NEM SCHEDULING ERROR

INCORRECT TASMANIAN SOUTHERN AREA LOAD

Published: **November 2015**

Updated: **September 2016**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO has prepared this report to advise of its consideration and determination of an incident using information available as at 30 October 2015, unless otherwise specified.

Disclaimer

AEMO has made every effort to ensure the quality of the information in this report but cannot guarantee its accuracy or completeness. Any views expressed in this report are those of AEMO unless otherwise stated, and may be based on information given to AEMO by other persons.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this report:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this report; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this report, or any omissions from it, or for any use or reliance on the information in it.

Copyright

© 2016 Australian Energy Market Operator Limited. The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

© 2016. The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

CONTENTS

1. SUMMARY 4
2. THIS REPORT 4
3. BACKGROUND 4
4. EVENT DETAILS 5
5. SCHEDULING ERROR DECLARATION 6
6. MARKET IMPACT OF SCHEDULING ERROR 7
7. FURTHER ACTIONS 8

APPENDIX A. CONSTRAINT EQUATION FORMULATION FOR BINDING CONSTRAINT EQUATIONS 9

A.1 Constraint Equation T>T_NIL_BL_3C 9
A.2 Constraint Equation T>T_NIL_BL_5C 10
A.3 Constraint Equation T>>T_NIL_BL_EXP_5F 12

APPENDIX B. GENERATING UNITS CONSTRAINED-OFF 14

B.1 New South Wales 14
B.2 Queensland 14
B.3 South Australia 15
B.4 Tasmania 16
B.5 Victoria 17

GLOSSARY 19

© AEMO 2016

1. SUMMARY

AEMO has determined that a scheduling error has occurred where the calculation in AEMO's Energy Management System (EMS) for the Tasmanian southern area load was incorrect between 2 May 2014 and 6 June 2014. The error arose as the EMS calculation of the term did not reflect the recent commissioning of some new lines in Tasmania.

The term is an input to the right-hand-side (RHS) of several constraint equations used in central dispatch, and a number of these constraint equations bound or violated during the period of the error. Most Tasmanian generators are represented in these constraint equations.

AEMO has investigated the incident and declares that it had made a scheduling error by failing to follow the central dispatch process set out in rule 3.8 of the National Electricity Rules (NER).

2. THIS REPORT

AEMO has prepared this report to declare a scheduling error under NER clause 3.8.24(a)(2).

Data from AEMO's EMS and EMMS has been used in analysing the event. Hydro Tasmania were consulted in the preparation of this report.

All references to time in this report are to Australian Eastern Standard Time.

3. BACKGROUND

Tasmanian southern area load is automatically calculated in AEMO's EMS. The calculation consists of all the loads in the southern end of the Tasmanian region, as shown in Figure 1.

The calculated EMS analogue is passed to AEMO's Electricity Market Management System (EMMS) as term 'TRLOAD_S'.

The TRLOAD_S term is an input into the RHS of a number of Tasmanian constraint equations used in central dispatch, including:

