AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Monthly Constraint Report

January 2021

A report for the National Electricity Market

Important notice

PURPOSE

This publication has been prepared by AEMO to provide information about constraint equation performance and related issues, as at the date of publication.

DISCLAIMER

This document or the information in it may be subsequently updated or amended. This document does not constitute legal or business advice, and should not be relied on as a substitute for obtaining detailed advice about the National Electricity Law, the National Electricity Rules, or any other applicable laws, procedures or policies. AEMO has made every effort to ensure the quality of the information in this document but cannot guarantee its accuracy or completeness.

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

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

Contents

Tables

Figures

1. Introduction

This report details constraint equation performance and transmission congestion related issues for January 2021. Included are investigations of violating constraint equations, usage of the constraint automation and performance of Pre-dispatch constraint equations. Transmission and generation changes are also detailed along with the number of constraint equation changes.

2. Constraint Equation Performance

2.1 Top 10 binding constraint equations

A constraint equation is binding when the power system flows managed by it have reached the applicable thermal or stability limit or the constraint equation is setting a Frequency Control Ancillary Service (FCAS) requirement. Normally there is one constraint equation setting the FCAS requirement for each of the eight services at any time. This leads to many more hours of binding for FCAS constraint equations - as such these have been excluded from the following table.

Table 1 Top 10 binding network constraint equations

Constraint Equation ID (System Normal Bold)	Description	#DIs (Hours)	Change Date
S>NIL_MHNW1_MHNW2	Out= Nil, avoid O/L Monash-North West Bend #2 132kV on trip of Monash-North West Bend #1 132kV line, Feedback	2270 (189.16)	29/09/2020
N^^N_NIL_2	Out=Nil , limit Darlington Point to Wagga line (63) line flow to avoid voltage collapse at Darlington Point 132kV post contingency trip of line 63, Feedback	1789 (149.08)	4/12/2020
N>>N-NIL_94T_947	Out= Nil, avoid O/L Molong to Orange North (94T) on trip of Wellington to Orange North (947), Feedback	1754 (146.16)	27/01/2021
N^^N_NIL_3	Out= Nil, limit power flow on line X5 from Balranald to Darlington Point (X5) to avoid voltage collapse for contingency trip of Bendigo-Kerang 220kV line in NW Victoria	1674 (139.5)	4/12/2020
V^^N_NIL_1	Out = Nil, avoid voltage collapse around Murray for loss of all APD potlines	1312 (109.33)	13/11/2020
V>V_NIL_17	Out = NIL, prevent pre-contingent overload of Wemen 220/66 kV txfmr, flow from 66 kV to 220 kV, feedback	989 (82.41)	29/09/2020
T_MRWF_FOS	Limit Musselroe wind farm due to upper limit on Tasmanian generator events. Limit is 153 MW (effective 144 MW at the connection point at Derby)	989 (82.41)	1/01/2020
V_S_NIL_ROCOF	Out = NIL, limit VIC to SA Heywood interconnection flow to prevent Rate of Change of Frequency exceeding 2 Hz/sec in SA immediately following loss of Heywood interconnector. [NOTE: Switches based on ON/OFF status of Dalry Battery in Load Mode)]	743 (61.91)	9/10/2020

Constraint Equation ID (System Normal Bold)	Description	#DIs (Hours)	Change Date
S>NIL_HUWT_STBG2	Out = Nil; Limit Snowtown WF generation to avoid Snowtown - Bungama line OL on loss of Hummocks - Waterloo line.[Note: Wattle PT trips when generating >=80 MW when Dalymple Battery (i.e. both Gen and Load component) is I/S]	484 (40.33)	1/12/2020
Q>NIL_YLMR	Out= Nil, avoid overload on 110kV feeders between Yarranlea and Middle Ridge(733/1 and 734/1), Feedback	481 (40.08)	9/04/2020

2.2 Top 10 binding impact constraint equations

Binding constraint equations affect electricity market pricing. The binding impact is used to distinguish the severity of different binding constraint equations.

The binding impact of a constraint is derived by summarising the marginal value for each dispatch interval (DI) from the marginal constraint cost (MCC) re-run[1] over the period considered. The marginal value is a mathematical term for the binding impact arising from relaxing the RHS of a binding constraint by one MW. As the market clears each DI, the binding impact is measured in $/MW/DI.

The binding impact in $/MW/DI is a relative comparison and a helpful way to analyse congestion issues. It can be converted to $/MWh by dividing the binding impact by 12 (as there are 12 DIs per hour). This value of congestion is still only a proxy (and always an upper bound) of the value per MW of congestion over the period calculated; any change to the limits (RHS) may cause other constraints to bind almost immediately after.

