Past Frequency Events

A System Operability Framework document

November 2019

nationalgridESO

Executive Summary

We at National Grid ESO control frequency by balancing electricity supply and demand. Occasionally we see a large loss of generation or demand which can cause a swing in system frequency. This report provides the brief summary of significant frequency events which has previously been provided in the System Incident report to the Grid Code Review Panel.

Background

National Grid Electricity System Operator has been providing a summary of the frequency events that cause a large Rate of Change of Frequency (RoCoF) annually to the industry, as endorsed by Grid Code Review Panel (GCRP) since 1998. The procedure was initiated in response to the concern that distributed generation protected by RoCoF protection could trip following a large generation loss. The effect of such trips could aggravate the resulting frequency change following the loss and have an adverse effect on normal frequency recovery.

National Grid ESO agreed to notify DNOs when an incident occurred which could have led to RoCoF operation; and following notification, DNOs inform National Grid of any generation tripping. The loss of mains protection is currently being changed under the Accelerated Loss of Mains Change Programme [1] to significantly reduce the risk of distributed generation tripping following the approval of DC0079 [2].

We have published this summary of the frequency events of 2018 and 2019 so far as part of the System Operability Framework. We have done this because we think it's valuable for the electricity industry and interested parties to know how the electricity system performs, in recognition of the increased interest in electricity system performance as it evolves to a low carbon form.

The summary contains events with a sudden generation or demand loss, resulting significant RoCoF and frequency deviated outside the operational limits between 50.2Hz and 49.8Hz. Figure 1 shows typical frequency traces with system imbalance.

The previous document submitted to GCRP can be found on the Grid Code website [3].

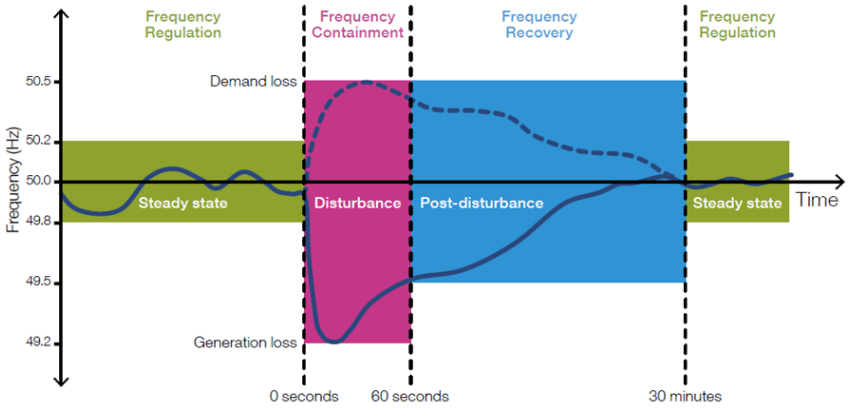

Figure 1: Illustrative frequency traces of system imbalance

Case Study

09-08-2019 Frequency event

On Friday 9 August 2019, a series of events occurred on the transmission network, which at the time was operating as normal. The rare and highly unusual set of circumstances caused frequency to reach 49.1Hz at 16:52:58 and 48.8Hz at 16:53:49 as shown in Figure 2 and Low Frequency Demand Disconnection was deployed to arrest the frequency fall. The largest RoCoF observed during the event was -0.15Hz/s. The disconnection of demand along with the actions of the ESO Control Room to dispatch additional generation returned the system to a normal stable state at 50Hz at 16:57. The detailed description and full technical report can be found on our website [4].

