SCHEDULING ERROR – 3 AND 4 JULY 2011

PREPARED BY: Electricity Market Performance

DATE: 30 November 2011

FINAL

Disclaimer

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Abbreviations and Symbols

ABBREVIATION	TERM
AEMO	Australian Energy Market Operator Ltd
CA	contingency analysis
DI	dispatch interval
EMS	Energy Management System
FCAS	frequency control ancillary service
MII	manifestly incorrect input
MW	megawatt
MWh	megawatt hour
NER	National Electricity Rules
SPS	special protection scheme

Contents

1 Summary

On 3 July 2011, AEMO received indication of a number of contingency analysis (CA) violations on lines in the vicinity of the Waterloo wind farm in South Australia. After discussion with staff from the Transmission Network Service Provider ElectraNet, a constraint equation was invoked from dispatch interval (DI) ending 1410 hrs to manage the flow on the most critical of the violations, the Waterloo–Templers 132 kV line for the trip of the Robertstown–Tungkillo 275kV line.

Following an enquiry by ElectraNet on 4 July 2011, AEMO identified that a special protection scheme (SPS) at Waterloo wind farm was not modelled in CA. The SPS operates to reduce output of Waterloo in the event of an overload of lines in the Waterloo area, which removes the need for the constraint equation. The constraint equation was revoked from DI ending 1130 hrs.

The constraint equation was binding for a number of DIs during the time it was invoked, but the market impact was small.

Under clause 3.8.24(a)(3) of the National Electricity Rules AEMO has determined that a scheduling error occurred during the DIs the constraint equation was invoked.

2 Event Details

From 1335 hrs on 3 July 2011 CA violations indicated the overload of a number of lines in the vicinity of the Waterloo wind farm. The most severe of these was the overload of the Waterloo–Templers 132 kV line for the tripping of the Robertstown-Tungkillo 275 kV line. High wind generation was present at the time and the Para-Brinkworth 275 kV line, which is parallel to the Waterloo–Templers 132 kV line, was out of service from 0937 hrs for planned work. The outage contributed to the CA violations as there was no constraint set associated with the work.

AEMO created an automated constraint equation CA_MQS_3D227641[1] to manage the post contingent loading on the Waterloo–Templers 132 kV line. The constraint equation was invoked from DI ending 1410 hrs on 3 July 2011 and all CA violations were cleared for the subsequent CA runs. No advice was received from Electranet at the time to suggest that the constraint equation was not required due to the presence of the control scheme. However, Electranet had provided AEMO with this advice prior to 3 July 2011.

The constraint equation could have affected generation output in the York Peninsula and the mid-north of South Australia during the time it was binding. Figure 1 is a simplified single line diagram of the area.

