**Paper GCRP**
**15th October 2009**

**Grid Code Review Panel**

# Annual Summary Report for Significant System Events (1 August 2008 to 31 July 2009)

By National Grid

## 1 Introduction

1.1 This report, for the period 1 August 2008 to 31 July 2009, 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 / 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 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 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 The procedure was triggered for generation losses of 1000 MW or more, demand losses of 1000 MW or any major transmission system events that is likely to cause the potential loss of embedded generation, such as three phase faults, are also covered by this report.

## 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 at least 900 MW or more occurred which caused a RoCoF event, together with a summary of any reported embedded generation trips subsequently reported to National Grid.

3.3 During the period of review there were four events that met the agreed reporting criteria of which two resulted in the loss of embedded generation.

## 4 Summary of reports 1st May 1998 to 31st July 2009

4.1 A summary of incidents is included in Appendix 2. Between 1st May 1998 and 31st July 2009 there have been 51 incidents where 1000 MW or more of generation was lost. Of these, 14 resulted in the loss of embedded generation.

4.2 The most embedded generation lost as a result of large loss was 406.2 MW on the 27th May 2008. This event of 1582 MW loss due to the loss of two generators within 2 minutes of each other that caused a rate of change of frequency of 0.073 Hz/s.

4.3 Losses of embedded generation during normal system operation have occasionally been reported in the course of normal operational contact.

4.4 Rates of change of frequency observed for the period 1st August 2008 to 31st July 2009 ranging from 0.05 to 0.07 Hz/s

## 5 Conclusions from the period reported

5.1 This last twelve months have seen 4 occasions which could have given rise to a RoCoF event.

5.2 The evidence from this year's review period generally 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.

5.3 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 the effects would be seen 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 7th September 2009.

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 Possible Rocof Trippings during the Period 01/08/08-31/07/09

APPENDIX 1

**INCIDENTS OF POSSIBLE RoCoF TRIPPINGS during the period 01/08/08-31/07/09**

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 DNOs AND MW LOST WHERE APPROPRIATE | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Central Networks | | EDF ENERGY | | | CE Electric | | SSE | | SP Power Systems | | UU | WPD | | RoCoF | Loss (-)/ Gain (+) | | Start | |
| Date | Time (Local) | East | West | EPN | LPN | (SPN) | YEDL | NEDL | E&W | SCO (SHETL) | E&W | SCO | | South West | South Wales | (Hz/Sec) | (MW) | Freq | Freq | Ref |
| 03/09/2008 | 09:47:00 | None | None | None | None | None | None | None | None | 9 | None | None | None | None | None | 0.056 | -1100 | 49.68 | 50.03 | |
| 08/11/2008 | 22:07:00 | None | None | None | None | 5.2 | None | None | None | None | None | None | 5.7 | None | None | 0.0695 | -1184 | 49.625 | 49.98 | |
| 29/01/2009 | 12:39:00 | None | None | None | None | None | None | None | None | None | None | None | None | None | None | 0.052 | -1190 | 49.606 | 49.983 | |
| 22/02/2009 | 07:02:00 | None | None | None | None | None | None | None | None | None | None | None | None | None | None | 0.0545 | -1000 | 49.749 | 50.339 | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

