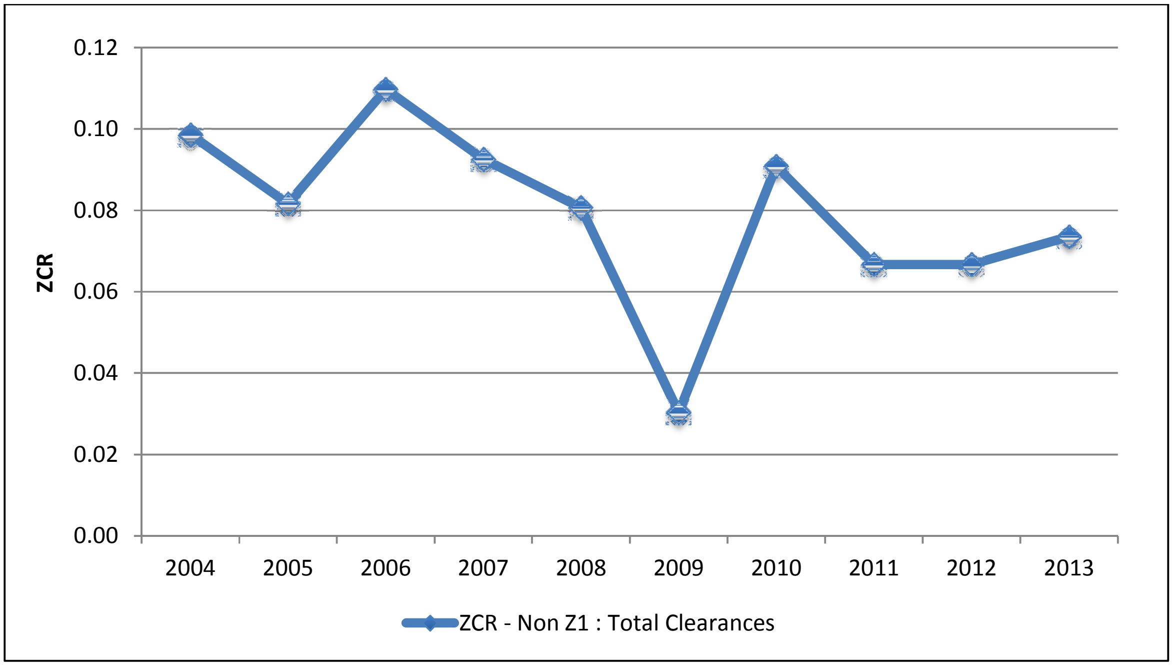


Figure 7.4.2: Zone Clearance Ratio 2004 - 2013

The number of Zone 1, non Zone 1 and Zone 2 clearances for each year are presented in Table 7.4.2. There were 68 short circuit faults cleared by protection on the Main System, an increase of 127 % year on year. This figure is made up of 67 Main System short circuits faults and one Non Main System fault on the DSO controlled Killonan - Nenagh 110 kV line. Of the 68 short circuit faults cleared by Main System protection, 63 were cleared in Zone 1, four were cleared in Zone 2 and one was cleared in Zone 3.

Clearance	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Zone 1	64	45	73	49	57	32	20	28	28	63
Non Zone 1	7	4	9	5	5	1	2	2	2	5
Zone 2	7	2	6	5	2	1	2	2	2	4

Table 7.4.2: Number of Zone 1 and non Zone 1 clearances 2004 - 2013

Two Zone 2 clearances, on the Coolroe - Kilbarry 110 kV and Great Island - Kilkenny 110 kV lines, were due to failure of permissive teleprotection signals to reach the associated impedance relay to allow accelerated tripping.

One Zone 2 clearance, on the Great Island - Kilkenny 110 kV line, was due to a fault being placed outside Zone 1 by the impedance protection because of the high resistance of the fault. The earth resistance reach of the impedance relays on the line have been extended to provide additional coverage for high resistance earth faults. The line requires a protection upgrade (planned as part of the Great Island refurbishment) to provide reliable high resistance earth fault protection.

One Zone 2 clearance was for a fault on T2102 110 kV GIS cubicle in Arklow. The fault was cleared in 360 ms by impedance protection on the T2102 220 kV cubicle which had been set down due to the lack of 110 kV busbar protection.

The Zone 3 clearance was also for a fault on T2102 110 kV GIS cubicle in Arklow as part of the same disturbance. The fault was cleared in 252 ms by impedance protection on the T2101 110 kV cubicle which had been set down due to the lack of 110 kV busbar protection. Although the fault was cleared in the impedance relay's reverse Zone 3, the clearance time is approximately half that of a typical Zone 3 clearance and could be classified as a Zone 1 clearance based on the duration.

7.6.Summary of Important Disturbances

7.6.1. Loss of Load

T47/2013: Knockumber

At 18:03 hours on Sunday 28 July 2013, a phase to phase fault (RT) occurred on the Gorman - Knockumber 110 kV line. The cause of the fault was lightning. The circuit breakers at both ends of the line were tripped by impedance protection to clear the fault in 57 ms. The load at Knockumber, which was tail fed from Gorman, was disconnected for 22 minutes. 0.041661 System Minutes were lost to an Industrial Customer.

T48/2013: Meath Hill

At 13:18 hours on Monday 29 July 2013, a three phase to ground fault occurred on the Louth - Meath Hill 110 kV line. The cause of the fault was lightning. The circuit breaker at Louth was tripped by its impedance protection to clear the fault in 76 ms. The load at Meath Hill, which was tail fed from Louth, was disconnected for 31 seconds. 0.000577 System Minutes were lost to Normal Tariff customers.

T64/2013: Bandon and Brinny

At 04:44 hours on Wednesday 02 October 2013, a single phase to ground fault (TE) occurred on the Bandon - Raffeen 110 kV line. The cause of the fault was lightning. The circuit breaker at Raffeen was tripped by its impedance protection to clear the fault in 75 ms. The load at Bandon, which was tail fed from Raffeen, was disconnected for up to 32 minutes. 0.025883 System Minutes were lost to Normal Tariff customers. The load at Brinny, which was tail fed from Bandon, was disconnected for 15 minutes 47 seconds. 0.006878 System Minutes were lost to an Industrial Customer. A total of 0.032760 System Minutes were lost due to this disturbance.

T86/2013: Kilkenny

At 07:04 hours on Saturday 21 December 2013, a single phase to ground fault (TE) occurred on the Great Island - Kilkenny 110 kV line. The cause of the fault was lightning. The circuit breaker at Great Island was tripped by its impedance protection, the circuit breaker at Kilkenny was not tripped and the fault was cleared when the impedance protection in Kellis tripped the Kilkenny 110 kV CB. The load at Kilkenny was disconnected for eight minutes. 0.043948 System Minutes were lost to Normal Tariff customers.

T86/2013: Arklow, Ballybeg and Shelton Abbey

At 07:25 hours on Saturday 21 December 2013, there was a lightning strike on a double circuit tower carrying the Arklow - Carrickmines 220 kV and Ballybeg - Carrickmines 110 kV lines. The fault was located approximately 20 km from Carrickmines. The Arklow - Carrickmines 220 kV line tripped and reclosed for a phase to phase to ground fault (RTE). The Ballybeg - Carrickmines 110 kV line tripped for a phase to phase to ground fault (RTE). A three phase fault developed simultaneously on the T2102 110 kV cubicle in Arklow. As no 110 kV busbar protection was in operation in Arklow, T2101 and T2102 tripped to clear this fault. The Arklow 110 kV CB in Ballybeg tripped due to the unusual conditions created by three simultaneous faults. The 110 kV supply to Ballybeg was disconnected for 14 minutes 47 seconds. 0.018770 System Minutes were lost to Normal Tariff customers. The load at Arklow was disconnected for 60 minutes. 0.200038 System Minutes were lost to Normal Tariff customers. The load at Shelton Abbey, which was tail fed from Arklow, was disconnected for 8 hours 32 minutes. 0.019420 System Minutes were lost to an Industrial Customer. A total of 0.238229 System Minutes were lost due to this disturbance.

T89/2013: Bellacorick and Moy

At 09:34 hours on Tuesday 24 December 2013, a three phase fault occurred on the Glenree - Moy 110 kV line. The cause of the fault was lightning. The circuit breakers at both ends of the line were tripped by differential protection to clear the fault in 65 ms. The Bellacorick - Castlebar 110 kV line also tripped for the fault due to Zone 4 and Zone 5 timers left set down to zero seconds on the 7SA612 impedance relays. The temporary settings had been applied when the line was energised following the installation of new CTs and VTs at both ends as part of a line uprate. The loads at Bellacorick and Moy were disconnected until the Glenree - Moy 110 kV line auto-reclosed after 578 ms. 0.000033 System Minutes were lost to Normal Tariff customers.

7.6.2. Under Frequency Load Shedding

T28/2013: East West Interconnector

At 11:40 hours on Friday 10 May 2013, EWIC tripped from 530 MW import from Great Britain. System frequency dropped from 50.05 Hz to 49.22 Hz at its nadir. The frequency recovered to 49.9 Hz within approximately four minutes. The STAR scheme was activated during this incident, which resulted in the disconnection of 23.1 MW of interruptible Industrial Customer load for 4 minutes 59 seconds. 0.021806 STAR System Minutes were lost. The System Minutes lost during this incident relate entirely to contracted STAR customers.

7.6.3. Other

T17/2013: Cullenagh - Knockraha 220 kV line

At 08:54 hours on Thursday 07 March 2013, the Cullenagh - Knockraha 220 kV line tripped, reclosed and tripped for a single phase to ground (SE) high resistance fault. The line was inspected between 15 km and 25 km from Cullenagh but no conclusive cause for the fault was identified. The line is 86.05 km long. A heli-patrol of the line was completed on Friday 08 March 2013 by ESBI. No damage was observed. ESBI confirmed to NCC that the line was clear and available to energise.

At 14:45 hours on Friday 08 March 2013, the Cullenagh 220 kV CB in Knockraha tripped for a single phase to ground (SE) high resistance fault immediately after being switched in. A further line foot-patrol and a climbing-patrol did not uncover the cause/location of the faults. On Monday 11 March 2013, additional climbing inspections and an inspection of the Knockraha 220 kV cubicle in Cullenagh station were performed in a further attempt to locate the cause of the fault.

In an effort to identify the faulted location, the line was broken at Mast 85 and energised successfully from the Knockraha end at 00:45 hours on Friday 15 March 2013. The line was also broken at Mast 22 and energised from the Cullenagh end at 00:47 hours that morning. The Knockraha 220 kV CB in Cullenagh tripped for a single phase to ground (SE) fault immediately after being switched in.

Following this trip the fault location still could not be determined thus it was decided to replace all S phase insulators from Cullenagh 220 kV station to Mast 22. A damaged S phase polymeric insulator was found at Mast 17, 5.06 km from Cullenagh. S phase insulators were replaced at Masts 1, 7, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21 & 22. Insulators were replaced on all phases at Mast 86.

At 00:32 hours on Sunday 17 March 2013, the Cullenagh - Knockraha 220 kV line was energised successfully from the Cullenagh end up to physical break at Mast 22. The jumpers were re-made at Mast 22 and the Cullenagh - Knockraha 220 kV line was switched in successfully at 16:11 hours on Sunday 17 March 2013.

SONI Transmission System Performance

8. SONI SUMMARY

- One of the key measures of performance is availability, both of the overall Northern Ireland transmission system, and interconnection to the system. System availability is calculated as a percentage of actual circuit hours available in relation to total possible circuit hours available. Circuit outages that result from both planned and unplanned unavailability are taken into account.

- The annual system availability was 97.99%, with a higher winter availability of 99.12%, reflecting that planned work on circuits is minimised over the winter months.

- The capacity of the Moyle interconnector continues to be an issue, having an annual availability of 43.50%. This all-time low figure was caused by the ongoing cable faults the interconnector has suffered in recent years.

- Only one cable (Pole 1) of the Moyle interconnector was available at the beginning of 2013 due to cable faults in previous years. There was a planned maintenance outage on the Auchencrosh– Mark Hill-Coylton line in Scotland in August – September 2013, which reduced the capacity to 0MW's.

- The North-South 275kV Tie Line's availability was 96.11%. The two 110kV Tie Lines had an annual availability of 98.97%, both figures fall within the operational norms for these circuits.

- Another key measure of performance is system security, which is captured by reporting on any incidents resulting in loss of supplies to customers. In 2013 there were four reportable incidents, which are detailed within this report. All four reportable incidents were experienced during the extreme weather conditions suffered on the 22nd March 2013.

- Quality of service is measured by the number of voltage and frequency excursions over the year, that fall outside statutory limits. There were no voltage excursions over the year. When we consider frequency excursions on the same basis as previous years, using 49.5Hz as a threshold, the number of incidents has increased from 4 within the 2012 report to 6 in 2013 report.

- With the exception of the Moyle Interconnector HVDC link all system availabilities have generally remained at the same level of performance when compared to previous year's reports. Unfortunately during the period of this report the Moyle interconnector continued to suffered from lengthy unplanned outages.

March 2013 Ice Storm

Due to bad weather conditions, there were a large number of trips of both transmission and distribution circuits throughout the day on Friday 22nd March. The transmission system was most affected in east of the province, including the network around Belfast. The problems on the transmission network appear to mainly have arisen from seriously windy conditions coupled with a build up of wet snow on the circuits. In some cases lines automatically restored after tripping, but in a number of cases they were forced out of service for prolonged periods.

There were incidents of customer outages throughout Northern Ireland due to transmission and distribution faults. Some customers remained without supply through the weekend, due to the large number of distribution faults and difficulties getting to sites to carry out repairs due to the continuing adverse weather conditions.

While there were a number of transmission incidents resulting in some loss of supply to customers, by far the most significant were two events affecting supply to Belfast City, one at 07:31 in the morning and one at 19:31 in the evening. The Belfast area is primarily supplied from two 275kV transmission stations, at Castlereagh and Hannahstown. These two stations are effectively fed from four 275kV circuits into the city.

Due to loss of the 275kV circuits supplying Hannahstown during the early morning, the load in the general north/west area of Belfast was being fed at 110kV and 33kV. Due to rising demand (and perhaps other factors), the 110kV and 33kV circuits tripped at 07:31 hours, leading to total loss of supply to Lisburn and North and West Belfast. Supply was restored to almost all of the area after 5 minutes. A relatively small amount of customer load (c. 10MW) remained without supply for a further 80 minutes due to lower voltage transformer outages.

During the course of the day, two of the four 275kV circuits supplying the Belfast area were forced out of service due to weather damage. Just before 19:30 hours, a third circuit was forced out and the single remaining circuit feeding the Belfast area tripped at 19:31 hours. Therefore supply was lost to both Hannahstown and Castlereagh stations, therefore shutting of supply to effectively the entire Belfast area.

It is estimated that some 400MW of customer load may have been lost. This resulted in a high-frequency event which in turn resulted in three generation units in RoI tripping of the system. The frequency dropped to below 50Hz and then recovered to normal levels.

One 275kV circuit was restored to service resulting in supply being restored to most areas in approximately 12 minutes. Belfast was largely being supplied by this single 275kV circuit (as well as 110kV circuits feeding into the area). Therefore supply to the city remained at considerable risk until a second 275kV circuit was restored on Saturday morning. The remaining 275kV circuits were restored later on Saturday.

This was of course a major power system incident involving loss of supply to large numbers of customers. The primary cause was loss of transmission circuits due to adverse weather conditions. In both of the major incidents affecting supply to Belfast city, supply was restored expeditiously due to the rapid actions of the SONI Control Centre staff on duty.

This data has been prepared by the System Operator for Northern Ireland Ltd. (SONI) in accordance with the requirements of Part 11 of Condition 20 of the ‘Licence to Participate in the Transmission of Electricity’.

SONI is responsible for the safe, secure, efficient and reliable operation of the Northern Ireland transmission network. The transmission network is operated at 275kV and 110kV. Its primary purpose is to transport power via overhead lines and cables from generators and interconnectors to Distribution Bulk Supply Points. The power is then transformed to lower voltages (33, 11 and 6.6kV) and distributed to customers.

Reporting is carried out in accordance with the definitions and principles of the National Fault and Interruption Reporting Scheme (NAFIRS), (Engineering Recommendation G43/2). The effects of national / regional emergencies and disputes are excluded.

This report covers the 12 month period from 1st January – 31st December 2013.

9. SYSTEM AVAILABILITY

9.1. Calculation Methodology

System Performance is monitored by reporting monthly variations in system availability, winter peak and average annual system availability, together with planned and unplanned system availability.

Availability is reduced whenever a circuit is taken out of operation, either for planned purposes e.g. maintenance work, or as the result of a fault, caused, e.g., by lightning strikes, high winds, equipment failure etc.

SONI is required under its licence to operate the transmission system in accordance with the Transmission and Distribution System Security and Planning Standards and the Grid Code.

Planned work is necessary to facilitate new user connections, network development and the maintenance of network assets necessary to deliver acceptable levels of system security and reliability.

The outages of transmission circuits either planned outages or faults resulting in forced outages have the net effect of reducing system availability to less than 100%. System availability is defined by the formula:

$$\textbf{System Availability} = \frac{\text{The sum of all circuit hours actually available x 100\%}}{\text{(Total No. of circuits) x (Total No. of hours in one year)}}$$

A circuit is defined as the overhead line, cable, transformer or any combination of these that connects two system bus bars together or connects the system to a User's busbar. Network bus bars are located in transmission substations; the bus bars, circuits and network configuration are described in the current SONI Transmission Seven Year Statement.

There are approximately 150 transmission (275kV and 110kV) circuits in the Northern Ireland transmission system, covering a total length of circa 2130km in the form of transmission overhead lines and cable circuits.

Planned unavailability - is defined as outages that are required to maintain transmission network assets. These are planned in excess of seven days prior to the outage. This also includes outages to facilitate user connections (generators etc.) and also general network maintenance that benefits all users.

Unplanned unavailability - is due to an outage which occurs as a result of breakdown, i.e. outages required and taken immediately upon request or planned at less than seven days notice.

9.2. Results

9.2.1. Annual System Availability

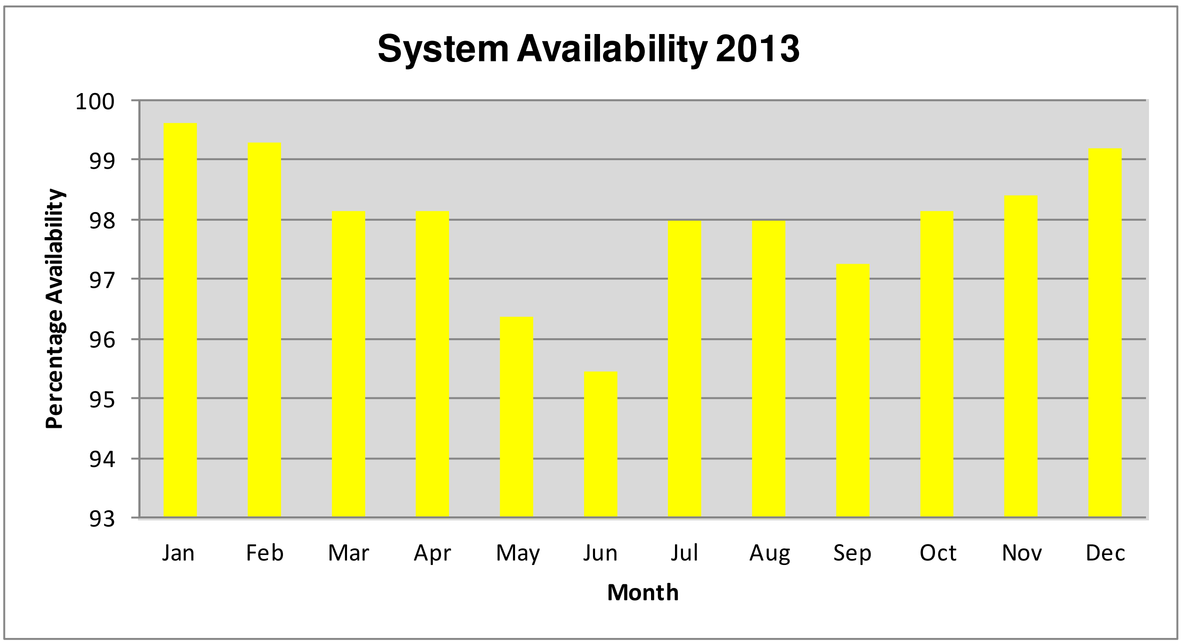
For 2013, the Average Annual Availability of the Northern Ireland Transmission System was 97.99%

9.2.2. Summer and Winter Availability

The Winter Peak System Availability (average system availability for the winter months Jan, Feb, Nov and Dec 2013) has increased to 99.12% from 99.00% in the 2012 report.

9.2.3. Monthly Variation

Figure 9.2.3 below shows the month by month variation in system availability in respect of the transmission network in Northern Ireland.



