

## Grid Code Review Panel

**Annual Summary Report for Rate of Change of Frequency and Significant System Incidents****(1 August 2006 to 31 July 2007)**

By National Grid

**1 Introduction**

- 1.1 This report, for the period 1 August 2006 to 31 July 2007, fulfils the requirement to provide the annual summary of the Rate of Change of Frequency (RoCoF) and Significant System Incidents, as endorsed by GCRP 06/10 (July 2006). The notified RoCoF events for the period are reviewed, and consideration given to the need for continued reporting.
- 1.2 Generation / Demand trips which caused a RoCoF event and severe system disturbances are reported for the above period.
- 1.3 Attached is the record of notified RoCoF tripping incidents for the period covered by this report.

**2 Background**

- 2.1 The present reporting procedure has been in place since July 2006 and was agreed by Panel representatives.
- 2.2 The origin of the procedure follows National Grid's concern that embedded 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 protected plant and the risk it may present to the system:  
  
National Grid agreed to notify DNOs when an incident occurred likely to lead to RoCoF operation.  
  
Following notification, DNOs inform National Grid of any generation tripping.
- 2.4 Originally, the procedure was always triggered for generation losses of 550 MW or more, however this was increased to 1000 MW and above, following the initial review period of May 1998 – July 1999.
- 2.5 Principally due to changes in French Interconnector behaviour, demand losses of 1000 MW or more are now also included. Following GCRP discussions, any major transmission system event (Significant System Incident) that is likely to cause the potential loss of embedded generation, such as three phase faults, are also covered by this report.
- 2.6 National Grid will also notify DNOs on those occasions when a generation/demand loss of less than 1000 MW has caused a frequency change which has the potential to initiate a RoCoF event.

### **3 Summary of notified events during the period of review**

- 3.1 Participants have provided the necessary information to National Grid following notification, including nil returns.
- 3.2 Appendix 1 provides details of each notified incident i.e. a generation / demand trip of at least 900 MW or more occurred which caused a RoCoF event or a Significant System Incident. A summary of any reported embedded generation trips subsequently reported to National Grid is also included.
- 3.3 During the period there have been no large demand or generation losses which could have led to a RoCoF event.
- 3.4 A Significant System Incident (three-phase fault) occurred at Lackenby on 8<sup>th</sup> September 2006. There was neither frequency deviation nor any RoCoF trips. However coincidentally an auxiliary (non BMU) generator tripped at Teeside Power Station, and Silverlink (Tynemouth 11kV) reported an interruption co-incident with trip

### **4 Summary of reports 1998 to July 2006**

- 4.1 A summary of incidents is included in Appendix 2. To date there have been 41 incidents where 1000 MW or more of generation was lost. Of these, 11 resulted in the loss of embedded generation.
- 4.2 Rates of change of frequency observed in this period range from -0.0045 to -0.0950 Hz/s
- 4.3 Embedded generation was lost for rates of change ranging from -0.0275 to -0.0950Hz/s.
- 4.4 The most embedded generation lost as a result of a large loss was 54 MW on the 26<sup>th</sup> May 2003. This was an 1175 MW loss that caused a rate of change of -0.095 Hz/s.
- 4.5 Losses of embedded generation during normal system operation have occasionally been reported in the course of normal operational contact.

### **5 Conclusions from the period reported**

- 5.1 This last twelve months there have been no large demand or generation losses which could have led to a RoCoF event.
- 5.2 There has been one Significant System Incident but there were not reports of embedded generation tripping.
- 5.3 As there has been no large demand or generation losses during this reporting period the conclusion drawn from previous years evidence remains. ROCOF operation following large losses is not significant for the rates of change of frequency experienced during normal operations and represents little risk to the system.

However, as few events have given rise to high rates of change of frequency, the effects of higher rates of change remain unknown.

- 5.4 BETTA may have altered the pattern of large generation losses or RoCoF operation, as two of the incidents were caused by generation trips in Scotland. However, it is now not uncommon for the French Interconnector to export power and so demand losses of 1000 MW or over, have been included in this report.
- 5.5 Normal operational contact has revealed occasions when embedded generation has tripped. It is not clear if these are consistently reported. However had there been a more onerous event we would see the effects on the National Grid system.

## **6 Recommendations**

- 6.1 Members of the Grid Code Review Panel are invited to :-
- i) Provide comments on the contents of this report.
  - ii) Note the summary of incidents of potential embedded generation trips (Appendix 1) was sent to all DNOs on 07<sup>th</sup> September 2007.
  - iii) Discuss the benefits of continuing the reporting requirements based on the evidence presented above, giving due consideration to the future impact of increasing levels of renewable and embedded generation and any known or anticipated changes in technology used in these applications.
  - iv) Note that National Grid will continue to take interest in any ROCOF operation, which is notified, from time to time via normal operational liaison.