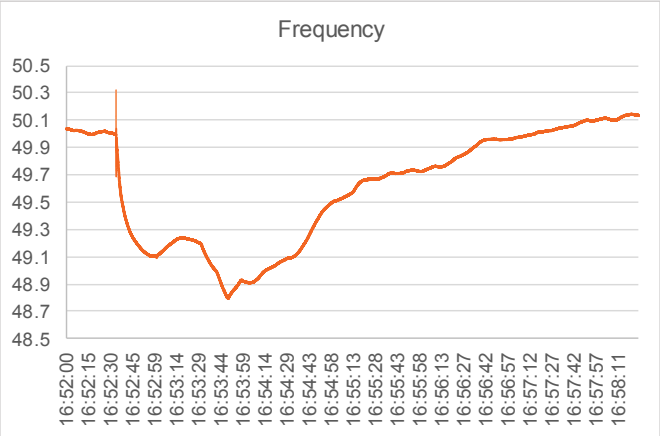

Figure 2: 09-08-2019 Frequency event

09-05-2019 NEMO interconnector trip event

NEMO interconnector tripped at 12:11 on 9 May 2019 when importing 999MW from Belgium. Largest RoCoF was -0.08Hz/s and frequency nadir reached 49.55Hz, as shown in Figure 3. Frequency returned within operational limits within two minutes at 12:13.

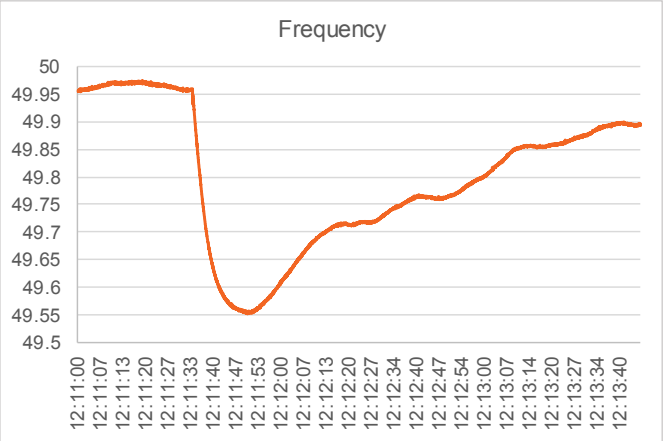

Figure 3: 09-05-2019 NEMO interconnector trip event

21-03-2019 Dinorwig trip event

Dinorwig tripped at 04:41 on 21 March 2019 while pumping and consuming approximately 1060MW demand. Largest RoCoF was 0.124Hz/s and the frequency rapidly rose to 50.28Hz, as shown in Figure 4.

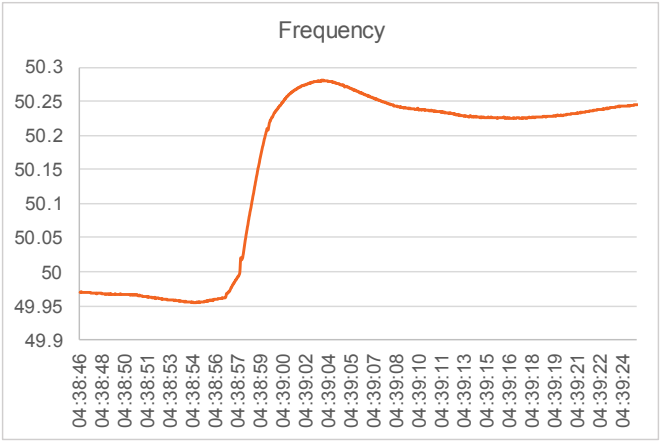

Figure 4: 21-03-2019 Dinorwig trip event

Past frequency event data

Table 1 lists the significant frequency events* occurred in 2018 and 2019 so far.