Table 2 Top 10 binding impact network constraint equations

Constraint Equation ID (System Normal Bold)	Description	∑ Marginal Values	Change Date
N^^N_NIL_2	Out=Nil , limit Darlington Point to Wagga line (63) line flow to avoid voltage collapse at Darlington Point 132kV post contingency trip of line 63, Feedback	1,467,612	4/12/2020
S>NIL_MHNW1_MHNW2	Out= Nil, avoid O/L Monash-North West Bend #2 132kV on trip of Monash-North West Bend #1 132kV line, Feedback	895,347	29/09/2020
N>>N-NIL_94T_947	Out= Nil, avoid O/L Molong to Orange North (94T) on trip of Wellington to Orange North (947), Feedback	828,484	27/01/2021
V>V_NIL_17	Out = NIL, prevent pre-contingent overload of Wemen 220/66 kV txfmr, flow from 66 kV to 220 kV, feedback	655,720	29/09/2020
N^^N_NIL_3	Out= Nil, limit power flow on line X5 from Balranald to Darlington Point (X5) to avoid voltage collapse for contingency trip of Bendigo-Kerang 220kV line in NW Victoria	594,576	4/12/2020
S>NIL_HUWT_STBG2	Out = Nil; Limit Snowtown WF generation to avoid Snowtown - Bungama line OL on loss of Hummocks - Waterloo line.[Note: Wattle PT trips when generating >=80 MW when Dalymple Battery (i.e. both Gen and Load component) is I/S]	468,980	1/12/2020
S_NIL_STRENGTH_1	Upper limit (1300 to 1750 MW) for South Australian non-synchronous generation for minimum synchronous generators online for system strength requirements. Automatically swamps out when required HIGH combination is online.	349,119	19/08/2020

1 The MCC re-run relaxes any violating constraint equations and constraint equations with a marginal value equal to the constraint equation's violation penalty factor (CVP) x market price cap (MPC). The calculation caps the marginal value in each DI at the MPC value valid on that date. MPC is increased annually on 1st July.

Constraint Equation ID (System Normal Bold)	Description	∑ Marginal Values	Change Date
T_MRWF_FOS	Limit Musselroe wind farm due to upper limit on Tasmanian generator events. Limit is 153 MW (effective 144 MW at the connection point at Derby)	293,467	1/01/2020
Q>NIL_COLNVSF1	Out = Nil, Limit Collinsville Solar Farm to thermal rating of Powerlink's RMU	255,308	5/11/2019
V>>V_NIL_14	Out= Nil, avoid O/L Wemen to Kerang 220kV line on trip of Horsham to Murra Warra to Kiamal 220kV line (this trips Murra Warra WF), Feedback	249,404	25/08/2020

2.3 Top 10 violating constraint equations

A constraint equation is violating when NEMDE is unable to dispatch the entities on the left-hand side (LHS) so the summated LHS value is less than or equal to, or greater than or equal to, the right-hand side (RHS) value (depending on the mathematical operator selected for the constraint equation). The following table includes the FCAS constraint equations. Reasons for the violations are covered in 2.3.1.

Table 3 Top 10 violating constraint equations

Constraint Equation ID (System Normal Bold)	Description	#DIs (Hours)	Change Date
F_I+RREG_0220	NEM Raise Regulation Requirement greater than 200 MW	9 (0.75)	16/05/2019
F_I+LREG_0210	NEM Lower Regulation Requirement greater than 210 MW	9 (0.75)	16/05/2019
F_TASCAP_RREG_0220	Mainland Raise Regulation Requirement, Cap Tas contribution to 50 MW	9 (0.75)	16/05/2019
F_TASCAP_LREG_0210	Mainland Lower Regulation Requirement, Cap Tas contribution to 50 MW	9 (0.75)	16/05/2019
NSA_V_NPSD_100	Newport unit >= 100 MW for Network Support Agreement	8 (0.66)	21/12/2018
F_MAIN+NIL_DYN_RREG	Mainland Raise Regulation Requirement, Feedback in Dispatch, increase by 60 MW for each 1s of time error below -1.5s	7 (0.58)	23/05/2019
F_T+NIL_WF_TG_R6	Out= Nil, Tasmania Raise 6 sec requirement for loss of a Smithton to Woolnorth or Norwood to Scotsdale tee Derby, Waddamana to Cattle Hill or Pieman to Granville Harbour line, Basslink unable to transfer FCAS	6 (0.5)	23/12/2020
F_T_AUFLS2_R6	TAS AUFLS2 control scheme. Limit R6 enablement based on loaded armed for shedding by scheme.	5 (0.41)	4/05/2018
F_MAIN++RREG_0220	Mainland Raise Regulation Requirement greater than 200 MW, Basslink able transfer FCAS	5 (0.41)	16/05/2019
F_MAIN++LREG_0210	Mainland Lower Regulation Requirement greater than 210 MW, Basslink able transfer FCAS	4 (0.33)	16/05/2019

