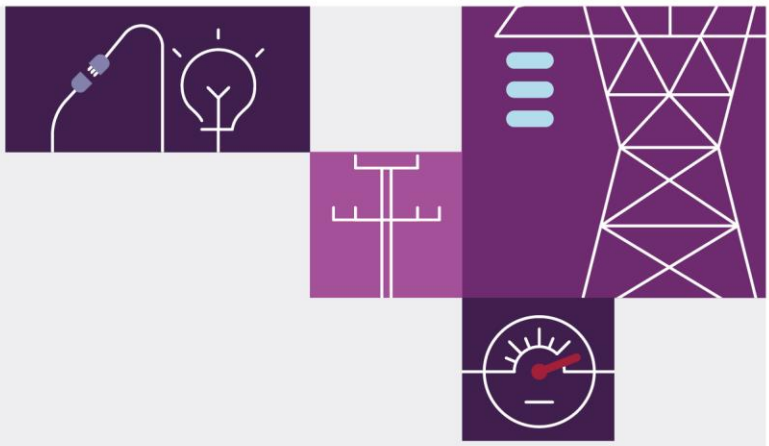
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Monthly Constraint Report

June 2024

A report for the National Electricity Market on Constraint results.



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.

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1 Introduction

This report details constraint equation performance and transmission congestion related issues for June 2024. 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)	Limit Type
N^^V_CTMN_1	Out = Collector - Marulan (4) or Collector - Yass (3L) or Marulan - Yass (5), avoid voltage collapse at Southern NSW for loss of the largest Vic generating unit or Basslink	1310 (109.16)	Voltage Stability
Q_CS_1100	Qld Central to Qld South upper transfer limit of 1100MW (discretionary)	1062 (88.5)	Discretionary
N>>NIL_964_84_S	Out= NIL, avoid O/L Port Macquarie to Herron Creek Tee (964/2) on trip of Tamworth to Liddell (84) line, Feedback	920 (76.66)	Thermal
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	852 (71.0)	Thermal
SVML_ZERO	SA to Vic on ML upper transfer limit of 0 MW	779 (64.91)	Interconnector Zero
N_X_MBTE_3A	Out= all three Directlink cables, Terranora_I/C_import <= Terranora_Load	686 (57.16)	Unit Zero
N_X_MBTE_3B	Out= all three Directlink cables, Terranora_I/C_import <= Terranora_Load	598 (49.83)	Unit Zero
S>>TBTU_TUTB_MOTB	Out= One Tailem Bend - Tungkillo 275kV line, avoid O/L Mobilong-Tailem Bend 132kV line on trip of remaining Tungkillo-Tailem Bend 275kV line, Feedback	598 (49.83)	Thermal
V_VS_LB_HY_50	Limit SA contingency size to 50 MW by limiting Heywood VIC to SA + Lake Bonney WF <= 50 MW when SA is at risk of separation. Constraint swamp out when Lake Bonney tripping scheme is O/S	551 (45.91)	System Strength
N>>NIL_86_85_S	Out= NIL, avoid O/L Armidale to Tamworth (86) on trip of Uralla to Tamworth (85) line, Feedback	470 (39.16)	Thermal

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	Limit Type
S-DLBAT-L_0	Discretionary upper limit for Dalrymple Battery (Load component) of 0 MW	1,427,704	Unit Zero
Q_CS_1100	Qld Central to Qld South upper transfer limit of 1100MW (discretionary)	958,770	Discretionary
V>>NIL_ELML_BAML2	Out= Nil, avoid O/L Elaine to Moorabool 220kV line on trip of Ballarat to Moorabool No.2 220kV line, Feedback	214,874	Thermal
F_T+RREG_0050	Tasmania Raise Regulation Requirement greater than 50 MW	178,667	FCAS
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	171,531	Thermal
V_KIAMSF_FLT_50	Limit Kiamal solar farm upper limit to 50 MW to manage post contingent voltage oscillation	144,658	System Strength
S_ISLE_CRK_10	Discretionary upper limit on Cathedral Rocks windfarm<=10 MW when 2-4 syn cons I/S for SA is at risk of islanding or in islanded mode(Note: this equation is swamped when 0-1 sync cons are I/S)	134,117	Discretionary
V_ARARATWF_FLT_0	Limit Ararat Wind Farm upper limit to 0 MW to manage post contingent voltage oscillation	125,054	System Strength
N^^V_CTMN_1	Out = Collector - Marulan (4) or Collector - Yass (3L) or Marulan - Yass (5), avoid voltage collapse at Southern NSW for loss of the largest Vic generating unit or Basslink	123,982	Voltage Stability
V_MURRAWRWF_FLT_100	Limit Murra Warra Wind Farm 1+2 upper limit to 100 MW to manage system stability on the next contingency due to voltage oscillation	123,289	System Strength

[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.

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 0.