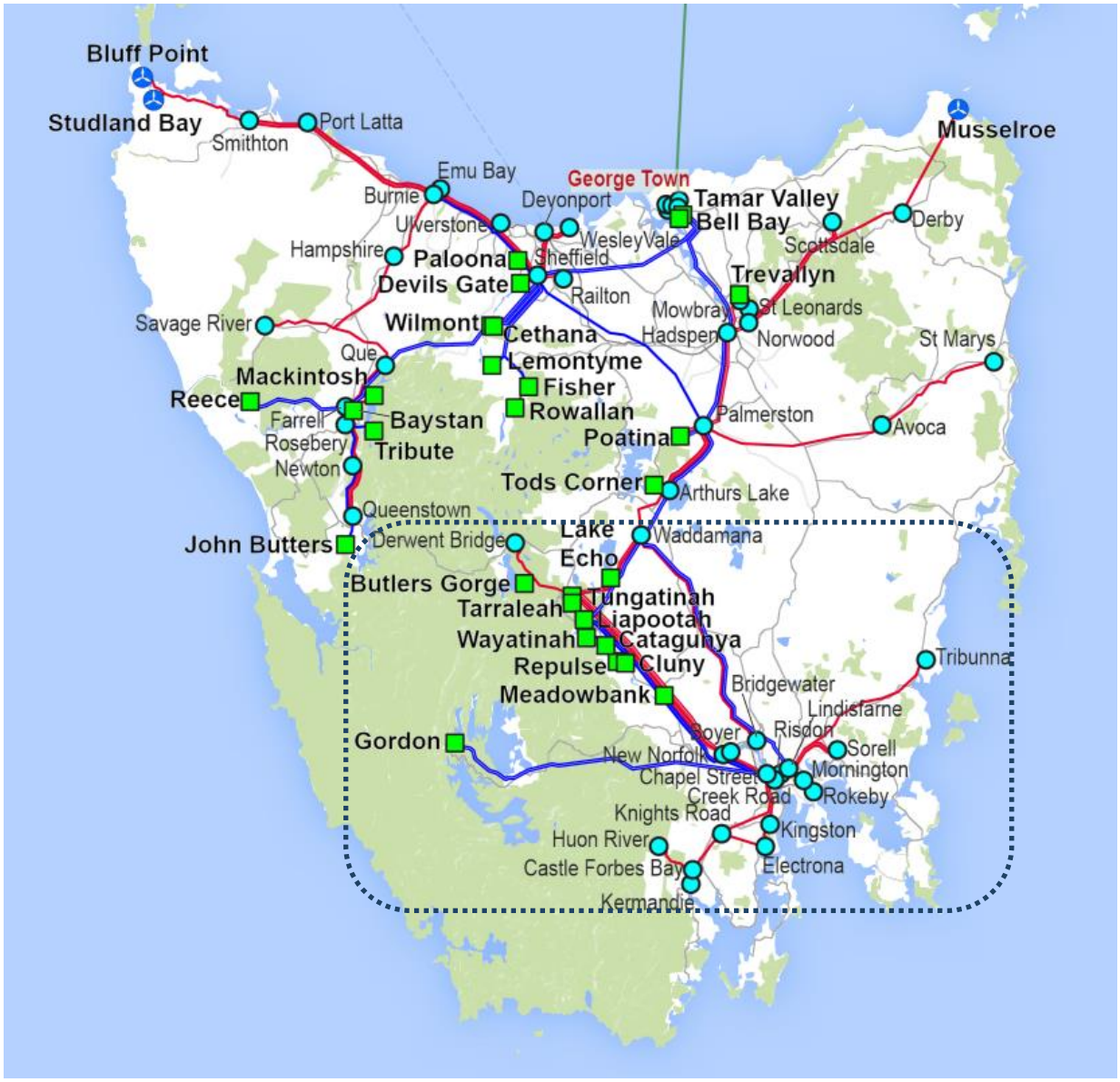
- T>T_NIL_BL_3C – manages the post-contingent flow on a Hadspen to Palmerston 220 kV line for trip of the parallel line.
- T>T_NIL_BL_5C – manages the post-contingent flow on a Hadspen to George Town 220 kV for trip of the parallel line.
- T>>T_NIL_BL_EXP_5F – manages the post-contingent flow on a Hadspen to George Town 220 kV line for trip of the parallel line.

The left-hand-side (LHS) and RHS terms of all three constraint equations are available from Appendix A.

If any of these constraint equations bind, the a number of Tasmanian generating units may be constrained (other than gas turbine power stations).

© AEMO 2016

Figure 1: Tasmanian Southern Area Load



4. EVENT DETAILS

Between DI ending 1110 hrs on 2 May 2014 and DI ending 1740 hrs on 6 June 2014, the EMS calculation of the TRLOAD_S term did not include the line flows of two recently commissioned transmission lines in Tasmania:

- Tungatinah to New Norfolk No.1 110 kV line, commissioned on 2 May 2014
- Creek Rd to Risdon No.1 110 kV line, commissioned on 23 May 2014

AEMO was aware of these network augmentations and had already updated its EMS to include the metering for each of the new lines. However, AEMO failed to update the Tasmanian southern area load calculation to include the metered line flows on the new lines. An augmentation checklist that AEMO follows did not include checking of the various area load calculations.