Appendix 1  
INCIDENTS OF POTENTIAL EMBEDDED GENERATION TRIPPINGS during the period 01/08/06-31/07/07

Notified incidents which were likely to lead to the tripping of embedded generation due to  
 A) the loss of 1000MW (or more) of Demand or Generation or  
 B) A significant System Event

NOTIFICATIONS RECEIVED FROM RECs AND MW LOST WHERE APPROPRIATE															RoCoF (Hz/Sec)	Loss (-)/ Gain (+) (MW)	Freq	Ref
Date	Time (Local)	Central Networks East	Central Networks West	EDF ENERGY	NEDL	SSE	SSE		SP Power Systems		UU	WPD	WPD Wales	YEDL				
							E&W	SCO (SHETL)	E&W	SCO								
08/09/2006	21:29:00	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	0.008	-	50.027	0

- Notes:-  
 1) RoCoF is calculated by taking the frequency at the time of disturbance, then two seconds later and dividing the difference by two  
 2) The sign convention denotes an increase in frequency if positive and a decrease in frequency if negative.

APPENDIX 2  
SUMMARY OF PREVIOUS INCIDENTS

Inc Date	Inc Time	Size Loss	RoCoF	Generation Lost (MW)	Max Freq reached	LOSS
18-May-98	9:53:00			0		
19-May-98	9:05:00	635		0	49.694	SCOTS 635MW instantaneous
27-May-98	11:28:00			0	49.76	
30-May-98	2:06:00			0	49.72	
20-Jun-98	14:26:00	1000		18	49.675	BIPOLE 1 1000MW instantaneous
29-Jun-98	5:03:00	410		0	49.77	SCOTS 410MW instantaneous
02-Jul-98	11:59:00	1100		0	49.69	1155 HEYS 1 550, 1159 HEYS 2 550 instantaneous
04-Jul-98	8:32:00	600		0	49.77	HATL 2 600 instantaneous
29-Jul-98	15:27:00	550	0.0395	0	49.74	HEYS 1 550 instantaneous
31-Jul-98	16:27:00		0.0485	0	49.75	
07-Aug-98	18:06:00	645	0.0372	0	49.8	DRAX 1 645 instantaneous
17-Aug-98	18:52:00		0.0275	10	49.7	
07-Oct-98	0:38:00	660	0.0550	0	49.79	CONQ3 and CONQ4 660 instantaneous
09-Oct-98	11:11:00	1090	0.0350	0	49.84	11:11 HRTL2 610 instantaneous, 11:12 FIDF1 480 loss
17-Oct-98	8:55:00	650	0.0260	0	49.86	DIDC6 650 instantaneous
17-Oct-98	9:57:00	1000	0.0690	0	49.637	BIPOLE 2 1000MW instantaneous
27-Oct-98	11:50:00	1000	0.0560	19	49.65	BIPOLE 1 1000MW instantaneous
14-Nov-98	11:26:00	1000	0.0630	0	49.677	BIPOLE 1 1000MW instantaneous
27-Nov-98	11:02:00	637	0.0850	0	49.78	Greystones 1=165,3=157,6=156,8=159 instantaneous
27-Nov-98	16:57:00	1095	0.0500	0	49.71	TESI 1 490MW, TESI 2 605MW instantaneous
28-Nov-98	11:16:00	680	0.0180	0	49.73	DIDC B6 680MW instantaneous
05-Dec-98	10:56:00	1000	0.0590	0	49.7	BIPOLE 2 1000MW instantaneous
19-Dec-98	20:29:00	1000	0.0500	0	49.83	BIPOLE 1 1000MW instantaneous
27-Dec-98	0:21:00	580	0.0850	15	49.7	Heysham 1 580MW instantaneous
27-Dec-98	7:30:00	1100	0.0500	2	49.83	Hunterston 1100MW instantaneous
02-Jan-99	5:05:00	1000	0.0780	0	49.65	BIPOLE 2 1000MW instantaneous
31-Jan-99	16:54:00	600	0.0160	0	49.76	Seabank 600MW instantaneous
14-Feb-99	0:38:00	100	0.0370	0	49.75	Unknown (no breakers opened on EMS at this time)
16-Feb-99	18:58:00	1000	0.0490	0	49.745	Bipole 2 1000MW instantaneous
21-Feb-99	11:52:00	1000	0.0630	0	49.71	Bipole 2 1000MW instantaneous
15-Mar-99	12:19:00	720	0.0260	0	49.795	Keadby 720MW instantaneous
27-Apr-99	13:48:00	310	0.0250	0	49.75	Drakelow 12 310MW instantaneous
09-Jun-99	21:47:00	650	0.0340	0	49.792	Heysham 28 650MW instantaneous
19-Jun-99	12:24:00	600	0.0410	0	49.8	Hartlepool 1 600MW instantaneous
28-Jun-99	12:30:00	640	0.0460	0	49.85	Hinkley 7 640MW instantaneous
03-Jul-99	3:32:00	735	0.0490	0	49.71	Sutton Bridge 735MW instantaneous
26-Jul-99	15:55:00	595	0.0420	0	49.71	Sizewell B1 tripped 595MW instantaneous
26-Jul-99	15:57:00	593	0.0420	0	49.66	Sizewell B2 tripped 593MW instantaneous
14-Aug-99	6:51:00	1188	0.0500	12	49.744	Sizewell B 1 & 2 tripped 1188MW instantaneous
14-Dec-99	22:54:00	650	0.0350	0	49.719	Hinkley Point B 7 650MW instantaneous
04-Jan-00	19:11:00	650	0.0390	0	49.709	Drax 6 650MW instantaneous
18-May-00	20:38:00	1200	0.0750	22	49.654	Sizewell B 1 & 2 tripped 1200MW instantaneous
03-Jun-00	9:01:00	1140	0.0250	0	49.744	HEYM11 & HEYM12 tripped within one second of each other. 1140MW
29-Jun-00	15:46:00	1000	0.0600	0	49.617	FREX 1000MW instantaneous
08-Jul-00	15:54:00	990	0.0440	0	49.7	FREX 990 MW