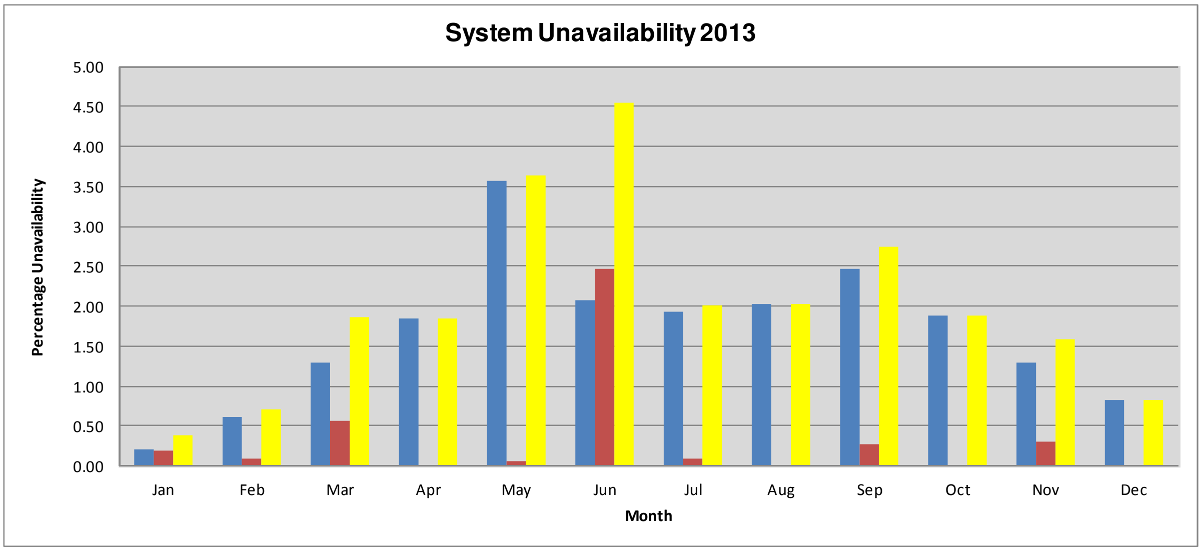
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.61	99.30	98.14	98.15	96.37	95.45	97.98	97.96	97.26	98.12	98.41	99.18

Figure 9.2.3: System Availability 2013

Overall, the availability of the system is high, particularly over the winter months, with an average of 99.12% for January, February, November and December 2013. The higher availability over the winter months is because planned outages are usually scheduled to take place over the summer months when network loading is generally lower. From May to August the availability is 97.43%; over 1.0% lower than winter value.

9.2.4. System Unavailability

Figure 9.2.4 below shows the month by month variation in planned, unplanned and total system unavailability.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Planned	0.20	0.61	1.30	1.85	3.57	2.08	1.92	2.02	2.47	1.88	1.29	0.82
Unplanned	0.18	0.10	0.56	0.01	0.06	2.47	0.09	0.01	0.27	0.00	0.30	0.00
All Outages	0.39	0.70	1.86	1.85	3.63	4.55	2.02	2.04	2.74	1.88	1.59	0.82

Figure 9.2.4: System Unavailability 2013

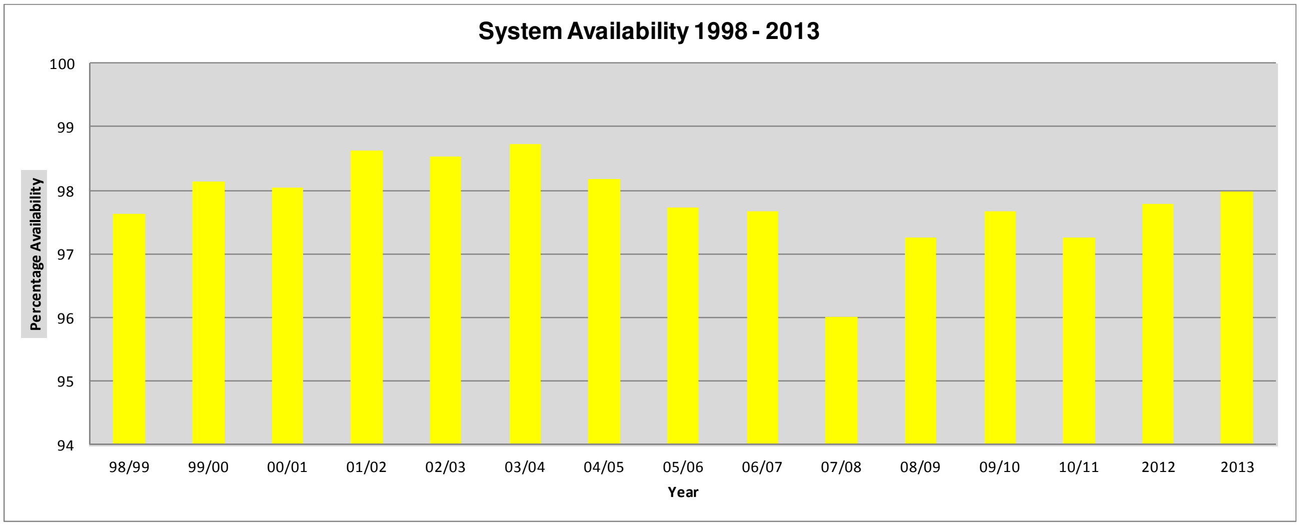
Total unavailability varied between 0.39% and 4.55% throughout the year, with the highest occurrence being in June 2013.

Figure 9.2.4 above shows that the majority of planned outages occurred during the summer months of May – August 2013. These four months have an average value of 3.06% for planned outages. The graph shows that planned outages far outweighed unplanned outages during the period of this report. The low unplanned outage average figure of 0.34% demonstrates how well the transmission system performed.

The spike in unavailability in June was due mostly to unplanned outages on Hannahstown Inter-bus Transformer 1 and the Power Station West – Donegal B circuit in Belfast.

9.2.5. System Historic Availability Performance

Figure 9.2.5 below shows the historic variation in system availability from 1998 to 2013 in respect of the transmission network in Northern Ireland.



98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	2012	2013
97.62	98.13	98.05	98.62	98.53	98.73	98.17	97.73	97.67	96.01	97.26	97.67	97.26	97.79	97.99

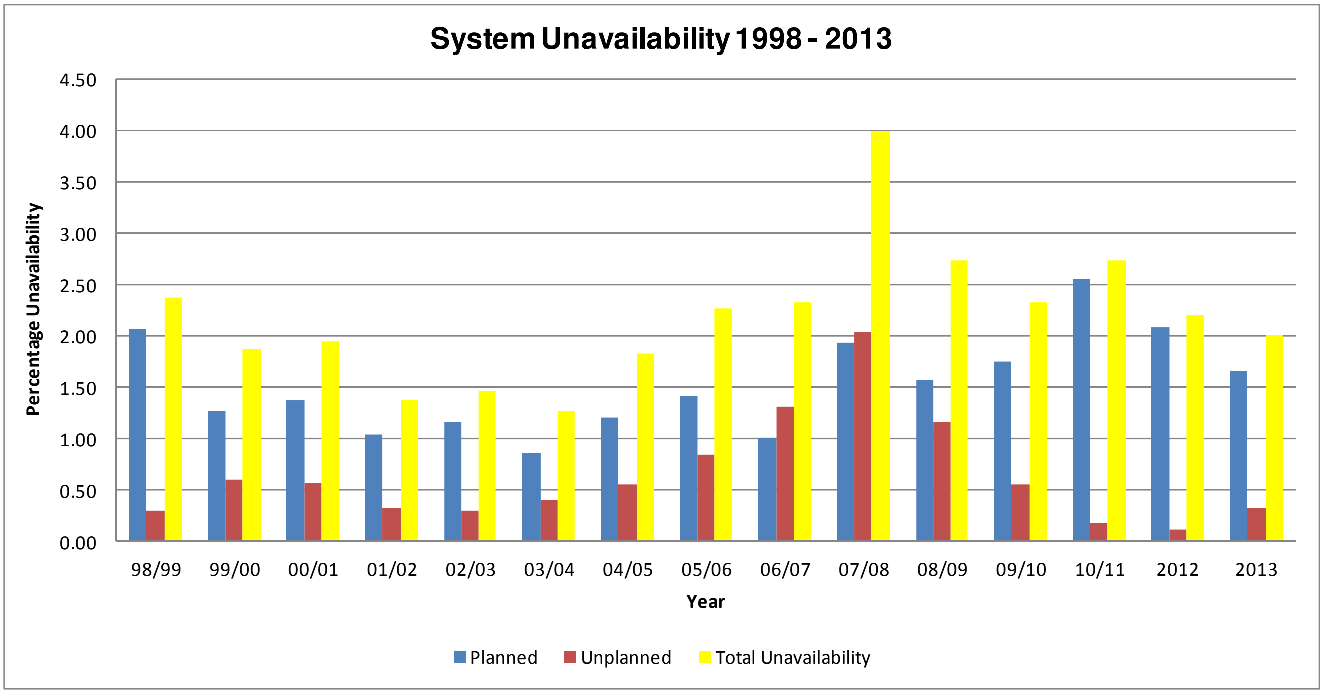
Figure 9.2.5: Historic System Availability 1998 – 2013

The Transmission System Performance report up until 2012 aligned to cover the financial year rather than a calendar year. From 2012 onwards SONI have aligned with the calendar year (Jan-Dec) this change has been made to a line with EirGrid TSO to produce an all Island report. This we believe makes sense as the Networks within both regions are interconnect via AC transmission lines at 275kV and 110kV making one synchronous area, therefore a single network event can have adverse effect on each TSO's regional area.

The percentage figure of system availability for 2013 shows a slight increase on the previous year, and remains ahead of the system low figure of 96.01% in 2007/08. The annual average over the period of the above graph is 97.82%. The figure of 97.99% for 2013 therefore is comparable with this average.

9.2.6. System Historic Unavailability Performance

Figure 9.2.6 below shows the breakdown of the system unavailability from 1997/98 to 2013.



	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	2012	2013
Planned	2.07	1.27	1.37	1.04	1.16	0.86	1.21	1.42	1.01	1.94	1.57	1.76	2.56	2.09	1.67
Unplanned	0.31	0.60	0.58	0.34	0.30	0.41	0.56	0.85	1.32	2.05	1.17	0.56	0.18	0.12	0.34
Total Unavailability	2.38	1.87	1.95	1.38	1.47	1.27	1.83	2.27	2.33	3.99	2.74	2.33	2.74	2.21	2.01

Figure 9.2.6: Historic System Unavailability 1998 – 2013

Figure 9.2.6; The annual system unavailability figure for 2013 shows a slight decrease when compared to the 2012 figure and unplanned outages continues to be low.

Using the data from the above graph the overall annual average percentage for system unavailability is 2.17%. The unavailability percentage for 2013 (2.01%) falls close to the average percentage figure over the entire data period of from 1998 – 2013.

10. INTERCONNECTOR and TIE-LINE AVAILABILITY

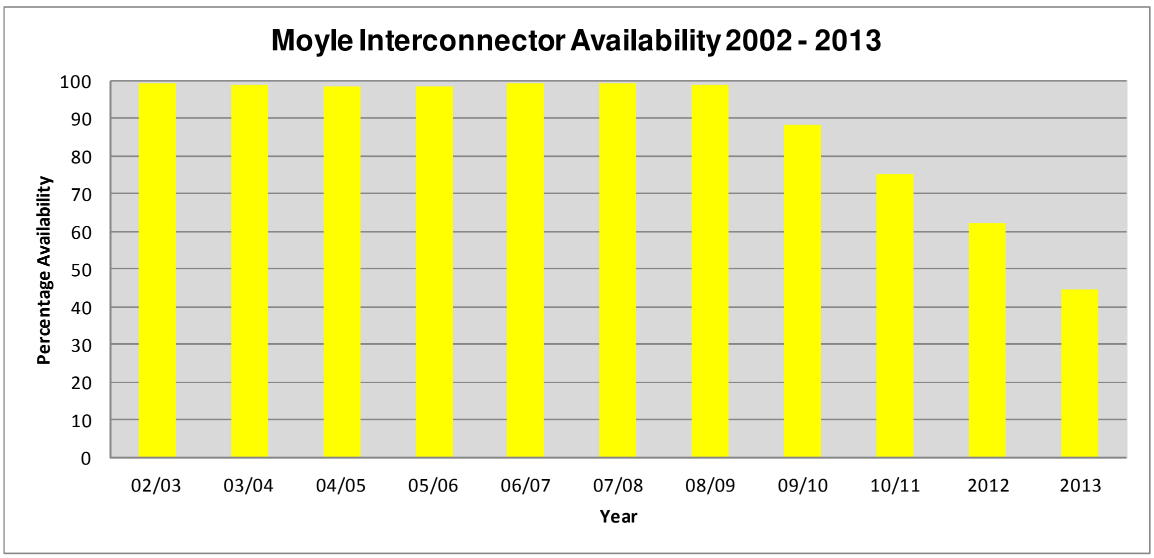
10.1. Interconnection with GB

The Moyle interconnector, NI-GB, commenced commercial operation in 2002 and is constructed as a dual monopole HVDC link with two coaxial undersea cables from Ballycronan More, Islandmagee to Auchencrosh, Ayrshire, Scotland. The 500MW link is operated by SONI, and the performance of this link falls under the scope of this report.

10.2. Moyle Interconnector Historic Availability

The 2013 Annual Availability of the Moyle Interconnector was significantly reduced to an all time historic low of 43.5%.

Figure 10.2 below shows the historic annual variation in the Moyle Interconnector availability from 2002/03 – 2013. With the exception of the past three years the availability of the Moyle interconnector has remained high since its introduction in 2002, with 2007/08 remaining the highest on record.



02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	2012	2013
99.40	98.77	98.43	98.34	99.35	99.46	99.09	88.18	75.16	62.02	43.50

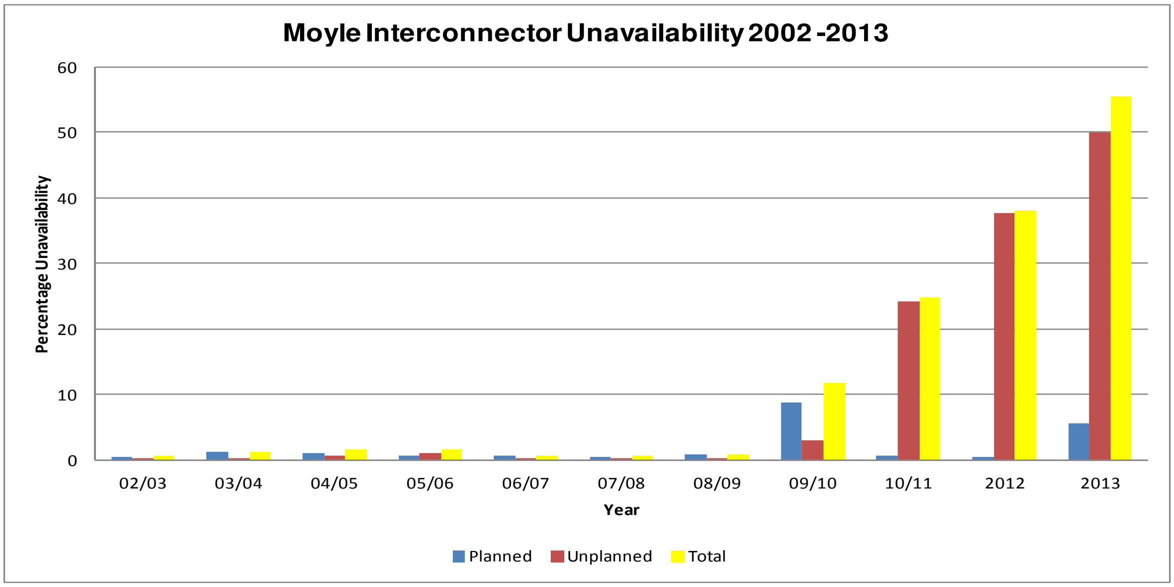
Figure 10.2: Historic Moyle Interconnector Availability 2002/03 – 2013

The considerable reduction of availability in 2013 on the Moyle Interconnector was mainly caused by the ongoing problems with cable faults.

10.2.1. Moyle Interconnector Historic Unavailability

The 2013 Annual Unavailability of the Moyle Interconnector was 56.50%.

Figure 10.2.1 below shows the historic annual variation in the Moyle Interconnector unavailability from 2002 to 2013.



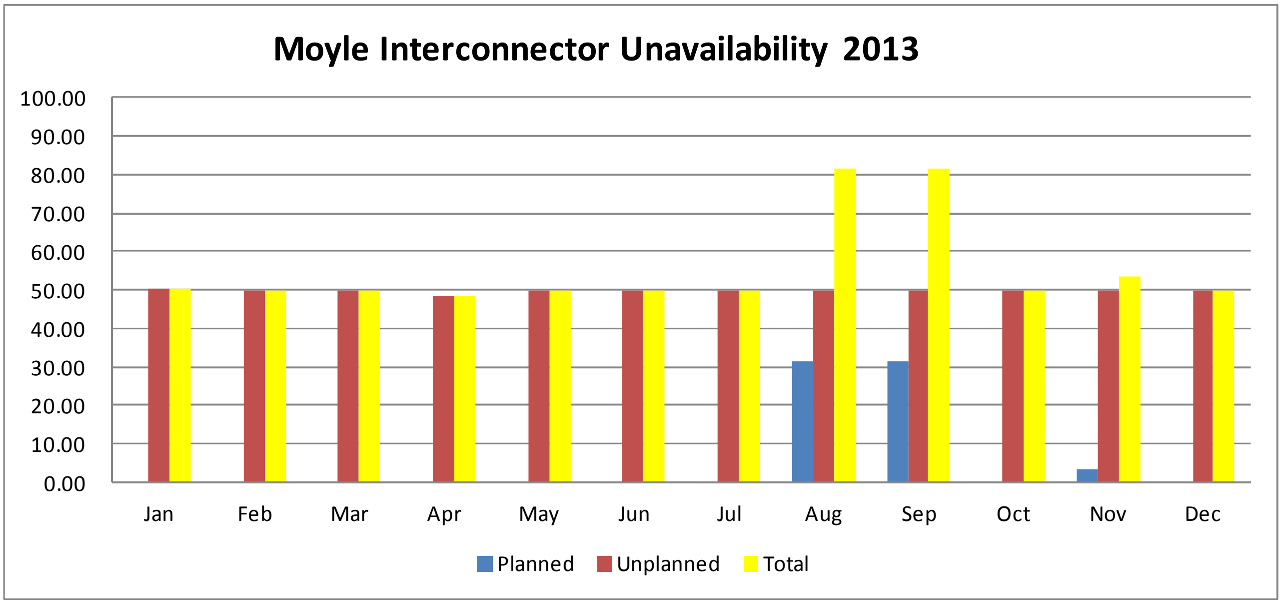
	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	2012	2013
Planned	0.47	1.16	1.00	0.65	0.60	0.50	0.74	8.80	0.67	0.35	5.55
Unplanned	0.13	0.07	0.57	1.02	0.05	0.05	0.17	3.01	24.17	37.63	50.95
Total	0.60	1.23	1.57	1.66	0.65	0.54	0.91	11.82	24.84	37.98	56.50

Figure 10.2.1: Historic Moyle Interconnector Unvailability 2002 – 2013

Until 2008/09 the average unavailability performance of the interconnector was 1.02%. Minimal outages had resulted in the low unavailability figures. However as can be seen in the graph above there is a sizable increase in the value of percentage Total Unavailability. The increase in Moyle unavailability for 2013 was caused by the ongoing cable faults in recent years.

10.3. Moyle Interconnector Monthly Unavailability

Figure 10.3 below shows the month by month variation of unavailability of the interconnector. The graph indicates during which months that maintenance has been undertaken by Moyle.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Planned	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.59	31.67	0.00	3.33	0.00
Unplanned	50.27	50.00	50.00	48.39	50.00	50.00	50.00	50.00	50.00	50.07	50.00	50.00
Total	50.27	50.00	50.00	48.39	50.00	50.00	50.00	81.59	81.67	50.07	53.33	50.00

Figure 10.3: Moyle Interconnector Unavailability 2013

Figure 10.3 above clearly shows how the Moyle Interconnector has been affected by the significant increases in unplanned outages.

The ongoing unplanned outage caused by faults on the underwater cable began in July 2011 and has unfortunately continued beyond the period of this report.

10.4. Tie-Lines with ROI

10.4.1. 275kV Tie Line

The synchronous interconnection is via the double circuit 275kV North-South Tie Line between Tandragee and Louth. Since the introduction of the Single Electricity Market (SEM) the circuit is treated as a Tie Line.

Outages are planned between the connected parties to allow work to be undertaken in an efficient manner.