Table 1: Frequency Events 2018-2019

Date	Time	Loss (MW)	RoCoF (Hz/s)	Starting Frequency (Hz)	Demand (GW)	Min/Max Frequency (Hz)	Event
06-Jan-18	02:34	560	0.048	49.95	28	50.28	Dinorwig
23-Feb-18	03:31	-1000	-0.110	49.98	29	49.62	IFA Bipole 2
07-Mar-18	12:04	-1000	-0.066	50.08	39	49.68	IFA Bipole 2
20-Apr-18	20:58	-500	-0.043	49.99	33	49.70	IFA Bipole 2
01-May-18	11:24	-630	-0.057	50.00	30	49.73	Torness
01-Jun-18	10:03	-1000	-0.082	50.10	33	49.68	IFA Bipole 2
04-Jul-18	00:32	-600	-0.066	50.00	22	49.70	Torness
11-Oct-18	16:57	-780	-0.069	50.01	34	49.69	IFA Bipole 2
11-Oct-18	19:48	-800	-0.067	50.05	35	49.60	IFA Bipole 2
30-Oct-18	06:18	-775	-0.028	49.90	32	49.69	Seabank
21-Nov-18	09:02	798	0.058	49.79	42	50.23	IFA Bipole 2
21-Nov-18	09:44	700	0.050	50.02	42	50.24	IFA Bipole 1
03-Jan-19	12:17	-725	-0.036	49.90	42	49.62	Keadby
11-Jan-19	11:56	1040	0.066	49.97	42	50.35	NEMO
20-Feb-19	17:46	-760	-0.052	49.90	41	49.61	Saltend
21-Mar-19	04:41	1060	0.124	49.96	23	50.30	Dinorwig
18-Apr-19	14:15	-1000	-0.104	49.96	27	49.61	IFA Bipole 1
09-May-19	12:12	-999	-0.078	49.97	33	49.55	NEMO
31-May-19	14:19	-950	-0.120	50.10	27	49.62	IFA Bipole 1
12-Jun-19	18:44	-1000	-0.086	50.00	35	49.63	IFA Bipole 2
20-Jun-19	15:58	-1235	-0.068	50.00	28	49.52	West Burton 'B'
01-Jul-19	08:27	-1000	-0.120	50.04	28	49.61	NEMO
03-Jul-19	07:15	-1000	-0.094	50.08	29	49.63	IFA Bipole 1
04-Jul-19	12:16	-620	-0.061	50.02	27	49.70	Drax
11-Jul-19	08:53	-1160	-0.073	50.02	31	49.58	Peterhead
21-Jul-19	23:08	1002	0.110	49.98	22	50.34	IFA Bipole 1
24-Jul-19	12:09	-390	-0.024	49.92	30	49.68	Spalding
09-Aug-19	16:52	-1878	-0.150	50	29	48.80	Series of events
12-Aug-19	21:42	-645	-0.057	49.93	30	49.70	Heysham
30-Aug-19	14:47	-650	-0.122	49.93	25	49.65	WHVDC
03-Oct-19	18:02	-790	-0.028	49.96	37	49.64	Spalding
07-Oct-19	16:48	-827	-0.081	49.94	37	49.64	Staythorpe
22-Oct-19	19:37	-880	-0.031	50.08	39	49.68	Spalding

*This table lists events that cause a significant RoCoF and meet either of the following criteria:

1) Frequency deviated outside operational limits (49.8-50.2Hz) for more than 5 minutes.
2) Frequency deviated outside 49.7-50.3Hz for any period.
3) Loss of generation or in-feed of 1000MW or more.

Conclusions

In this report, we have summarised a table consisting of the frequency events in 2018 and 2019 so far. We aim to annually publish the significant frequency events to share the knowledge of system behaviours with the wider industry. This can help facilitate the development of new market products and services to mitigate the risks that we are facing when operating the system.

References

[1] http://www.energynetworks.org/electricity/engineering/accelerated-loss-of-mains-change-programme.html

[2] https://www.ofgem.gov.uk/publications-and-updates/distribution-code-dc0079-frequency-changes-during-large-disturbances-and-their-impact-total-system-phase-4-dcrp1808

[3] https://www.nationalgrideso.com/codes/grid-code/meetings/grid-code-panel-meeting-22-february-2018

[4] https://www.nationalgrideso.com/information-about-great-britains-energy-system-and-electricity-system-operator-eso

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nationalgrideso.com/insights/system-operability-framework-sof