2.3.1 Reasons for constraint equation violations

Table 4 Reasons for constraint equation violations

Constraint Equation ID (System Normal Bold)	Description
F_I+RREG_0220	Constraint equation violated for 9 non-consecutive DIs on 06/01/2021 and 24/01/2021 with max violation of 220 MW occurring on 06/01/2021 at 1300 hrs and 1305 hrs and on 24/01/2021 at 1550 hrs. Constraint equation violated due to SCADA failure resulting the EMS receiving zero availability for FCAS regulation.
F_I+LREG_0210	Constraint equation violated for 9 non-consecutive DIs on 06/01/2021 and 24/01/2021 with max violation of 210 MW occurring on 06/01/2021 at 1300 hrs and 1305 hrs and on 24/01/2021 at 1550 hrs. Constraint equation violated due to the same reason as F_I+RREG_0220.
F_TASCAP_RREG_0220	Constraint equation violated for 9 non-consecutive DIs on 06/01/2021 and 24/01/2021 with violation degree 170 MW. Constraint equation violated due to the same reason as F_I+RREG_0220.
F_TASCAP_LREG_0210	Constraint equation violated for 9 non-consecutive DIs on 06/01/2021 and 24/01/2021 with violation degree 160 MW. Constraint equation violated due to the same reason as F_I+RREG_0220.
NSA_V_NPSD_100	Constraint equation violated for 8 non-consecutive DIs on 01/01/2021 and 17/01/2021 with max violation 74.88 MW occurring on 17/01/2021 at 1335 hrs. Constraint equation violation occurred due to Newport PS being limited by its start-up profile.
F_MAIN+NIL_DYN_RREG	Constraint equation violated for 7 DIs on 24/01/2021, 6 of which were consecutive with violation degree of 350 MW. Constraint equation violated due to the same reason as F_I+RREG_0220.
F_T+NIL_WF_TG_R6	Constraint equation violated for 6 non-consecutive DIs on 04/01/2021, 12/01/2021, 27/01/2021 and 30/01/2021 with max violation 25.11 MW occurring on 27/01/2021 at 1420 hrs. Constraint equation violation occurred due to Tasmania raise 6-second service availability being less than the requirement.
F_T_AUFLS2_R6	Constraint equation violated for 5 DIs on 12/01/2021, 19/01/2021 and 27/01/2021 with max violation 64.2 MW occurring on 27/01/2021 at 1415 hrs. Constraint equation violation occurred due to Tasmania raise 6-second service availability being less than the requirement.
F_MAIN++RREG_0220	Constraint equation violated for 5 DIs on 24/01/2021 with violation degree 2 MW. Constraint equation violated due to the same reason as F_I+RREG_0220.
F_MAIN++LREG_0210	Constraint equation violated for 4 DIs on 06/01/2021 and 24/01/2021 with violation degree 2 MW. Constraint equation violated due to the same reason as F_I+RREG_0220.

2.4 Top 10 binding interconnector limit setters

Binding constraint equations can set the interconnector limits for each of the interconnectors on the constraint equation left-hand side (LHS). Table 5 lists the top (by binding hours) interconnector limit setters for all the interconnectors in the NEM and for each direction on that interconnector.

Table 5 Top 10 binding interconnector limit setters

Constraint Equation ID (System Normal Bold)	Interconnector	Description	#DIs (Hours)	Average Limit (Max)
S>NIL_MHNW1_MHNW2	V-S-MNSP1 Export	Out= Nil, avoid O/L Monash-North West Bend #2 132kV on trip of Monash-North West Bend #1 132kV line, Feedback	2003 (166.92)	162.57 (204.35)
F_MAIN++APD_TL_L60	T-V-MNSP1 Import	Out = Nil, Lower 60 sec Service Requirement for a Mainland Network Event-loss of APD potlines due to undervoltage following a fault on MOPS-HYTS-APD 500 kV line, Basslink able to transfer FCAS	1816 (151.33)	-377.15 (-459.0)

Constraint Equation ID (System Normal Bold)	Interconnector	Description	#DIs (Hours)	Average Limit (Max)
N^^N_NIL_3	VIC1-NSW1 Export	Out= Nil, limit power flow on line X5 from Balranald to Darlington Point (X5) to avoid voltage collapse for contingency trip of Bendigo-Kerang 220kV line in NW Victoria	1411 (117.58)	453.7 (969.91)
N^^N_NIL_2	V-S-MNSP1 Import	Out=Nil , limit Darlington Point to Wagga line (63) line flow to avoid voltage collapse at Darlington Point 132kV post contingency trip of line 63, Feedback	1245 (103.75)	134.14 (-117.5)
F_MAIN++APD_TL_L5	T-V-MNSP1 Import	Out = Nil, Lower 5 min Service Requirement for a Mainland Network Event-loss of APD potlines due to undervoltage following a fault on MOPS-HYTS-APD 500 kV line, Basslink able to transfer FCAS	1244 (103.67)	-400.53 (-459.0)
V^^N_NIL_1	V-S-MNSP1 Export	Out = Nil, avoid voltage collapse around Murray for loss of all APD potlines	1132 (94.33)	-14.62 (182.77)
V^^N_NIL_1	VIC1-NSW1 Export	Out = Nil, avoid voltage collapse around Murray for loss of all APD potlines	1124 (93.67)	769.52 (978.75)
N^^N_NIL_3	V-S-MNSP1 Import	Out= Nil, limit power flow on line X5 from Balranald to Darlington Point (X5) to avoid voltage collapse for contingency trip of Bendigo-Kerang 220kV line in NW Victoria	1076 (89.67)	123.51 (-152.14)
F_MAIN++APD_TL_L6	T-V-MNSP1 Import	Out = Nil, Lower 6 sec Service Requirement for a Mainland Network Event-loss of APD potlines due to undervoltage following a fault on MOPS-HYTS-APD 500 kV line, Basslink able to transfer FCAS	876 (73.0)	-438.33 (-459.0)
V_S_NIL_ROCOF	V-SA Export	Out = NIL, limit VIC to SA Heywood interconnection flow to prevent Rate of Change of Frequency exceeding 2 Hz/sec in SA immediately following loss of Heywood interconnector. [NOTE: Switches based on ON/OFF status of Dalry Battery in Load Mode)]	743 (61.92)	438.52 (572.67)