10.4.2. 110kV Tie Lines

110kV connections with RoI are as follows:

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

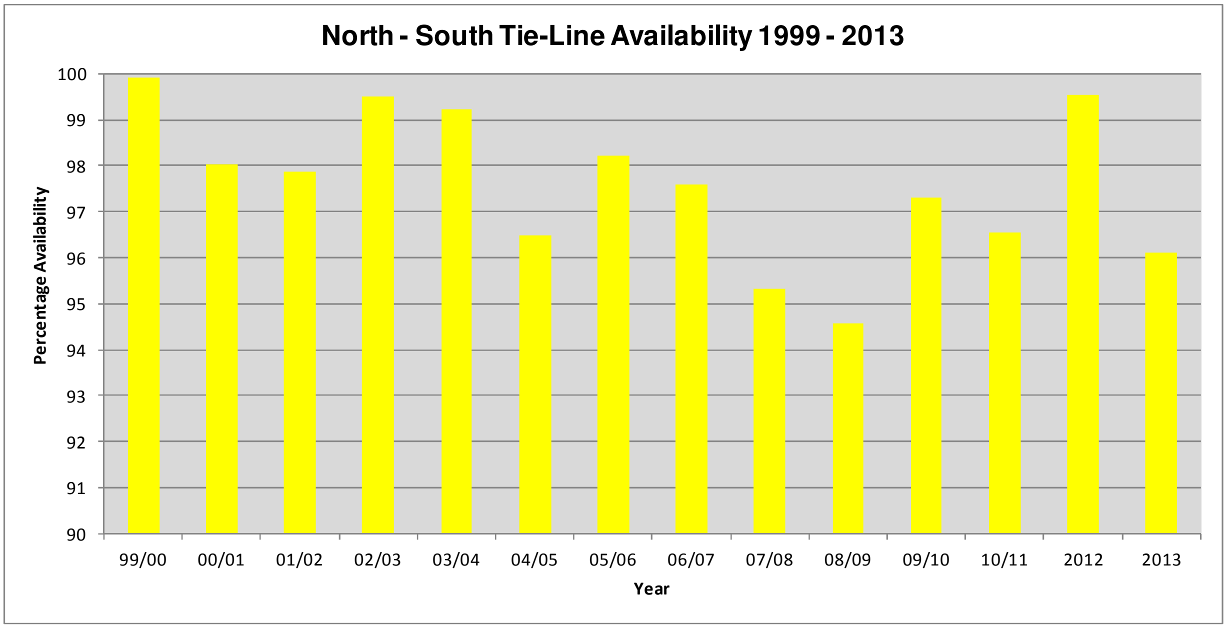
Until 2001, both circuits operated in a standby mode, but were then converted into permanent connections by the deployment of power flow controllers, rated at 125MW. The power flow controllers are normally adjusted to maintain a 0MW transfer, but can be set to any desired value to support either system during abnormal operating conditions. Since the introduction of SEM, the circuits are treated as Tie Lines.

The two circuits are automatically taken out of service during the outage of both 275kV circuits on the North-South Tie Line. This is to ensure that the all-Island network operates in a stable manner.

The Strabane – Letterkenny Tie Line is now also used to import excess wind from Donegal on a regular basis.

10.4.3. 275kV North-South Tie Line Annual Availability

The annual availability of the 275kV North-South Tie Line was 96.11%. Figure 10.4.3 below shows the annual variation in the availability of the Tie Line from 1999 to 2013.



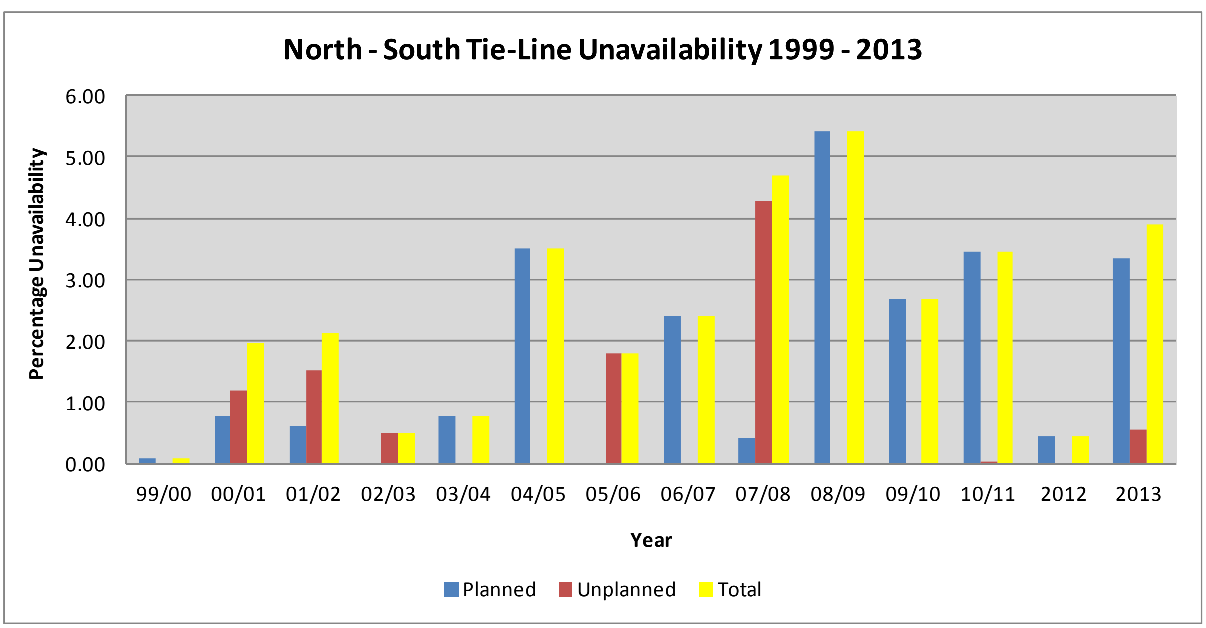
	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	2012	2013
Availability	99.91	98.04	97.87	99.51	99.22	96.49	98.21	97.60	95.31	94.58	97.31	96.54	99.55	96.11

Figure 10.4.3: Historic North-South Tie Line Availability 1999 – 2013

The 2013 availability figure of 96.11% is a decrease on last year's reporting period.

10.4.4. 275kV North-South Tie Line Annual Unavailability

Figure 10.4.4 below shows how the total unavailability for the years 1999 to 2013 is split between planned and unplanned outages.



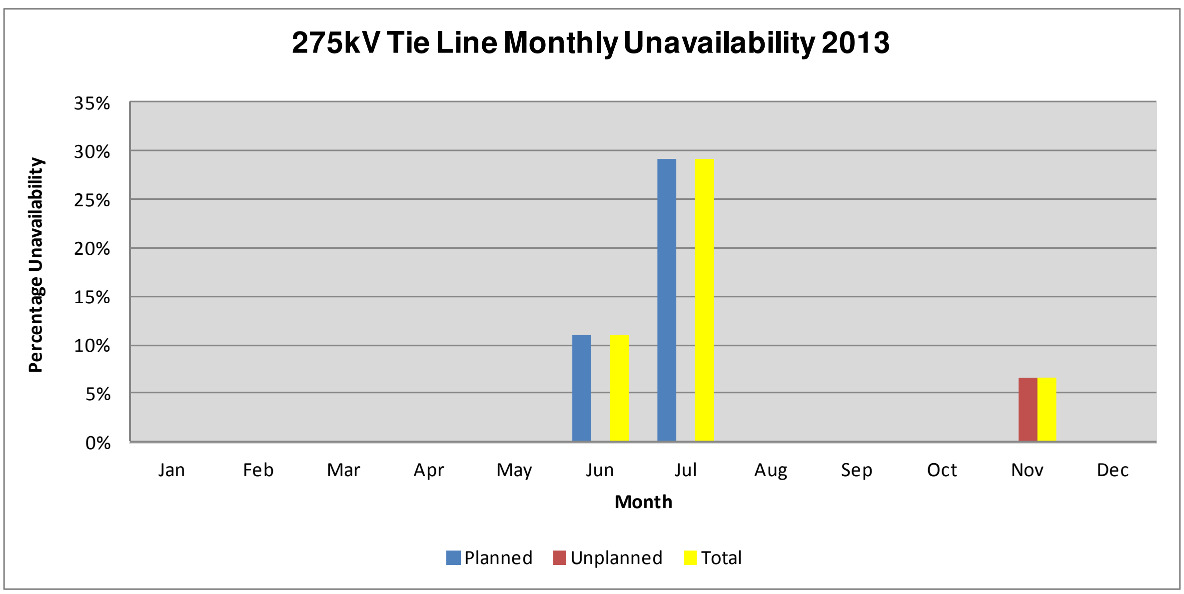
	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	2012	2013
Planned	0.09	0.77	0.62	0.00	0.78	3.51	0.00	2.40	0.41	5.42	2.69	3.45	0.45	3.34
Unplanned	0.00	1.18	1.51	0.49	0.00	0.00	1.79	0.00	4.28	0.00	0.00	0.01	0.00	0.56
Total	0.09	1.96	2.13	0.49	0.78	3.51	1.79	2.40	4.69	5.42	2.69	3.46	0.45	3.89

Figure 10.4.4: Historic North-South Tie Line Unavailability 1999 – 2013

The level of unavailability for the North – South tie line for 2013 was 3.89%, which is made up mainly by planned outages on both circuits within June – July.

10.4.5. 275kV North-South Tie Line Monthly Unavailability

Figure 10.4.5 below shows the month by month variation of unavailability of the North-South Tie Line.



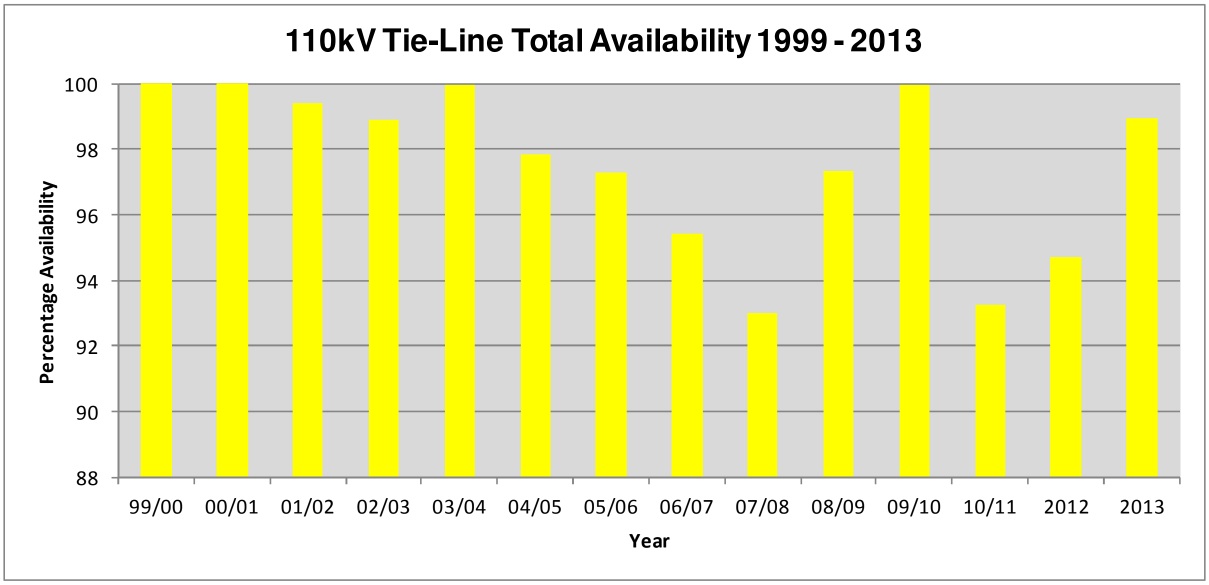
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Planned	0.00	0.00	0.00	0.00	0.00	10.92	29.12	0.00	0.00	0.00	0.00	0.00
Unplanned	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	6.66	0.00
Total	0.00	0.00	0.00	0.00	0.00	10.92	29.12	0.00	0.00	0.00	6.66	0.00

Figure 10.4.5: North-South Tie Line Monthly Unavailability 2013

Figure 10.4.5 highlights that the total percentage unavailability on the 275kV Tie Line for the period January 2013 – December 2013 was due almost entirely to a planned outage carried out in June - July 2013.

10.4.6. 110kV Tie Lines Annual Availability

The availability of the 110kV Tie Lines was 98.97% for the period January 2013 to December 2013. Figure 10.4.6 below shows the annual variation in the availability of the Tie Lines from 1999/00 to 2013.



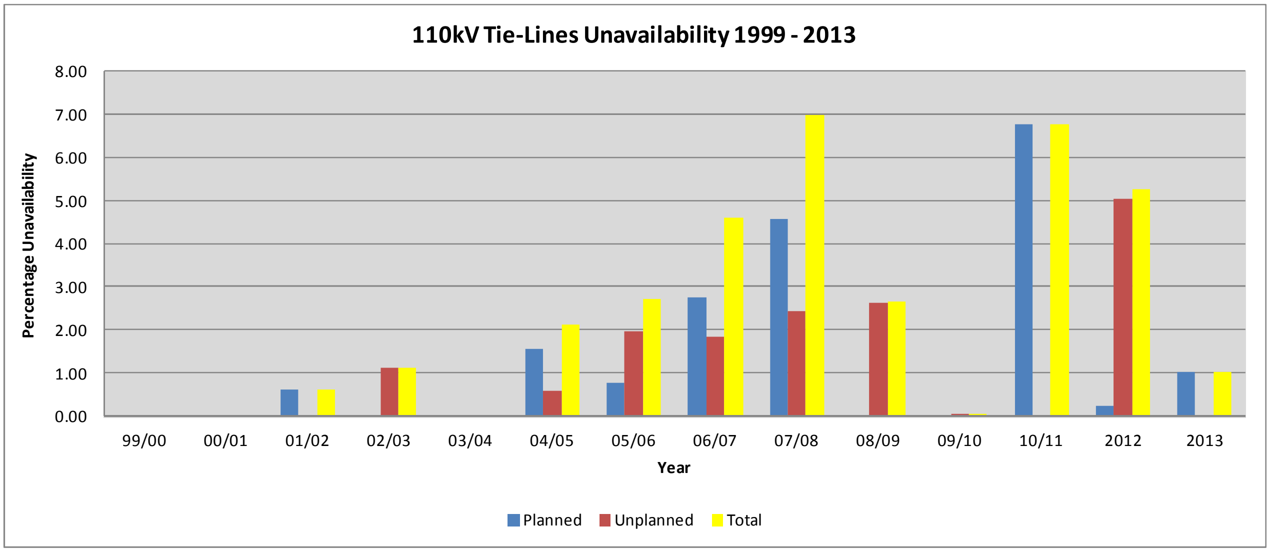
	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	2012	2013
Availability	100	100	99.39	98.88	99.97	97.87	97.27	95.41	93.01	97.35	99.94	93.24	94.72	98.97

Figure 10.4.6: Historic 110kV Tie Line Availability 1999 – 2013

The figures for 2013 show an increase 110kV tie-line availability to 98.97% on the previous reporting period 2012 of 94.72.

10.4.7. 110kV Tie Lines Annual Unavailability

The unavailability of the 110kV Tie Lines was 1.03% for the period January 2013 to December 2013. Figure 10.4.7 below shows the annual variation in the unavailability of the Tie Lines from 1999–2013.



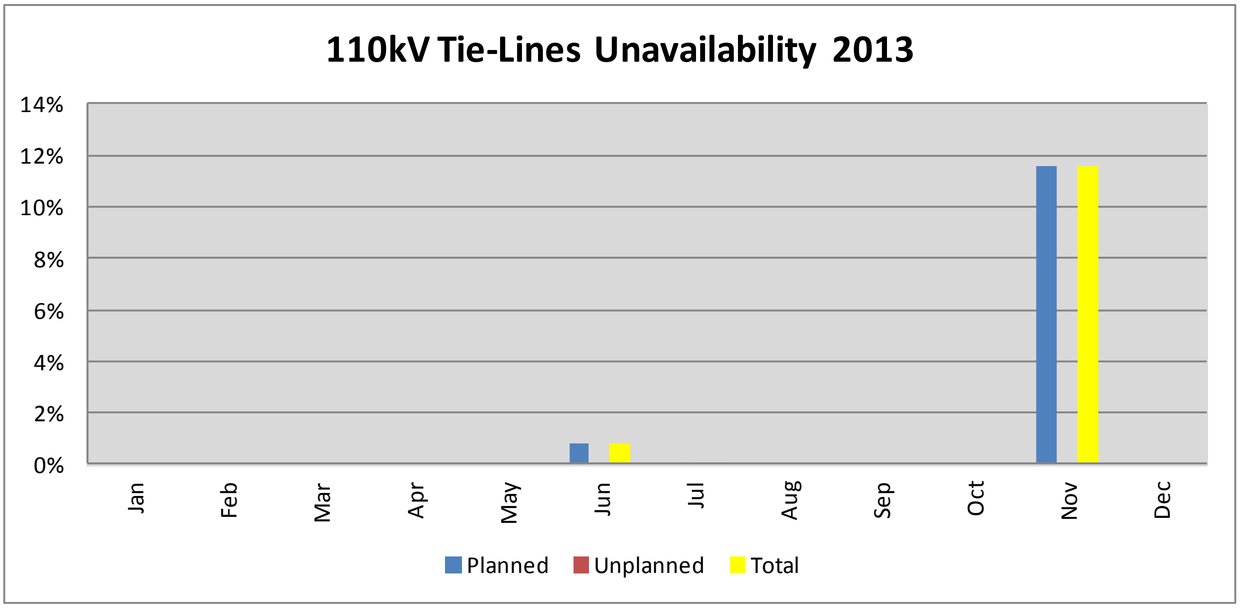
	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	2012	2013
Planned	0.00	0.00	0.61	0.00	0.00	1.54	0.77	2.76	4.56	0.02	0.00	6.76	0.23	1.03
Unplanned	0.00	0.00	0.00	1.12	0.03	0.59	1.96	1.83	2.43	2.63	0.06	0.00	5.05	0.00
Total	0.00	0.00	0.61	1.12	0.03	2.13	2.73	4.59	6.99	2.65	0.06	6.76	5.27	1.03

Figure 10.4.7: Historic 110kV Tie Line Unavailability 1999 – 2013

As can be seen in figure 10.4.7 above, total unavailability figure for the 110kV tie-lines was 1.03 the majority of this figure was due to planned outages on the Strabane-Letterkenny circuit during June and November.

10.4.8. 110kV Tie Lines Monthly Unavailability

Figure 10.4.8 below shows the month by month variation of unavailability of the 110kV Tie Lines.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Planned	0.00	0.00	0.00	0.00	0.00	0.82	0.01	0.00	0.00	0.00	11.59	0.00
Unplanned	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.82	0.01	0.00	0.00	0.00	11.59	0.00

Figure 10.4.8: 110kV Tie Line Unavailability 2013

Figure 10.4.8 above shows the extent of outages on the 110kV Tie Lines during January 2013 to December 2013.

11. SYSTEM SECURITY

All Transmission System related events that occurred in Northern Ireland that resulted in a loss of supplies are reported individually, giving information concerning the nature and cause of the incident and location, duration and an estimate of energy unsupplied.

An incident is defined as any system event that results in a single or multiple loss of supply.

11.1. Number Of Incidents And Estimated Unsupplied Energy

Within the Northern Ireland system there were four events that resulted in a loss of supply.

The unsupplied energy from the Northern Ireland system during 2013 was estimated to be 1082 MWh.

11.2. Incidents For 2013

Table 11.2 below lists the incidents that are required to be included in this report.

Incident Date, Time and Location	MW Lost	Mins	MWh Unsupplied	Customers affected
22/03/2013 Finaghy, Donegall, Central Belfast, Lisburn and surrounding area. **Reason:** Severe weather conditions.	Approx. 203MW	5	16.92	159,411
22/03/2013 Antrim town and surrounding areas **Reason:** Severe weather conditions.	Approx. 38MW	5	3.17	19,118
22/03/2013 Finaghy, Donegall, Central Belfast, Newtownards, Knock, Cregagh, Rosebank, Rathgael, Ballynahinch and surrounding areas. **Reason:** Severe weather conditions	Approx. 442MW	Many Restoration Times, all customers on within 24min	94.38	320,589
22/03/2013 Antrim town and surrounding areas **Reason:** Severe weather conditions.	Approx. 24MW	241	968.00	19118

Table 11.2: Transmission System Incidents 2013

The criterion for reporting incidents is specified in Schedule 4, paragraph 35, of the Electricity Supply Regulations (Northern Ireland) 1991. An incident shall be reported if there has been:

- Any single interruption of supply to one or more consumers of 20MW or more for a period of one minute or longer; or
- Any single interruption of supply to one or more consumers of 5MW or more for a period of one hour or longer; or
- Any single interruption of supply to 5,000 or more consumers for a period of one hour or longer.

11.2.1. System Security - Incident Analysis

Figure 11.2.1 below shows the number of incidents which occurred historically in Northern Ireland. The red bars on the graph below represent the number of incidents each year, whist the blue line is the average duration of each incident.

