Public

Grid Code Development Forum

6 November 2024

NESO
National Energy System Operator

Agenda

1	Introduction, meeting objectives and review of previous actions - **Claire Newton, NESO**
2	Introduction of a new industry protocol in Operating Code 6 of the Grid Code - **Rebecca Scott / John Zammit-Haber , NESO**
3	Introduction of contacts for Network Access Planning into the Compliance Process and Compliance Repeat Plan – **Rhiannon Whitty, NESO**
4	Analysis of system incidents and losses of load or generation on transmission and/or distribution networks throughout the GB power system - **Sabiha Farzana, Statkraft**
5	AOB and Meeting Close **Claire Newton, NESO**

GCDF – Objectives and Expectations

Objective
Develop ideas, understand impacts to industry and modification content discussion, in relation to Grid Code related issues.
Anyone can bring an agenda item (not just the NESO!)

Expectations
Explain acronyms and context of the update or change
Be respectful of each other's opinions and polite when providing feedback and asking questions
Contribute to the discussion
Language and Conduct to be consistent with the values of equality and diversity
Keep to agreed scope

The Forum will be recorded and made available on the GCDF webpage along with summary notes.

Review of Previous Actions

ID	Month	Description	Owner	Notes	Target Date	Status

Demand Control Rotation Protocol

Modification to Operating Code 6

6th November 2024

Resilience & Emergency Management

NESO
National Energy System Operator

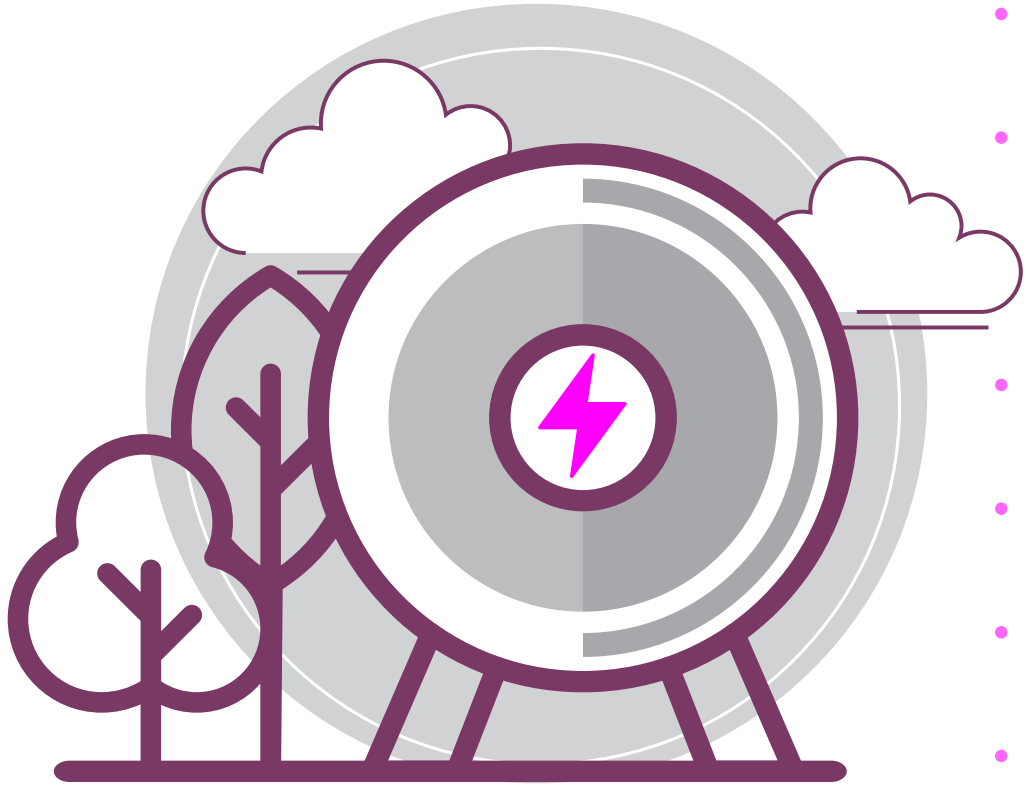
Demand Control Rotation Protocol (DCRP)

The Demand Control Rotation Protocol (DCRP) was **created in 2023** in response to recent geopolitical changes in the global energy sector. For the Winter period 2024/25, we formalised DCRP procedures with DNOs. The final protocol was **signed off by industry (ETG) and circulated in October 2024 after five periods of review during 2024.**

DCRP has been created, as reasonably practicable, using current obligations under OC6.5.3. However, OC6.5.3 does not fully cover what the protocol endeavours to achieve as it **limits the flexibility of when it can be used and does not accurately represent how DCRP would be used in practice**.

We have agreed with industry (ETG) to raise a modification to Operating Code 6 that considers the Demand Control Rotation Protocol (DCRP) as a stand-alone tool.

We are looking for endorsement from the Grid Code Development Panel on the proposed modification.



Our Proposal

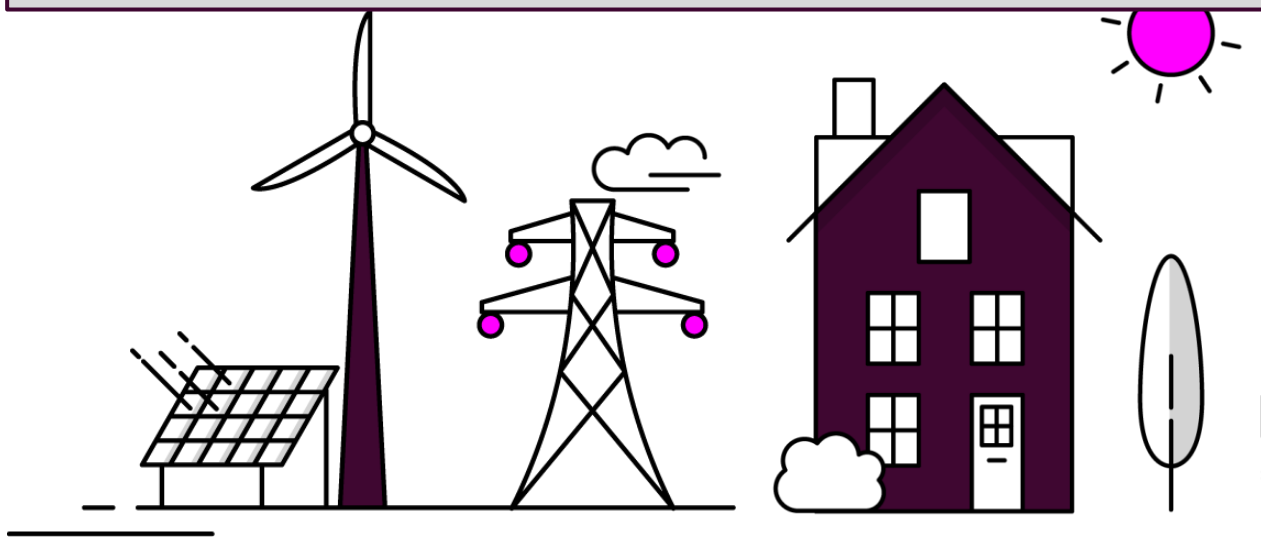
- Create a new section (OC6.9) to reflect DCRP.
- Amend OC6.5.6 to accommodate DCRP (or remove if OC6.5.6 becomes superfluous).

OC6.9 - Considerations

- How DCRP will be instructed
- Reprieve for DNOs from other incentivised obligations
- Ownership of DCRP – Does NESO host the protocol and produce updates in consultation with industry?

Grid Code Associated Documents

For national security reasons, we will be unable to publish the complete version of DCRP into the public domain. We will be able to provide a summary of what the protocol does for the Grid Code Associated Documents.



NESO
National Energy System Operator

Thank you.

Resilience & Emergency Management

NESO

Grid Code Modification Proposal

Introduction of contacts for Network Access Planning into the Compliance Process and Compliance Repeat Plan.

NESO
National Energy System Operator

Issue

NESO Network Access Planning (NAP) require confirmation of Generator and Interconnector planning contacts to allow them to share impact assessments for network outages.

There is currently no requirements under the Compliance Process or Compliance Repeat Plan for Users or OTSUA Users to provide planning contacts prior to connection or following a staff changes or a change in ownership.

This makes planning network outages difficult as essential third-party agreement cannot be obtained.

Proposed solution

A minor addition to Grid Code to bring this requirement into the Compliance Process (CC/ECC.5.2.1) and the Compliance Repeat Plan (CP/ECP.8.2)

Draft Legal Text

CC/ECC.5.2.1 (n) a list of User contact details for outage and network planning, which shall be updated by the User as needed.