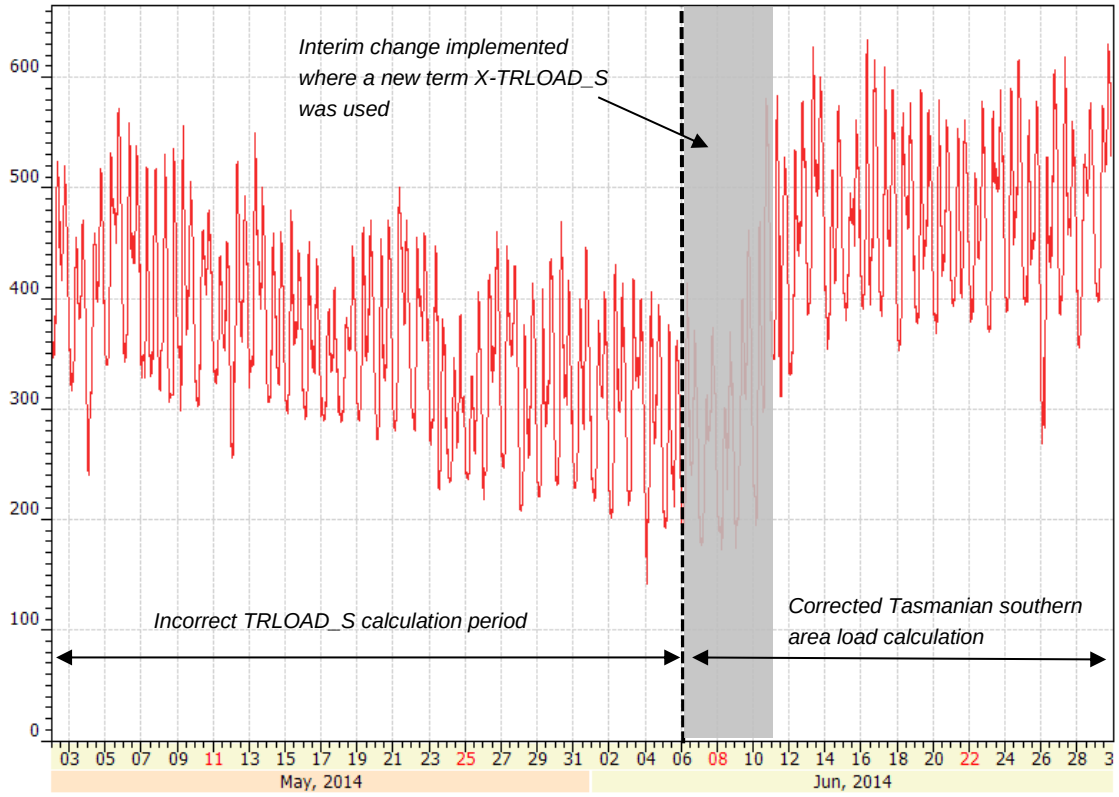
Hydro Tasmania notified AEMO of the error on 6 June 2014.

© AEMO 2016

Upon notification, AEMO made immediate changes to correct the calculation of the Tasmanian southern area load. This change involved creating a temporary term, X-TRLOAD_S, that calculates the southern area load inclusive of the loads from the new transmission lines. This interim change was in place until the next available EMS production release. The TRLOAD_S term was permanently corrected on 11 June 2014.

Figure 2 shows the value of the TRLOAD_S term during the error and after it was corrected.

Figure 2: Tasmanian Southern Area Load TRLOAD_S



5. SCHEDULING ERROR DECLARATION

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

AEMO has determined that it failed to follow the central dispatch process because it did not update the EMS calculation for the Tasmanian southern area load in a timely manner to include recent network changes, resulting in an incorrectly low values input to central dispatch.

Hence, AEMO declares that a scheduling error has occurred between DI ending 1110 hrs on 2 May 2014 and DI ending 1740 hrs on 6 June 2014, a total of 10,159 DIs.

As noted in section 6, the scheduling error resulted in the a number of Tasmanian generators being constrained down for a total of 128 dispatch intervals (DIs) when relevant network constraints were binding or violated.

© AEMO 2016

6. MARKET IMPACT OF SCHEDULING ERROR

During the scheduling error, the TRLOAD_S term was input to the RHS of the following binding or violated constraint equations:

- T>T_NIL_BL_3C
- T>T_NIL_BL_5C
- T>>T_NIL_BL_EXP_5F

These constraint equations, formulated to manage the Network Control System Protection Scheme (NCSPS), bound for a total of 128 DIs.

Table 1 summarises the date and number of DIs that these constraint equations bound or violated.