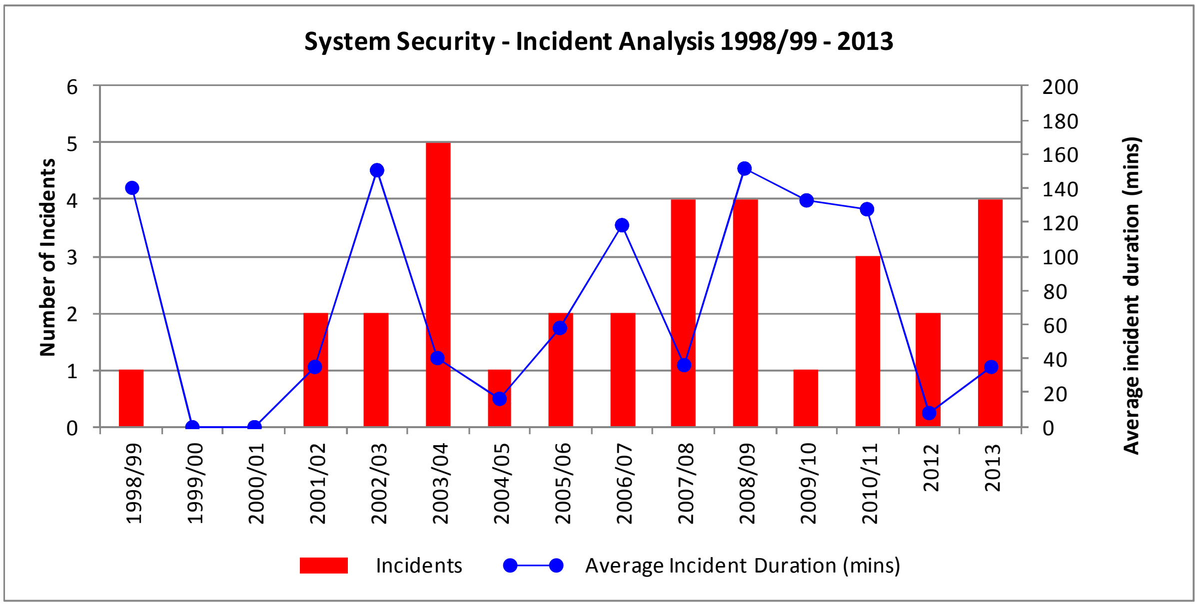


Figure 11.2.1: Historic System Security 1998 – 2013

As seen in Figure 11.2.1 above, the number of incidents has decreased to two, from the previous year's three incidents. The average incident time for 2013 reduced significantly on the previous years.

11.2.2. System Security - Unsupplied Energy

Figure 11.2.2 below shows the historic amount of unsupplied energy to Northern Ireland customers. The red bars are the total for each year in MWh and the blue line is the average amount of unsupplied energy per incident.

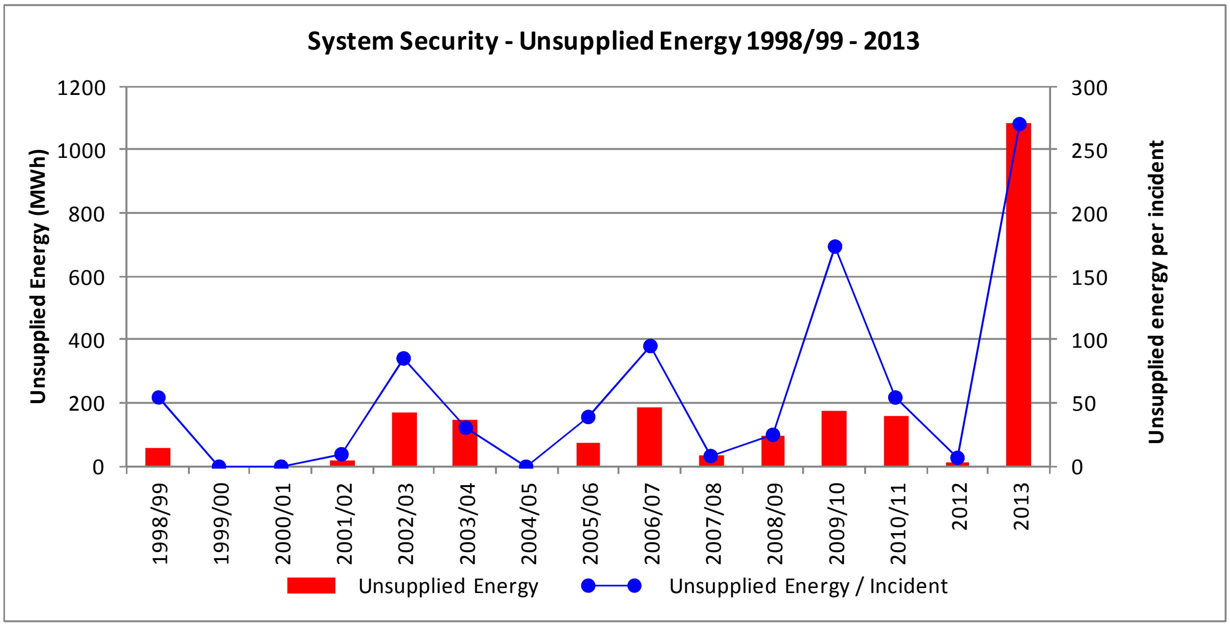


Figure 11.2.2: Historic Unsupplied Energy 1998 – 2013

12. QUALITY OF SERVICE

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

12.1. Voltage

The Electricity Supply Regulations (Northern Ireland) 1991 permit variations of voltage not exceeding 10% for voltages of 110 kV and higher (Regulation 31.2B).

SONI must keep the voltage within these limits, apart from under abnormal conditions e.g. a system fault. The Northern Ireland Transmission & Distribution Security and Planning Standards state that the voltage should not vary by more than 6% following a single contingency event.

For the purpose of this report the 6% limit is used.

12.2. Voltage Excursions

During 2013, there were no voltage excursions exceeding these limits.

12.3. Frequency

The Electricity Supply Regulation (Northern Ireland) 1991 permit variations in frequency not exceeding 2.5% above and below 50Hz, a range of 48.75Hz to 51.25Hz (Regulation 31.2A).

The SONI Grid Code (CC5.3) imposes a more arduous criterion to within 1% of 50Hz, a range of 49.5Hz to 50.5Hz. In previous reports the SONI Grid Code limits are used when reporting excursions.

For the purposes of this report SONI have decided that they will report on any frequency excursions that impact below a 49.6 Hz or greater than 50.5 Hz threshold. This will increase the number of reportable events providing more information. It was felt that this information would be useful in the light of the changing generation plant portfolio and the introduction of Harmonised Ancillary Services agreements with generators on 1 February 2010.

Table 5.1 provides detailed information for each frequency excursion including maximum rate of change of frequency, minimum frequency reached and time below 49.6 Hz.

As both the NI and RoI transmission networks are connected with 275kV and 110kV Tie Lines to form a synchronous network. Poor generation reliability in either jurisdiction will have a negative impact on its neighbour

The individual frequency event graphs appear in Appendix A in this report.

12.3.1. Frequency Excursions

In accordance with SONI's decision to report on any frequency excursion in excess of 49.6 Hz, there were 16 reportable frequency excursions during 2013. Table 12.3.1 below details these excursions.

Cause of Incident	Date	Generator Capacity MW	Pre-incident Frequency Hz	Minimum Frequency - Entire Event Hz	Minimum Frequency - POR Hz	Maximum Rate of Change of Frequency		t< 49.6 Hz (secs)	System Load			Wind			N - S Tie-Line Flow (MW)	Moyle Interconnection Flow (MW)
						Max df/dt Hz/sec	Average df/dt Hz/sec		RoI	NI	Total	RoI	NI	Total		
MONEYPOINT UNIT 1	12/01/13	282	49.906	49.58	49.587	-0.13	-0.10	1	2430.92	874.112	3305.032	353.03	104.023	457.053	-90.683	107
DUBLIN BAY	05/03/13	403	50.025	49.53	49.537	-0.32	-0.21	3.9	3540.12	1268.557	4808.677	445.49	45.814	491.304	208.538	245
LINE TRIP	22/03/13		50.004	49.503	49.503	-1.86	-0.50	4	4042.04	1408.523	5450.563	872	244.762	1116.762	-116.254	14
COOLKEERAGH C30	07/04/13	402	49.947	49.531	49.533	-0.65	-0.17	36.1	2532.8	782.565	3315.365	316.06	58.658	374.718	166.997	109
HUNTSTOWN UNIT 2	10/04/13	400	49.961	49.554	49.556	-0.49	-0.18	3.1	2587.89	892.549	3480.439	226.21	103.611	329.821	-86.404	-79
COOLKEERAGH C30	13/04/13	402	49.951	49.372	49.372	-0.40	-0.24	5	2585.63	917.951	3503.581	1091.46	239.022	1330.482	-75.288	71
DUBLIN BAY	06/05/13	403	49.974	49.248	49.245	-0.67	-0.40	6.9	1957.93	646.528	2604.458	528.12	140.17	668.29	101.381	88
EWIC	10/05/13	500	50.050	49.213	49.213	-0.53	-0.32	9.1	3301.16	1259.631	4560.791	904.76	139.505	1044.265	-107.157	244
DUBLIN BAY	27/05/13	403	50.021	49.487	49.487	-0.29	-0.25	4.4	2918.78	1030.818	3949.598	318.08	61.08	379.16	182.392	245

HUNTSTOWN UNIT 2	25/07/13	400	50.029	49.577	49.577	-0.31	-0.21	1.9	3386.24	1216.946	4603.186	46.77	4.549	51.319	28.059	241
DUBLIN BAY	05/08/13	403	49.962	49.514	49.514	-0.26	-0.20	4.2	2588.26	1128.527	3716.787	409.42	131.476	540.896	-26.441	245
COOLKEERAGH C30	25/08/13	402	49.988	49.467	49.467	-0.30	-0.22	4.9	2714.99	944.488	3659.478	193.53	14.592	208.122	- 106.583	1
AGHADA UNIT 2	30/09/13	432	50.035	49.333	49.333	-0.42	-0.29	37.8	3239.03	1225.455	4464.485	666.18	248.685	914.865	133.789	246
MONEYPOINT UNIT 3	13/11/13	282	49.982	49.585	49.585	-0.21	-0.17	1	2338.08	814.455	3152.535	325.64	160.75	486.39	72.122	151
AGHADA UNIT 1	11/12/13	258	50.078	49.569	49.569	-0.40	-0.23	2.2	3359.14	1286.663	4645.803	1409.74	451.255	1860.995	-16.508	237
WHITEGATE	19/12/13	445	50.064	49.500	49.500	-0.38	-0.32	5.6	4364.13	1638.37	6002.5	928.35	327.09	1255.44	166.18	246

Table 12.3.1: Frequency Excursions in NI in 2013

- Note 1: NS and Interconnection flows, VE+ represents an import to Northern Ireland
- Note 2: The System Load figures are in generated metered terms

Event Definitions.

Time 0 seconds	Considered to be when the frequency falls through 49.8 Hz
Pre Incident frequency	Average system frequency between t - 60seconds and t -30 seconds
Minimum Frequency (Entire Event)	Minimum system frequency from t 0 to t + 6 minutes
Minimum Frequency (POR)	Minimum frequency during POR period from t + 5 seconds to t + 15 seconds
Maximum Rate of Change of Frequency	Maximum negative rate of change of frequency during the period t – 5 seconds to t + 30 seconds. (This is calculated from a five point moving average with a sample rate of 100 milliseconds)
Average Rate of Change of Frequency	This is the rate of change of frequency observed between two points in time. The first point being when the frequency passes through 49.8 Hz and the second when the frequency nadir is observed between t + 5 seconds and t + 15 sceonds (See HAS agreement)

12.3.2. Annual Frequency Excursions

Figure 12.3.2 below shows the number of frequency excursions from 1998 to 2013. The significant increase to 29 incidents is due the decision to change the criteria for reporting frequency excursions to any incident under 49.6 Hz. To compare against previous years criteria of only including frequency excursions below 49.5Hz, there would have been 4 incidents in the 2013 period.

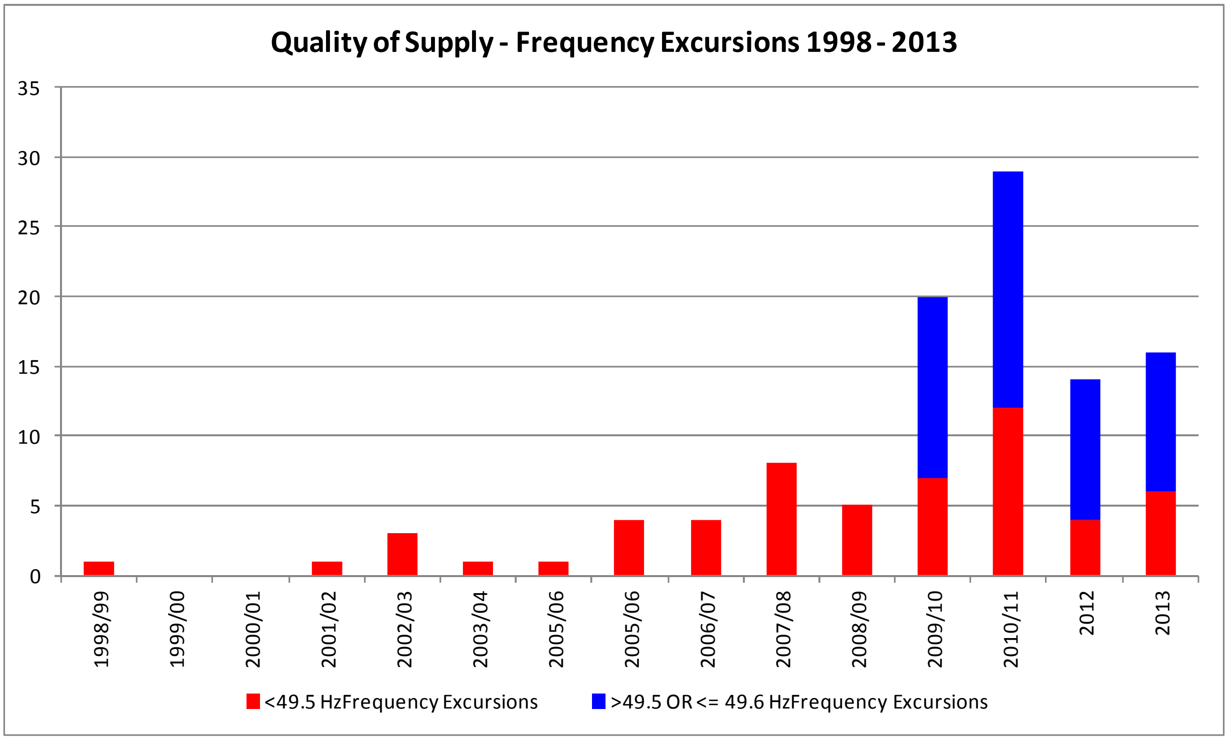


Figure 12.3.2: Historic Frequency Excursions 1998 – 2013

In recent years, a number of large combined cycle gas turbine (CCGT) units have been commissioned on the island of Ireland. These units tend to be base load, higher efficiency plant, generating for a high proportion of the time. As the all-island generating plant portfolio tends towards a smaller number of larger units, there is an increased possibility that frequency excursions will occur. However, during 2013 there were no incidents where the Electricity Supply Regulations (Northern Ireland) 1991 statutory limit of 2.5% was exceeded.

13. CONCLUSIONS

- The annual system availability for the 12 month period of this report 2013 (97.99%) has risen slightly when compared with the figure in the previous report for 2012 (97.79%)

- The 2013 availability figure of 96.11 for the 275kV tie-line is a slight decrease of availability on previous yearly report and remains well ahead of the record low figure of 2008/09 which was 94.58%.

- All of the four incidents which caused reportable interruptions of supplies to customers were due to the storm weather condition experienced 22 March 2013

- The number of frequency excursions below 49.6Hz within 2013 has risen to 16 from 14 in 2012.

Appendix 1 - All-Island Fully Dispatchable Generation Plant

Company	Unit	Capacity (MW)	Fuel	365 Day Rolling Average Availability [%]
Activation Energy	AEDSU – AE1	48	Demand Side Unit	69.42
Aughinish Alumina Ltd	Seal Rock - SK3	85	Gas / Distillate Oil	87.7
	Seal Rock - SK4	85	Gas / Distillate Oil	82.85
Bord Gáis	Whitegate – WG1	444	Gas / Distillate Oil	92.89
Edenderry Power Ltd	Edenderry – ED1	118	Peat	76.59
	Edenderry – ED3	58	Gas / Distillate Oil	94.96
	Edenderry – ED5	58	Gas / Distillate Oil	94.96
SSE Generation Ireland	Great Island - GI1	54	Heavy Fuel Oil	98.88
	Great Island - GI2	54	Heavy Fuel Oil	89.68
	Great Island - GI3	109	Heavy Fuel Oil	91.19
	Rhode – RP1	52	Distillate Oil	98.57
	Rhode – RP2	52	Distillate Oil	98.59
	Tarbert – TB1	54	Heavy Fuel Oil	96.85
	Tarbert – TB2	54	Heavy Fuel Oil	99.92
	Tarbert – TB3	241	Heavy Fuel Oil	97.86
	Tarbert – TB4	243	Heavy Fuel Oil	98.68
	Tawnaghmore - TP1	52	Distillate Oil	99.8
	Tawnaghmore - TP3	52	Distillate Oil	97.95
ESB Energy Ireland	Aghada - AD1	258	Gas / Distillate Oil	50.04
	Aghada - AD2	431	Gas / Distillate Oil	92.09
	Aghada - AT1	90	Gas / Distillate Oil	94.75
	Aghada - AT2	90	Gas / Distillate Oil	94.73
	Aghada - AT4	90	Gas / Distillate Oil	89.69
	Ardnacrusha - AA1	21	Hydro	62.91
	Ardnacrusha - AA2	22	Hydro	69.23
	Ardnacrusha - AA3	19	Hydro	42.51
	Ardnacrusha - AA4	24	Hydro	61.59

	Erne - ER1	10	Hydro	95.54
	Erne - ER2	10	Hydro	50.84
	Erne - ER3	22	Hydro	7.21
	Erne - ER4	22	Hydro	98.64
	Lee - LE1	15	Hydro	91.66
	Lee - LE2	4	Hydro	93.43
	Lee - LE3	8	Hydro	92.51
	Liffey - LI1	15	Hydro	87.59
	Liffey - LI2	15	Hydro	89.61
	Liffey - LI4	4	Hydro	98.83
	Liffey - LI5	4	Hydro	89.6
	Lough Ree Power - LR4	91	Peat	92.5
	Marina - MRC	95	Gas / Distillate Oil	76.42
	Moneypoint - MP1	285	Coal / Heavy Fuel Oil	94.23
	Moneypoint - MP2	285	Coal / Heavy Fuel Oil	73.38
	Moneypoint - MP3	285	Coal / Heavy Fuel Oil	72.66
	North Wall - NW5	104	Gas / Distillate Oil	90.92
	North Wall – NWC	154	Gas / Distillate Oil	0.0
	Poolbeg - PB4	154	Gas / Distillate Oil	97.4
	Poolbeg - PB5	154	Gas / Distillate Oil	98.39
	Poolbeg - PB6	182	Gas / Distillate Oil	90.29
	Turlough Hill - TH1	73	Hydro – Pumped Storage	93.52
	Turlough Hill - TH2	73	Hydro – Pumped Storage	90.3
	Turlough Hill - TH3	73	Hydro – Pumped Storage	96.61
	Turlough Hill - TH4	73	Hydro – Pumped Storage	96.26
	West Offaly Power - WO4	137	Peat	91.88
Dalkia Alternative Energy Ltd	DAE VPP – DP1	19	Demand Side Unit	26.27
Indaver	Indaver – IW1	16	Waste	88.46
Synergen	Dublin Bay - DB1	405	Gas / Distillate Oil	93.61
Tynagh Energy Ltd	Tynagh – TYC	384	Gas / Distillate Oil	94.1
Viridian Power & Energy	Huntstown - HN2	400	Gas / Distillate Oil	87.18

	Huntstown - HNC	342	Gas / Distillate Oil	95.94
AES	Ballylumford - B10	94	Gas / Distillate Oil	88.62
	Ballylumford - B21	249	Gas / Distillate Oil	81.77
	Ballylumford - B22	249	Gas / Distillate Oil	87.75
	Ballylumford - BGT1	58	Gas / Distillate Oil	95.35
	Ballylumford - BGT2	58	Gas / Distillate Oil	82.74
	Ballylumford - BPS4	170	Gas / Distillate Oil	82.31
	Ballylumford - BPS5	170	Gas / Distillate Oil	99.55
	Ballylumford - BPS6	170	Gas / Distillate Oil	99.43
	Kilroot - KGT1	29	Gas / Distillate Oil	92.27
	Kilroot - KGT2	29	Gas / Distillate Oil	90.92
	Kilroot - KGT3	42	Gas / Distillate Oil	94.6
	Kilroot - KGT4	42	Gas / Distillate Oil	92.71
	Kilroot - KPS1	238	Coal/ Heavy Fuel	95.83
	Kilroot - KPS2	238	Coal/ Heavy Fuel	92.78
Contour Global	Contour Global - CG3	3	Gas / Distillate Oil	99.67
	Contour Global - CG4	3	Gas / Distillate Oil	99.93
	Contour Global - CG5	3	Gas / Distillate Oil	99.96
Coolkeeragh ESB	Coolkeeragh - C30	408	Gas / Distillate Oil	83.05
	Coolkeeragh - CG8	53	Gas / Distillate Oil	96.71
iPower	iPower AGU	74	Distillate	99.3
Total		**9,251**		**88.45**

Appendix 2 – Significant EirGrid TSO Capital Projects Completed in 2013

2013 Transmission System Performance Report - Appendix 2 - Significant Capital Projects		
CP No.	**Project Title**	**Project Type**
CP0371	Ballydine - Doon 110kV line uprate	Circuit Uprates and Refurbishments
CP0384	Lisdrum - Louth 110kV line refurbishment	Circuit Uprates and Refurbishments
CP0559	Butlerstown - Killoteran 110kV line uprate	Circuit Uprates and Refurbishments
CP0640	Bandon - Dunmanway 110kV line refurbishment	Circuit Uprates and Refurbishments
CP0667	Inchicore - Maynooth No. 1 &2 220kV line uprate	Circuit Uprates and Refurbishments
CP0696	Marina - Trabeg No. 1 & 2 110kV circuit uprate	Circuit Uprates and Refurbishments
CP0701	Cullenagh - Dungarvan 110kV line uprate	Circuit Uprates and Refurbishments
CP0702	Butlerstown - Cullenagh 110kV line uprate	Circuit Uprates and Refurbishments
CP0717	Clashavoon - Knockraha 220kV line uprate	Circuit Uprates and Refurbishments
CP0719	Inniscarra- Macroom 110kV line uprate	Circuit Uprates and Refurbishments
CP0762	Charleville - Mallow 110kV line uprate	Circuit Uprates and Refurbishments
CP0764	Cathaleen's Fall - Drumkeen (to Clogher) 110kV line uprate	Circuit Uprates and Refurbishments
CP0768	Kellis - Kilkenny 110kV line refurbishment	Circuit Uprates and Refurbishments
CP0479	Athea 110kV station	Connections for Generators
CP0605	Booltiagh Wind Farm Extension	Connections for Generators
CP0710	Reamore 110kV station	Connections for Generators
CP0715	Great Island 220kV station connection of Generation	Connections for Generators
CP0733	Cloghran 110kV station	Connections for Generators
CP0739	Mount Lucas 110kV station	Connections for Generators

CP0228	Marina 110kV station replacement	Station Uprates and Refurbishments
CP0372	Ballydine 110kV station busbar uprate	Station Uprates and Refurbishments
CP0529	Thurles 110kV station installation of reactive support	Station Uprates and Refurbishments
CP0559	Butlerstown 110kV station busbar uprate	Station Uprates and Refurbishments
CP0594	Mullingar 110 kV station installation of reactive support	Station Uprates and Refurbishments
CP0657	Thurles 110kV station busbar A1 uprate	Station Uprates and Refurbishments
CP0674	Tralee 110kV station installation of a new coupler	Station Uprates and Refurbishments
CP0682	Woodland 400kV Station - 3rd 400/220 500MVA transformer	Station Uprates and Refurbishments
CP0689	Ennis 110kV station busbar uprate	Station Uprates and Refurbishments
CP0714	Clonkeen 110kV station reconfiguration	Station Uprates and Refurbishments
CP0723	Cushaling 110kV station busbar uprate	Station Uprates and Refurbishments
CP0734	Cathaleen’s Fall 110kV station busbar A1/B1 uprate	Station Uprates and Refurbishments
CP0773	Bellacorick 110kV station busbar uprate	Station Uprates and Refurbishments

Appendix 3 – Maintenance Policy Terms

Appendix 3.1 – Transmission System Maintenance Policy Terms

The following summarises the main terms and activities in the asset maintenance policy as operated by EirGrid. The need to ensure that equipment continues to operate in a safe, secure, economic and reliable manner, while minimising life cycle costs, underlies the principles behind this asset maintenance policy. Effective maintenance management balances the costs of repair, replacement and refurbishment against the consequences of asset failure.