CP/ECP.8.2 (c) a list of User contact details for outage and network planning, which shall be updated by the User as needed.

Impact

The modification is expected to have a positive impact on

1. NESO Network Access Planning by improving efficiency
2. Generators by improving their visibility of transmission outages and their expected impact
3. NESO's compliance with Special Licence Condition 2.5 / the TO's Network Access Policy which requires NESO to have a key role in liaising with impacted stakeholders and to share formal outage notifications with them.

No negative impacts have been identified.

We are proposing that this is raised as a self-governance modification that will proceed directly to Code Administrator Consultation

Statkraft

Analysis of system incidents and losses of load or generation on transmission and/or distribution networks throughout the GB power system.

SABIHA FARZANA

Aims of this Presentation

Reports are available for industry and the Grid Code Panel to monitor the effectiveness of technical requirements in the Grid Code and Distribution Code – GC105 and GC151 which are published on the NESO website. However, no evidence seen that NESO has considered or reviewed this data.

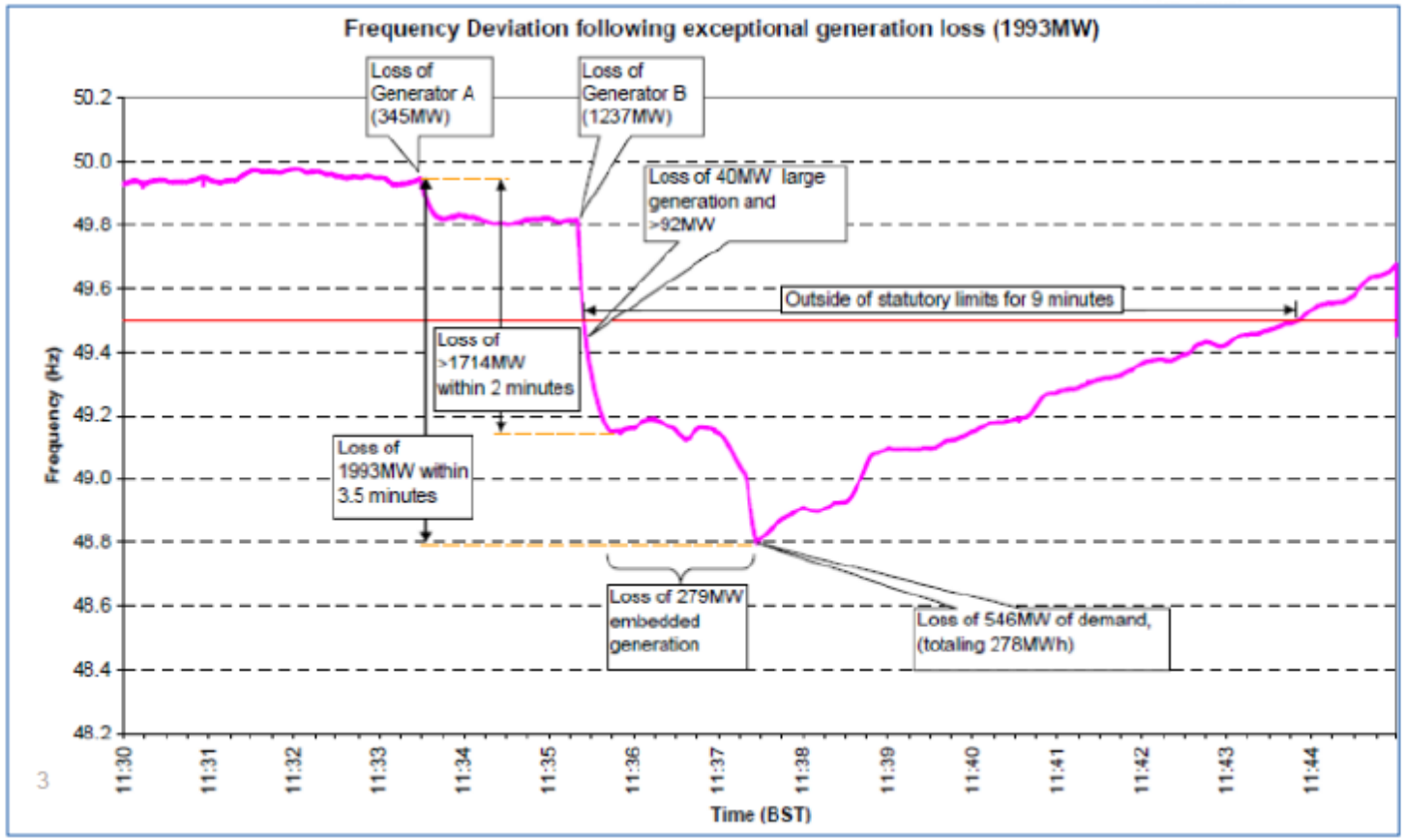
The need to analyse these vast amount of data & understand the trend is discussed here.

Recommend possible future changes to the Grid Code to enhance the effectiveness of the data that is currently produced in relation to incident reporting.

Background

Report of the National Grid Investigation into the Frequency Deviation and Automatic Demand Disconnection that occurred on the 27th May 2008

Issued: February 2009



Under the auspices of the GB Grid Code Review Panel, a reporting procedure was established in 1997 where the DNOs are required to provide National Grid with information on embedded generation that may have tripped in the event of a significant incident on the GB transmission system including generation trips causing large frequency deviations.

1. Grid Code established this reporting procedure, but it wasn't encoded in the grid code system.
2. Grid Code modification raised in Oct 2017.
3. GC105 & GC151 established in June 2020.

Statkraft

GCRP January 2016 pp16/19
NEW INCIDENTS

Inc Date	Inc Time	DoW	ToD	Size Loss (MW)	Reported Generation Lost (MW)	RoCoF (Hz/s)	Starting F (Hz)	Estimated Residual H Equivalent (s)	Demand (MW)	Min/ Max Freq	Event
24 Dec 2013	01:12	Tue	Night	-925	-	-0.135	50.05	0.199	29137	49.73	IFA Bipole 1 following Dung-Sell 2 trip and co-incident with Dung-Ninf 2 trip
24 Dec 2013	03:32	Tue	Night	-925	-	-0.145	50.11	0.196	25248	49.79	IFA Bipole 1 co-incident with Dung-Sell 2 trip
25 Jan 2014	08:06	Sat	Day	-1000	-	-0.087	50	2.880	33716	49.68	IFA-Bipole 2
20 Mar 2014	23:06	Thu	Night	500						50.26	Dinorwig 1 & 6 tripped while in pumping mode
16 Apr 2014	20:35	Wed	Eve	-800						49.67	Shutdown of Northwest SHETL group; 1000MW lost generation (500mW wind, 250MW hydro, 100MW Glendoe, 150MW Foyers 1) and 200MW lost demand
27 Apr 2014	11:37	Sun	Day	-1000	-	-0.104	49.98	1.773	32946	49.57	IFA Bipole 2 followed by Dungeness 2 (545MW) at 11:38
01 May 2014	09:52	Thu	Day	-1280						49.56	All 4 Staythorpe units
08 May 2014	18:17	Thu	Eve	-1000			-			49.63	IFA Bipole 2
16 Oct 2014	09:06	Thu	Day	-1000	-	-0.081	49.93	1.434	39793	49.56	IFA Bipole 2
09 Jan 2015	15:56	Fri	Day	-830						49.7	Spalding North
13 Jan 2015	02:31	Tue	Night	-285						49.8	Dinorwig moving to Spin Pump later than expected, frequency trace suggests some other events may have followed this
05 Jun 2015	14:55	Fri	Day	-950	-	-0.077	49.98	3.268	31471	49.68	IFA Bipole 2
21 Jul 2015	15:28	Tue	Day	-748						49.96	IFA Bipole 2
06 Aug 2015	06:21	Thu	Night	-1000	-	-0.103	50.02	3.329	24528	49.69	IFA Bipole 2
11 Nov 2015	01:54	Wed	Night	-991	-	-0.119	50	2.921	22727	49.6	IFA Bipole

Power Available >

System Performance Reports >

Balancing services performance monitoring report >

Data finder and explorer >

Forecast volumes and costs >

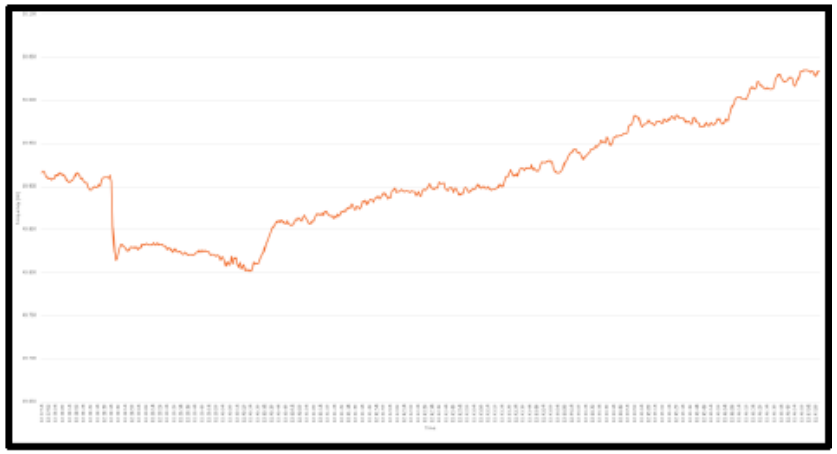
GB Electricity System Operator Daily Reports >

System Performance Reports

At NESO, we're committed to being transparent and sharing information with our partners in the energy industry.

