

## **Grid Code Review Panel**

### **Summary Report for Significant System Events**

By National Grid

#### **1 Introduction**

- 1.1 This Significant System event report fulfils the requirement to provide a summary of the Rate of Change of Frequency (RoCoF) information, as endorsed by GCRP 00/16 (September 2000).
- 1.2 Generation / Demand trips which caused a RoCoF event and severe system disturbances are reported.

#### **2 Background**

- 2.1 The present ROCOF reporting procedure has been in place since May 1998 and was agreed by Panel representatives.
- 2.2 The procedure was initiated in response to National Grid's concern that distributed generation protected by Rate of Change of Frequency (RoCoF) protection could trip following a large generation loss. The effect of such RoCoF trips could aggravate the resulting frequency change following the loss and have an adverse effect on normal frequency recovery.
- 2.3 In order to increase the knowledge of the behaviour of this RoCoF based protection and the risk it may present to the system:
  - National Grid 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.
- 2.4 The procedure is triggered for generation losses of 1000 MW or more, demand losses of 1000 MW or more. Information on smaller significant losses is also presented in this report.
- 2.5 Issues relating to RoCoF driven Loss of Mains Protection are currently being considered by the GC0079 Workgroup, following on from the completion of GC0035. Consideration of RoCoF Withstand issues is now included within the current GC0087 terms of reference, 1Hz/S for new generators has been recommended by workgroup and the work will go out for consultation shortly.

#### **3 Summary of Incidents**

- 3.1 New information on 9 incidents in the period from December 2015 through to the end of November 2016 is presented in this report. The maximum deviation of RoCoF,  $-0.1116$  Hz/s, was driven by the IFA Bipole 2 trip on 20 Nov 2016. There were 2 events in which generation loss reports were received from Distribution Network Operators (DNOs).

#### **4 Three Phase to Earth Faults**

- 4.1 When the previous Significant System Event report was presented, the Panel asked for an update on the occurrence of Three Phase to Earth faults on the National Electricity Transmission System. A review of primary system faults back to 2006 highlighted three unrelated incidents in 2006 (May, June and September). No further events were recorded in the data available.

#### **5 Recommendations**

- 5.1 Members of the Grid Code Review Panel are invited to:
- Note the contents of this report.

## PREVIOUS INCIDENTS

Inc Date	Inc Time	Size Loss	RoCoF	Generation Lost (MW)	Max Freq reached	LOSS
18-May-98	09:53			0	0	
19-May-98	09:05	635		0	49.694	Scots 635MW
27-May-98	11:28			0	49.76	
30-May-98	02:06			0	49.72	
20-Jun-98	14:26	1000		18	49.675	Bipole 1 1000MW
29-Jun-98	05:03	410		0	49.77	Scots 410MW
02-Jul-98	11:59	1100		0	49.69	Heysham 1 550MW followed by Heysham 2 550MW four minutes later
04-Jul-98	08:32	600		0	49.77	Hartlepool 2 600MW
29-Jul-98	15:27	550	0.0395	0	49.74	Heysham 1 550MW
31-Jul-98	16:27		0.0485	0	49.75	
07-Aug-98	18:06	645	0.0372	0	49.8	Drax 1 645 MW
17-Aug-98	18:52		0.0275	10	49.7	
07-Oct-98	00:38	660	0.055	0	49.79	Connahs Quay 660MW
09-Oct-98	11:11	1090	0.035	0	49.84	Hartlepool 610MW followed by Fiddlers Ferry 480MW one minute later
17-Oct-98	08:55	650	0.026	0	49.86	Didcot6 650MW
17-Oct-98	09:57	1000	0.069	0	49.637	Bipole 2 1000MW
27-Oct-98	11:50	1000	0.056	19	49.65	Bipole 1 1000MW
14-Nov-98	11:26	1000	0.063	0	49.677	Bipole 1 1000MW
27-Nov-98	11:02	637	0.085	0	49.78	Teesside 637MW
27-Nov-98	16:57	1095	0.05	0	49.71	Teesside 1 490MW, Teesside 2 605MW instantaneous
28-Nov-98	11:16	680	0.018	0	49.73	DIDC B6 680MW
05-Dec-98	10:56	1000	0.059	0	49.7	BIPOLE 2 1000MW
19-Dec-98	20:29	1000	0.05	0	49.83	BIPOLE 1 1000MW
27-Dec-98	00:21	580	0.085	15	49.7	Heysham 1 580MW
27-Dec-98	07:30	1100	0.05	2	49.83	Hunterston 1100MW
02-Jan-99	05:05	1000	0.078	0	49.65	BIPOLE 2 1000MW
31-Jan-99	16:54	600	0.016	0	49.76	Seabank 600MW
14-Feb-99	00:38	100	0.037	0	49.75	Unknown
16-Feb-99	18:58	1000	0.049	0	49.745	Bipole 2 1000MW
21-Feb-99	11:52	1000	0.063	0	49.71	Bipole 2 1000MW
15-Mar-99	12:19	720	0.026	0	49.795	Keadby 720MW
27-Apr-99	13:48	310	0.025	0	49.75	Drakelow 12 310MW
09-Jun-99	21:47	650	0.034	0	49.792	Heysham 28 650MW
19-Jun-99	12:24	600	0.041	0	49.8	Hartlepool 1 600MW
28-Jun-99	12:30	640	0.046	0	49.85	Hinkley 7 640MW
03-Jul-99	03:32	735	0.049	0	49.71	Sutton Bridge 735MW
26-Jul-99	15:55	595	0.042	0	49.71	Sizewell B1 595MW
26-Jul-99	15:57	593	0.042	0	49.66	Sizewell B2 593MW
14-Aug-99	06:51	1188	0.05	12	49.744	Sizewell B 1 & 2 1188MW
14-Dec-99	22:54	650	0.035	0	49.719	Hinkley Point B 7 650MW
04-Jan-00	19:11	650	0.039	0	49.709	Drax 6 650MW
18-May-00	20:38	1200	0.075	22	49.654	Sizewell B 1 & 2 1200MW
03-Jun-00	09:01	1140	0.025	0	49.744	Heysham 1140MW
29-Jun-00	15:46	1000	0.06	0	49.617	Bipole 1000MW