[1] Refer to Appendix 5.1 for the formulation of the constraint equations

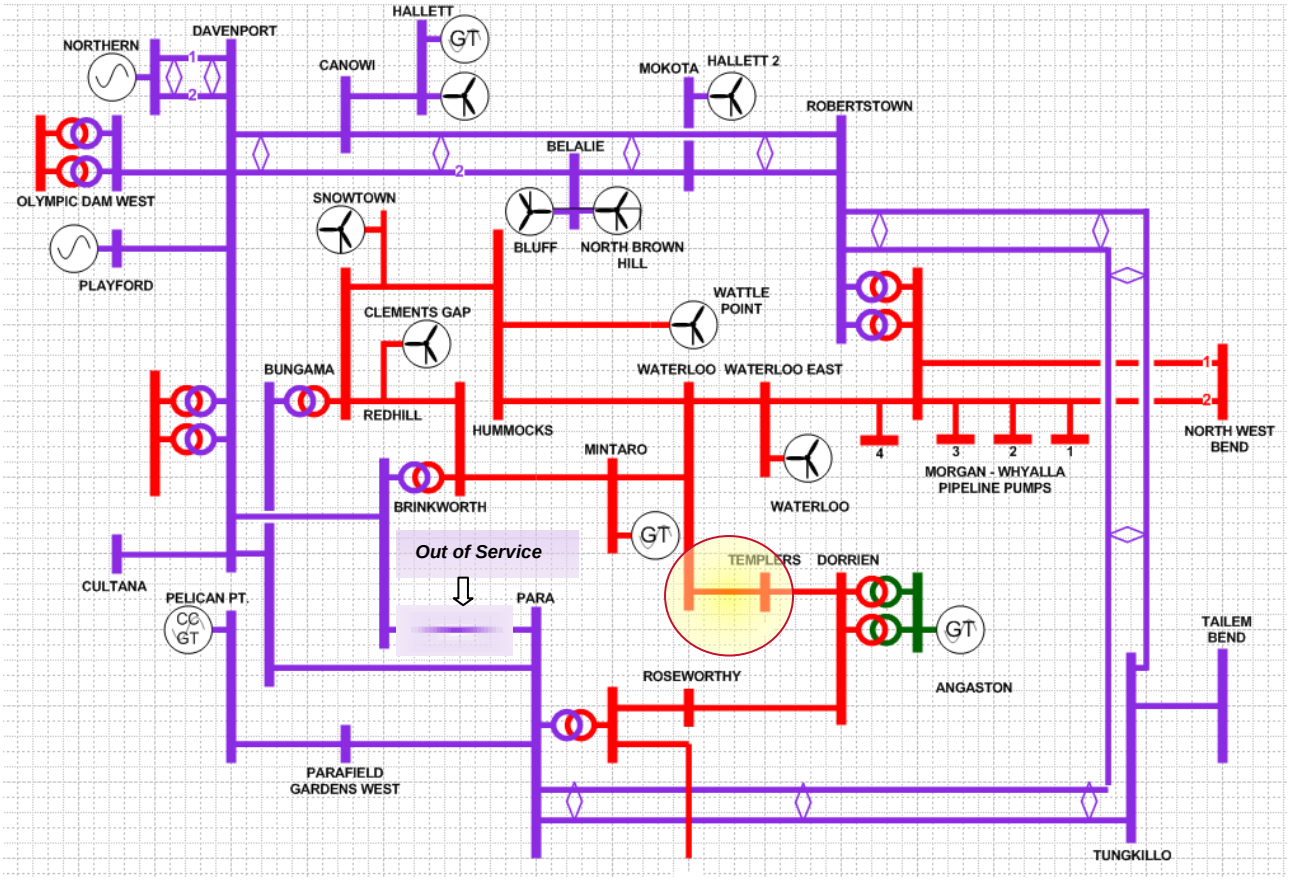

Figure 1 Simplified diagram of South Australia Mid-North and York Peninsula area as at 3 July 2011

Following an enquiry from ElectraNet at about 0830 hrs on 4 July 2011, AEMO identified that the Waterloo runback scheme had not been modelled in the Energy Management System (EMS) and was therefore not considered in the CA. The runback scheme operates to reduce the generation at the Waterloo wind farm to a level that reduces the loading on a number of network assets below their limits, one of which was the Waterloo–Templers 132 kV line.

AEMO has determined that it failed to model the Waterloo wind farm runback scheme in the EMS. As a result the preventative action of the SPS was not taken into account in central dispatch and resulted in the contingency violations. The constraint equation was removed at 1130 hrs on 4 July 2011.

The constraint equation was binding for a total of 49 DIs, up to and including DI ending 0625 hrs on 4 July, as shown in Figure 2.

Another unrelated constraint, managing load on a 132 kV line from Waterloo East to Morgan Whyalla No.4 Pump for a trip of the Waterloo–Templers line (S>>V_NIL_WTTP_WEMW [2]**Error! Bookmark not defined.**), was binding for most of the period. Figure 2 also shows the times this constraint bound. This constraint equation limited output of Waterloo.

Subsequent to the event, ElectraNet also clarified and broadened the extent of operation of the Waterloo runback scheme. As a result, a number of additional constraint equations were amended, including the equation managing flow from Waterloo East to Morgan Whyalla No.4 Pump.