2.5 Constraint Automation Usage

The constraint automation is an application in AEMO's energy management system (EMS) which generates thermal overload constraint equations based on the current or planned state of the power system. It is currently used by on-line staff to create thermal overload constraint equations for power system conditions where there were no existing constraint equations or the existing constraint equations did not operate correctly.

The following section details the reason for each invocation of the non-real time constraint automation constraint sets and the results of AEMO's investigation into each case.

Table 6 Non-Real-Time Constraint Automation usage

Constraint Set ID	Date Time	Description
CA_BRIS_4F1FE461	24/01/2021 21:25 to 25/01/2021 09:20	Constraint automation was used to prevent overload on Mobilong to Tailem Bend 132 kV feeder during the outage of Tailem Bend to Cherry Gardens 275 kV line, Cherry Gardens to Mount Barker South 275 kV line and Cherry Gardens to Mount Barker 132 kV lines on trip of Tungkillo to Tailem Bend 275 kV line due to Heywood interconnector not correctly following target.
CA_SYDS_4F1E1FC4	23/01/2021 13:20 to 23/01/2021 16:30	Constraint automation was used to prevent overload on Armidale to Tamworth (86) 330 kV line on trip of the Armidale to Tamworth (85) 330 kV line due to QNI not correctly following target.
CA_BRIS_4F1FDF04	24/01/2021 21:05 to	Constraint automation was used to prevent overload on Tailem Bend #4 transformer during the outage of Tailem Bend to Cherry Gardens 275 kV line, Cherry Gardens to Mount Barker South 275

Constraint Set ID	Date Time	Description
	24/01/2021 21:20	kV line and Cherry Gardens to Mount Barker 132 kV lines on trip of Tungkillo to Tailem Bend 275 kV line due to Heywood interconnector not correctly following target.

2.5.1 Further Investigation

CA_BRIS_4F1FE461: After investigation, recommendation is made to use Dynamic interconnector discretionary constraint sets to resolve the issue.

CA_SYDS_4F1E1FC4: Constraint automation wasn't effective. Discretionary constraints were invoked which resolved the issue.

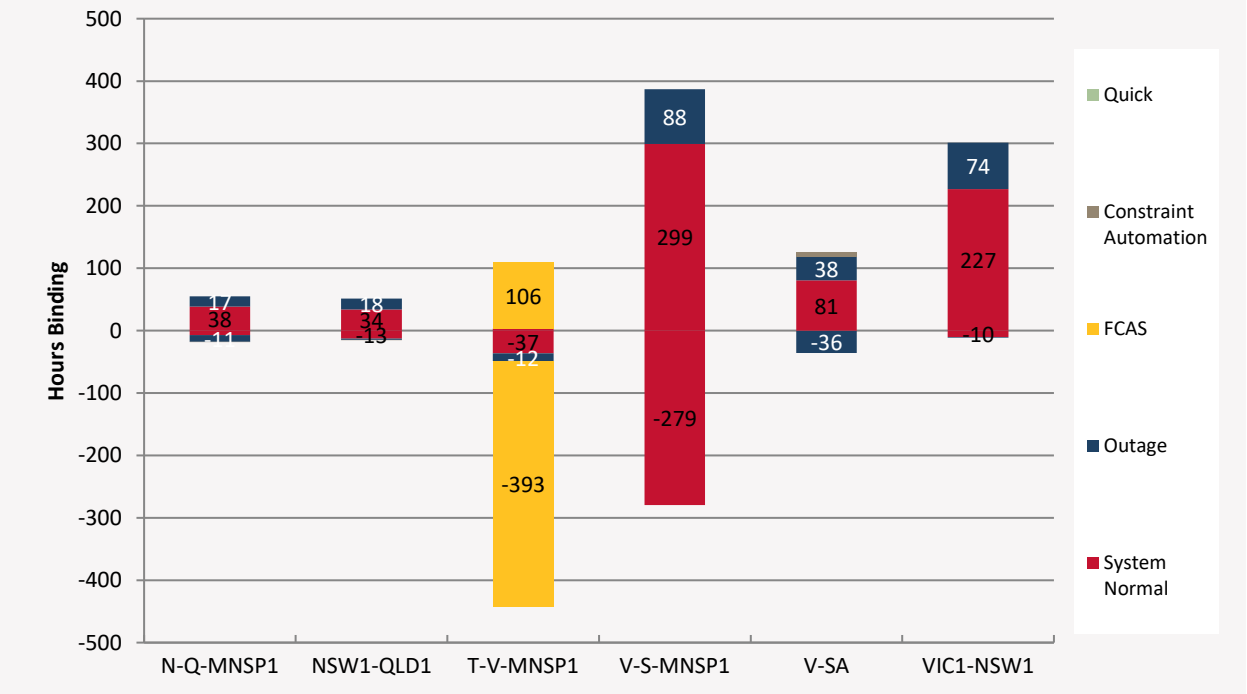
CA_BRIS_4F1FDF04: After investigation, recommendation is made to use Dynamic interconnector discretionary constraint sets to resolve the issue.