Inc Date	Inc Time	Size Loss	RoCoF	Generation Lost (MW)	Max Freq reached	LOSS
08-Jul-00	15:54	990	0.044	0	49.7	Bipole 990 MW
29-Jul-00	13:55	1000	0.037	0	49.694	Bipole 1000 MW
06-Dec-00	13:44	1260	0.0725	0	49.684	1260MW Sizewell B
05-Jan-01	08:26	1150	0.0475	0	49.632	1150 MW Saltend
10-Jan-01	05:09	1260	0.0755	0	49.709	1260MW Sizewell B
16-Jan-01	02:29	1170	0.06	0	49.65	1170MW Saltend
12-Mar-01	05:36	1100	0.0195	0	49.733	1100MW Longannet
30-Apr-01	11:56	1140	0.04	2	49.731	1140MW Saltend
13-Jun-01	17:53	930	0.011	0	49.728	930MW Connahs Quay
29-Jun-01	11:56	925	0.0235	0	49.799	925MW Connahs Quay
25-Aug-01	14:19	1000	0.0575	0	49.726	Bipole
26-Aug-01	16:51	1000	0.0575	0	49.709	Bipole
16-Oct-01	06:08	1174	0.0675	0	49.735	Sizewell B
22-Jun-02	17:14	1170	0.0865	6	49.598	Sizewell B
09-Jul-02	06:29	1045	0.0465	2	49.62	Peterhead
19-Oct-02	07:11	1200	0.0705	0	49.684	Sizewell B 1200MW
21-Oct-02	08:13	1300	0.037	0	49.667	Peterhead 1300MW
26-May-03	01:36	1175	0.095	54	49.418	Sizewell B 1175MW
17-Jul-03	11:20	1100	0.0565	10	49.633	Saltend 1, 2 & 3
09-Oct-03	10:25	-1000	0.02	0	50.219	System Event
11-Oct-03	09:05	1000	0.056	0	49.676	Loss of Peterhead 1050MW
24-Apr-04	12:52	1000	0.049	0	49.695	Loss of Peterhead 980MW
15-Apr-05	14:44	-		0	0	3 phase fault
19-Apr-05	19:05	1050	0.0045	0	49.676	Loss of Peterhead 1050 MW
21-May-05	05:52	980	0.047	2.3	49.695	Loss of Peterhead 980 MW ,
04-Sep-05	11:50	1110	0.0255	0	49.661	Loss of Peterhead 1110MW
04-Oct-05	13:43	1122	0.0405	3	49.59	Loss of Peterhead 1122MW
02-Dec-05	22:48	1000	0.0205	0	49.751	Loss of Bipole 2 1000MW
10-Jan-06	18:17	966	0.055	0	49.685	Loss of all units at Wylfa 966MW
21-May-06	00:16			0	-	Elstree-Watford South 1 3 phase fault
22-May-06	15:45	1000	0.0565	0	49.632	Loss of Bipole 1 of 1000MW
08-Sep-06	21:29		0	0	0	3 phase fault at Lackenby
06-Oct-07	07:52	1000	0.0035	0	49.74	1000MW loss on Bipole 2
09-Feb-08	12:34	1000	0.0575	0	49.71	1000MW loss on Bipole 2
9-Mar-08	03:22	1050	0.0475	0	49.68	Loss of Peterhead 1050MW
21-May-08	11:40	1000	0.045	0	49.679	1000 MW loss of Bipole 2
27-May-08	11:36	1582	0.073	406.2	48.795	350 MW loss of Longannet followed by 1237 MW Sizewell B
19-Jul-08	01:02	1000	0.058	0	49.656	1000 MW loss of Bipole 2
03-Sep-08	09:47	1100	0.056	9	49.68	Lon gannet Intertrip Operated
08-Nov-08	22:07	1184	0.0695	10.9	49.625	Loss of SIZE-B (Circuit breaker opened at SIZB-1)
29-Jan-09	12:29	1190	0.052	0	49.606	Both Sizewell B units tripped
22-Feb-09	07:02	1000	0.0545	0	49.749	Bipole tripped via High frequency relay resulting in loss of 1000MW
09-Jan-10	01:51	1000	-0.0425	0	50.361	Bipole 2 tripped whilst at 1000MW GB to France
19-Apr-11	08:41	1175	0.0705	0	49.667	PEHE-1 Tripped
23-May-11	19:07	763	1.35	400 estimate	52.17 in islanded group	Multiple circuit trips and loss of supply to Inverness and Western Isles group during high winds.