Table 1: Constraint Impact of Scheduling Error

Date	DIs Affected
24/05/2014	5
25/05/2014	14
02/06/2014	4
03/06/2014	6
04/06/2014	27
05/06/2014	37
06/06/2014	35

Energy and FCAS prices in Tasmania were below the reporting threshold during the period when the EMS calculation was incorrect, other than on two occasions[1]:

- 3 May 2014 – Tasmanian energy spot price was -$142.31/MWh for trading interval ending 0000 hrs when there was a brief loss of SCADA communications between Hydro Tasmania and AEMO.
- 4 June 2014 – Tasmanian energy spot price was $2,235.23/MWh for trading interval ending 0230 hrs when constraint equation T>>T_NIL_BL_EXP_5F violated in dispatch and reduced the generation from a number of units in Tasmania.

Only the second event on 4 June 2014 was impacted by the incorrect EMS calculation of TRLOAD_S.

To assess the market impact due to the scheduling error, AEMO carried out simulated re-runs of NEMDE dispatch files between DI ending 1110 hrs on 2 May 2014 and DI ending 1740 hrs on 6 June 2014, replacing the incorrect load calculation with the correct amount based on data available in AEMO's EMS. Based on the simulated re-runs, a total of 3,248 MWh of generation was constrained-off across all regions in the NEM due to the scheduling error. The trading interval ending 0300 hrs on 4 June 2014 in Tasmania had the highest market impact.

Appendix B lists the amount of generation constrained-off for each unit.

Scheduled and semi-scheduled generating units in the NEM that were constrained-off are included in Appendix B. The constrained-off amount is the difference between targets in the simulated "no error" run and the actual loading for each of the generating units. In accordance with NER clause 3.16.2(d), only generating units that would have been dispatched higher in the simulated run for each trading interval of the scheduling error period have been considered in determining the constrained-off MWh.

[1] AEMO. 2014. *Pricing Event Reports.* Available: http://www.aemo.com.au/Electricity/Resources/Reports-and-Documents/Pricing-Event-Reports

© AEMO 2016

7. FURTHER ACTIONS

AEMO has updated the augmentation checklist for Tasmania to include an extra step of updating the load/ demand calculation in the EMS for future network augmentations.

AEMO will review relevant constraint equations with each augmentation notice to ensure that all the terms in the constraint equation are up-to-date.

© AEMO 2016

APPENDIX A. CONSTRAINT EQUATION FORMULATION FOR BINDING CONSTRAINT EQUATIONS

A.1 Constraint Equation T>T_NIL_BL_3C

Constraint type: LHS<=RHS
Effective date: 21/08/2013
Version No: 1
Weight: 30
Constraint active in: Dispatch and DS PASA, Predispatch and PD PASA
5 Min Predispatch RHS: Dispatch

Constraint description: Out = Nil, avoid O/L a Hadspen to Palmerston 220 kV line (flow to Hadspen) for trip of the other Hadspen to Palmerston 220 kV line considering NCSPS action, ensure sufficient NCSPS generation dispatched.
Impact: Tasmanian Generation
Source: Transend
Limit type: Thermal
Reason: Avoid overload of a Hadspen to Palmerston 220 kV line for trip of the other Hadspen to Palmerston 220 kV line
Modifications: Add Musselroe Wind Farm
Additional Notes: NCSPS Type 2 constraint - NCSPS IDs 31, 32. Swamped if NCSPS scheme disabled or Basslink not exporting > 280 MW or lines set to firm rating or NCSPS IDs not enabled. Transend limit advice 3/1/2013. CCR 567

LHS=

0.2823 x Cethana hydro (ENERGY)
0.0923 x Musselroe wind farm (ENERGY)
0.2823 x Devils Gate hydro (ENERGY)
0.2823 x Bastyan hydro (ENERGY)
0.2823 x Fisher hydro (ENERGY)
0.9343 x Gordon hydro (3 aggregated units) (ENERGY)
0.2823 x John Butters hydro (ENERGY)
0.798 x Lake Echo hydro (ENERGY)
0.9616 x Liapootah, Catagunya and Wayatinah aggregated hydro (ENERGY)
0.2823 x Mackintosh hydro (ENERGY)
0.8691 x Meadowbank hydro (ENERGY)
+ Poatina hydro (units 3, 4, 5 & 6 aggregated) (ENERGY)
0.5262 x Poatina hydro (units 1 & 2 aggregated) (ENERGY)
0.2823 x Reece hydro unit 1 (ENERGY)
0.2823 x Reece hydro unit 2 (ENERGY)
0.2823 x Lemonthyme and Wilmot hydro (aggregated) (ENERGY)
0.8211 x Tarraleah hydro (6 aggregated units) (ENERGY)
0.2823 x Tribute hydro (ENERGY)
0.0923 x Trevallyn hydro (4 aggregated units) (ENERGY)
0.8207 x Tungatinah hydro (5 aggregated units) (ENERGY)