2.6 Binding Dispatch Hours

This section examines the number of hours of binding constraint equations on each interconnector and by region. The results are further categorized into five types: system normal, outage, FCAS (both outage and system normal), constraint automation and quick constraints.

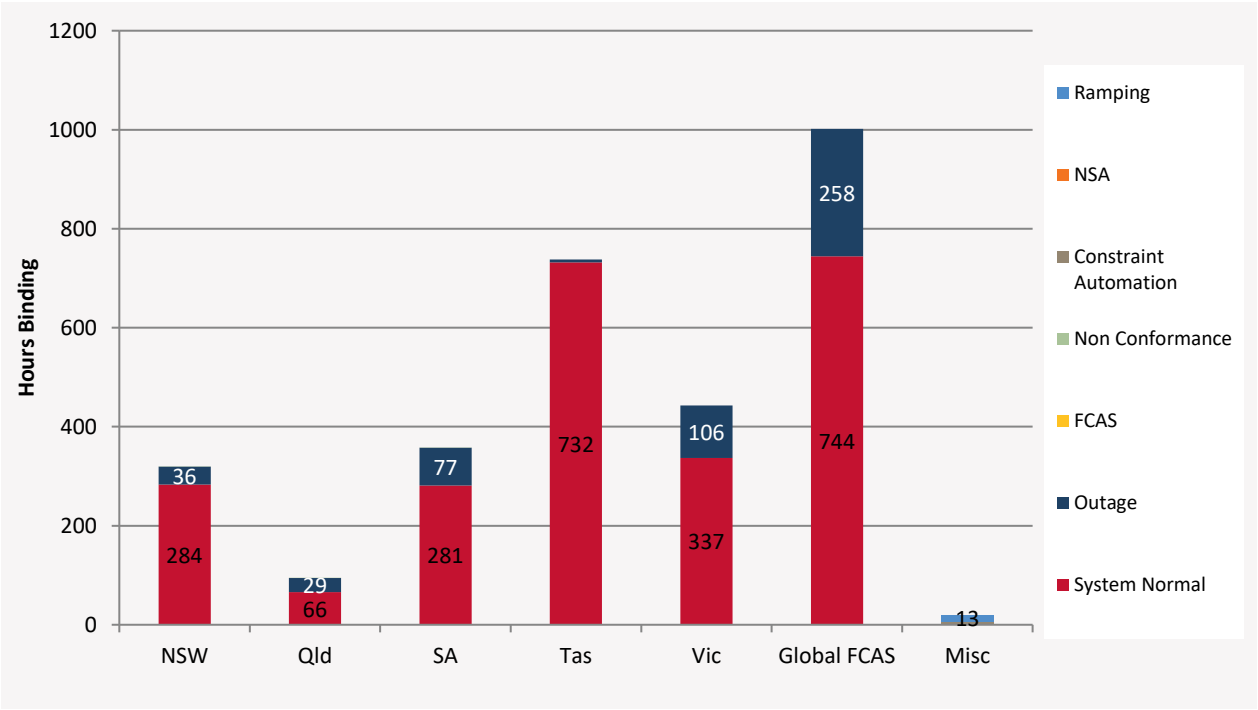
In the following graph the export binding hours are indicated as positive numbers and import with negative values.

Figure 1 Interconnector binding dispatch hours



The regional comparison graph below uses the same categories as in Figure 1 as well as non-conformance, network support agreement and ramping. Constraint equations that cross a region boundary are allocated to the sending end region. Global FCAS covers both global and mainland requirements.