Inc Date	Inc Time	Size Loss	RoCoF	Generation Lost (MW)	Max Freq reached	LOSS
08-Aug-11	00:28	1000	0.0695	103	49.696	IFA Bipole 2 tripped (1000MW F to GB), DINO-4 pump LF operated at 49.75Hz (275MW), .Alcan LF operated at 49.70Hz (307MW)
02-Mar-12	20:14	1260	0.064	0	49.641	Sizewell B tripped
14-Mar-12	15:10	1000	0.0475	0	49.528	PEHE-1 tripped
18-Jul-12	17:10	1200	0.0825	0	49.597	SIZEB-1 and 2 tripped from 1200MW. A total of 215MW of OCGTs started via LF relays set to 49.6Hz
25-Jul-12	12:50	1000	0.058	0	49.619	IFA Bipole 2 tripped from 1000MW, Frequency recovered by FFR+Dino SG LF125
28-Sep-12	02:48	1000	0.1075	200	49.706	IFA Bipole 2 tripped from 1000MW, Frequency recovered by LF and SP instructions on DINO/CRUA Gen on FOYE-1
30-Sep-12	15:03	1000	0.0875	134	49.615	Sellindge Bipole 2 trip
22-Feb-13	19:33	1000	0.0587	0	49.718	Sellindge Bipole 1 trip
08-May-13	18:24	980	0.0583	0	49.739	BRITNED Trip
31-May-13	08:27	1000	0.1093	0	49.607	Sellindge Bipole 1 trip