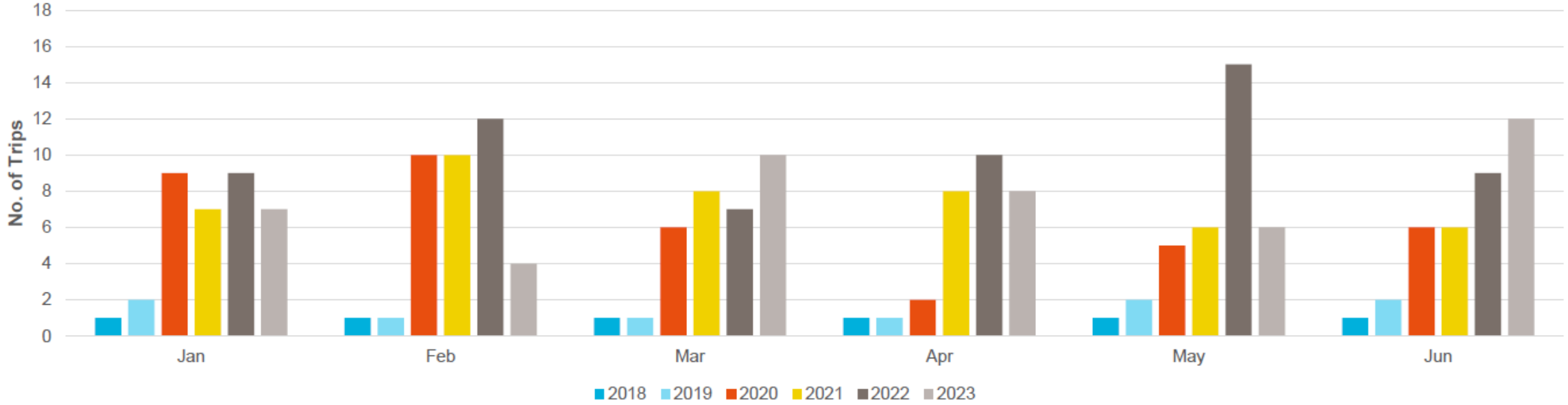
On this page, you will find reports that NESO publishes as required for:

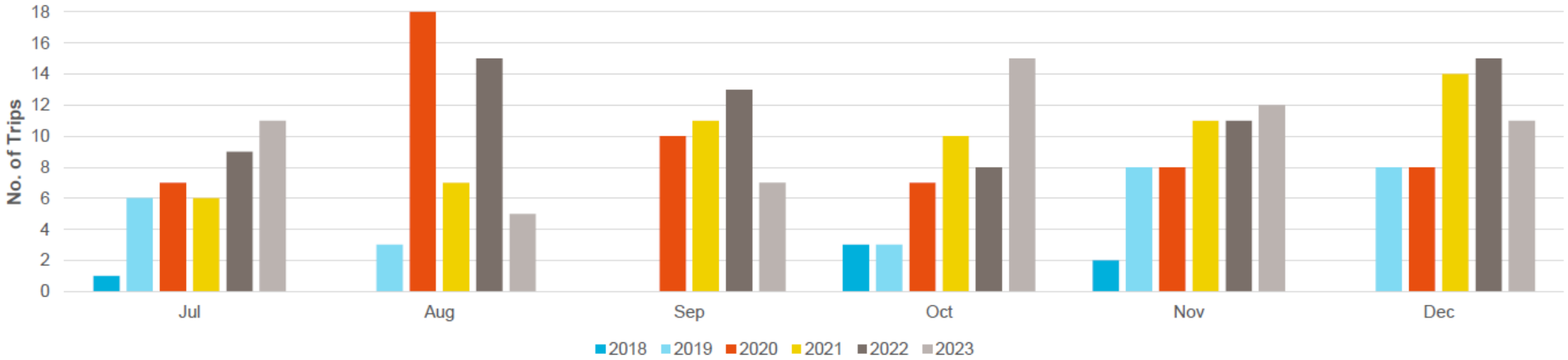
- GB National electricity transmission system performance as required by Transmission Licence Standard Condition C17: Transmission System Security Standard and Quality of Service.
- Reports for industry and the Grid Code Panel to monitor the effectiveness of technical requirements in the Grid Code and Distribution Code – GC105 and GC151
- UK Statutory Instrument – Electricity Network Codes and Guidelines (Markets and Trading) (Amendment) (EU Exit) Regulations – Article 15 and 16.
- UK Statutory Instrument – The Electricity and Gas (Internal Markets and Network Codes) (Amendment) (EU Exit) Regulations – Clean Energy Package Article 13.



	A	B	D	E	F	G	H	I	J	K	L	M
1			Date and time of the incident	System frequency trace (1-second interval) for the incident	System frequency immediately before the incident	System frequency immediately after the incident	Maximum/Minimum rate of change of frequency (RoCoF) of the incident	System inertia at the time of the incident	Where known, MW trip/loss of all generation/ interconnection related to the incident		Where known, MW trip/loss of all Embedded Generation(EG) related to the incident	
2	Reference	Name	Date Time	System Frequency (Refer to sheet)	Pre-Event Frequency (Hz)	Post-Event Frequency (Hz)	RoCoF (Hz/s)	System Inertia (GVAs)	Generation/Interconnection (MW)		EG (MW)	
3	20240702-1	Trip of IFA2	02/07/2024 07:06:00	20240702-1	49.90	49.68	-0.164	159	IFA2	992.35		
4	20240705-1	Trip of STAY-2	05/07/2024 17:06:00	20240705-1	50.06	49.87	-0.076	184	STAY-2	396.08		
5	20240706-1	Loss of Supply at Glenniston 33kV substation	06/07/2024 17:47:00	20240706-1				128				
6	20240717-1	Trip of PEMB-11	17/07/2024 00:33:40	20240717-1	49.93	49.82	-0.029	151	PEMB-11	436.80		
7	20240722-1	Trip of DRAXX-4	22/07/2024 17:24:00	20240722-1	50.02	49.81	-0.088	197	DRAXX-4	641.48		
8	20240723-1	Trip of DAMC-1	23/07/2024 17:27:00	20240723-1	50.02	49.89	-0.045	206	DAMC-1	344.44		