Table 3 Top 10 violating constraint equations

Constraint Equation ID (System Normal Bold)	Description	#DIs (Hours)	Limit Type
Q_STR_7C0K_MEWF_10	Limit 20% to Mt Emerald WF if Stan>=2+Stan+Cal>=3+Glad>=2+ (Stan+Cal+Glad) >=7, NQLD>350&370(AVG),Ross_FN>150&170(AVG), Swamp out if Kareeya >= 2 or Haughton ON. Zero otherwise.	10 (0.83)	System Strength
Q_STR_7C0K_MEWF_3	Limit Mt Emerald WF 80% if Stan>=2+Stan+Cal>=3+Glad>=2+ (Stan+Cal+Glad)>=7,Kar>=2, NQLD>350&370(AVG),Ross_FN>150&170(AVG), no limit if Haughton syncon ON or night,40% if Kar < 2 ,40% if NQLD>250,Ross_FN>100 or 25% if Syncon OFF or Kareeya <2. 0 otherwise	10 (0.83)	System Strength
N_WSTWYSF1_0INV	West Wyalong Solar Farm inverter limit of zero. Constraint to violate if West Wyalong Solar Farm inverter availability greater than zero. Swamp out otherwise. DS only	6 (0.5)	System Strength
Q_STR_7C0K_KBWF_10	Limit 20% to Kaban WF if Stan>=2+Stan+Cal>=3+Glad>=2+ (Stan+Cal+Glad) >=7, NQLD>350&370(AVG),Ross_FN>150&170(AVG), Swamp out if Kareeya >= 2 or Haughton ON. Zero otherwise.	6 (0.5)	System Strength
Q_STR_7C0K_KBWF_2	Limit to Kaban WF 80% if Stan>=2+Stan+Cal>=3+Glad>=2+ (Stan+Cal+Glad)>=7,Kar>=2, NQLD>350&370(AVG),Ross_FN>150&170(AVG), no limit if Haughton syncon ON or night,40% if Kar < 2 ,40% if NQLD>250,Ross_FN>100 or 25% if Syncon OFF or Kar <2, 0 otherwise	6 (0.5)	System Strength
NSA_Q_BARCALDN	Network Support Agreement for Barcaldine GT to meet local islanded demand for the planned outage of 7153 T71 Clermont to H15 Lilyvale or 7154 T72 Barcaldine to T71 Clermont 132kV line	5 (0.41)	Network Support
Q-X>RS2TX_TX_TX_O	Out= Two Ross 275/132 KV transformers, avoid O/L on the remaining Ross 275/132 KV transformer on trip of another Ross 275/132 KV transformer with 132 KV network between Ross and Woree Opened, Feedback	5 (0.41)	Thermal
T_ROCOF_3	Out = NIL, limit non-synchronous generation and Basslink to prevent high Rate of Change of Frequency in TAS following fault and trip of generation during periods of low TAS inertia	4 (0.33)	ROC Frequency
F_T+RREG_0050	Tasmania Raise Regulation Requirement greater than 50 MW	4 (0.33)	FCAS
S_ISLE_CRK_10	Discretionary upper limit on Cathedral Rocks windfarm<=10 MW when 2-4 syn cons I/S for SA is at risk of islanding or in islanded mode(Note: this equation is swamped when 0-1 sync cons are I/S)	3 (0.25)	Discretionary