RHS

Default RHS value= 1000

Dispatch RHS=
1.6975 x **(** 0.89 x **(** Min
(
Tasmania: Palmerston - Hadspen #2 220kV Line Continuous Rating,
Tasmania: Palmerston - Hadspen #1 220kV Line Continuous Rating
))
- 0.9 {Intercept}
- 0.4835 x [Bulters Gorge PS]
- 0.562 x [Cluny PS]
- 0.1663 x [Paloona PS (SCADA)]
- 0.562 x [Repulse PS]
- 0.1663 x [Rowallan PS (SCADA)]
- 0.1663 x [Total SCADA MW for Woolnorth Windfarm - Combined output of Bluff Point & Studland Bay wind farms]
+ 0.0969 x [Northern MW load supplied from Palmerston & Hadspen (Palmerston, Trevallyn, Mowbray, Aurora, Derby, Scottsdale, Norwood, Avoca, St Marys, Arthurs Pump). Native load]

© AEMO 2016

+ 0.173 x [North West MW load normally radial from Sheffield (Hampshire, Burnie, Port Latta, Smithton, Emu Bay, Ulverstone, Devonport, Wesley Vale, Railton). Native Load]
+ 0.5598 x [Southern TAS MW load. All load south of Palmerston, including industrial loads. Native Load. Sum of South East, SouthernX and Hobart area loads]
+ 0.173 x [West Coast MW load normally radial from Farrell (Rosebery, Queenstown, Newton, Que, Savage River). Native Load]
+ 0.5891 x [Min MW operating limit for Poatina unit 4. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.5665 x [Min MW operating limit for Catagunya Unit 1. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.5504 x [Min MW operating limit for Gordon unit 2. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.5891 x [Min MW operating limit for Poatina unit 5. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.5665 x [Min MW operating limit for Catagunya Unit 2. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.5504 x [Min MW operating limit for Gordon unit 3. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]**)**
+ **if**
  1 {Swamping_Offset}
  + 2 x [Firm flow enablement status for PMHA No.1 line]
  + 2 x [Firm flow enablement status for PMHA No.2 line]
  + 2 x [*Generic Equation:* PM_HA12_NCSPS_DISAB]
  - NCSPS enablement status for PMHA No.1 on trip of PMHA No.2 trip
  - NCSPS enablement status for PMHA No.2 on trip of PMHA No.1 trip **<= 0**
then
  0
else
  10000

Equation: PM_HA12_NCSPS_DISAB

if
  Absolute**(if**
    MW flow north on the Basslink DC Interconnector
    - 280 {Export_offset} **<= 0**
  then
    0
  else
    1
  + Georgetown Basslink frequency controller operational enablement status
  + On status of the Tas Network SPS
  - 3 {Offset}**) <= 0**
then
  0
else
  1

A.2 Constraint Equation T>T_NIL_BL_5C

Constraint type: LHS<=RHS
Effective date: 30/09/2013
Version No: 1
Weight: 30
Constraint active in: Dispatch and DS PASA, Predispatch and PD PASA
5 Min Predispatch RHS: Predispatch

Constraint description: Out = Nil, avoid O/L a Hadspen to George Town 220 kV line (flow to George Town) for trip of the other Hadspen to George Town 220 kV line considering NCSPS action, ensure sufficient NCSPS generation dispatched.
Impact: Tasmanian Generation
Source: Transend
Limit type: Thermal
Reason: Avoid overload of a Hadspen to George Town 220 kV line for trip of the other Hadspen to George Town 220 kV line
Modifications: Recalculated. Now derived directly from corresponding Type 4 constraint formulation.
Additional Notes: NCSPS Type 2 constraint - NCSPS IDs 71, 72. Swamped if NCSPS disabled or Basslink export below 280 MW or lines set to firm rating or NCSPS IDs not enabled. Transend limit advice 3/1/2013.