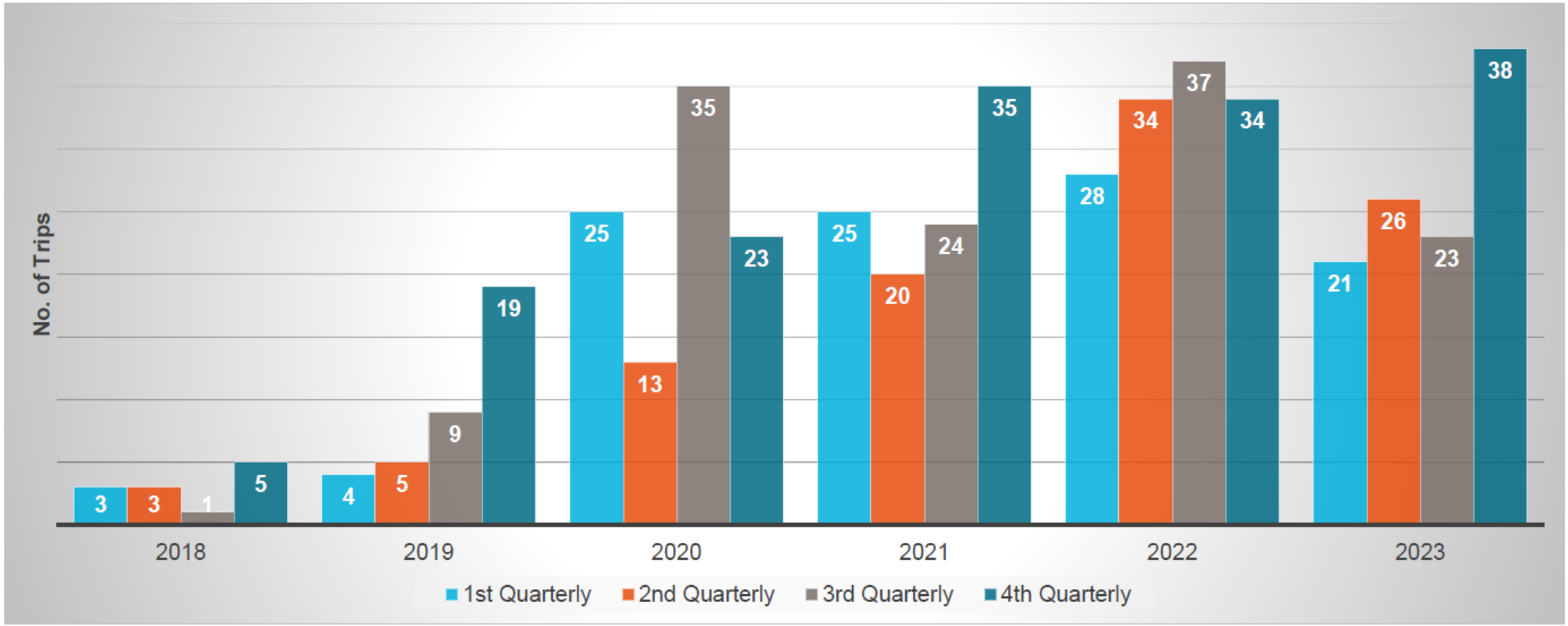
Monthly Analysis of No. of Trips from 2018-2023





Statkraft

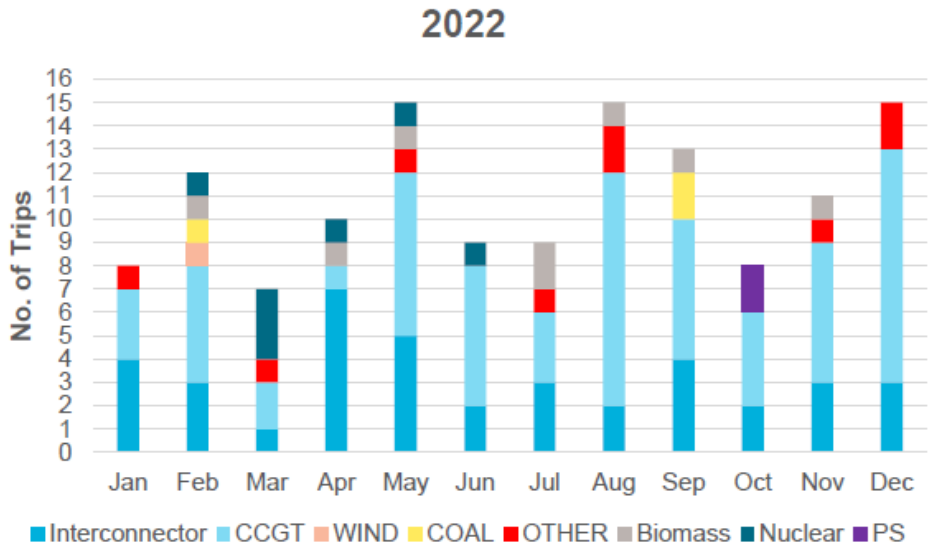
No. of Trips Analysis in Quarterly Basis (Jan 2018- Dec 2023)

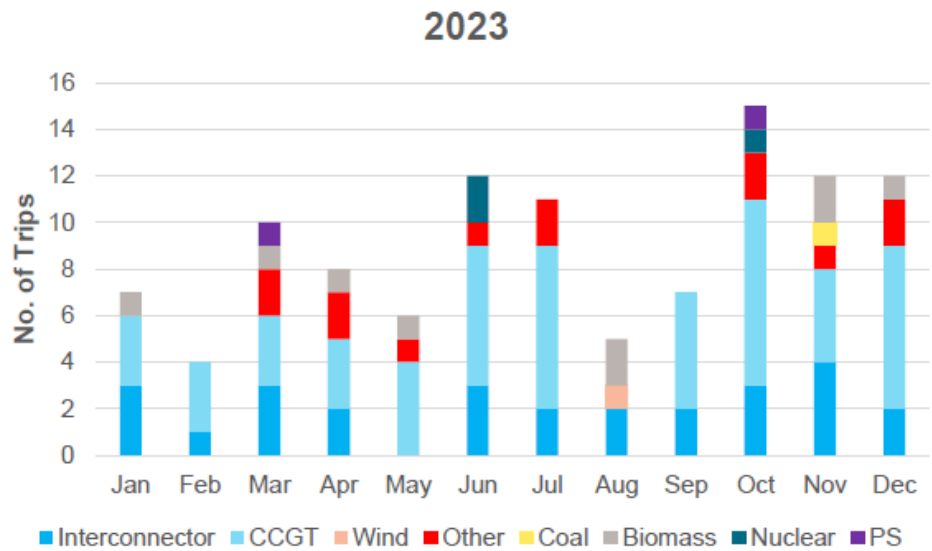


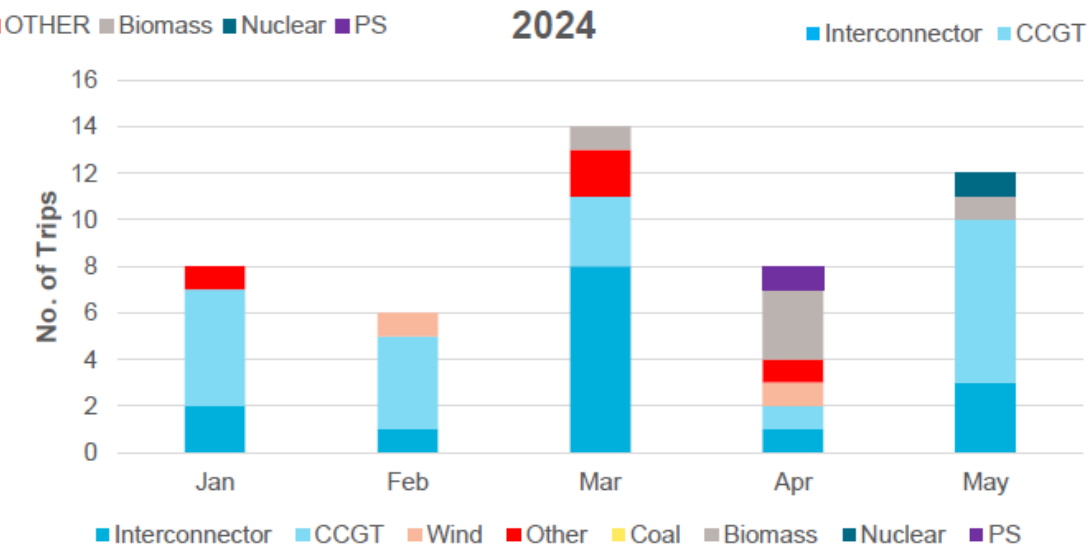
Statkraft

What's causing the trips?