Inc Date	Inc Time	Size Loss	RoCoF	Generation Lost (MW)	Max Freq reached	LOSS
29-Jul-00	13:55:00	1000	0.0370	0	49.694	Bipole 1000 MW
06-Dec-00	13:44:00	1260	0.0725	0	49.684	1260MW SIZEWELL B
05-Jan-01	8:26:00	1150	0.0475	0	49.632	1150 MW SALTEND
10-Jan-01	5:09:00	1260	0.0755	0	49.709	1260MW SIZEWELL B
16-Jan-01	2:29:00	1170	0.0600	0	49.65	1170MW SALTEND
12-Mar-01	5:36:00	1100	0.0195	0	49.733	1100MW Longannet
30-Apr-01	11:56:00	1140	0.0400	2	49.731	1140MW Saltend
13-Jun-01	17:53:00	930	0.0110	0	49.728	930MW Connahs Quay
29-Jun-01	11:56:00	925	0.0235	0	49.799	925MW Connahs Quay
25-Aug-01	14:19:00	1000	0.0575	0	49.726	Bipole
26-Aug-01	16:51:00	1000	0.0575	0	49.709	Bipole
16-Oct-01	6:08:00	1174	0.0675	0	49.735	SIZB1 & 2
22-Jun-02	17:14:00	1170	0.0865	6	49.598	SIZB1 & 2
09-Jul-02	6:29:00	1045	0.0465	2	49.62	Peterhead
19-Oct-02	7:11:00	1200	0.0705	0	49.684	Sizewell B 1200MW
21-Oct-02	8:13:00	1300	0.0370	0	49.667	Peterhead 1300MW
26-May-03	1:36:00	1175	0.0950	54	49.418	Sizewell B 1175MW
17-Jul-03	11:20:00	1100	0.0565	10	49.633	Saltend 1, 2 & 3
<b>09-Oct-03</b>	<b>10:25:00</b>	<b>-1000</b>	<b>0.0200</b>	<b>0</b>	<b>50.219</b>	System Event
11-Oct-03	9:05:00	1000	0.0560	0	49.676	Loss of Peterhead 1050MW
24-Apr-04	12:52:00	1000	0.0490	0	49.695	Loss of Peterhead 980
15-Apr-05	14:44:00	-		0	0	3 phase fault no RoCoF
19-Apr-05	19:05:00	1050	0.0045	0	49.676	Loss of Peterhead 1 doing 1050 MW
21-May-05	5:52:00	980	0.0470	2.3	49.695	Loss of Peterhead 980 MW ,
04-Sep-05	11:50:01	1110	0.0255	0	49.661	loss of Peterhead 1110MW - interesting trace PEHE fell off in intervals
04-Oct-05	13:43:00	1122	0.0405	3	49.59	Loss of Peterhead over 30 secs
02-Dec-05	22:48:00	1000	0.0205	0	49.751	Loss of Bipole 2 1000Mw's Frequency report 264 refers
10-Jan-06	18:17:00	966	0.0055	0	49.685	Loss of All units at Wylfa approx. 966MW lost instantaneously
21-May-06	0:16:00	-		0	-	Elstree-Watford South 1 3 phase fault
22-May-06	15:45:00	1000	0.0565	0	49.632	Loss of Bipole 1 infeed of 1000MW frequency report 277
08-Sep-06	21:29:00	-	0.0000	0	0	3 phase fault at Lackenby

NB the incident on 9<sup>th</sup> October 2003 was due to a Bipole trip whilst exporting to France. Hence the Size of Loss is shown here to be negative.