© AEMO 2016

LHS=

0.2568 x Cethana hydro (ENERGY)
+ Musselroe wind farm (ENERGY)
0.2568 x Devils Gate hydro (ENERGY)
0.2568 x Bastyan hydro (ENERGY)
0.2568 x Fisher hydro (ENERGY)
0.9167 x Gordon hydro (3 aggregated units) (ENERGY)
0.2568 x John Butters hydro (ENERGY)
0.9305 x Lake Echo hydro (ENERGY)
0.9138 x Liapootah, Catagunya and Wayatinah aggregated hydro (ENERGY)
0.2568 x Mackintosh hydro (ENERGY)
0.9239 x Meadowbank hydro (ENERGY)
0.9097 x Poatina hydro (units 3, 4, 5 & 6 aggregated) (ENERGY)
0.2568 x Reece hydro unit 1 (ENERGY)
0.2568 x Reece hydro unit 2 (ENERGY)
0.2568 x Lemonthyme and Wilmot hydro (aggregated) (ENERGY)
0.9281 x Tarraleah hydro (6 aggregated units) (ENERGY)
0.2568 x Tribute hydro (ENERGY)
+ Trevallyn hydro (4 aggregated units) (ENERGY)
0.9281 x Tungatinah hydro (5 aggregated units) (ENERGY)

RHS

Default RHS value= 1000

Dispatch RHS=
1.417 x **(** 0.89 x **(** Min
(
Tasmania: Hadspen - Georgetown #2 220kV Line Continuous Rating,
Tasmania: Hadspen - Georgetown # 1 220kV Line Continuous Rating
))
+ 0.6801 x [Southern TAS MW load. All load south of Palmerston, including industrial loads. Native Load. Sum of South East, SouthernX and Hobart area loads]
+ 0.7197 x [MW load supplied from Hadspen (Hadspen, Trevallyn, Mowbray, St Leonards, Norwood, Scottsdale, Derby) Native load]
+ 0.1749 x [All TAS North West and West Coast MW load supplied from Sheffield and Farrell. Sum of existing West Coast and North West load terms. Native load.]
+ 0.7168 x [MW load supplied from Palmerston (Palmerston, Avoca, St Marys, Arthurs). Native load]
- 3.012 {Constant}**)**
- 0.9281 x [Bulters Gorge PS]
- 0.9146 x [Cluny PS]
- 0.2568 x [Paloona PS (SCADA)]
- 0.9146 x [Repulse PS]
- 0.2568 x [Rowallan PS (SCADA)]
- 0.2568 x [Total SCADA MW for Woolnorth Windfarm - Combined output of Bluff Point & Studland Bay wind farms]
+ 0.9167 x [Min MW operating limit for Gordon unit 2. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.9167 x [Min MW operating limit for Gordon unit 3. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.9138 x [Min MW operating limit for Catagunya Unit 1. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.9138 x [Min MW operating limit for Catagunya Unit 2. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.9097 x [Min MW operating limit for Poatina unit 4. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ 0.9097 x [Min MW operating limit for Poatina unit 5. MW guaranteed available for NCSPS tripping. Transend limit advice 8-2-07.]
+ **if**
1 {Swamping_Offset}
+ 2 x [Firm flow enablement status for HAGT No.1 line]
+ 2 x [Firm flow enablement status for HAGT No.2 line]
+ 2 x [*Generic Equation:* HA_GT_NCSPS_DISAB]
- NCSPS enablement status for HAGT No.1 on trip of HAGT No.2 trip
- NCSPS enablement status for HAGT No.2 on trip of HAGT No.1 trip **<= 0**
then
0
else
10000

Equation: HA_GT_NCSPS_DISAB

© AEMO 2016

if
Absolute**(if**
MW flow north on the Basslink DC Interconnector
- 280 {Export_offset} **<= 0**
then
0
else
1
+ Georgetown Basslink frequency controller operational enablement status
+ On status of the Tas Network SPS
- 3 {Offset}**) <= 0**
then
0
else
1

A.3 Constraint Equation T>>T_NIL_BL_EXP_5F

Constraint type: LHS<=RHS
Effective date: 30/09/2013
Version No: 1
Weight: 30
Constraint active in: Dispatch and DS PASA, Predispatch and PD PASA
5 Min Predispatch RHS: Predispatch

Constraint description: Out = Nil, avoid O/L a Hadspen to George Town 220 kV line (flow to George Town) for trip of the other Hadspen to George Town 220 kV line considering NCSPS action, ensure Basslink can fully compensate NCSPS action.
Impact: Tasmanian Generation + Interconnectors
Source: Transend
Limit type: Thermal
Reason: Avoid overload of a Hadspen to George Town 220 kV line for trip of the other Hadspen to George Town 220 kV line
Modifications: Recalculated. Now derived directly from corresponding Type 4 constraint formulation.
Additional Notes: NCSPS Type 3 constraint - NCSPS IDs 71, 72. Swamped if NCSPS disabled or Basslink export below 280 MW or lines set to firm rating or NCSPS IDs not enabled or no overload will occur on monitored ccts. Transend limit advice 3/1/2013.

