Paper GCRP 05/22
9 September 2005

Grid Code Review Panel

Annual Summary Report for Significant System Events (1 August 2004 to 31 July 2005) by Pavinder Kaur Babra

1 Introduction

1.1 This report, for the period 1 August 2004 to 31 July 2005, fulfils the requirement to provide the annual summary of the Rate of Change of Frequency (ROCOF) information, as endorsed by GCRP 00/16 (September 2000). The notified ROCOF events for the period are reviewed, and consideration given to the need for continued reporting.

1.2 Generation trips of 1000 MW or more are reported for the above period. In addition this year, demand trips of 1000 MW or more and severe system disturbances have also been included.

1.3 Attached is the record of notified ROCOF tripping incidents for the previous 12 month period.

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 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 triggered for generation losses of 550 MW or more, however this was changed 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. No demand losses of this magnitude have occurred during previous reporting periods. Following GCRP discussions, any major transmission system event that is likely to cause the potential loss of embedded generation, such as three phase faults, are also covered by this report.

Updated to add min/max frequency level reached after event in Appendix 1, 1st October 2004

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 where a generation / demand trip of 1000 MW or more occurred, together with a summary of any reported embedded generation trips subsequently reported to National Grid.

3.3 During the period there have been two large generation losses, meeting the agreed reporting criteria, one of 1050MW the other of 980MW. There was one occurrence of a Serious System Event that met the new criteria. The last incident may have caused 2.3 MW of generation to trip in the SSE area.

3.4 For these events, the rate of change of frequency, calculated over a two second period, was –0.0045 to –0.047

4 Summary of reports 1998 to July 2003

4.1 A summary of incidents is included in Appendix 2. Since reporting began there have been 37 incidents where 1000 MW or more of generation was lost. Of these, ten resulted in the loss of embedded generation.

4.2 Rates of change of frequency observed in this period range from -0.095 to 0.02Hz/s.

4.3 Embedded generation was lost for rates of change ranging from -0.04 to -0.095 Hz/s.

4.4 The most embedded generation lost as a result of a large loss was 54 MW on the 26th 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.

4.6 The largest loss of embedded generation during routine operation was on the 28th April 2001 when 48 MW was lost co-incident with switching.

5 Conclusions from the period reported

5.1 This last twelve months have generally been consistent with previous experience.

5.2 The evidence from this year's review period supports the conclusion of last year, that 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, few events have given rise to high rates of change of frequency. As reported last year, the effects of higher rates of change remain unknown.

5.3 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.

5.4 Normal operational contact has revealed occasions that embedded generation have tripped. It is not clear if these are consistently reported however none of those reported have had an adverse effect 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 possible ROCOF (Appendix 1) was sent to all DNOs on 17th August 2005

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.

INCIDENTS OF POSSIBLE RoCoF TRIPPINGS during the period 01/08/04-31/07/05

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)
Date	Time (Local)	Central Networks East	Central Networks West	EDF ENERGY	NEDL	SSE	SSE		SP Power		UU	WPD	WPD Wales	YEDL		
							E&W	SCO (SHETL)	E&W	SCO						
15/04/2005	14:44	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	N/A	System Event
19/04/2005	19:05	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	-0.0045	-1050
21/05/2005	5:52	NONE	NONE	NONE	NONE	NONE	NONE	2.3 MW	NONE	NONE	NONE	NONE	NONE	NONE	-0.047	-980

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.
3) 2.3MW reported loss at THURSO by SSE