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Inc Date	Inc Time	Size Loss	Generation Lost (MW)	RoCoF (Hz/s)				Residual H equivalent	Max Freq reached	LOSS
				Over 2 Seconds	Max over 500ms	Min Over 500ms	Range			
29-Jan-09	12:39	1190	0	0.052					49.606	Both Sizewell B units tripped
22-Feb-09	07:02	1000	0	0.0545					49.749	Bipole tripped via High frequency relay resulting in loss of 1000MW
09-Jan-10	01:51	1000	0	-0.0425					50.361	51 Bipole 2 tripped whilst at 1000MW GB to France
10-May-10	11:50	570			-0.040	-0.040	0.000	1.79		Longannet
10-Jun-10	09:13	720			-0.062	-0.062	0.000	1.71		Peterhead
03-Oct-10	22:51	550			-0.050	-0.050	0.000	1.75		Peterhead
19-Apr-11	08:41	1175	0	0.0705					49.667	PEHE-1 Tripped
23-May-11	19:07	763	400 estimate	1.35					52.17 in islanded group	Multiple circuit trips and loss of supply to Inverness and Western Isles group during high winds.
08-Aug-11	00:28	1000	103	0.0695	-0.139	-0.103	0.036	1.99	49.696	IFA Bipole 2 tripped (1000MW F to GB), DINO-4 pump LF operated at 49.75Hz (275MW), .Alcan LF operated at 49.70Hz (307MW),
02-Mar-12	20:14	1260	0	0.064					49.641	Sizewell B tripped
14-Mar-12	15:10	1000	0	0.0475					49.528	PEHE-1 tripped
22-Mar-12	03:24	1000			-0.094	-0.063	-0.031	1.86		Britned Trip
18-Jul-12	17:10	1200	0	0.0825					49.597	SIZEB-1 and 2 tripped from 1200MW. A total of 215MW of OCGTs started via LF relays set to 49.6Hz
25-Jul-12	12:50	1000	0	0.058	-0.078	-0.047	0.031	1.46	49.619	IFA Bipole 2 tripped from 1000MW, Frequency recovered by FFR+Dino SG LF125
28-Sep-12	02:48	1000			-0.168	-0.116	0.052	1.58		IFA Bipole trip
08-May-13	18:24	980	-	-	-0.085	-	-	2.02	49.74	Britned trip
31-May-13	08:25	1000	-	-	-0.047	-	-	1.68	49.603	IFA Bipole trip
18-Aug-13	07:59	1000	-	-	-0.128	-0.120	0.008	1.83	49.623	IFA Bipole trip
25-Nov-13	17:18	1000	-	-	-0.062	-0.058	0.004	1.79	49.712	IFA Bipole trip

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Inc Date	Inc Time	DoW	ToD	Size Loss	Reported Generation Lost (MW)	RoCoF (Hz/s)	Starting F (Hz)	Estimated Residual H Equivalent (s)	Demand (MW)	Min/Max Freq	Event
24-Dec-13	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-13	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-14	08:06	Sat	Day	-1000	-	-0.087	50.00	2.880	33716	49.68	IFA-Bipole 2
20-Mar-14	23:06	Thu	Night	500						50.26	Dinorwig 1 & 6 tripped while in pumping mode
16-Apr-14	20:53	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-14	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-14	09:52	Thu	Day	-1280						49.56	All 4 Staythorpe units
08-May-14	18:17	Thu	Eve	-1000			-			49.63	IFA Bipole 2
16-Oct-14	09:06	Thu	Day	-1000	-	-0.081	49.93	1.434	39793	49.56	IFA Bipole 2
09-Jan-15	15:56	Fri	Day	-830						49.70	Spalding North
13-Jan-15	02:31	Tue	Night	-285						49.80	Dinorwig moving to Spin Pump later than expected, some other events may have followed this.
05-Jun-15	14:55	Fri	Day	-950	-	-0.077	49.98	3.268	31471	49.68	IFA Bipole 2
21-Jul-15	15:28	Tue	Day	-748						49.96	IFA Bipole 2
06-Aug-16	06:21	Thu	Night	-1000	-	-0.103	50.02	3.329	24528	49.69	IFA Bipole 2
11-Nov-15	01:54	Wed	Night	-991	-	-0.119	50.00	2.921	22727	49.60	IFA Bipole
11-Jan-16	04:16	Mon	Night	1000	3	-0.0791	49.99		25000	49.64	IFA Bipole 2
09-Jun-16	17:31	Thu	Eve	1000	-	-0.0664	49.98		33970	49.59	IFA Bipole 2 due to DC differential fault on Pole4
23-Jun-16	17:02	Thu	Eve	1100	-	-0.0524	49.98		35000	49.60	SCCL-1, SCCI-2 and SCCL-3
10-Aug-16	08:59	Wed	Mor	1000	41 Estimated	-0.0708	49.95		32000	49.59	IFA Bipole 1
13-Sep-16	14:12	Tue	Mor	1000	-	-0.0712	49.97		34750	49.65	IFA Bipole 2
01-Nov-16	08:44	Tue	Mor	1000	-	-0.0591	50.04		38090	49.73	IFA Bipole2
15-Nov-16	10:34	Tue	Mor	1378	-	-0.0353	50.06		39690	49.70	Didcot B (both units 5 and 6)
16-Nov-16	13:33	Wed	Mor	-1000	-	0.1023	50.03		36400	50.31	IFA Bipole 2
20-Nov-16	09:25	Sun	Day	1000	-	-0.1116	49.91		34400	49.61	IFA Bipole 2