[2] Refer to Appendix 5.1 for the formulation of the constraint equations

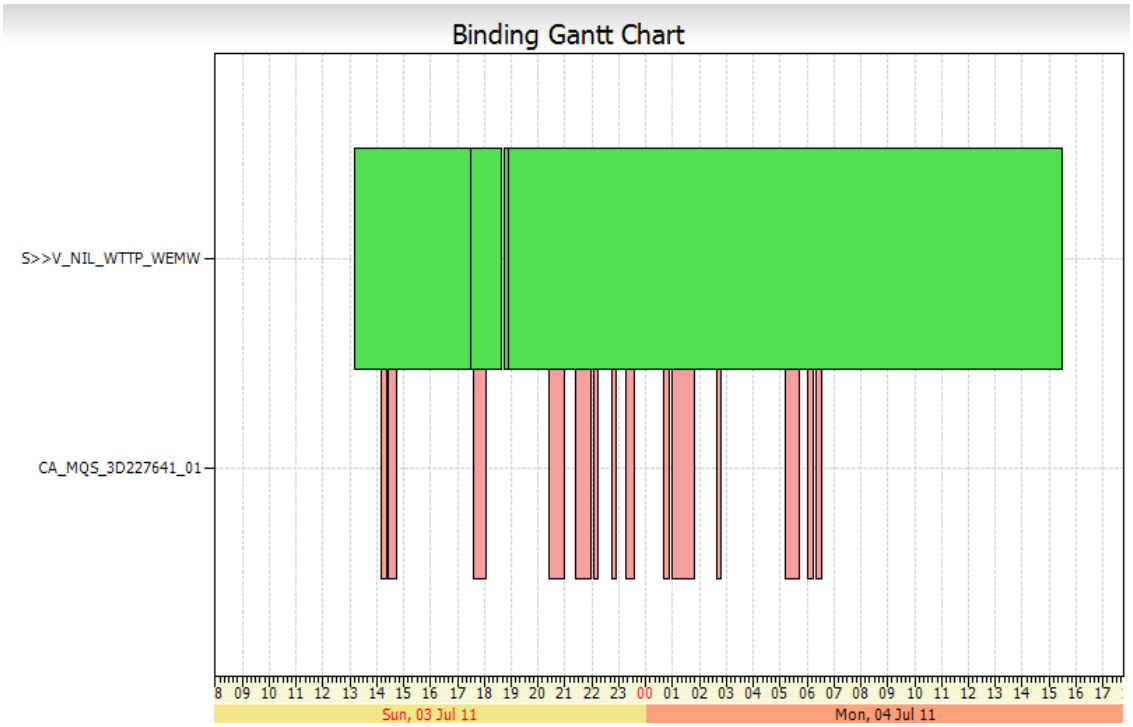

Figure 2 Dispatch intervals with S>>V_NIL_WTTP_WEMW and the constraint equation binding

3 Scheduling Error

Under clause 3.8.24(a) (2) of the National Electricity Rules, a scheduling error occurs when AEMO determines that it has failed to follow the central dispatch process set out in rule 3.8.

In this case, constraint equation CA_MQS_3D227641 was an incorrect representation of the intra-regional network constraint since Electranet enabled a special protection scheme to manage the post contingent loadings on Waterloo–Templers 132 kV line. As a result AEMO declares that a scheduling error occurred from DI ending 1410 hrs on 3 July 2011 to DI ending 1130 hrs on 4 July 2011.

4 Impact of the Scheduling Error

The constraint equation CA_MQS_3D227641_01 resulted in a reduction in output at Northern Power Station (NPS) but did not affect the energy and frequency control and ancillary services (FCAS) prices for South Australia. AEMO estimates the total energy reduction was around 10 MWh for each NPS unit over 18 dispatch intervals. During this period, South Australian prices were low or negative and the overall settlement impact would have been around $15.

The generation output at Waterloo wind farm was limited for 39 DIs during the period under review, but this was due to the operation of the Morgan Whyalla Pump constraint and not the subject of the scheduling error.

5 Action taken to Mitigate Against Similar Recurrences

Following this incident, AEMO has also reviewed all existing SPS and confirmed these are correctly modelled in EMS and constraint equations.

AEMO also identified improvements in the way transmission line ratings are communicated between AEMO and TNSPs, the documentation of SPS such as the Waterloo runback scheme, and the implementation of SPS in AEMO's EMS. Recommendations from this review are largely complete, with further work underway on implementation of SPS in the EMS.

Appendix

Constraint Equations

CA_MQS_3D227641_01

Constraint description: Constraint Automation, O/L WATTEM_1 @W_LOO for CTG LSIR on trip of R_TOWN - TUNKIL 275KV LINE
Impact: SA Generation + Interconnectors
Limit type: Thermal
Reason: Trip of R_TOWN - TUNKIL 275KV LINE

LHS

0.352301 x North Brown Hill wind farm
0.488259 x Clements Gap wind farm
- Angaston GT unit 1
- Angaston GT unit 2
0.352368 x Hallet GT (13 aggregated units)
0.352367 x Hallett 1 wind farm
0.352753 x Hallett 2 wind farm
0.738061 x Mintaro GT
0.350349 x Northern unit 1
0.350349 x Northern unit 2
0.535454 x Snowtown wind farm
0.350354 x Port Lincoln Unit 3
0.350354 x Port Lincoln GT (2 aggregated units)
0.350349 x Playford (4 aggregated units)
0.77074 x Waterloo Wind Farm 1
0.515052 x MW flow west on the Murraylink DC Interconnector