	Interconnector	CCGT	Wind	Coal	Other	Biomass	Nuclear	PS
Total No. of Trips	81	136	4	4	26	22	11	5



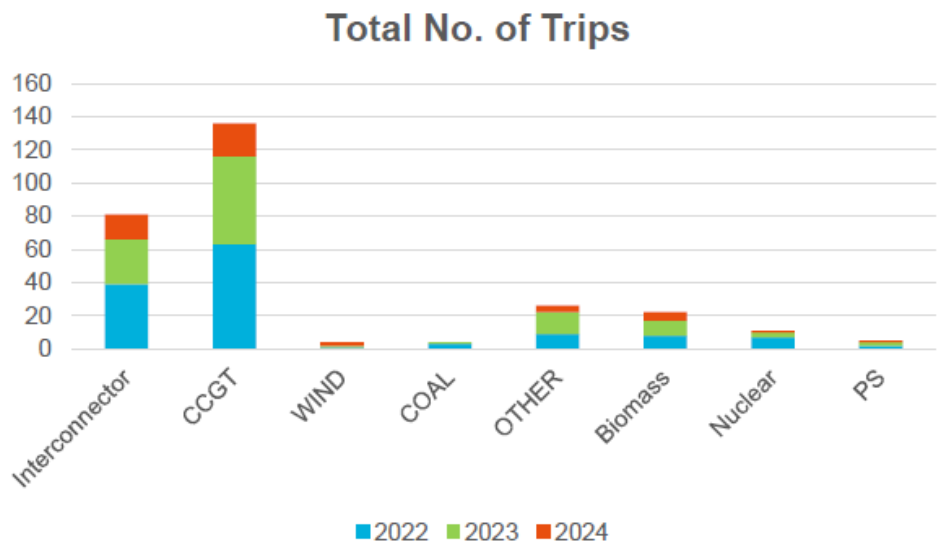


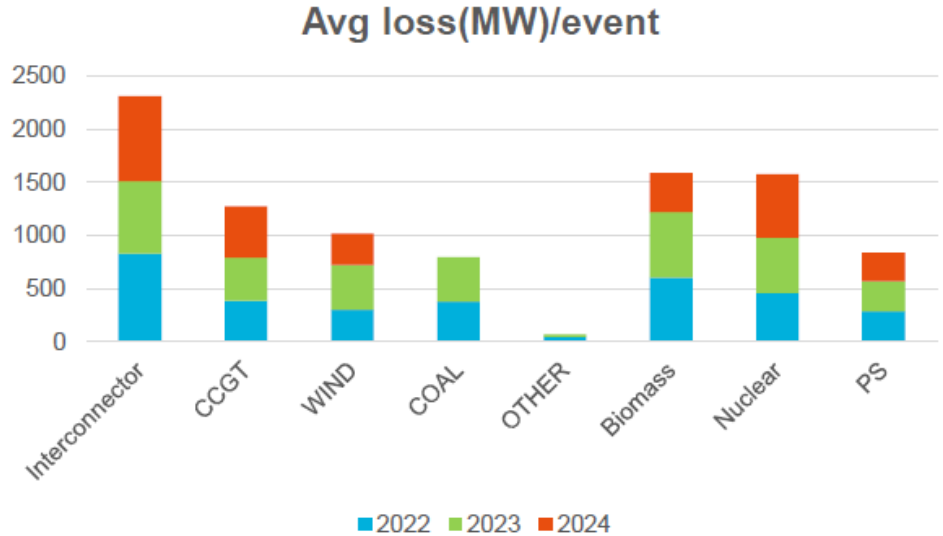


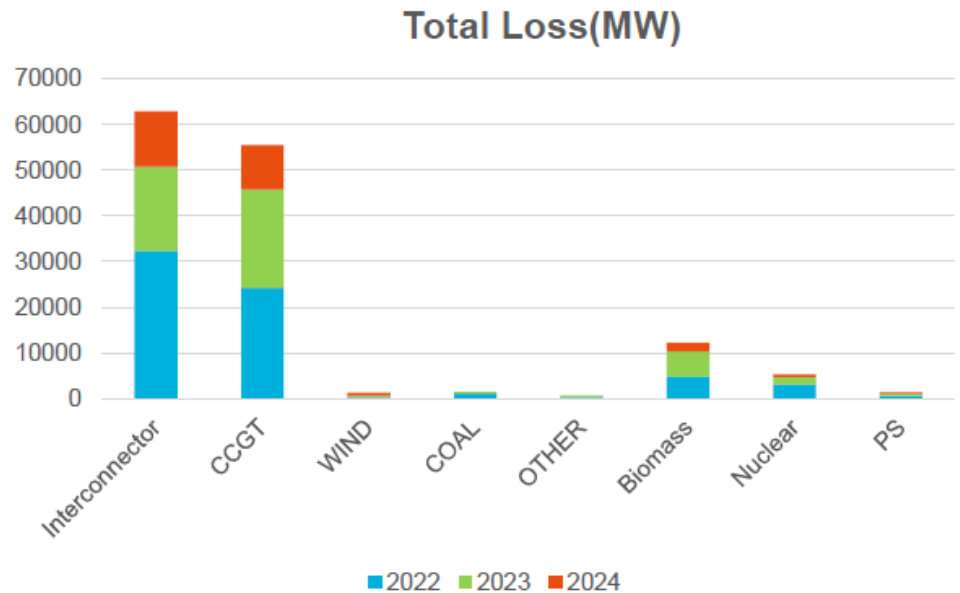
Other-Transmission/network losses like loss of supply at substations, low frequency deviation, demand loss, busbar & circuit trips.