Maintenance Works are the works that are carried out on a regular basis to check the operability of the transmission equipment (such as Operational Tests and Cable Inspections) or works that arise as a result of inspections to maintain and/ repair equipment.

There are 4 main categories of Maintenance:

- **Preventive/Routine Maintenance** – Preventive/Routine Maintenance is planned at predetermined levels 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 frequency of routines is pre-determined by the EirGrid Asset Maintenance Policy.
- **Corrective Maintenance** – Corrective Maintenance may consist of repair, restoration or replacement of equipment before functional failure. Corrective Maintenance requirements are identified through regular inspections. An inspection identifies the potential for failure in time for the solution to be planned and scheduled and then performed during the next available outage.
- **Statutory Maintenance** - Maintenance which is carried out to facilitate statutory requirements e.g. Pressure Vessel Inspections
- **Fault Maintenance** – These are unplanned activities arising from equipment failure in service and are disruptive.

Stations:

Preventive maintenance is carried out at routine intervals on all station assets regardless of age. The following summarises the primary routine preventive maintenance tasks on station equipment:

1. **Operational tests:** These involve, among other activities, opening and closing the breakers and disconnects locally and remotely, carrying out tripping checks on the breakers and checking of interlocking. These tests are designed to ensure that equipment will operate correctly when called upon to do so. Operational Tests are an annual requirement.
2. **Ordinary services:** Every 4 or 5 years (depending on the voltage and criticality of the circuit in the system), more detailed inspection and measurements are taken. All measurements and test values are checked for conformity with standards or other norms established by best industry practice or experience. The measurements and test values are compared to those of previous measurements and tests. Any significant changes or trends are noted and satisfactory

explanations sought. Breakers and disconnects are also operated locally and remotely during an Ordinary Service.

3. **Condition assessment:** This non-invasive procedure combines an evaluation of the asset's operational, maintenance and fault histories with a detailed site inspection and site and laboratory tests. The condition assessment evaluates the asset's present condition and residual life and provides data for life management decisions such as required corrective maintenance, further monitoring and future operation (including loading/ over-loading restrictions, refurbishment and replacement). The EirGrid policy is to carry out condition assessments at 8 – 10 year intervals depending on the voltage and criticality of the circuit.
4. **Tap changer inspections:** These are detailed inspections of the transformer tap changers to ensure that the tap changer works correctly, and that remote operation of the tap changer is effective. Where necessary, the tap changer oil is replaced. These tests are programmed every 8 – 10 years.

Overhead Lines:

Overhead line maintenance is largely condition based, with the result that routine line maintenance activities are inspections and/or condition assessments. These include helicopter patrols, climbing patrols, ground patrols, bolt patrols, sag checks, infrared thermography patrols, pole rot surveys, conductor corrosion surveys and line condition surveys. Planned maintenance of overhead lines implements requirements for preventive maintenance, corrective maintenance, and repairs, which are identified by inspections and condition assessments.

Examples include:

- Timber cutting;
- Elimination of type faults (e.g. removal of insulator types, the metal parts of which have been discovered to be prone to rapid corrosion);
- Replacement of corroded conductors or rotten wood poles;
- Repair of OHL joints
- Replacement of items damaged by flashovers;
- Repair of tower damage; and
- General line refurbishment.

Although age may be a factor contributing to increased corrective maintenance requirements there are other factors which significantly affect required maintenance that are not age independent. These include location (heavily fertilised farmland/polluted industrial environment/coastal areas), damage by livestock/farm machinery, local climate (damp environment conducive to corrosion), timber growth, vandalism, damage by birds, loading of lines and climate related events.

Cables:

Inspections are carried out at monthly, quarterly and annual intervals for oil filled cables and at annual intervals for cross-linked polyethylene (XLPE) cables. Cable routes are patrolled continuously and all third party excavations near transmission cables are monitored to ensure the ongoing integrity of the cables.

Appendix 4 – Definitions & Formulae

Appendix 4.1 – Availability & Unavailability Formula

The availability of 110kV, 220 kV, 275 kV and 400 kV lines is calculated using

Equation 4-1:

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

Equation 4-1

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

The Availability of 220 kV/110 kV, 275 kV/220 kV and 400 kV/220 kV transformers is calculated using Equation 4-2:

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

Equation 4-2

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

m = The total number of transformers at that voltage level

System Unavailability, for any period, is calculated using equation 4-3. Equation 4-3 is the same as that used by OFGEM (The Office Of Gas And Electricity Markets) in the UK.

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

Equation 4-3

Appendix 4.2 – System Minute Formula

The international benchmark for system performance and reliability is the System Minute.

This index measures the severity of each system disturbance. It is determined by calculating the ratio of unsupplied energy during an outage to the energy that would be supplied during one minute, if the supplied energy was at its peak value. When this index is greater than one minute the incident is classified as “major”.

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

Equation 4-4

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

Equation 4-5

Where: Power factor = 0.9

Appendix 4.3 – Protection Zones

Zone 1 on a 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. Typical Zone 1 clearance times are 50 to 150 ms.

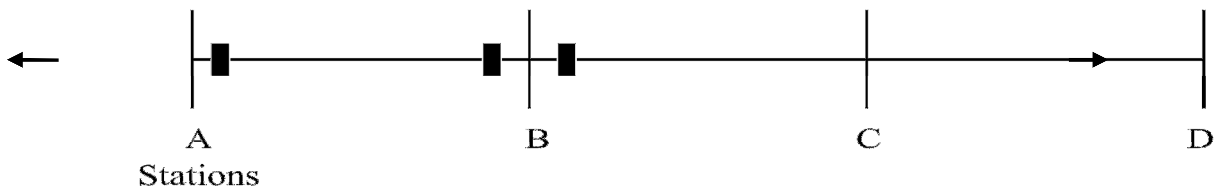
Zone 2 on a distance relay is used as the backup protection zone and is set to 100 % of the circuit length plus 20 – 50 % of the length of the shortest feeder at the remote end of the protected circuit. A delay of approximately 400 ms is applied in zone 2 settings and so typical zone 2 fault clearance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

Zone 3 on a distance relay is used as the backup protection zone and is the first reverse zone. It 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 milliseconds.

Zone 4 is the third forward step of a distance scheme (time delay 900 ms)

Zone 5 is the second reverse step of a distance protection scheme (time delay of 1 second)

Zone 4 and 5 trips are very rarely executed due to the in built time delays.



The more faults cleared in Zone 1, the quicker the fault is taken off the power system which reduces the risk of system instability, plant damage and injury to personnel.

$$\text{Zone Clearance Ratio} = \frac{\text{Short circuit faults not cleared in Zone 1}}{\text{Total number of short circuit faults cleared}}$$

Equation 4-6

Appendix 4.3: Protection Glossary

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.

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.

MAJOR INCIDENT

A major incident is one which results in the loss of greater than or equal to one System Minute for the entire incident.

MAIN SYSTEM

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 interconnector and 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 (ESB DSO load transformers, directly connected industrial customers load transformers and generator 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.

MVA MINUTE LOST

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

NON MAIN SYSTEM/ OUTSIDE THE MAIN SYSTEM

All HV plant on the Irish electricity network that does not form part of the Main System: The Dublin 110 kV network which is controlled by the NDCC (the MV system in Ireland is controlled by the ESB SDCC in Wilton and the NDCC in Leopardstown), all DSO and Industrial Customer load transformers, all IPP generator transformers, and all plant on the NIE owned, SONI controlled, HV system in Northern Ireland.

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.

PERMANENT FAULT

A fault is permanent if:

An overhead line trips, recloses and trips again (locking out).

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 have to carry out equipment repairs or replacement, or an inspection 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.

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.

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.

STAR SCHEME

Short Term Active Response is a scheme operated by EirGrid whereby large electricity consumers voluntarily contract to make their load available for short term interruptions. This service provides EirGrid with approximately 45 MW of static reserve that is utilised in the event of system frequency falling below 49.3 Hz.

SUSTAINED INTERRUPTION

A sustained interruption is one which lasts for more than one minute. For example, if a fault causes a supply interruption to demand customers and supply is not restored by reclosing the affected circuit breaker or by MV back feeding within one minute then this is classified as a sustained interruption. If supply is restored in less than one minute this is a non sustained interruption.

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.

TRANSIENT FAULT

A fault is transient if:

An overhead line trips and recloses successfully.

An overhead line trips and stays out of service due to the absence or outage of reclosing facilities but is returned to service by maintenance staff without the necessity of any repair work.

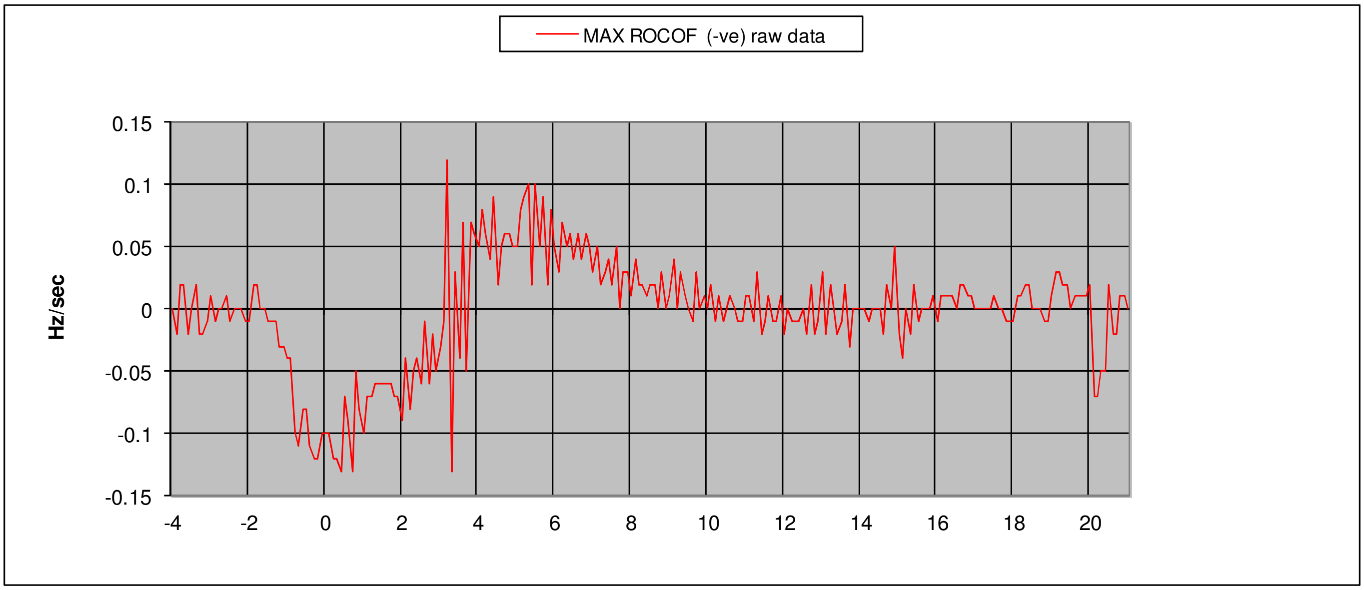
Any other piece of plant trips and is returned to service by maintenance staff without the necessity of any repair work.

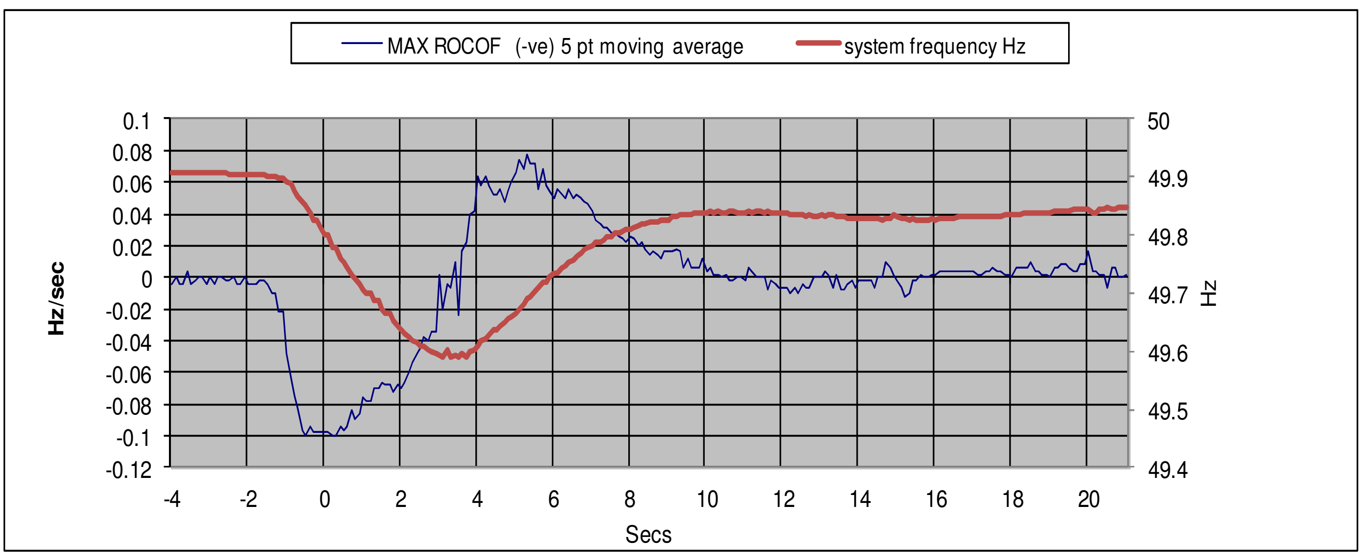
Appendix 5 - Frequency Excursion Graphs

The following is a list of graphs contained in this section.

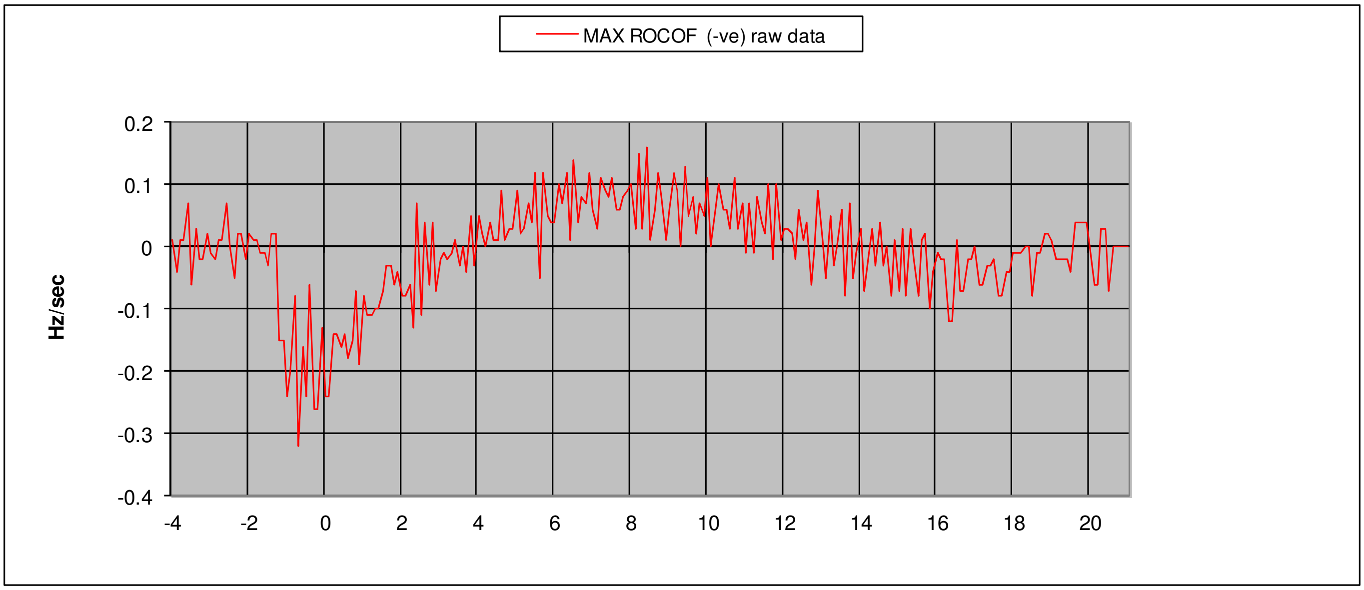
N.B. On all the following graphs the term ROCOF means Rate of Change of Frequency