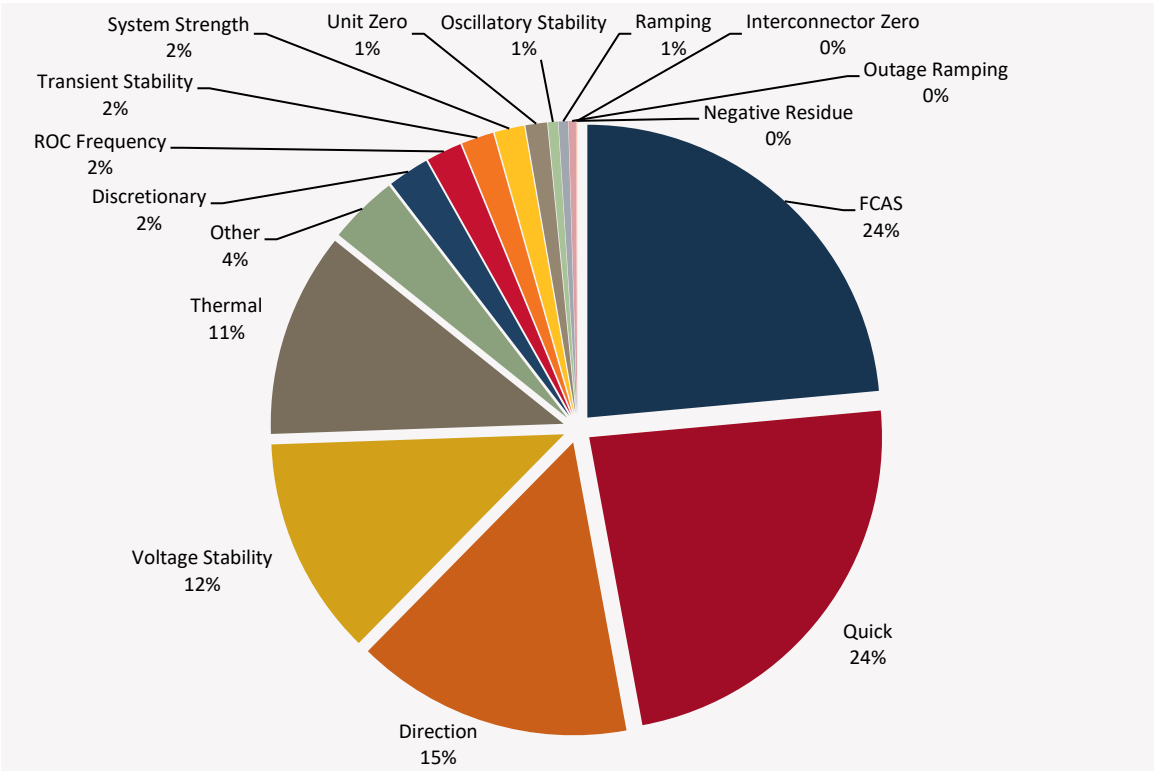
Figure 2 Regional binding dispatch hours



2.7 Binding Constraint Equations by Limit Type

The following pie charts show the percentage of dispatch intervals from for January 2021 that the different types of constraint equations bound.

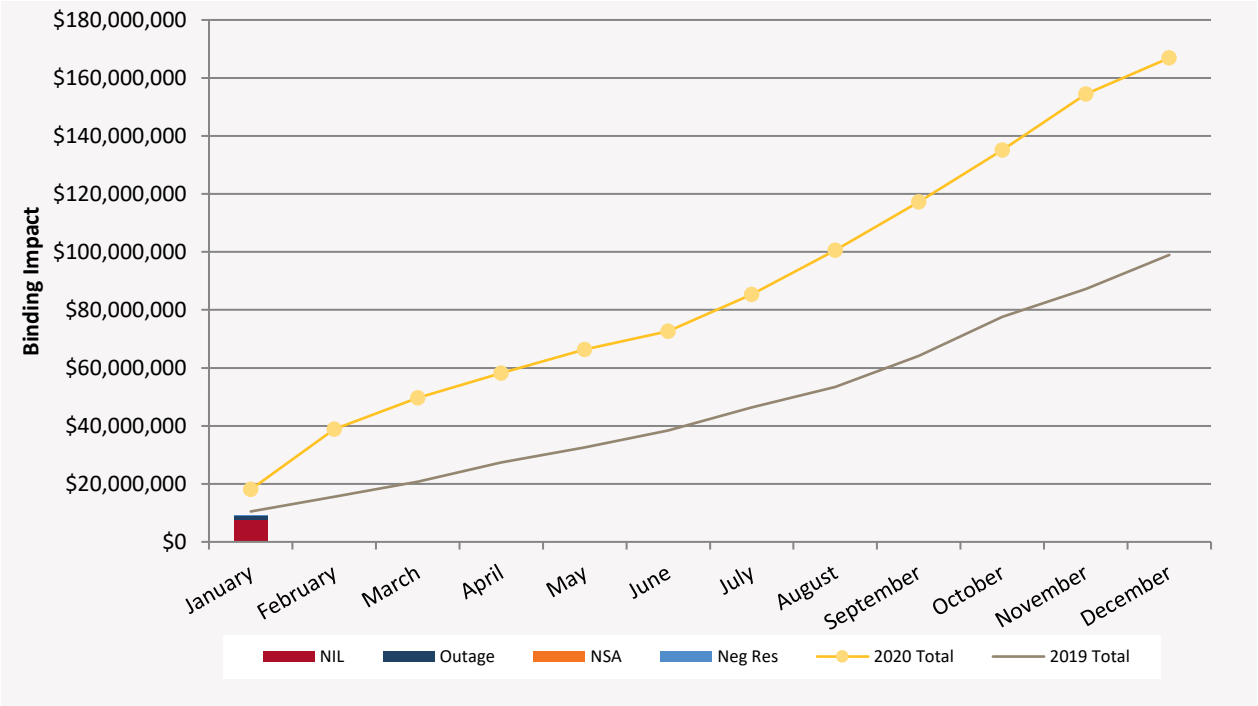
Figure 3 Binding by limit type



2.8 Binding Impact Comparison

The following graph compares the cumulative binding impact (calculated by summating the marginal values from the MCC re-run – the same as in section 2.2) for each month for the current year (indicated by type as a stacked bar chart) against the cumulative values from the previous two years (the line graphs). The current year is further categorised into system normal (NIL), outage, network support agreement (NSA) and negative residue constraint equation types.