Statkraft

Extent of Trips



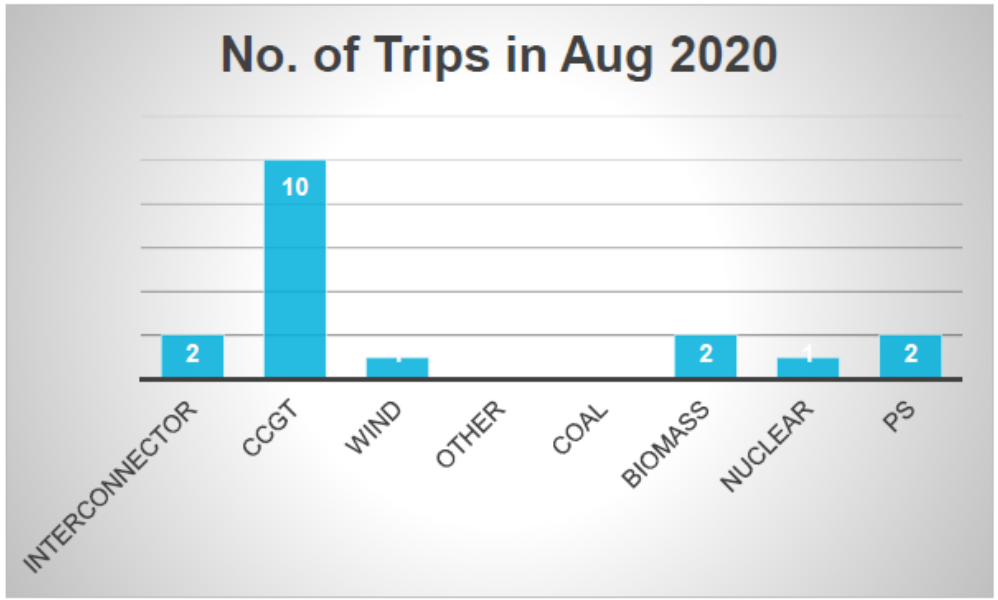


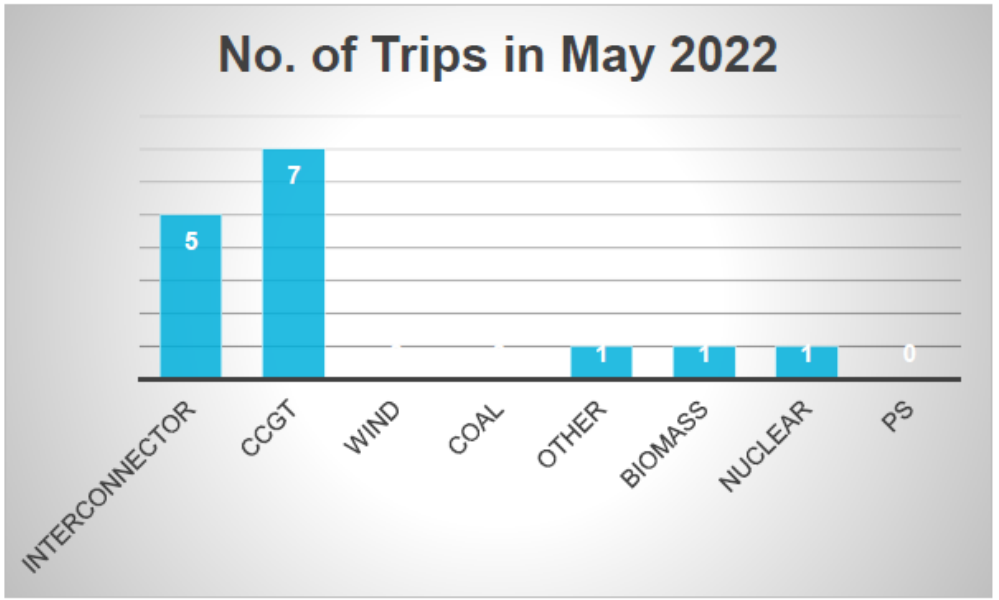


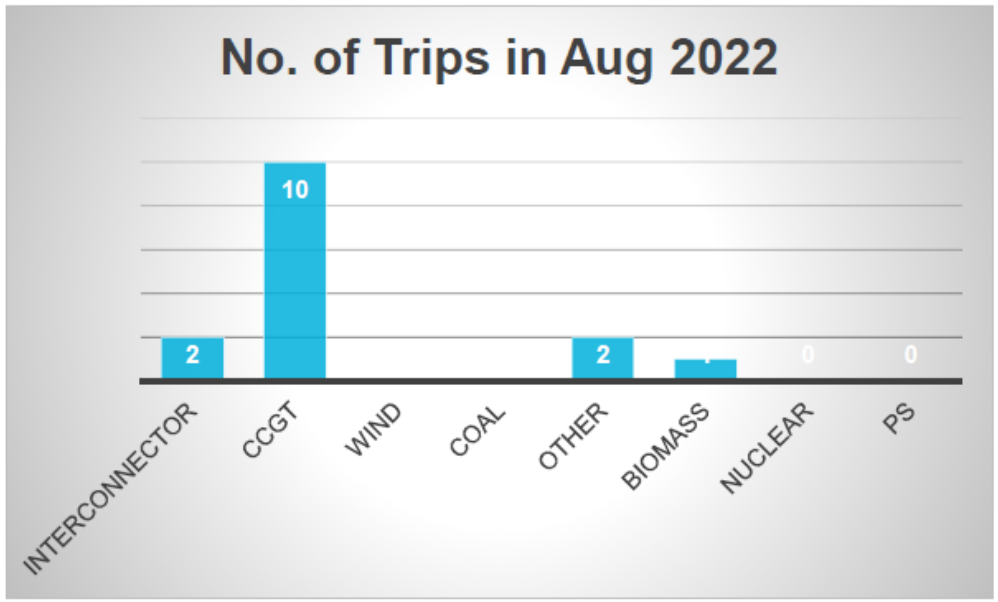
Other-Transmission/network losses like loss of supply at substations, low frequency deviation, demand loss, busbar & circuit trips.