LHS=

0.2568 x Cethana hydro (ENERGY)
+ Musselroe wind farm (ENERGY)
0.2568 x Devils Gate hydro (ENERGY)
0.2568 x Bastyan hydro (ENERGY)
0.2568 x Fisher hydro (ENERGY)
0.9167 x Gordon hydro (3 aggregated units) (ENERGY)
0.2568 x John Butters hydro (ENERGY)
0.9305 x Lake Echo hydro (ENERGY)
0.9138 x Liapootah, Catagunya and Wayatinah aggregated hydro (ENERGY)
0.2568 x Mackintosh hydro (ENERGY)
0.9239 x Meadowbank hydro (ENERGY)
0.9097 x Poatina hydro (units 3, 4, 5 & 6 aggregated) (ENERGY)
0.9565 x Poatina hydro (units 1 & 2 aggregated) (ENERGY)
0.2568 x Reece hydro unit 1 (ENERGY)
0.2568 x Reece hydro unit 2 (ENERGY)
0.2568 x Lemonthyme and Wilmot hydro (aggregated) (ENERGY)
0.9281 x Tarraleah hydro (6 aggregated units) (ENERGY)
0.2568 x Tribute hydro (ENERGY)
+ Trevallyn hydro (4 aggregated units) (ENERGY)
0.9281 x Tungatinah hydro (5 aggregated units) (ENERGY)
-0.9097 x MW flow north on the Basslink DC Interconnector

RHS

Default RHS value= 750

Dispatch RHS=
1.417 x **(** 0.89 x **(** Min

© AEMO 2016

```
   (
  Tasmania: Hadspen - Georgetown # 1 220kV Line Continuous Rating,
  Tasmania: Hadspen - Georgetown # 1 220kV Line Continuous Rating
   ) )
+ 0.6801 x [Southern TAS MW load. All load south of Palmerston, including industrial loads. Native Load. Sum of South East,
        SouthernX and Hobart area loads]
+ 0.7197 x [MW load supplied from Hadspen (Hadspen, Trevallyn, Mowbray, St Leonards, Norwood, Scottsdale, Derby) Native
        load]
+ 0.1749 x [All TAS North West and West Coast MW load supplied from Sheffield and Farrell. Sum of existing West Coast and
        North West load terms. Native load.]
+ 0.7168 x [MW load supplied from Palmerston (Palmerston, Avoca, St Marys, Arthurs). Native load]
- 3.012 {Constant}
+ 0.642 x ( -50 {Min_Export_offset}
- 144 {Max_Overtripping}) )
- 0.9281 x [Bulters Gorge PS]
- 0.9146 x [Cluny PS]
- 0.2568 x [Paloona PS (SCADA)]
- 0.9146 x [Repulse PS]
- 0.2568 x [Rowallan PS (SCADA)]
- 0.2568 x [Total SCADA MW for Woolnorth Windfarm - Combined output of Bluff Point & Studland Bay wind farms]
+ if
  1 {Swamping_Offset}
  + 2 x [Firm flow enablement status for HAGT No.1 line]
  + 2 x [Firm flow enablement status for HAGT No.2 line]
  + 2 x [Generic Equation: HA_GT_NCSPS_DISAB]
  - NCSPS enablement status for HAGT No.1 on trip of HAGT No.2 trip
  - NCSPS enablement status for HAGT No.2 on trip of HAGT No.1 trip <= 0
then
  0
else
  10000
+ 10000 x [Generic Equation: NCSPS3_71_72_SWMP_DS]
```

Equation: HA_GT_NCSPS_DISAB

```
if
  Absolute( if
    MW flow north on the Basslink DC Interconnector
    - 280 {Export_offset} <= 0
  then
    0
  else
    1
  + Georgetown Basslink frequency controller operational enablement status
  + On status of the Tas Network SPS
  - 3 {Offset}) <= 0
then
  0
else
  1
```