Figure 4 Binding Impact comparison



2.9 Pre-dispatch RHS Accuracy

Pre-dispatch RHS accuracy is measured by the comparing the dispatch RHS value and the pre-dispatch RHS value forecast four hours in the future. The following table shows the pre-dispatch accuracy of the top ten largest differences for binding (in dispatch or pre-dispatch) constraint equations. This excludes FCAS constraint equations, constraint equations that violated in Dispatch, differences larger than ±9500 (this is to exclude constraint equations with swamping logic) and constraint equations that only bound for one or two Dispatch intervals. AEMO investigates constraint equations that have a Dispatch/Pre-dispatch RHS difference greater than 5% and ten absolute difference which have either bound for greater than 25 dispatch intervals or have a greater than $1,000 binding impact. The investigations are detailed in 2.9.1.

Table 7 Top 10 largest Dispatch / Pre-dispatch differences

Constraint Equation ID (System Normal Bold)	Description	#DIs	% + Max Diff	% + Avg Diff
V_S_HEYWOOD_UFLS	Out= Nil, Limit Heywood flows when SA under frequency load shedding (UFLS) is insufficient (i.e. when UFLS blocks in SA <1000 MW) to manage for double-circuit loss of Heywood IC.Note: Constraint is swamped if UFLS blocks >= 1000 MW.	86	1,892% (9,498)	219% (985)
V_T_NIL_FCSPS	Basslink limit from Vic to Tas for load enabled for FCSPS	170	647% (386.17)	13.26% (42.92)

Constraint Equation ID (System Normal Bold)	Description	#DIs	% + Max Diff	% + Avg Diff
S>NIL_HUWT_STBG2	Out = Nil; Limit Snowtown WF generation to avoid Snowtown - Bungama line OL on loss of Hummocks - Waterloo line.[Note: Wattle PT trips when generating >=80 MW when Dalymple Battery (i.e. both Gen and Load component) is I/S]	110	383% (153.66)	55.59% (42.25)
V^SML_BUDP_3	Out = Buronga to Balranald (X3) or Balranald to Darlington Pt (X5) 220 kV line, avoid voltage collapse for loss of Bendigo to Kerang 220kV line	4	313% (160.4)	265% (144.55)
V::N_HWSM_V2	Out = Hazelwood to South Morang OR Hazelwood to Rowville 500kV line, prevent transient instability for fault and trip of a HWTS-SMTS 500 kV line, VIC accelerates, Yallourn W G1 on 500 kV.	27	312% (254.04)	83.81% (61.37)
T::T_NIL_1	Out = NIL, prevent transient instability for fault and trip of a Farrell to Sheffield line, Swamp if less than 3 synchronous West Coast units generating or Farrell 220kV bus coupler open or Hampshire 110kV line is closed.	91	194% (255.03)	49.06% (138.82)
V^^SML_NSWRB_2	Out = NSW Murraylink runback scheme, VIC to SA transfer limit on Murraylink to avoid voltage collapse at Red Cliffs for the loss of either the Darlington Point to Balranald (X5) or Balranald to Buronga (X3) 220kV lines	99	164% (273.28)	86.51% (167.81)
N>>N-NIL_94T_947	Out= Nil, avoid O/L Molong to Orange North (94T) on trip of Wellington to Orange North (947), Feedback	353	132.76% (198.27)	16.1% (26.89)
N_X_MBTE_3B	Out= all three Directlink cables, Terranora_I/C_import <= Terranora_Load	17	120.% (30.7)	58.51% (14.5)
N>N-NIL_LSDU	Out = Nil, avoid overloading Lismore to Dunoon line (9U6 or 9U7) on trip of the other Lismore to Dunoon line (9U7 or 9U6), Feedback	66	110.81% (67.54)	49.8% (26.84)

2.9.1 Further Investigation

The following constraint equation(s) have been investigated:

V_S_HEYWOOD_UFLS: Investigated and no improvement can be made to the constraint equation at this stage. Changes to the status of the reactive devices between DS/PD contributes to the PD accuracy.

V_T_NIL_FCSPS: This constraint equation uses analog values for the load enabled for the FCSPS in Pre-dispatch. This value can change quickly in dispatch and this is not possible to predict in Pre-dispatch. No changes proposed.

S>NIL_HUWT_STBG2: Investigated and no improvement can be made to the constraint equation at this stage.