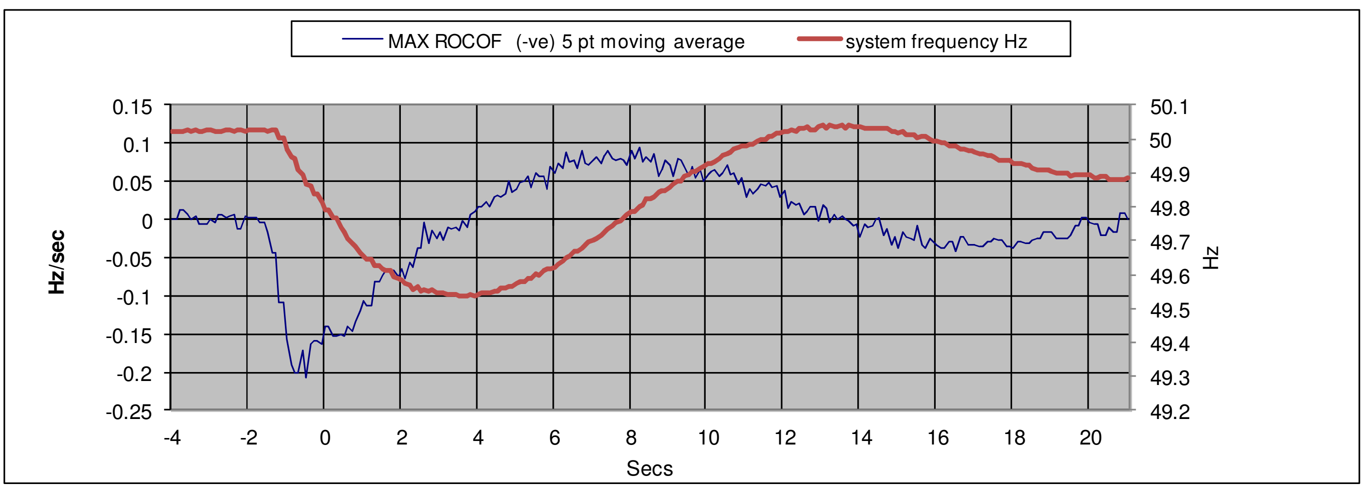
12/01/13 MONEYPOINT UNIT 1



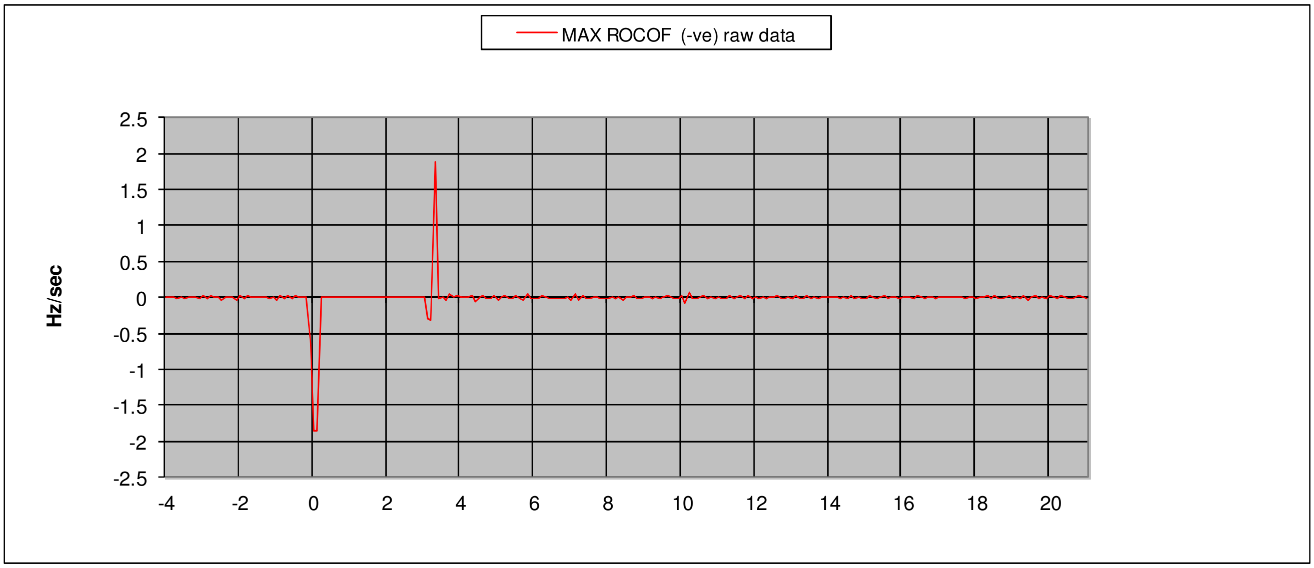


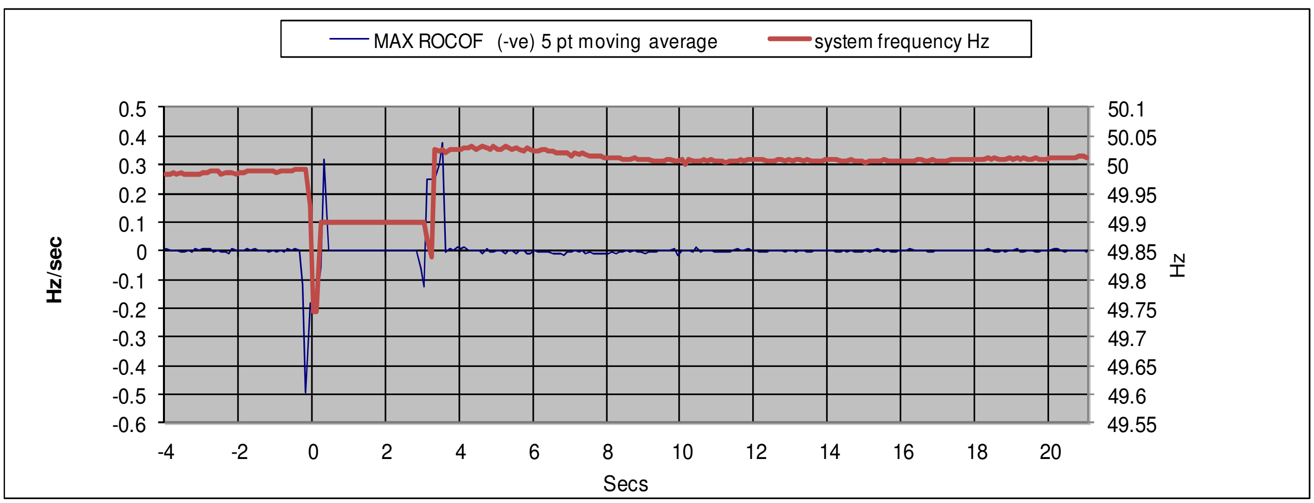
05/03/13 DUBLIN BAY



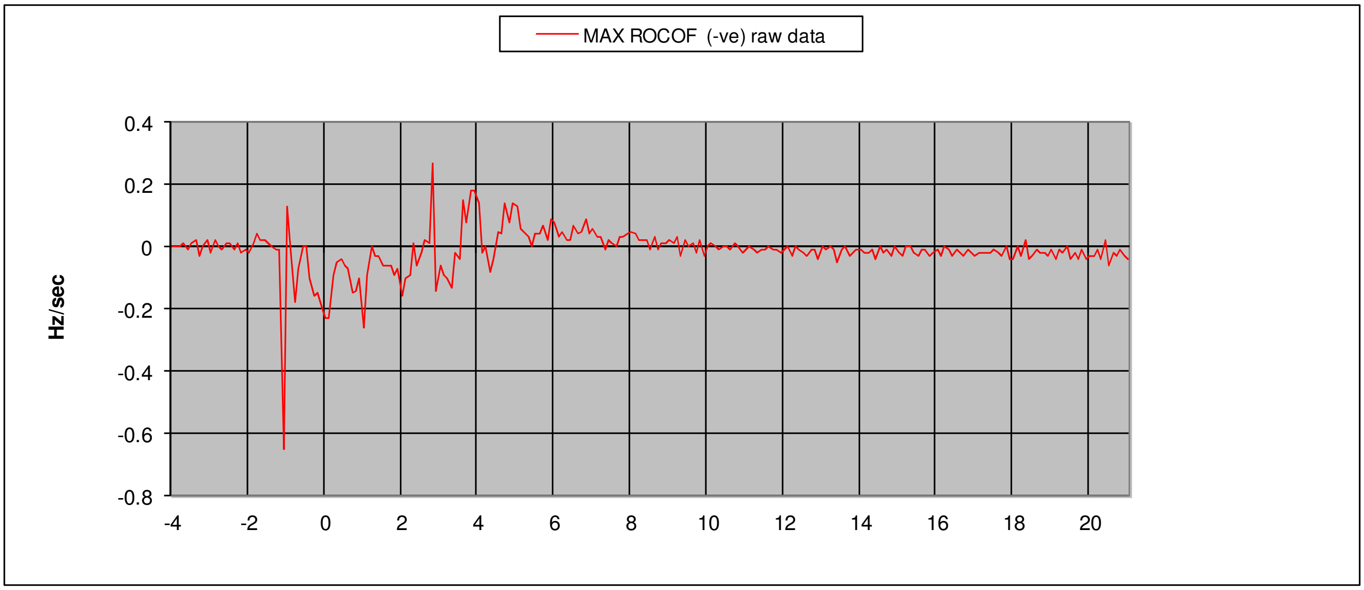


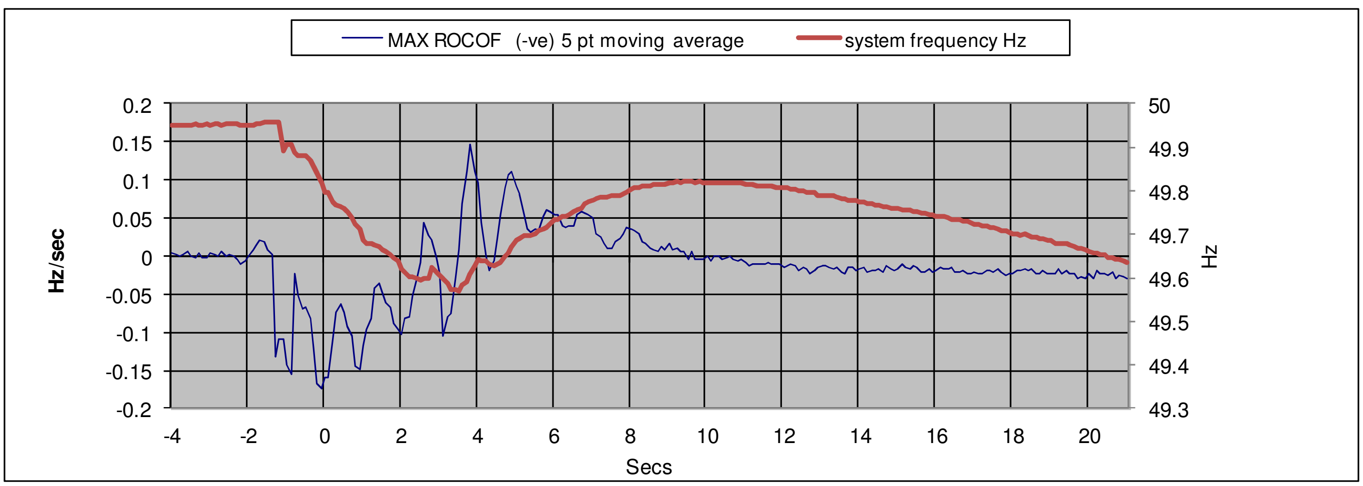
22/03/13 LINES TRIP (Ice storm)