Equation: NCSPS3_71_72_SWMP_DS

```
if
  Min
(
    0.95 x [Tasmania: Hadspen - Georgetown #2 220kV Line 15 min Rating]
    - MVA flow on #2 Hadspen to George Town 220kV line at Hadspen, Line end switched MVA
    - 0.7247 x [MVA flow on #1 Hadspen to George Town 220kV line at Hadspen, Line end switched MVA],
    0.95 x [Tasmania: Hadspen - Georgetown #1 220kV Line 15 min Rating]
    - MVA flow on #1 Hadspen to George Town 220kV line at Hadspen, Line end switched MVA
    - 0.7247 x [MVA flow on #2 Hadspen to George Town 220kV line at Hadspen, Line end switched MVA]
) <= 0
then
  0
else
  1
```

© AEMO 2016

APPENDIX B. GENERATING UNITS CONSTRAINED-OFF

B.1 New South Wales

DUID	Constrained-off MWh
VP5	103
UPPTUMUT	68
LD04	61
ER01	51
BW03	41
MP1	32
VP6	32
ER04	30
TALWA1	27
BW02	27
LD01	25
MP2	22
ER02	20
BW01	19
SITHE01	12
BW04	12
GUNNING1	9
URANQ11	7
WOODLWN1	6
GULLRWF1	5
URANQ14	5
URANQ13	5
SHGEN	3
URANQ12	2
GUTHEGA	2
TUMUT3	1
HUMENSW	1

B.2 Queensland

DUID	Constrained-off MWh
CPP_4	197
GSTONE1	48

© AEMO 2016

GSTONE3	46
GSTONE5	46
GSTONE4	42
GSTONE2	42
KPP_1	40
GSTONE6	38
DDPS1	34
STAN-1	23
SWAN_E	21
STAN-3	21
STAN-4	21
MPP_1	17
YABULU	15
YABULU2	12
BRAEMAR3	12
CALL_B_2	12
MPP_2	10
CPSA	8
BRAEMAR5	7
BRAEMAR2	6
BRAEMAR6	5
STAN-2	5
KAREEYA1	5
KAREEYA3	4
YARWUN_1	4
KAREEYA2	4
KAREEYA4	4
TARONG#3	3
TARONG#1	2
ROMA_7	2
TNPS1	1
BRAEMAR1	1

B.3 South Australia

DUID	Constrained-off MWh
TORRA4	44
TORRB2	32

© AEMO 2016

TORRA2	22
NPS1	21
TORRA3	16
LKBONNY2	13
PPCCGT	12
NBHWF1	9
TORRA1	9
HALLWF2	8
QPS3	8
SNOWTWN1	7
TORRB1	7
QPS1	6
HALLWF1	6
LADBROK2	5
QPS2	5
WATERLWF	5
SNOWNTH1	5
OSB-AG	5
BLUFF1	4
CLEMGPWF	4
SNOWSTH1	4
LADBROK1	4
LKBONNY3	4
NPS2	2
QPS4	1

B.4 Tasmania

DUID	Constrained-off MWh
POAT220	348
POAT110	210
GORDON	54
MUSSELR1	42
TARRALEA	32
TUNGATIN	26
REECE1	17
REECE2	13
LI_WY_CA	9

© AEMO 2016

TREVALLN	5
CETHANA	5
JBUTTERS	4
TVPP104	3
DEVILS_G	3
MEADOWBK	3
LEM_WIL	2
FISHER	2
TRIBUTE	2
MACKNTSH	1
BASTYAN	1
TVCC201	1

B.5 Victoria

DUID	Constrained-off MWh
LYA1	226
MOR1	123
MCKAY1	65
LYA4	65
HWPS8	56
MURRAY	48
AGLSOM	41
LYA2	16
MORTLK11	14
YWPS3	14
MORTLK12	14
MACARTH1	13
LYA3	13
HWPS5	11
LOYYB1	10
LOYYB2	10
APS	10
HWPS6	10
NPS	9
WKIEWA1	8
HWPS7	8
YWPS4	8

© AEMO 2016

HWPS3	6
MERCER01	5
HUMEV	4
OAKLAND1	2
HWPS1	1
DARTM1	1

© AEMO 2016

GLOSSARY

Abbreviations	Term
AEMO	Australian Energy Market Operator Ltd
DI	Dispatch Interval
EMMS	Electricity Market Management System
EMS	Energy Management System
LHS	Left-Hand-Side
NCSPS	Network Control System Protection Scheme
NEM	National Electricity Market
NEMDE	NEM Dispatch Engine
NER	National Electricity Rules
RHS	Right-Hand-Side
SCADA	Supervisory Control and Data Acquisition
TI	Trading Interval

© AEMO 2016