V::N_HWSM_V2: Investigated and no improvement can be made to the constraint equations at this stage.

T::T_NIL_1: Investigated and no improvement can be made to the constraint equation at this stage.

V^^SML_NSWRB_2: Investigated and no improvement can be made to the constraint equation at this stage.

N>>N-NIL_94T_947: Constraint equation is currently under investigation.

N_X_MBTE_3B: Investigated and the mismatch was due to issues with forecasting of the Terranora load. The forecasting of the Terranora load has been improved in November 2018.

N>N-NIL_LSDU: Investigated and the mismatch is due to modelling of DFS and SCADA value on Terranora load. DFS forecasting is being investigated to improve its performance. No improvements can be made to the constraint equation at this stage.

3. Generator / Transmission Changes

One of the main drivers for changes to constraint equations is from power system change, whether this is the addition or removal of plant (either generation or transmission). The following table details changes that occurred in for January 2021.

Table 8 Generator and transmission changes

Project	Date	Region	Notes
Commissioning of 330kV Ravine Substation	9/01/2021	NSW	A network augmentation has been commissioned in the NSW region as follows: Ravine Substation has been cut into the existing Upper Tumut - Yass (02) 330 kV Line to form the following circuits: Upper Tumut - Ravine 6X 330 kV Transmission Line, Ravine - Yass 2 330 kV Transmission Line

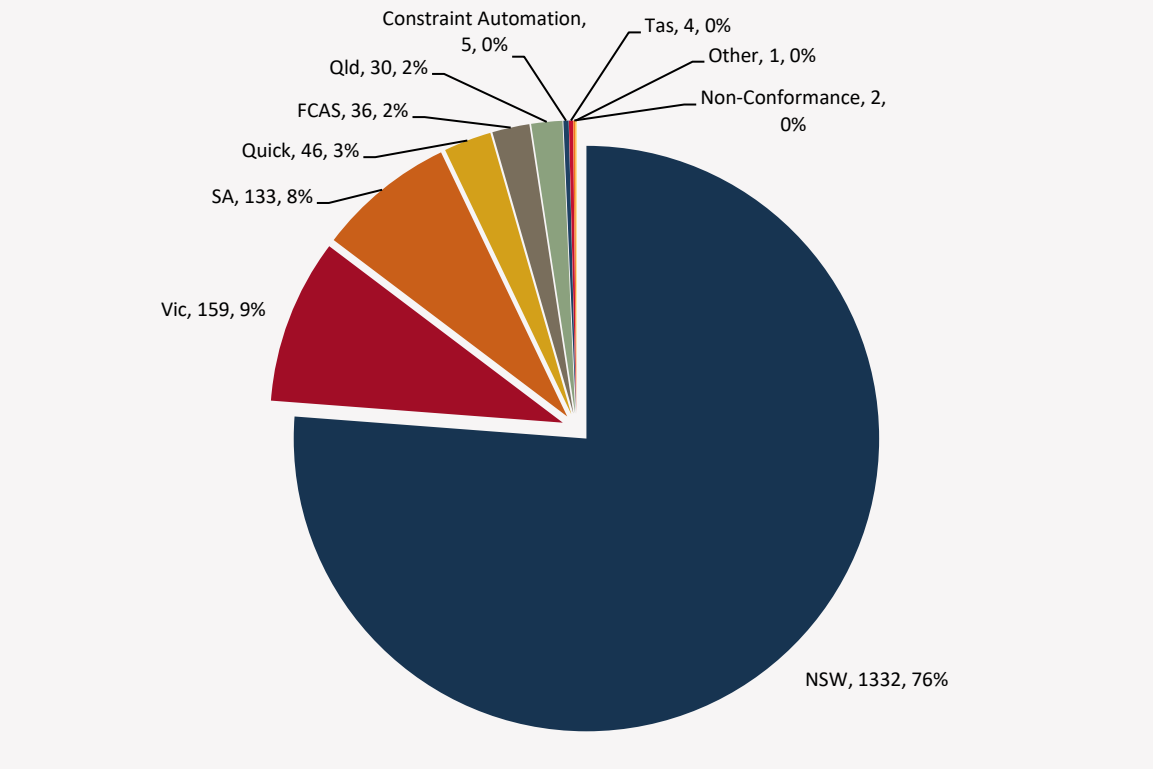
3.1 Constraint Equation Changes

The following pie chart indicates the regional location of constraint equation changes. For details on individual constraint equation changes refer to the Weekly Constraint Library Changes Report[2] or the constraint equations in the MMS Data Model.[3]

[2] AEMO. *NEM Weekly Constraint Library Changes Report*. Available at: http://www.nemweb.com.au/REPORTS/CURRENT/Weekly_Constraint_Reports/

[3] AEMO. *MMS Data Model*. Available at: https://www.aemo.com.au/energy-systems/market-it-systems/nem-guides/wholesale-it-systems-software

Figure 5 Constraint equation changes



The following graph compares the constraint equation changes for the current year versus the previous two years. The current year is categorised by region.

Figure 6 Constraint equation changes per month compared to previous two years