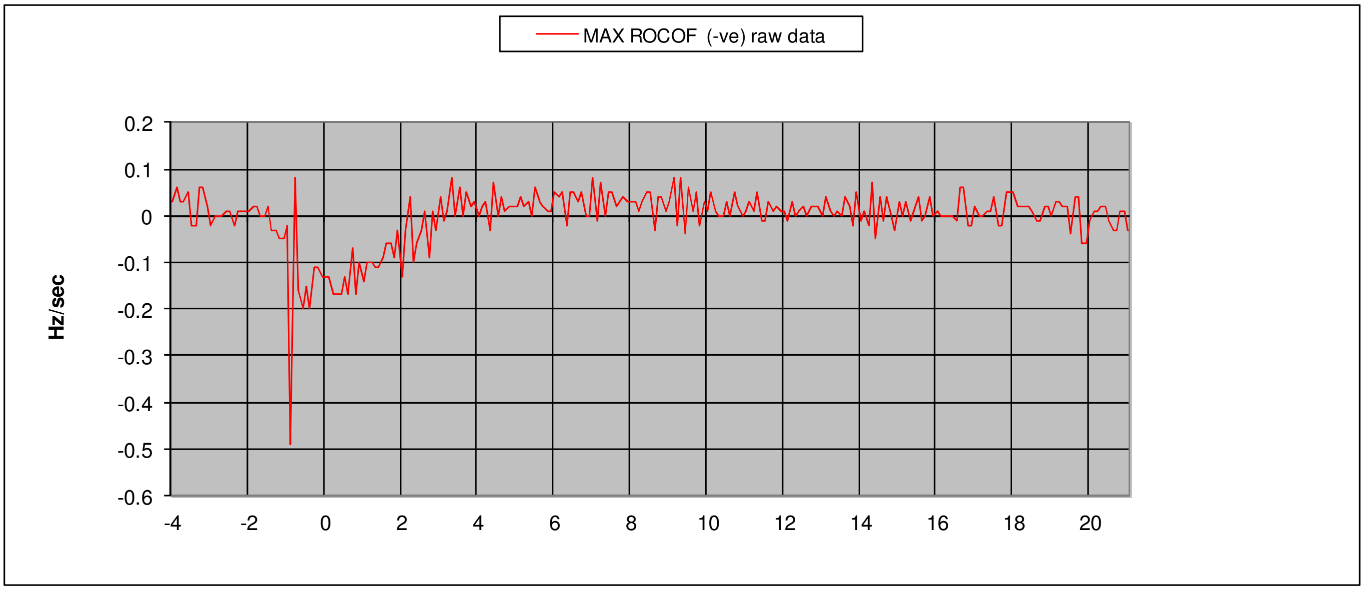


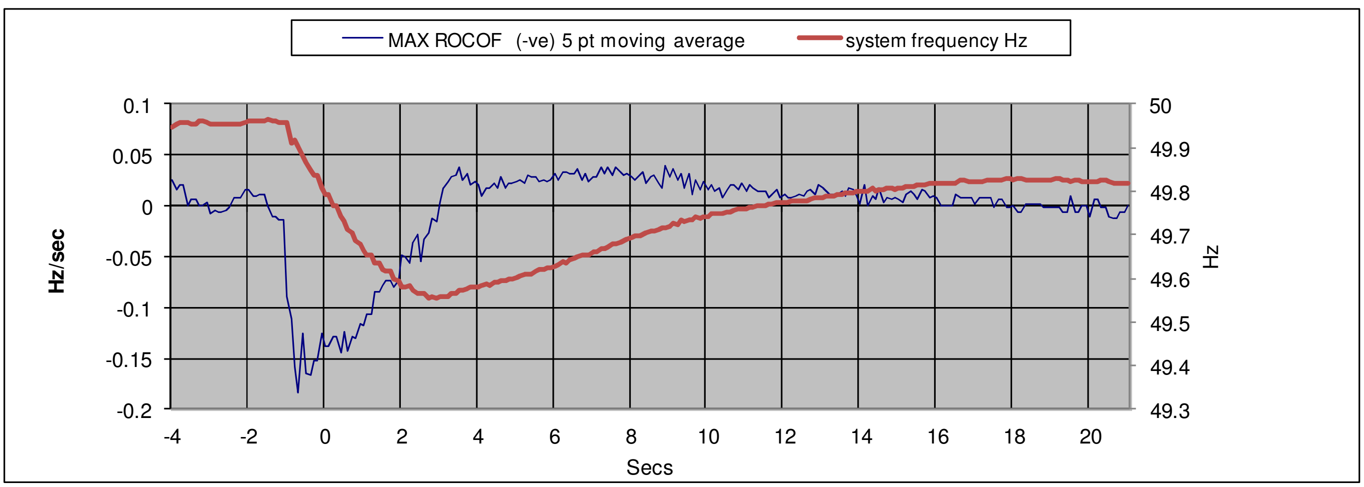
07/04/13 COOLKEERAGH C30



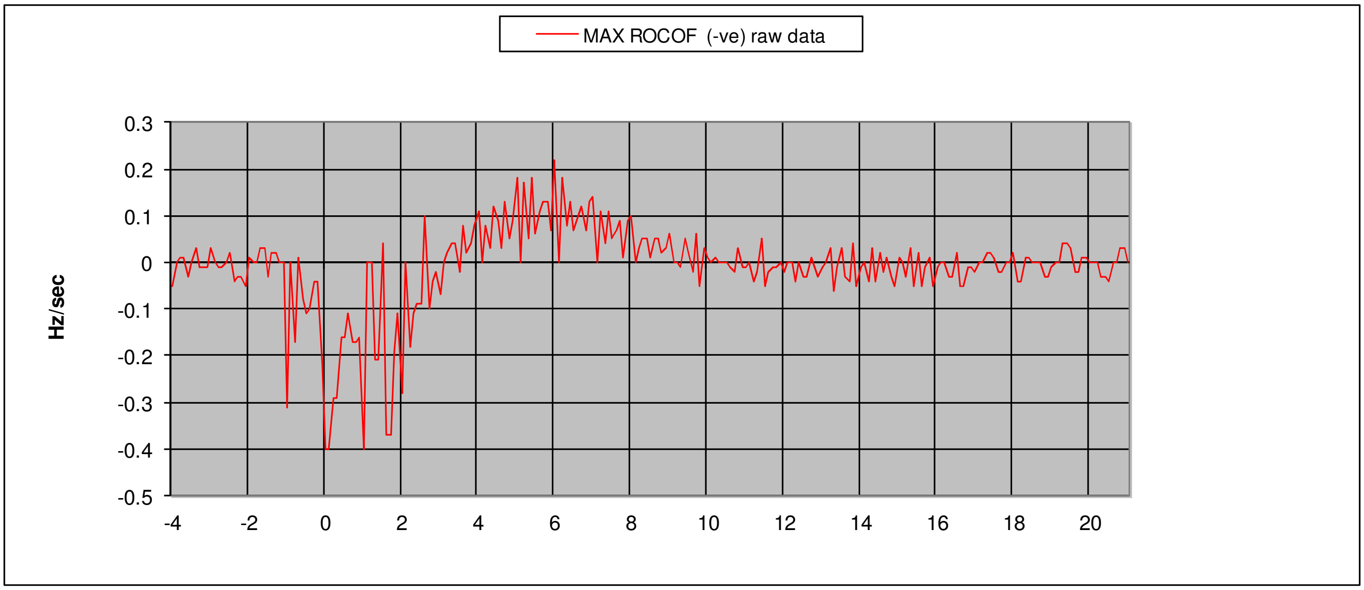


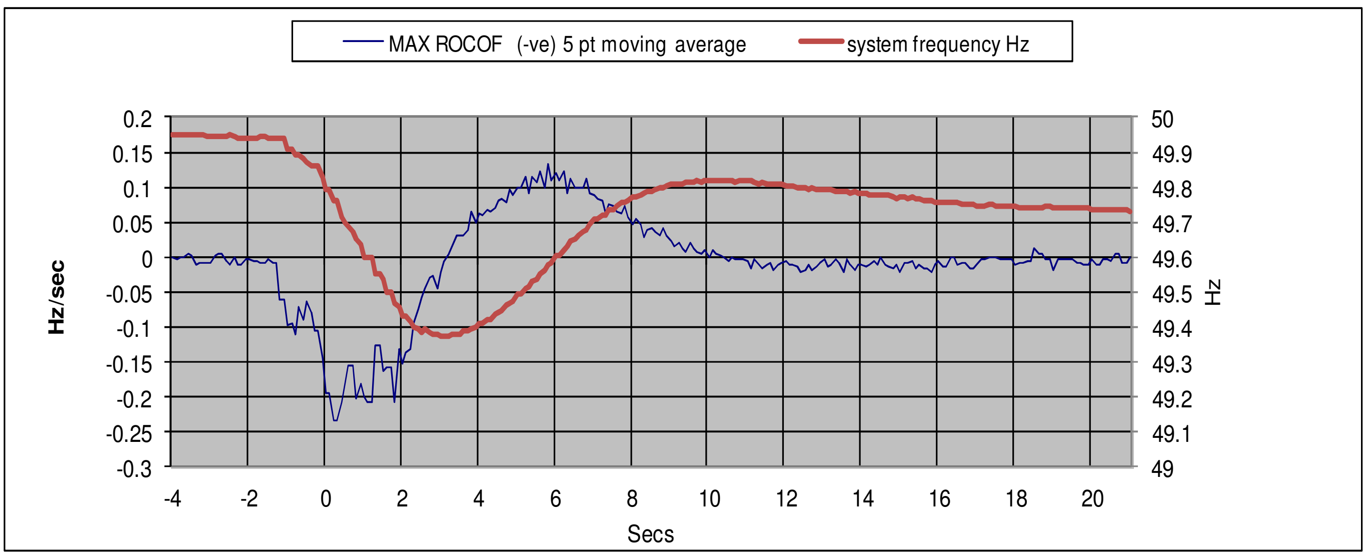
10/04/13 HUNTSTOWN UNIT 2



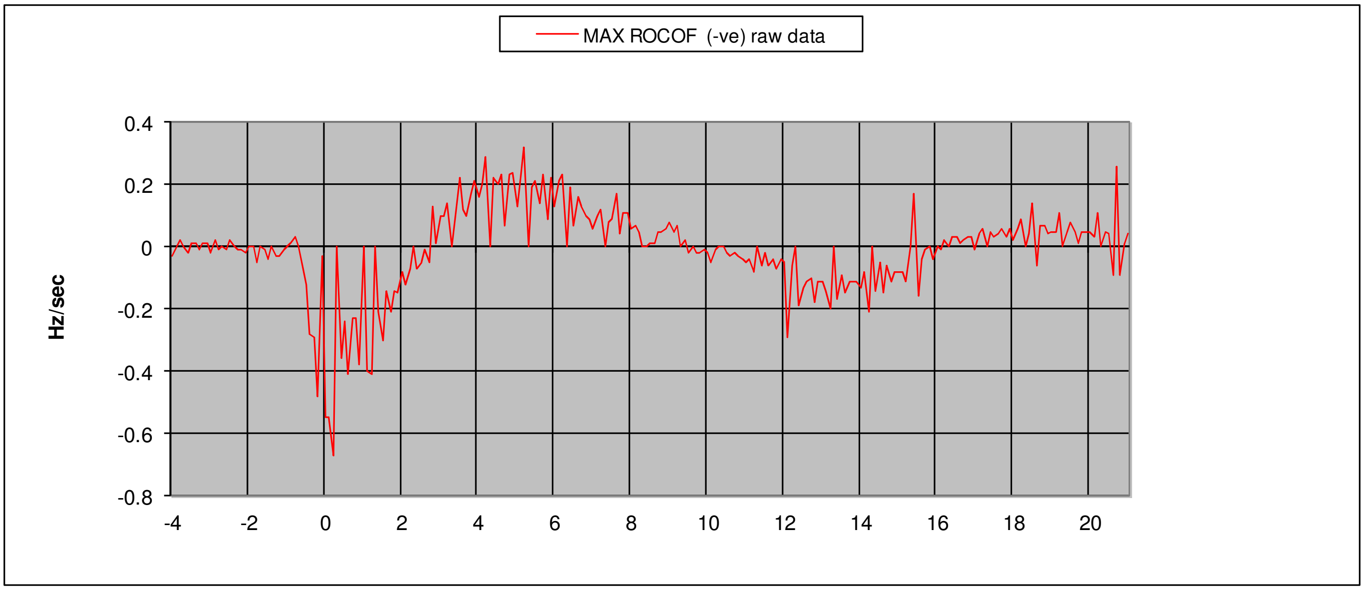


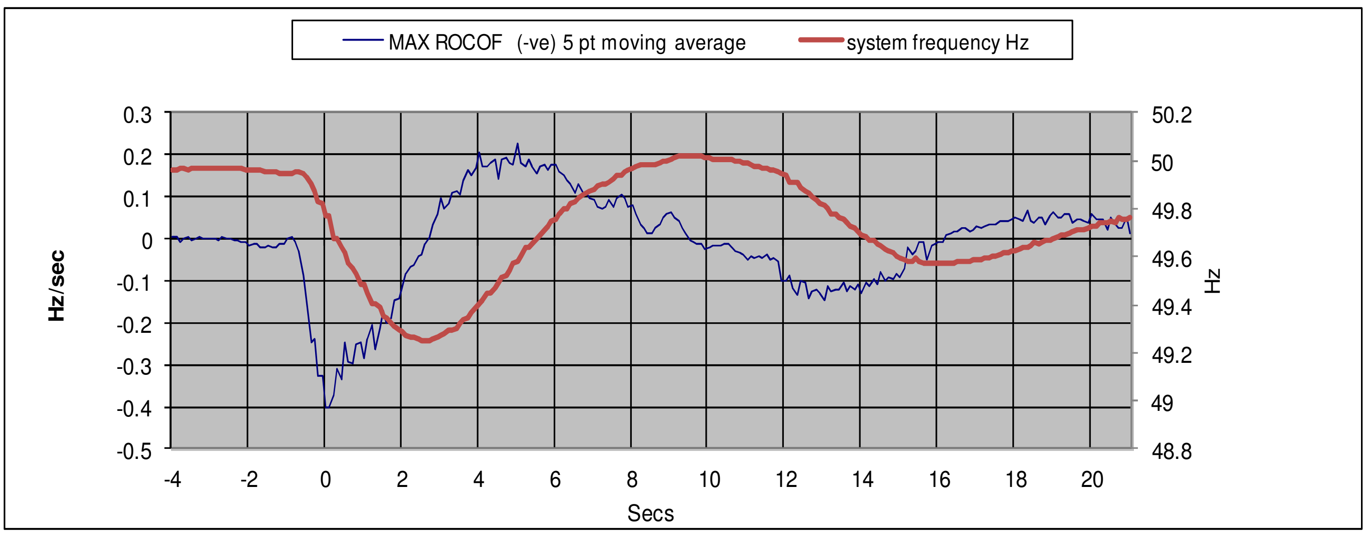
13/04/13 COOLKEERAGH C30



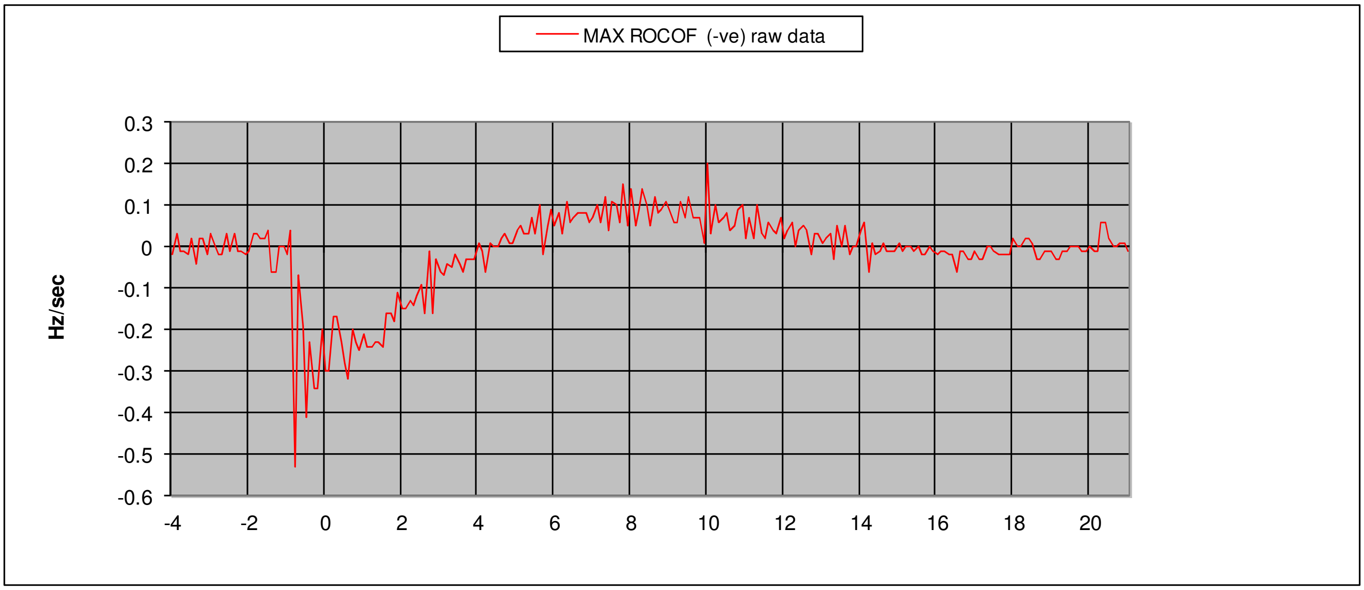


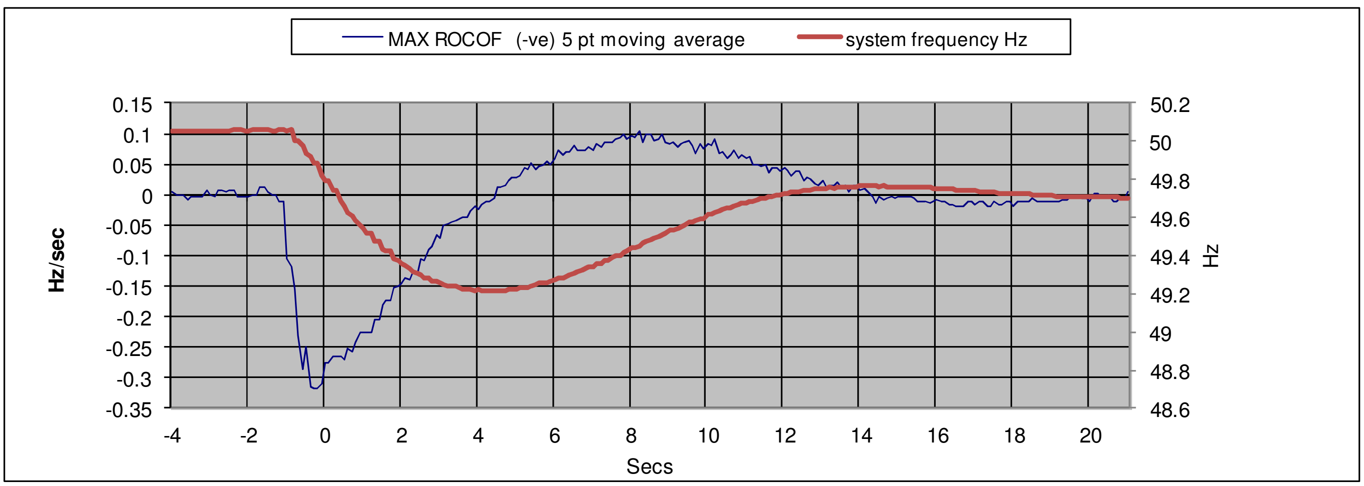
06/05/13 DUBLIN BAY



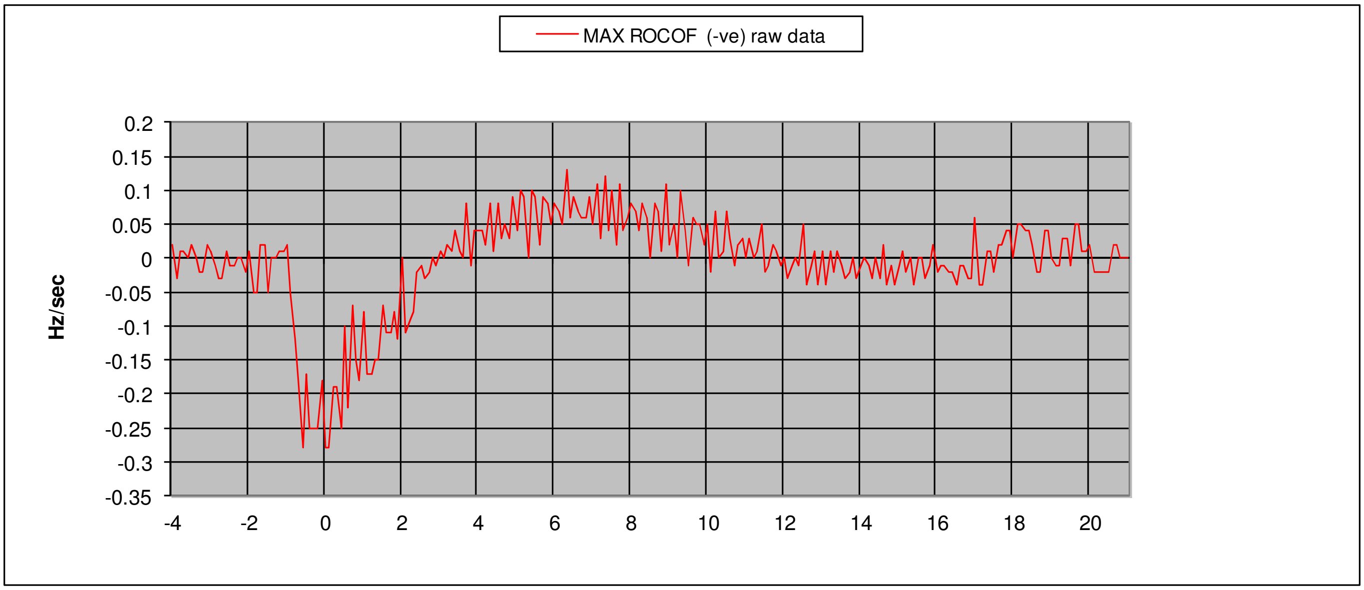


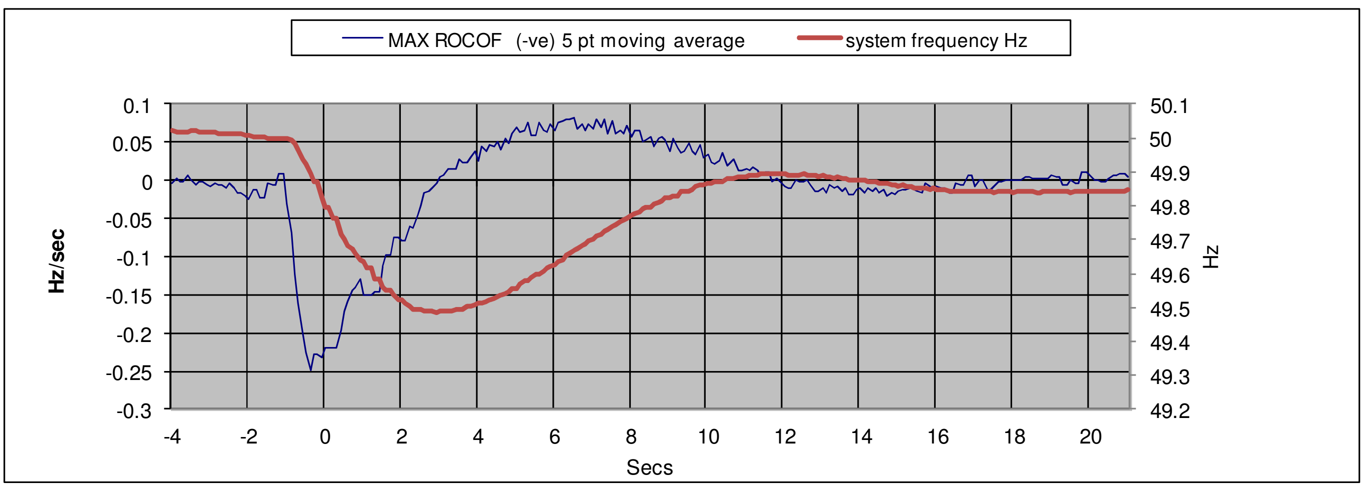
10/05/13 EWIC


MAX ROCOF (-ve) raw data
Hz/sec
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-4
-2
0
2
4
6
8
10
12
14
16
18
20

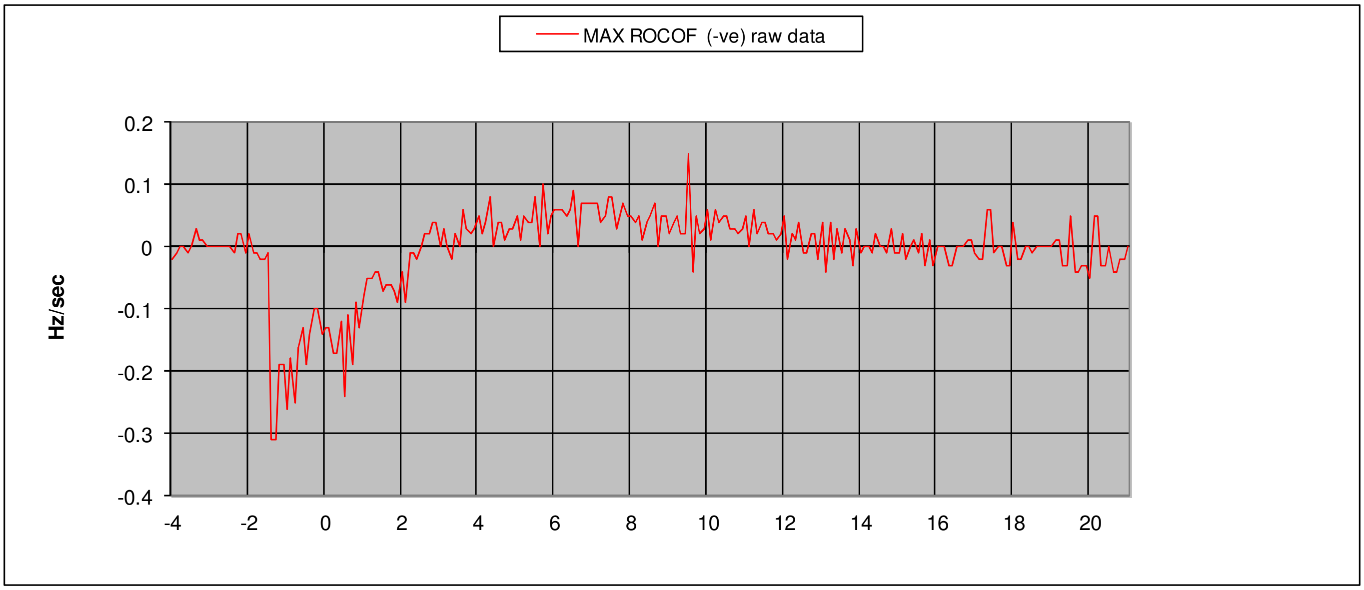

MAX ROCOF (-ve) 5 pt moving average
system frequency Hz
Hz/sec
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
50.2
50
49.8
49.6
49.4
49.2
49
48.8
48.6
Hz
-4
-2
0
2
4
6
8
10
12
14
16
18
20
Secs