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 generation if positive and a decrease in generation 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 | 09:53:00 | | | 0 | 0 | |
| 19-May-98 | 09:05:00 | 635 | | 0 | 49.694 | Scots 635MW |
| 27-May-98 | 11:28:00 | | | 0 | 49.76 | |
| 30-May-98 | 02:06:00 | | | 0 | 49.72 | |
| 20-Jun-98 | 14:26:00 | 1000 | | 18 | 49.675 | Bipole 1 1000MW |
| 29-Jun-98 | 05:03:00 | 410 | | 0 | 49.77 | Scots 410MW |
| 02-Jul-98 | 11:59:00 | 1100 | | 0 | 49.69 | Heysham 1 550MW followed by Heysham 2 550MW four minutes later |
| 04-Jul-98 | 08:32:00 | 600 | | 0 | 49.77 | Hartlepool 2 600MW |
| 29-Jul-98 | 15:27:00 | 550 | 0.0395 | 0 | 49.74 | Heysham 1 550MW |
| 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 MW |
| 17-Aug-98 | 18:52:00 | | 0.0275 | 10 | 49.7 | |
| 07-Oct-98 | 00:38:00 | 660 | 0.055 | 0 | 49.79 | Connahs Quay 660MW |
| 09-Oct-98 | 11:11:00 | 1090 | 0.035 | 0 | 49.84 | Hartlepool 610MW followed by Fiddlers Ferry 480MW one minute later |
| 17-Oct-98 | 08:55:00 | 650 | 0.026 | 0 | 49.86 | Didcot6 650MW |
| 17-Oct-98 | 09:57:00 | 1000 | 0.069 | 0 | 49.637 | Bipole 2 1000MW |
| 27-Oct-98 | 11:50:00 | 1000 | 0.056 | 19 | 49.65 | Bipole 1 1000MW |
| 14-Nov-98 | 11:26:00 | 1000 | 0.063 | 0 | 49.677 | Bipole 1 1000MW |
| 27-Nov-98 | 11:02:00 | 637 | 0.085 | 0 | 49.78 | Teesside 637MW |
| 27-Nov-98 | 16:57:00 | 1095 | 0.05 | 0 | 49.71 | Teesside 1 490MW, Teesside 2 605MW instantaneous |
| 28-Nov-98 | 11:16:00 | 680 | 0.018 | 0 | 49.73 | DIDC B6 680MW |
| 05-Dec-98 | 10:56:00 | 1000 | 0.059 | 0 | 49.7 | BIPOLE 2 1000MW |
| 19-Dec-98 | 20:29:00 | 1000 | 0.05 | 0 | 49.83 | BIPOLE 1 1000MW |
| 27-Dec-98 | 00:21:00 | 580 | 0.085 | 15 | 49.7 | Heysham 1 580MW |
| 27-Dec-98 | 07:30:00 | 1100 | 0.05 | 2 | 49.83 | Hunterston 1100MW |
| 02-Jan-99 | 05:05:00 | 1000 | 0.078 | 0 | 49.65 | BIPOLE 2 1000MW |
| 31-Jan-99 | 16:54:00 | 600 | 0.016 | 0 | 49.76 | Seabank 600MW |
| 14-Feb-99 | 00:38:00 | 100 | 0.037 | 0 | 49.75 | Unknown |
| 16-Feb-99 | 18:58:00 | 1000 | 0.049 | 0 | 49.745 | Bipole 2 1000MW |
| 21-Feb-99 | 11:52:00 | 1000 | 0.063 | 0 | 49.71 | Bipole 2 1000MW |
| 15-Mar-99 | 12:19:00 | 720 | 0.026 | 0 | 49.795 | Keadby 720MW |
| 27-Apr-99 | 13:48:00 | 310 | 0.025 | 0 | 49.75 | Drakelow 12 310MW |
| 09-Jun-99 | 21:47:00 | 650 | 0.034 | 0 | 49.792 | Heysham 28 650MW |
| 19-Jun-99 | 12:24:00 | 600 | 0.041 | 0 | 49.8 | Hartlepool 1 600MW |
| 28-Jun-99 | 12:30:00 | 640 | 0.046 | 0 | 49.85 | Hinkley 7 640MW |
| 03-Jul-99 | 03:32:00 | 735 | 0.049 | 0 | 49.71 | Sutton Bridge 735MW |
| 26-Jul-99 | 15:55:00 | 595 | 0.042 | 0 | 49.71 | Sizewell B1 595MW |
| 26-Jul-99 | 15:57:00 | 593 | 0.042 | 0 | 49.66 | Sizewell B2 593MW |
| 14-Aug-99 | 06:51:00 | 1188 | 0.05 | 12 | 49.744 | Sizewell B 1 & 2 1188MW |
| 14-Dec-99 | 22:54:00 | 650 | 0.035 | 0 | 49.719 | Hinkley Point B 7 650MW |
| 04-Jan-00 | 19:11:00 | 650 | 0.039 | 0 | 49.709 | Drax 6 650MW |
| 18-May-00 | 20:38:00 | 1200 | 0.075 | 22 | 49.654 | Sizewell B 1 & 2 1200MW |
| 03-Jun-00 | 09:01:00 | 1140 | 0.025 | 0 | 49.744 | Heysham 1140MW |
| 29-Jun-00 | 15:46:00 | 1000 | 0.06 | 0 | 49.617 | Bipole 1000MW |
| 08-Jul-00 | 15:54:00 | 990 | 0.044 | 0 | 49.7 | Bipole 990 MW |