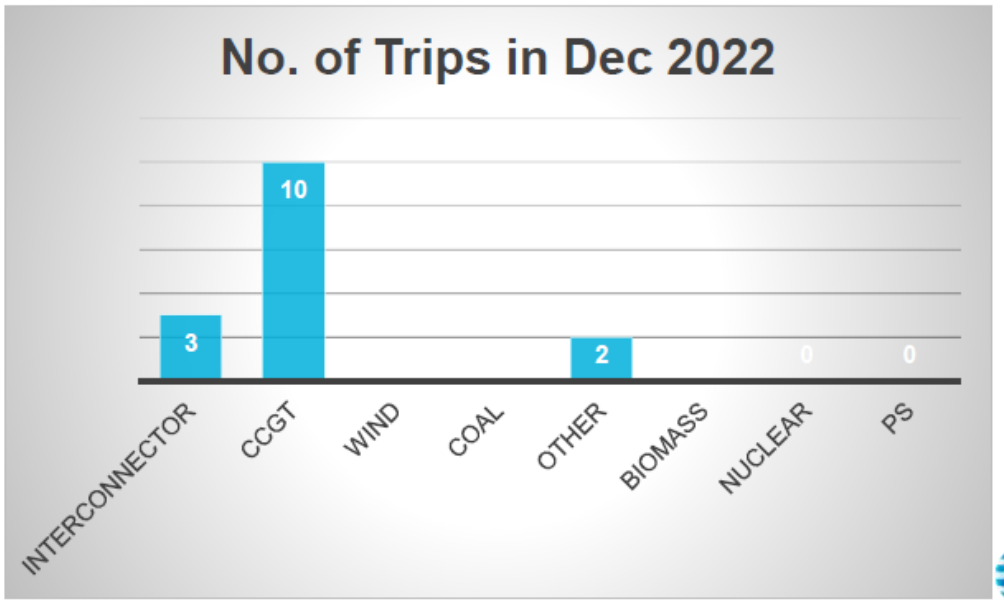
Statkraft

Analysis of months with maximum number of trips



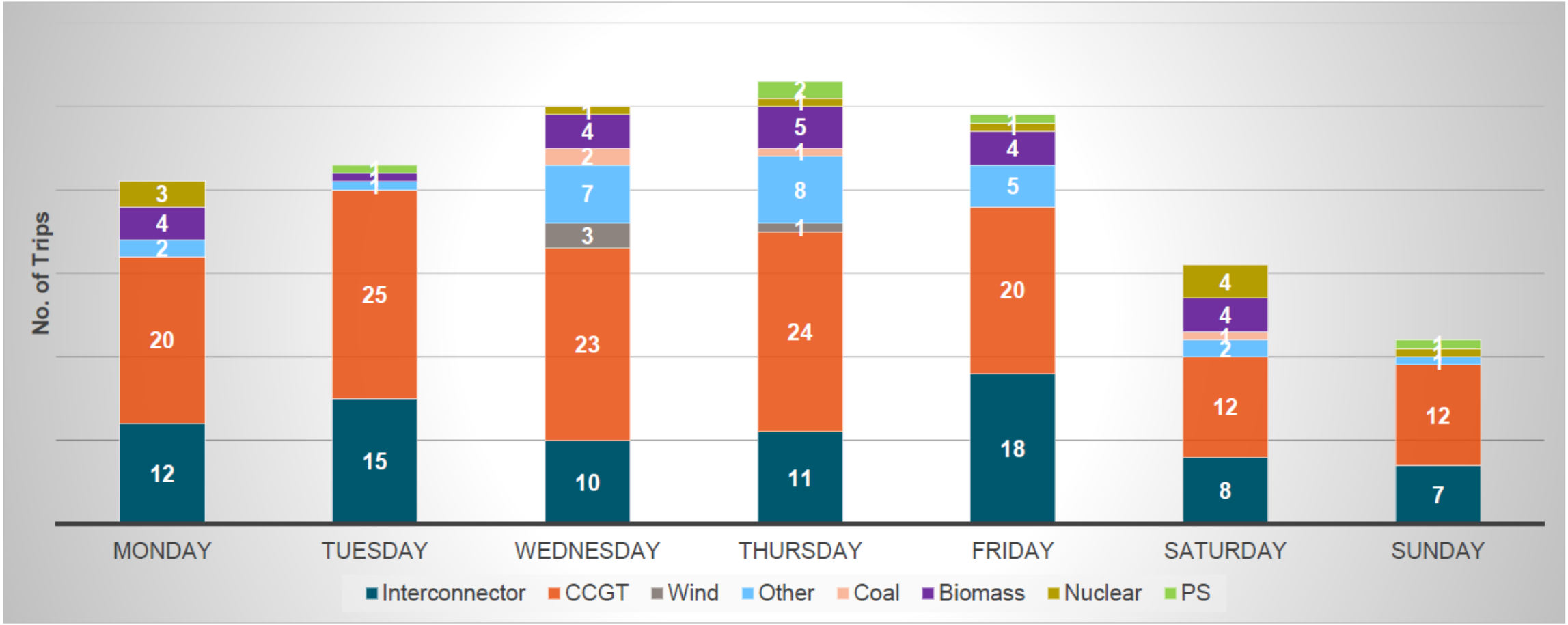






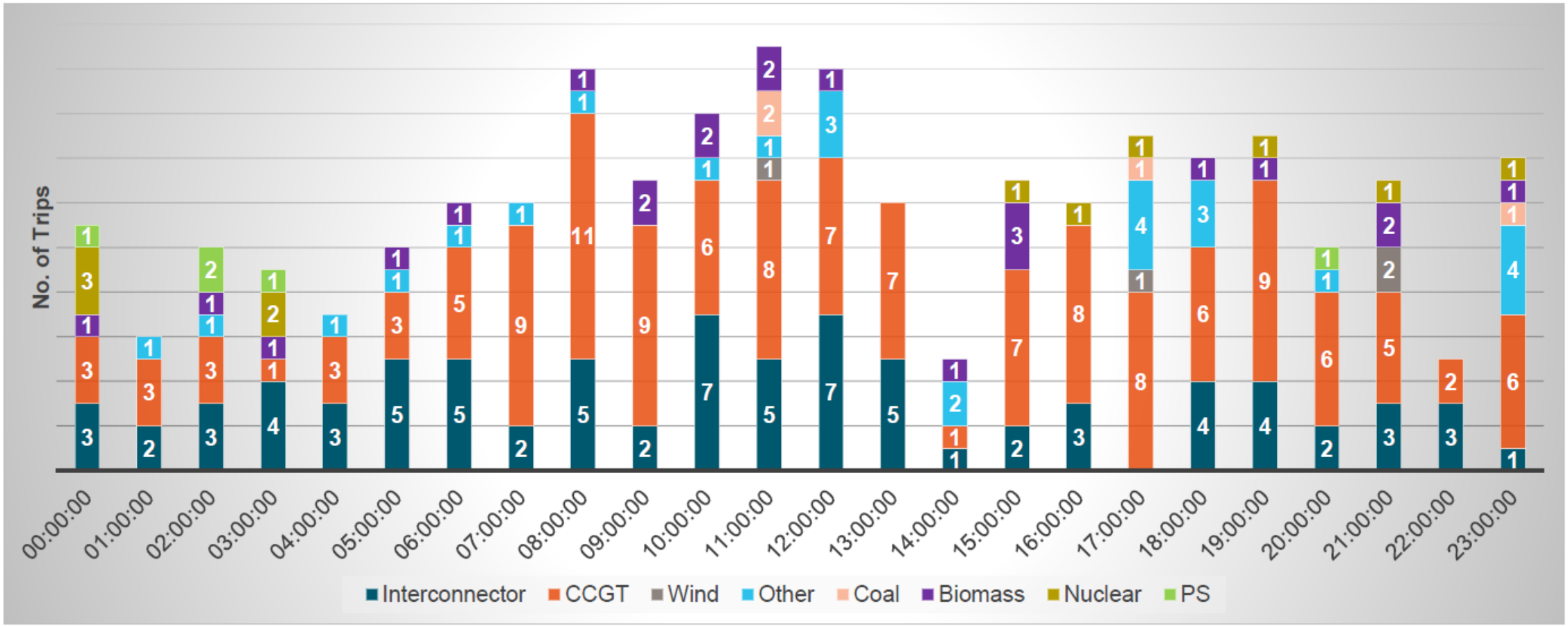
Statkraft

No. of Trips Analysis against the Days of the Week (Jan 2022- May 2024)



Statkraft

No. of Trips Analysis against the Time of the Day (Jan 2022- May 2024)