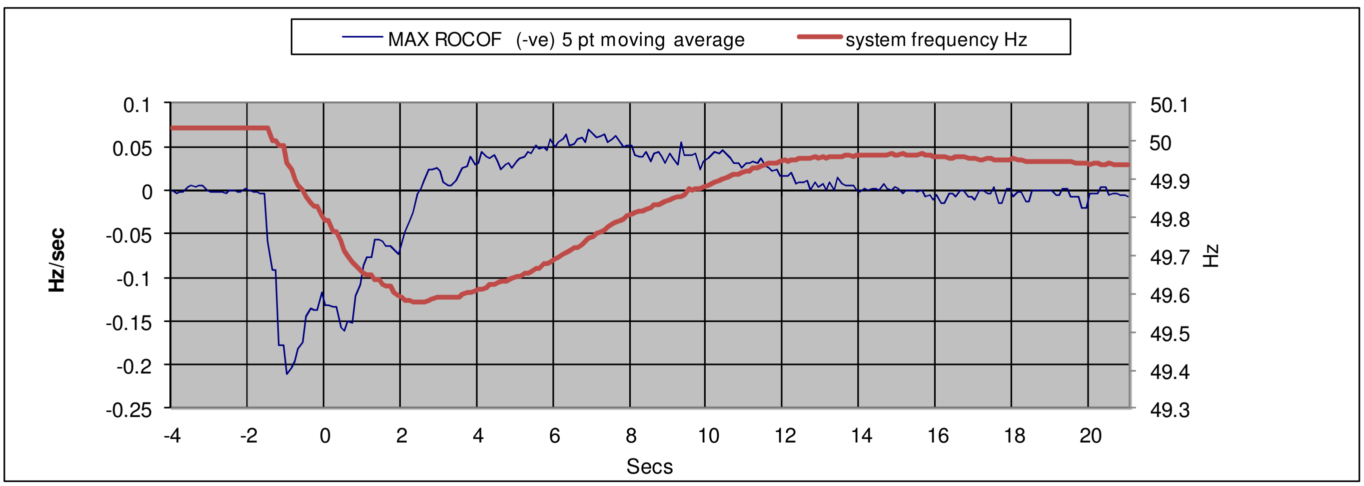
27/05/13 DUBLIN BAY



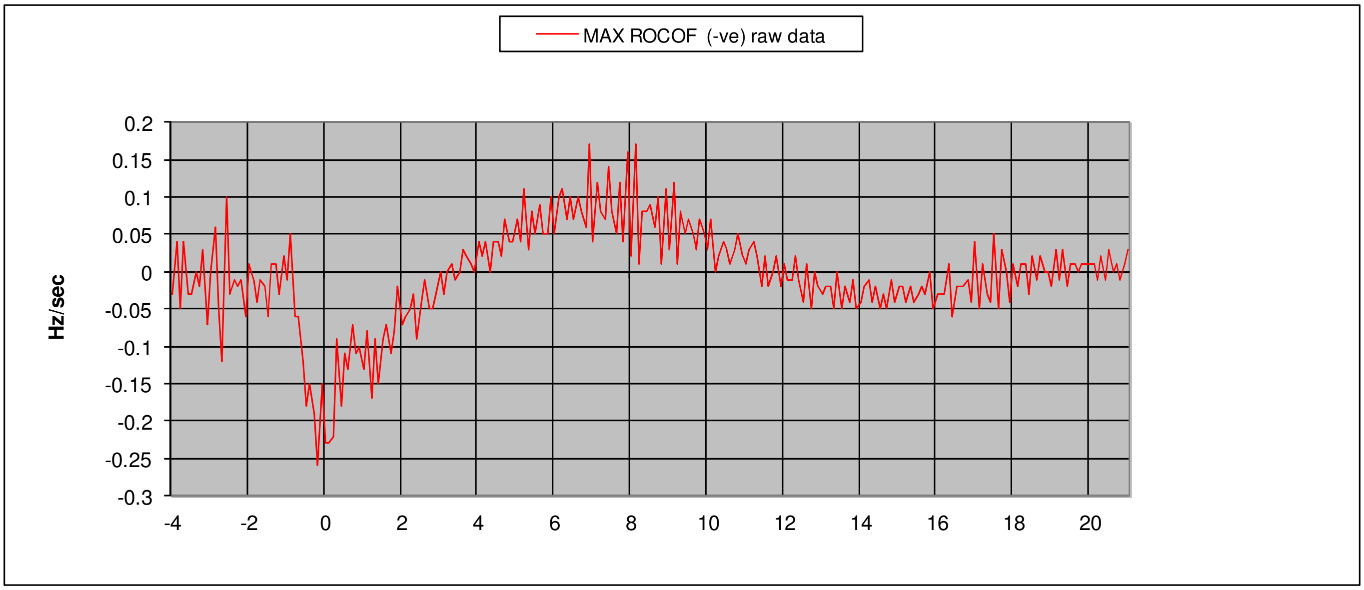


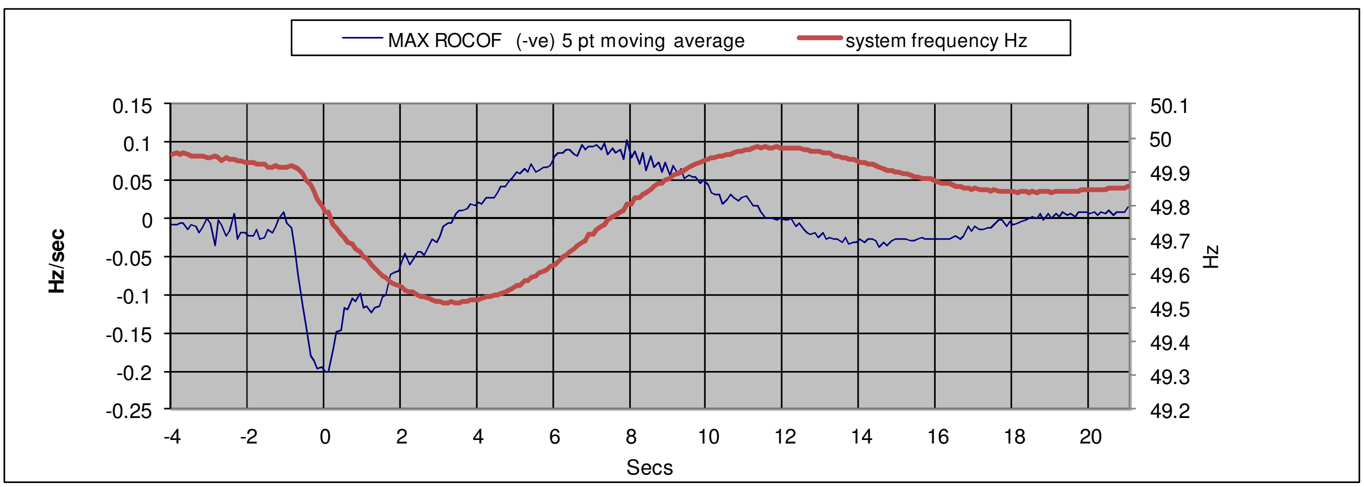
25/07/13 HUNTSTOWN UNIT



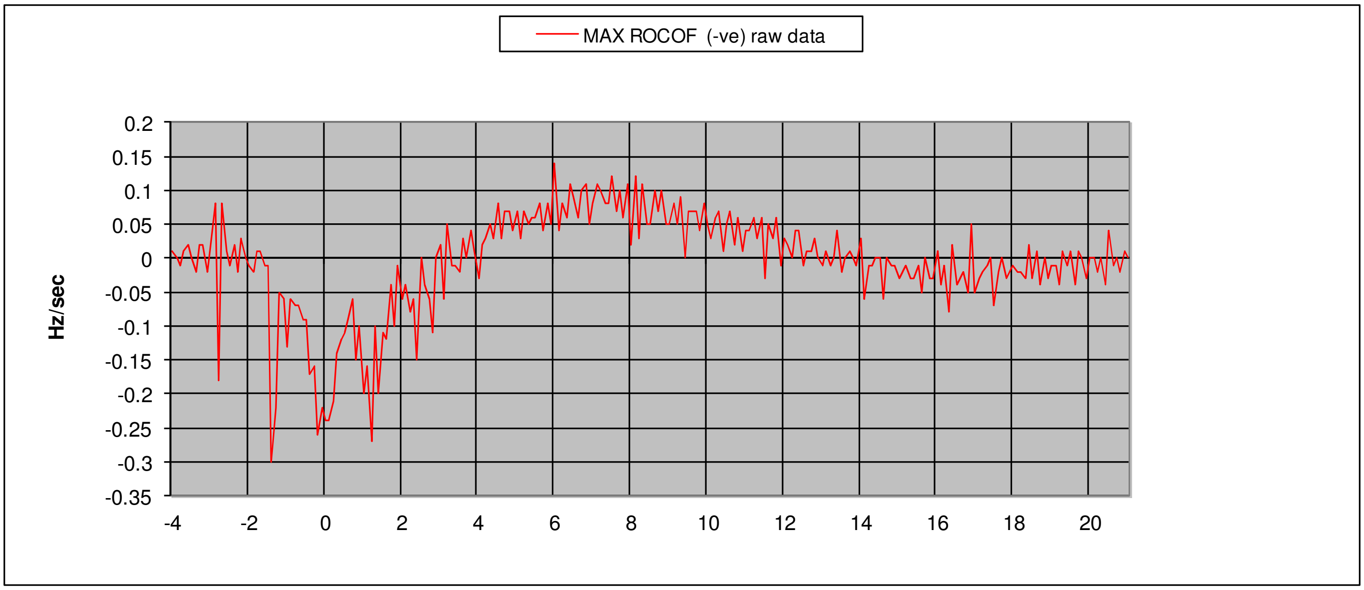


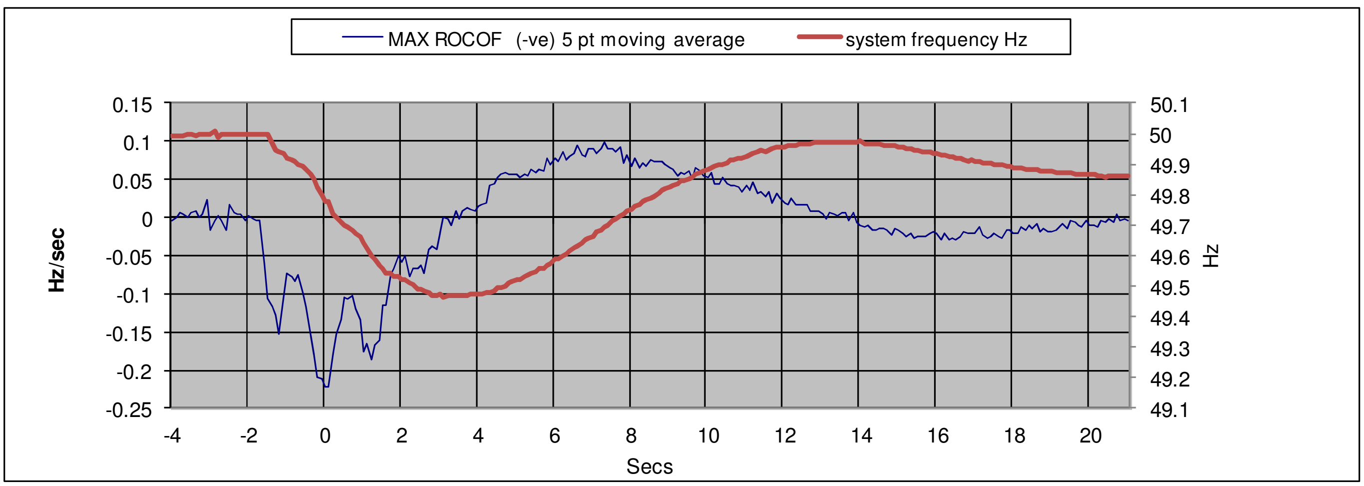
05/08/13 DUBLIN BAY



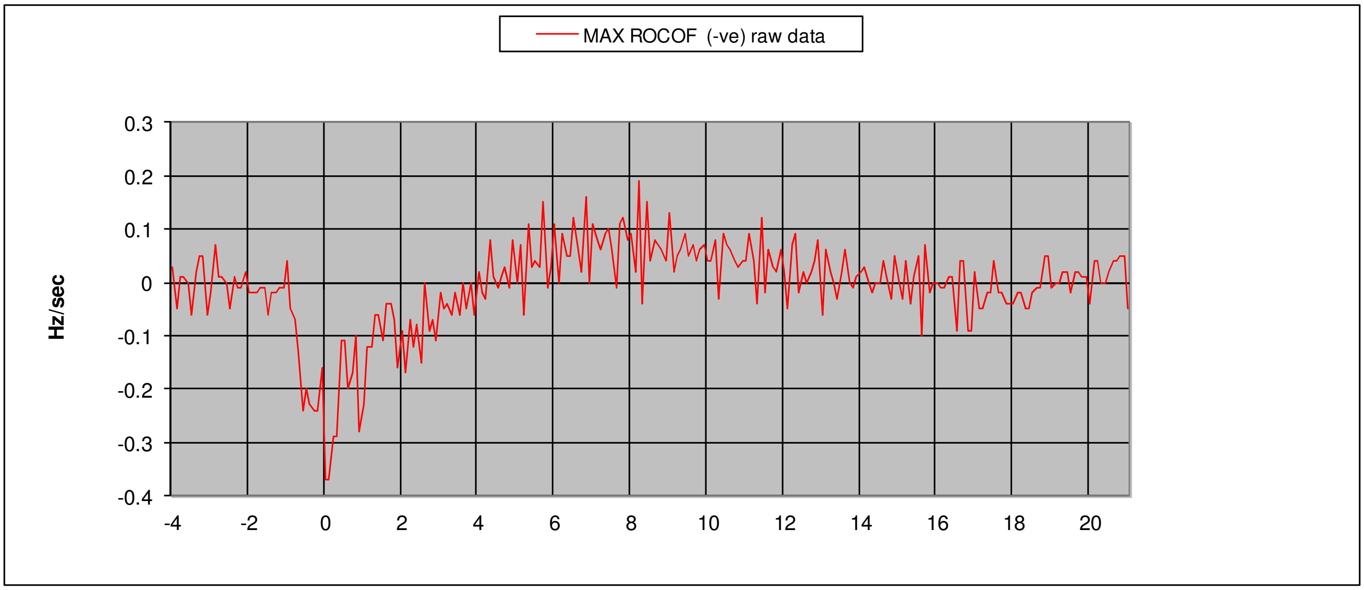


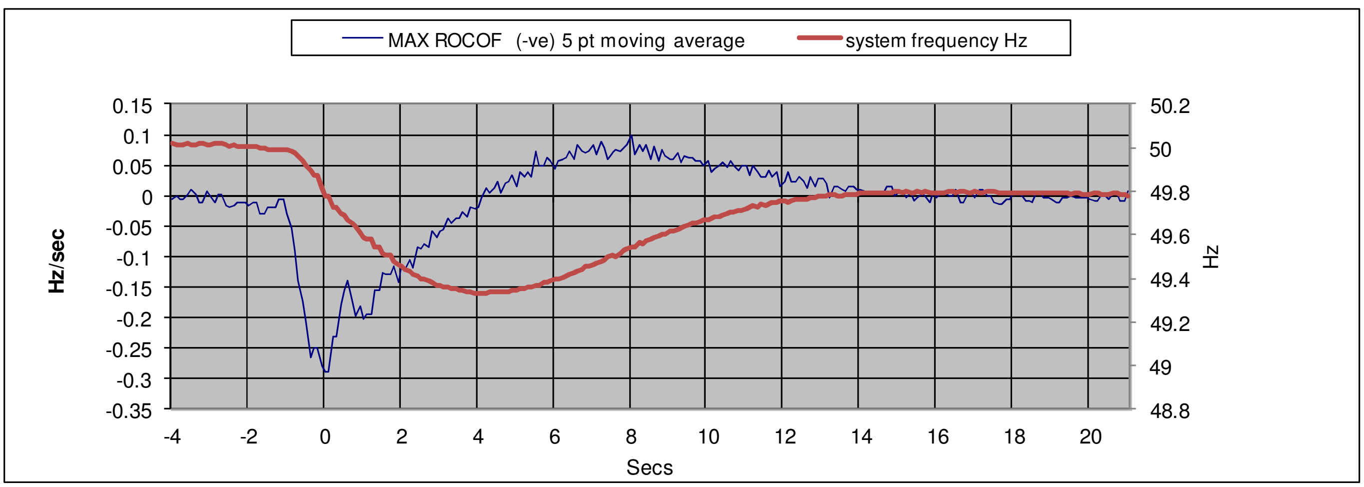
25/08/13 COOLKEERAGH C30



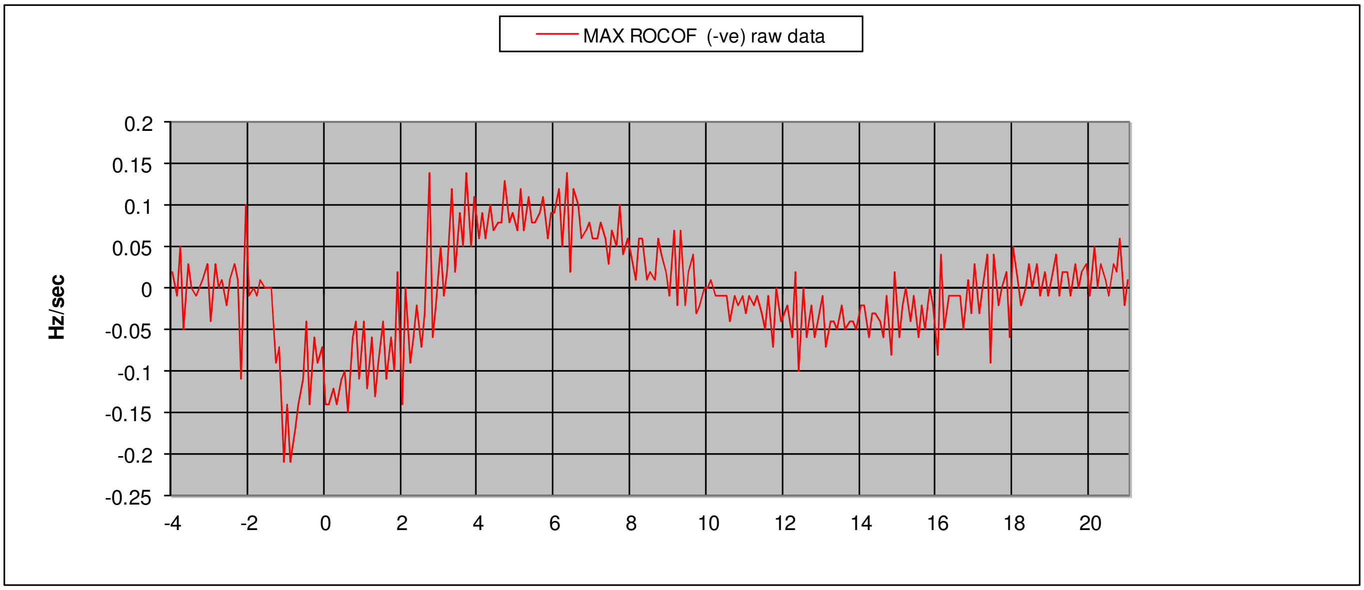


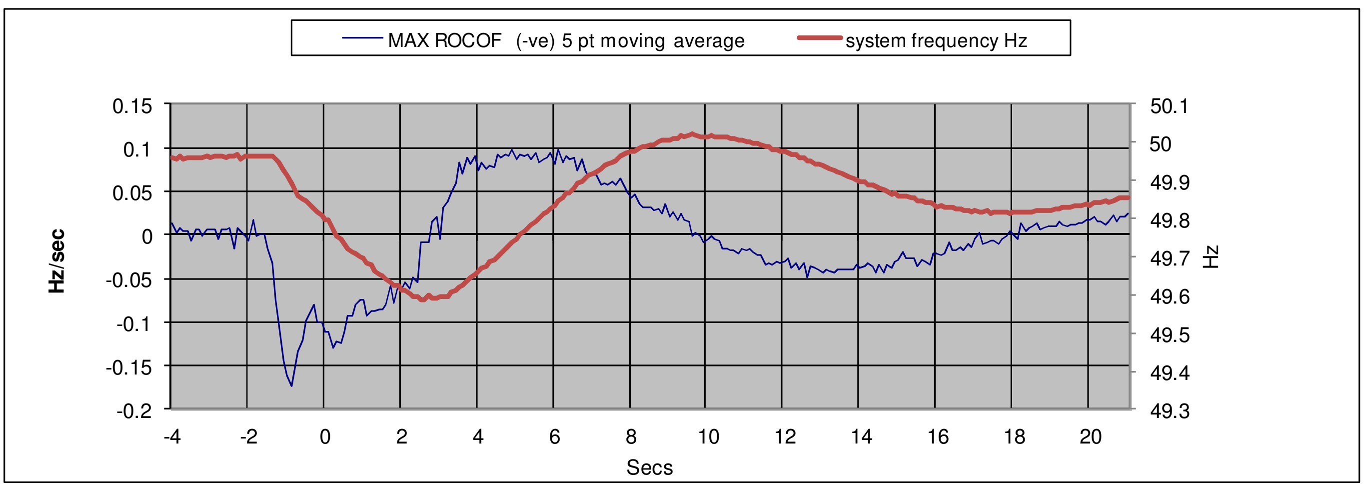
30/09/13 AGHADA UNIT 2



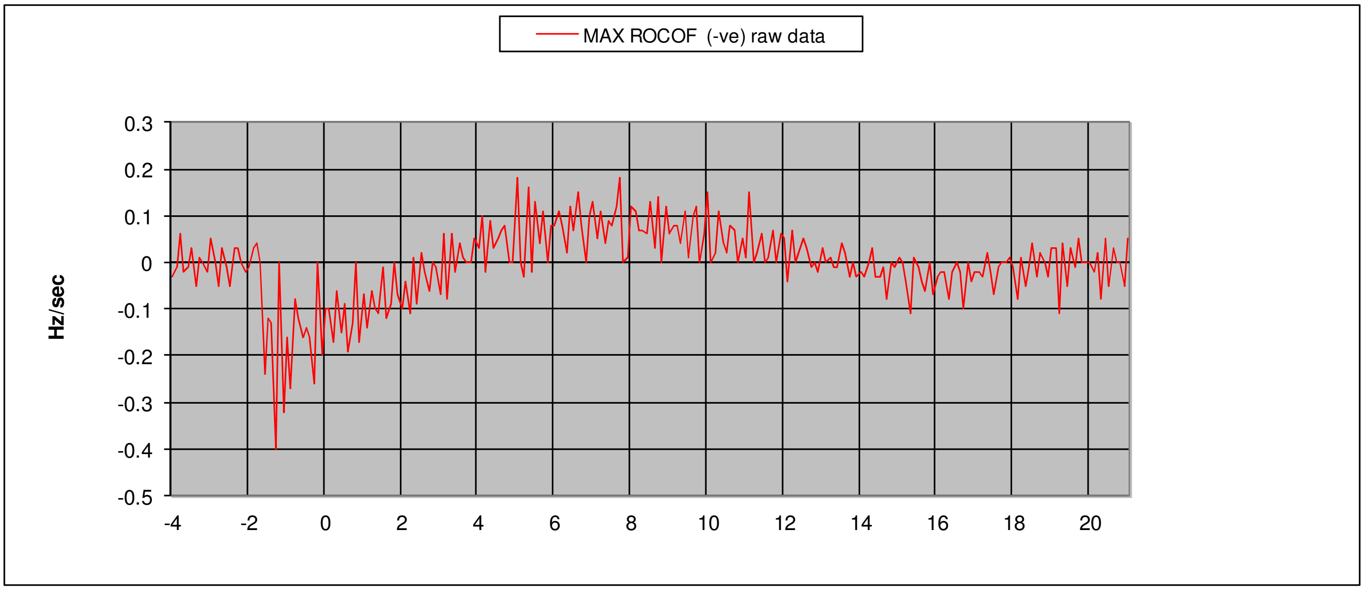


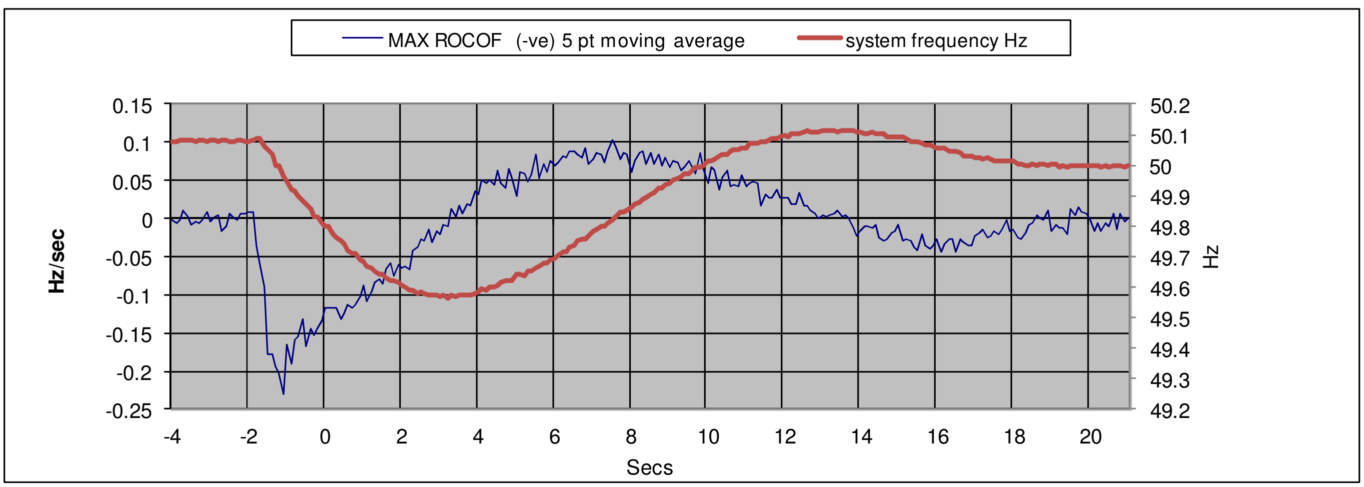
13/11/13 MONEYPOINT UNIT 3





11/12/13 AGHADA UNIT 1





Z_1 t = 0s

19/12/13 WHITEGATE