RHS

2.785797 x (MVA flow on Templers to Waterloo 132kV line at Templers, line end switched flow
- 0.129104 x [Robertstown to Tungkillo 275kV line MVA flow, Robertstown end.]
+ SA: Waterloo to Templers 132kV Emergency Rating
- 10 {Margin})
+ 0.350354 x [PORT LINCOLN UNIT 3]
+ 0.488259 x [Clements Gap wind farm]
+ 0.738061 x [Mintaro GT]
- Angaston GT unit 1
- Angaston GT unit 2
+ 0.352753 x [Hallett 2 wind farm]
+ 0.515052 x [MW flow west on the Murraylink DC Interconnector]
+ 0.350349 x [Northern unit 1]
+ 0.350349 x [Northern unit 2]
+ 0.77074 x [Waterloo Wind Farm 1]
+ 0.352367 x [Hallett 1 wind farm]
+ 0.535454 x [Snowtown wind farm]
+ 0.350354 x [Port Lincoln GT (2 aggregated units)]
+ 0.350349 x [Playford (4 aggregated units)]
+ 0.352368 x [Hallet GT (13 aggregated units)]
+ 0.352301 x [North Brown Hill wind farm]

S>>V_NIL_WTTP_WEMW4

Constraint type: LHS<=RHS
Constraint description: Out= Nil, avoid O/L Waterloo East to Morgan Whyalla pump 4 on trip of Waterloo to Templers 132 kV line, Feedback
Impact: SA Generation + Interconnectors
Limit type: Thermal
Reason: Trip of Waterloo to Templers 132 kV line

LHS

0.3492 x Clements Gap wind farm
0.7979 x Mintaro GT
0.4895 x Snowtown wind farm
+ WATERLOO WIND FARM 1
-0.3094 x MW flow west on the Murraylink DC Interconnector

RHS

1.605 x (SA: Mogan-Whyalla P4 to Robertstown 132kV LDSH Rating
- MVA flow on Waterloo East to Mogan-Whyalla Pump 4 132 kV line
+ 0.6224 x [MVA flow on Templers to Waterloo 132kV line at Templers, line end switched flow]
- 10 {Operating_Margin})
+ 0.3492 x [Clements Gap wind farm]
+ 0.4895 x [Snowtown wind farm]
+ WATERLOO WIND FARM 1
+ 0.7979 x [Mintaro GT]
- 0.3094 x [MW flow west on the Murraylink DC Interconnector]

Dispatch Intervals affected by the scheduling error [3]

	SETTLEMENTDATE	MARGINALVALUE
1	03/07/2011 14:10	-19.597
2	03/07/2011 14:15	-20.857
3	03/07/2011 14:25	-19.261
4	03/07/2011 14:30	-19.219
5	03/07/2011 14:35	-17.822
6	03/07/2011 17:35	-26.385
7	03/07/2011 17:40	-25.853
8	03/07/2011 17:45	-25.455
9	03/07/2011 17:50	-25.672
10	03/07/2011 17:55	-26.881
11	03/07/2011 20:25	-28.568
12	03/07/2011 20:30	-27.951
13	03/07/2011 20:35	-28.212
14	03/07/2011 20:40	-28.789
15	03/07/2011 20:45	-29.944
16	03/07/2011 20:50	-30.514
17	03/07/2011 21:25	-28.722
18	03/07/2011 21:30	-28.491
19	03/07/2011 21:35	-28.913
20	03/07/2011 21:40	-25.911
21	03/07/2011 21:45	-25.959
22	03/07/2011 21:50	-25.900
23	03/07/2011 22:05	-25.071
24	03/07/2011 22:45	-24.361
25	03/07/2011 23:15	-13.325
26	03/07/2011 23:20	-13.508
27	03/07/2011 23:25	-23.874
28	04/07/2011 00:40	-21.202
29	04/07/2011 00:45	-24.780
30	04/07/2011 01:00	-17.599
31	04/07/2011 01:05	-24.950
32	04/07/2011 01:10	-20.550
33	04/07/2011 01:15	-17.066
34	04/07/2011 01:20	-19.810
35	04/07/2011 01:25	-19.730
36	04/07/2011 01:30	-19.554
37	04/07/2011 01:35	-17.186
38	04/07/2011 01:40	-17.009
39	04/07/2011 02:40	-13.046
40	04/07/2011 05:10	-14.517
41	04/07/2011 05:15	-10.513
42	04/07/2011 05:20	-10.491
43	04/07/2011 05:25	-10.716
44	04/07/2011 05:30	-18.644
45	04/07/2011 05:35	-18.440
46	04/07/2011 06:00	-14.343
47	04/07/2011 06:05	-15.306
48	04/07/2011 06:20	-15.291
49	04/07/2011 06:25	-18.706

[3] Although the constraint equation was invoked from 3 July 2011 1410 hrs to 4 July 2011 1230 hrs, the constraint was only binding for the dispatch intervals listed