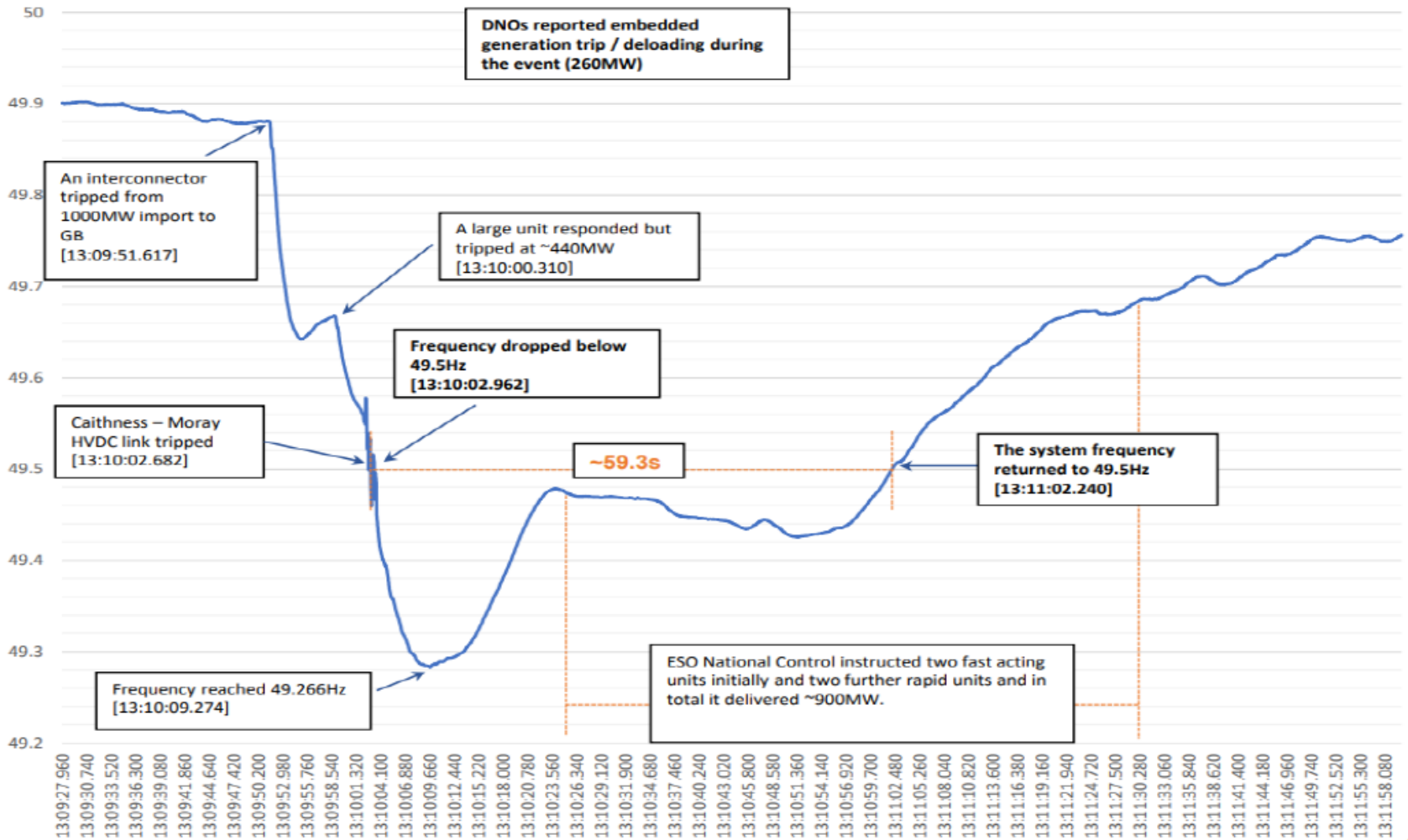


Statkraft

Analysing the 22nd Dec 2023 event at 13:09

Sli.do code #OTF

Annotated Frequency Trace of the Events



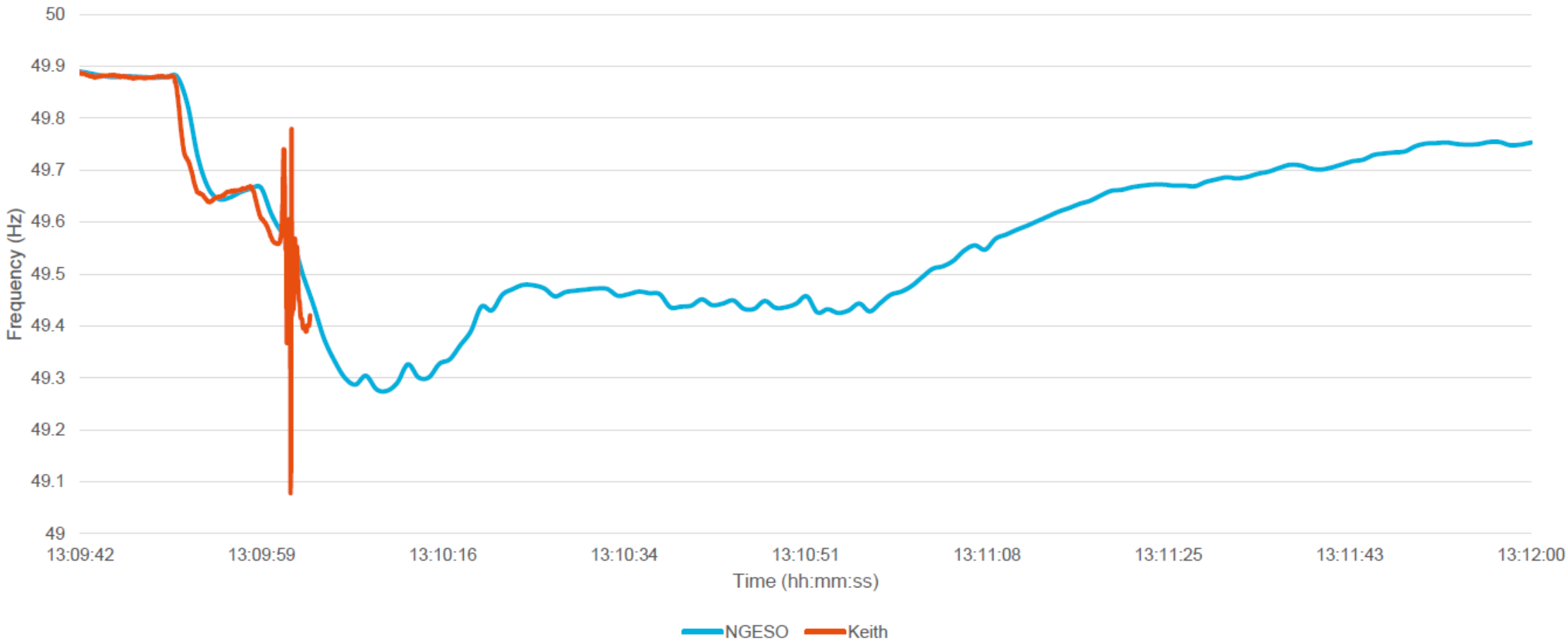
ESO

* Note: the graph is based on currently available data

Statkraft

ESO Transparency Forum 24-01-17vFinal.pdf

Comparison between NGESO frequency & Keith frequency during the incident



NESO, Keith & MODO Analysis.xlsx

Statkraft

RoCoF calculation in 2 ways

Using Equation & values from NESO website

$$\text{RoCoF}=\frac{P(loss\ of\ generation\ in\ MW)\times Fi(initial\ frequency\ in\ Hz)}{2Eo(Inertia\ in\ MWs)}$$

- RoCoF of the Interconnector trip $=\frac{1000\times49.826}{2\times161\times1000}=-0.155\text{Hz/s}$
- RoCoF of the CDCL unit trip $=\frac{440\times49.666}{2\times161\times1000}=-0.068\ \text{Hz/s}$
- RoCoF of the HVDC link trip $=\frac{260\times49.564}{2\times161\times1000}=-0.04\ \text{Hz/s}$

Using data from graph

$$\text{RoCoF}=\frac{F2-F1\ (in\ Hz)}{T2-T1\ (in\ s)}$$

- RoCoF of Interconnector trip $=\frac{49.724-49.826}{13:09:53-13:09:52}$ = -0.102 Hz/s
- RoCoF of the CDCL unit trip $=\frac{49.615-49.666}{13:10:00-13:09:59}$ = -0.051 Hz/s
- RoCoF of the HVDC link trip $=\frac{49.498-49.564}{13:10:03-13:10:02}=-0.066\ \text{Hz/s}$

Comparison between the theoretical & graphical RoCoF values

- Ratio(Interconnector)= (155-102)/102= 52% ► Theoretical RoCoF is 52% higher than graphical value.
- Ratio(CDCL unit)= (68-51)/51= 33% ► Theoretical RoCoF is 33% higher than graphical value.
- Ratio(HVDC link)= (66-4)/66= 94% ► Graphical RoCoF is 94% higher than theoretical value.

ESO Transparency Forum 24-01-17vFinal.pdf inertia.csv NGESO, Keith & MODO Analysis.xlsx

Statkraft

Understanding the power loss for the HVDC Link incident

Applying these ratios to 3rd incident (HVDC Link) means the ROCOF could be:

i. 0.066*1.52=0.100

ii. 0.066*1.33=0.088

Based on these ROCOFs what would the MW loss have been?

i. For 0.100 Hz/s

$$P\ (loss\ of\ generation\ in\ MW) = \frac{RoCoF \times 2Eo(Inertia\ in\ MWs)}{Fi(initial\ frequency\ in\ Hz)}$$

= (0.1*2*161*1000)/49.564 = 649 MW

i. For 0.088 Hz/s

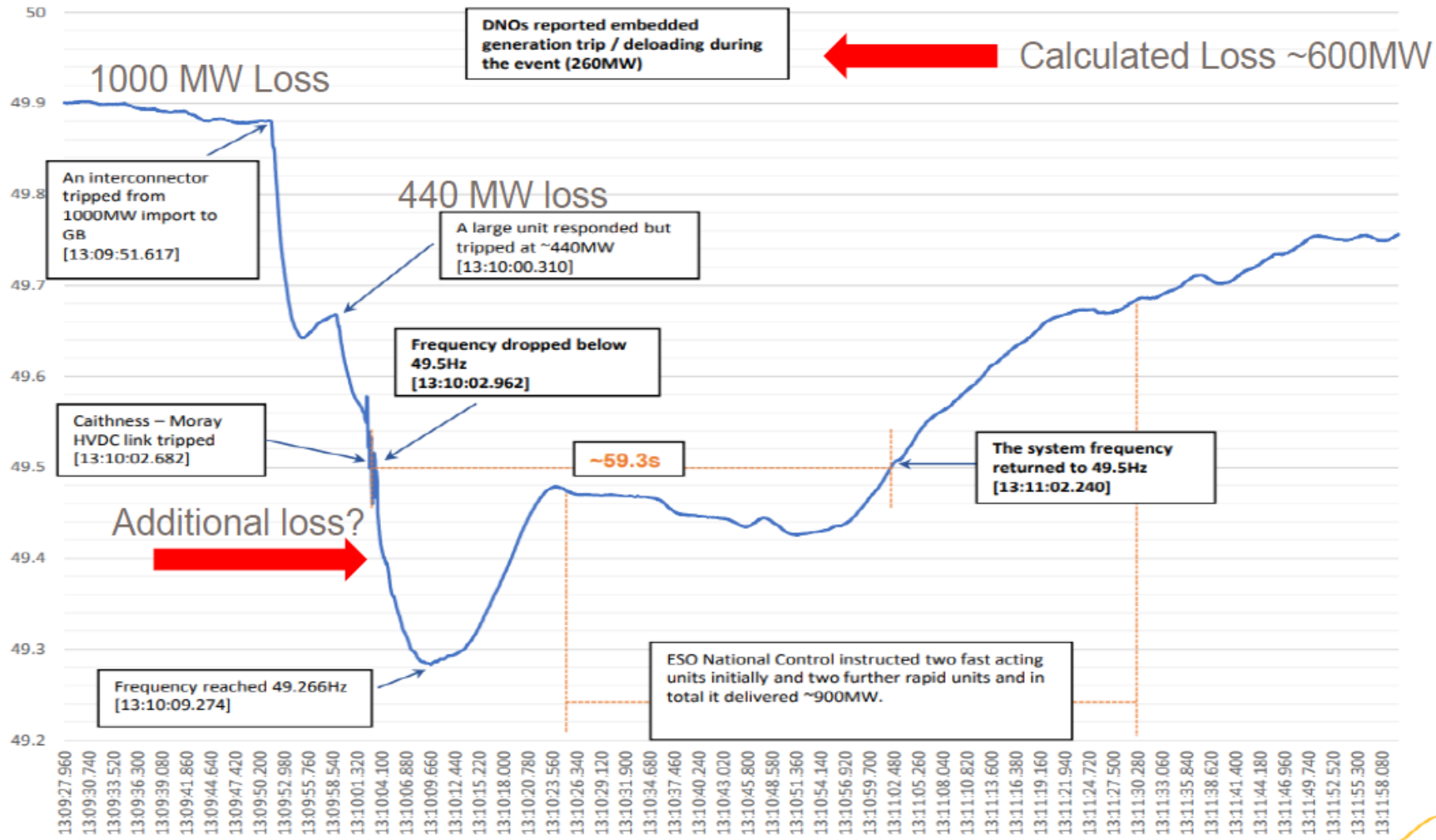
$$P\ (loss\ of\ generation\ in\ MW) = \frac{RoCoF \times 2Eo(Inertia\ in\ MWs)}{Fi(initial\ frequency\ in\ Hz)}$$

= (0.088*2*161*1000)/49.564 = 571 MW

Analysing the 22nd Dec 2023 event at 13:09

Sli.do code #OTF

Annotated Frequency Trace of the Events



ESO

* Note: the graph is based on currently available data

Statkraft

ESO Transparency Forum 24-01-17vFinal.pdf

Possible future changes to the grid code relating to this data / part of the grid code

1. Improving the reporting time e.g. from 3 months to 1 month or 1 week.

Advantage- it would be easier to access data from other parties soon after the event than 3 months later.

2. Getting more granular data at a higher sampling rate (ie. faster than 0.5s) to analyse events more effectively.

3. Getting data from different locations in GB to better see any regional variations.

Statkraft

The proposer would welcome comments, suggestions, feedback or any improvements.

Sabiha Farzana
Grid Stability Analyst Intern, Statkraft UK
Sabiha.Farzana@statkraft.com

Thank You

NESO
National Energy System Operator