APPENDIX 2
SUMMARY OF PREVIOUS INCIDENTS

Inc Date	Inc Time	Size Loss	RoCoF	Generation Lost MW	Max Frequency
18-May-98	09:53			0	
19-May-98	09:05	635		0	49.694
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
29-Jun-98	05:03	410		0	49.77
02-Jul-98	11:59	1100		0	49.69
04-Jul-98	08:32	600		0	49.77
29-Jul-98	15:27	-550	-0.0395	0	49.74
31-Jul-98	16:27		-0.0485	0	49.75
07-Aug-98	18:06	-645	-0.0372	0	49.8
17-Aug-98	18:52		-0.0275	10	49.7
07-Oct-98	00:38	-660	-0.055	0	49.79
09-Oct-98	11:11	-1090	-0.035	0	49.84
17-Oct-98	08:55	-650	-0.026	0	49.86
17-Oct-98	09:57	-1000	-0.069	0	49.637
27-Oct-98	11:50	-1000	-0.056	19	49.65
14-Nov-98	11:26	-1000	-0.063	0	49.677
27-Nov-98	11:02	-637	-0.085	0	49.78
27-Nov-98	16:57	-1095	-0.05	0	49.71
28-Nov-98	11:16	-680	-0.018	0	49.73
05-Dec-98	10:56	-1000	-0.059	0	49.7
19-Dec-98	20:29	-1000	-0.05	0	49.83
27-Dec-98	00:21	-580	-0.085	15	49.7
27-Dec-98	07:30	-1100	-0.05	2	49.83
02-Jan-99	05:05	-1000	-0.078	0	49.65
31-Jan-99	16:54	-600	-0.016	0	49.76
14-Feb-99	00:38	-100	-0.037	0	49.75
16-Feb-99	18:58	-1000	-0.049	0	49.745
21-Feb-99	11:52	-1000	-0.063	0	49.71
15-Mar-99	12:19	-720	-0.026	0	49.795
27-Apr-99	13:48	-310	-0.025	0	49.75
09-Jun-99	21:47	-650	-0.034	0	49.792
19-Jun-99	12:24	-600	-0.041	0	49.8
28-Jun-99	12:30	-640	-0.046	0	49.85
03-Jul-99	03:32	-735	-0.049	0	49.71
26-Jul-99	15:55	-595	-0.042	0	49.71
26-Jul-99	15:57	-593	-0.042	0	49.66
14-Aug-99	06:51	-1188	-0.05	12	49.744
14-Dec-99	22:54	-650	-0.035	0	49.719
04-Jan-00	19:11	-650	-0.039	0	49.709
18-May-00	20:38	-1200	-0.075	22	49.654
03-Jun-00	09:01	-1140	-0.025	0	49.744
29-Jun-00	15:46	-1000	-0.06	0	49.617
08-Jul-00	15:54	-990	-0.044	0	49.7
29-Jul-00	13:55	-1000	-0.037	0	49.694
06-Dec-00	13:44	-1260	-0.0725	0	49.684
05-Jan-01	08:26	-1150	-0.0475	0	49.632
10-Jan-01	05:09	-1260	-0.0755	0	49.709

Inc Date	Inc Time	Size Loss	RoCoF	Generation Lost MW	Max Frequency
16-Jan-01	02:29	-1170	-0.06	0	49.65
12-Mar-01	05:36	-1100	-0.0195	0	49.733
30-Apr-01	11:56	-1140	-0.04	2	49.731
13-Jun-01	17:53	-930	-0.011	0	49.728
29-Jun-01	11:56	-925	-0.0235	0	49.799
25-Aug-01	14:19	-1000	-0.0575	0	49.726
26-Aug-01	16:51	-1000	-0.0575	0	49.709
16-Oct-01	06:08	-1174	-0.0675	0	49.735
22-Jun-02	17:14	-1170	-0.0865	6	49.598
09-Jul-02	06:29	-1045	-0.0465	2	49.62
19-Oct-02	07:11	-1200	-0.0705	0	49.684
21-Oct-02	08:13	-1300	-0.037	0	49.667
26-May-03	01:36	-1175	-0.095	54	49.418
17-Jul-03	11:20	-1100	-0.0565	10	49.633
09-Oct-03	10:25	1000	0.02	0	50.212
11-Oct-03	09:05	-1000	-0.056	0	49.678
24-Apr-04	12:52	-1000	-0.053	0	49.697
15-Apr-05	14:44	System Event	0	0	0
19-Apr-05	19:05	-1050	-0.0045	0	49.676
21-May-05	05:52	980	-0.047	2.3	49.695