| Inc Date | Inc Time | Size Loss | RoCoF | Generation Lost (MW) | Max Freq reached | LOSS |
|---|---|---|---|---|---|---|
| 29-Jul-00 | 13:55:00 | 1000 | 0.037 | 0 | 49.694 | Bipole 1000 MW |
| 06-Dec-00 | 13:44:00 | 1260 | 0.0725 | 0 | 49.684 | 1260MW Sizewell B |
| 05-Jan-01 | 08:26:00 | 1150 | 0.0475 | 0 | 49.632 | 1150 MW Saltend |
| 10-Jan-01 | 05:09:00 | 1260 | 0.0755 | 0 | 49.709 | 1260MW Sizewell B |
| 16-Jan-01 | 02:29:00 | 1170 | 0.06 | 0 | 49.65 | 1170MW Saltend |
| 12-Mar-01 | 05:36:00 | 1100 | 0.0195 | 0 | 49.733 | 1100MW Longannet |
| 30-Apr-01 | 11:56:00 | 1140 | 0.04 | 2 | 49.731 | 1140MW Saltend |
| 13-Jun-01 | 17:53:00 | 930 | 0.011 | 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 | 06:08:00 | 1174 | 0.0675 | 0 | 49.735 | Sizewell B |
| 22-Jun-02 | 17:14:00 | 1170 | 0.0865 | 6 | 49.598 | Sizewell B |
| 09-Jul-02 | 06:29:00 | 1045 | 0.0465 | 2 | 49.62 | Peterhead |
| 19-Oct-02 | 07:11:00 | 1200 | 0.0705 | 0 | 49.684 | Sizewell B 1200MW |
| 21-Oct-02 | 08:13:00 | 1300 | 0.037 | 0 | 49.667 | Peterhead 1300MW |
| 26-May-03 | 01:36:00 | 1175 | 0.095 | 54 | 49.418 | Sizewell B 1175MW |
| 17-Jul-03 | 11:20:00 | 1100 | 0.0565 | 10 | 49.633 | Saltend 1, 2 & 3 |
| 09-Oct-03 | 10:25:00 | -1000 | 0.02 | 0 | 50.219 | System Event |
| 11-Oct-03 | 09:05:00 | 1000 | 0.056 | 0 | 49.676 | Loss of Peterhead 1050MW |
| 24-Apr-04 | 12:52:00 | 1000 | 0.049 | 0 | 49.695 | Loss of Peterhead 980MW |
| 15-Apr-05 | 14:44:00 | - | | 0 | 0 | 3 phase fault |
| 19-Apr-05 | 19:05:00 | 1050 | 0.0045 | 0 | 49.676 | Loss of Peterhead 1050 MW |
| 21-May-05 | 05:52:00 | 980 | 0.047 | 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 |
| 04-Oct-05 | 13:43:00 | 1122 | 0.0405 | 3 | 49.59 | Loss of Peterhead 1122MW |
| 02-Dec-05 | 22:48:00 | 1000 | 0.0205 | 0 | 49.751 | Loss of Bipole 2 1000MW |
| 10-Jan-06 | 18:17:00 | 966 | 0.055 | 0 | 49.685 | Loss of all units at Wylfa 966MW |
| 21-May-06 | 00:16:00 | | | 0 | - | Elstree-Watford South 1 3 phase fault |
| 22-May-06 | 15:45:00 | 1000 | 0.0565 | 0 | 49.632 | Loss of Bipole 1 of 1000MW |
| 08-Sep-06 | 21:29:00 | | 0 | 0 | 0 | 3 phase fault at Lackenby |
| 06-Oct-07 | 07:52:00 | 1000 | 0.0035 | 0 | 49.74 | 1000MW loss on Bipole 2 |
| 09-Feb-08 | 12:34:00 | 1000 | 0.0575 | 0 | 49.71 | 1000MW loss on Bipole 2 |
| 9-Mar-08 | 03:22:00 | 1050 | 0.0475 | 0 | 49.68 | Loss of Peterhead 1050MW |
| 21-May-08 | 11:40:00 | 1000 | 0.045 | 0 | 49.679 | 1000 MW loss of Bipole 2 |
| 27-May-08 | 11:36:00 | 1582 | 0.073 | 406.2 | 48.795 | 350 MW loss of Longannet followed by 1237 MW Sizewell B |
| 19-Jul-08 | 01:02:00 | 1000 | 0.058 | 0 | 49.656 | 1000 MW loss of Bipole 2 |
| 03-Sep-08 | 09:47:00 | 1100 | 0.056 | 9 | 49.68 | Lon gannet Intertrip Operated |
| 08-Nov-08 | 22:07:00 | 1184 | 0.0695 | 10.9 | 49.625 | Loss of SIZE-B (Circuit breaker opened at SIZB-1) |
| 29-Jan-09 | 12:29:00 | 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 |