2.3.1 Reasons for constraint equation violations

Table 4 Reasons for constraint equation violations

Constraint Equation ID (System Normal Bold)	Description
Q_STR_7C0K_MEWF_10	Constraint equation violated for 10 consecutive DIs between 8/06/2024 1140 hrs and 8/06/2024 1225 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Mt Emerald Wind Farm exceeding its MVAr limit.
Q_STR_7C0K_MEWF_3	Constraint equation violated for 10 consecutive DIs between 8/06/2024 1140 hrs and 8/06/2024 1225 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Mt Emerald Wind Farm exceeding its MVAr limit.
N_WSTWYSF1_0INV	Constraint equation violated for 6 non-consecutive DIs between 24/06/2024 0705 hrs and 24/06/2024 1455 hrs with a violation degree of 0.001 MW. Constraint equation violated due to West Wyalong Solar Farm inverter availability exceeding its limit.
Q_STR_7C0K_KBWF_10	Constraint equation violated for 6 non-consecutive DIs between 8/06/2024 1140 hrs and 8/06/2024 1350 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Kaban Wind Farm exceeding its MVAR limit.
Q_STR_7C0K_KBWF_2	Constraint equation violated for 6 non-consecutive DIs between 8/06/2024 1140 hrs and 8/06/2024 1350 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Kaban Wind Farm exceeding its MVAR limit.
NSA_Q_BARCALDN	Constraint equation violated for 5 non-consecutive DIs from 7/06/2024 1005 hrs to 7/06/2024 1720 hrs with a max violation degree of 18.26 MW occurring at 7/06/2024 1020hrs. Constraint equation violated due to Barcaldine GT non-conforming to the Network Service Agreement to meet the local islanded demand requirement.
Q-X>RS2TX_TX_TX_O	Constraint equation violated for 5 consecutive DIs between 12/06/2024 2115 hrs and 12/06/2024 2135 hrs with a max violation degree of 17.9 MW on 12/06/2024 2120 hrs. Constraint equation violated due to Yabulu unit 1 becoming unavailable and ramp rate limit of Kareeya units 1, 2, 3 and 4.
T_ROCOF_3	Constraint equation violated for 4 consecutive DIs between 25/06/2024 1330 hrs and 25/06/2024 1345 hrs with a max violation degree of 276.23 MW on 25/06/2024 1330 hrs. Constraint equation violated due to a SCADA issue combined with an AEMO market systems site failover.
F_T+RREG_0050	Constraint equation violated for 1 DI on 24/06/2024 1115 hrs and 3 consecutive DIs on 25/06/2024 1330 hrs, 1335 hrs 1340 hrs with a max violation degree of 50 MW on the 3 consecutive DIs between 25/06/2024 1330 hrs and 25/06/2024 1340 hrs. Constraint equation violated on 24/06/2024 1115 hrs due Tasmania raise regulation service availability being less than the requirement and violated between 25/06/2024 1330 hrs and 25/06/2024 1340 hrs due to a SCADA issue.
S_ISLE_CRK_10	Constraint equation violated for 3 consecutive DIs on 10/06/2024 0815 hrs, 10/06/2024 0820 hrs and 10/06/2024 0825 hrs with a max violation of 25.7 MW on 10/06/2024 0825 hrs. Constraint equation violated due to non-conformance of Cathedral Rocks Wind Farm.

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)
N^^V_CTMN_1	VIC1-NSW1 Import	Out = Collector - Marulan (4) or Collector - Yass (3L) or Marulan - Yass (5), avoid voltage collapse at Southern NSW for loss of the largest Vic generating unit or Basslink	1309 (109.08)	-282.02 (-813.39)
N^^V_CTMN_1	V-S-MNSP1 Import	Out = Collector - Marulan (4) or Collector - Yass (3L) or Marulan - Yass (5), avoid voltage collapse at Southern NSW for loss of the largest Vic generating unit or Basslink	1302 (108.5)	100.35 (-45.0)
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	1003 (83.58)	-369.85 (-478.0)
N>>NIL_964_84_S	N-Q-MNSP1 Import	Out= NIL, avoid O/L Port Macquarie to Herron Creek Tee (964/2) on trip of Tamworth to Liddell (84) line, Feedback	880 (73.33)	25.31 (-147.24)
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	851 (70.92)	158.95 (182.2)
N>>NIL_964_84_S	NSW1-QLD1 Import	Out= NIL, avoid O/L Port Macquarie to Herron Creek Tee (964/2) on trip of Tamworth to Liddell (84) line, Feedback	713 (59.42)	-1012.81 (-1297.16)
N_X_MBTE_3A	N-Q-MNSP1 Export	Out= all three Directlink cables, Terranora_I/C_import <= Terranora_Load	686 (57.17)	-25.87 (12.5)
F_T++NIL_ML_L6	T-V-MNSP1 Export	Out = Nil, Lower 6 sec requirement for a Tasmania Load Event, Basslink able to transfer FCAS	608 (50.67)	219.85 (564.51)
SVML_ZERO	V-S-MNSP1 Import	SA to Vic on ML upper transfer limit of 0 MW	602 (50.17)	0.0 (0.0)
N_X_MBTE_3B	N-Q-MNSP1 Import	Out= all three Directlink cables, Terranora_I/C_import <= Terranora_Load	598 (49.83)	-18.04 (-47.3)

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 1 – Non-Real-Time Constraint Automation usage

Constraint Set ID	Date Time	Description
CA_SYDS_5589CE0E	23/06/2024 07:40 to 23/06/2024 07:40	CA_SYDS_5589CE0E was built to manage the overloading of Tallawarra – Dapto 983 132 kV line on trip of Tallawarra – Dapto 987 132 kV line.
CA_SYDS_5590C0E2	28/06/2024 14:00 to 28/06/2024 15:30	CA_SYDS_5590C0E2 was built to manage the overloading of ARTS – CWTS 220 kV line after CA violations were observed on this line for the contingency of BETS – KGTS 220 kV line.

2.5.1 Further Investigation

CA_SYDS_5589CE0E: Constraint automation equation was invoked and binding. CA_SYDS_5589CE0E was built after CA violations were observed. Constraint automation equation was revoked at 0740 hrs due to Tallawarra B receiving a target of 190 MW while it was generating 309 MW. Quick constraint #NSW1_E_20240623 was invoked at 0750 hrs to manage the thermal overloading issue. #NSW1_E_20240623 was revoked at 0905 hrs after both Tallawarra units A and B went out of service. Constraint equation N>NIL_983_987 was built to manage the issue in the future.

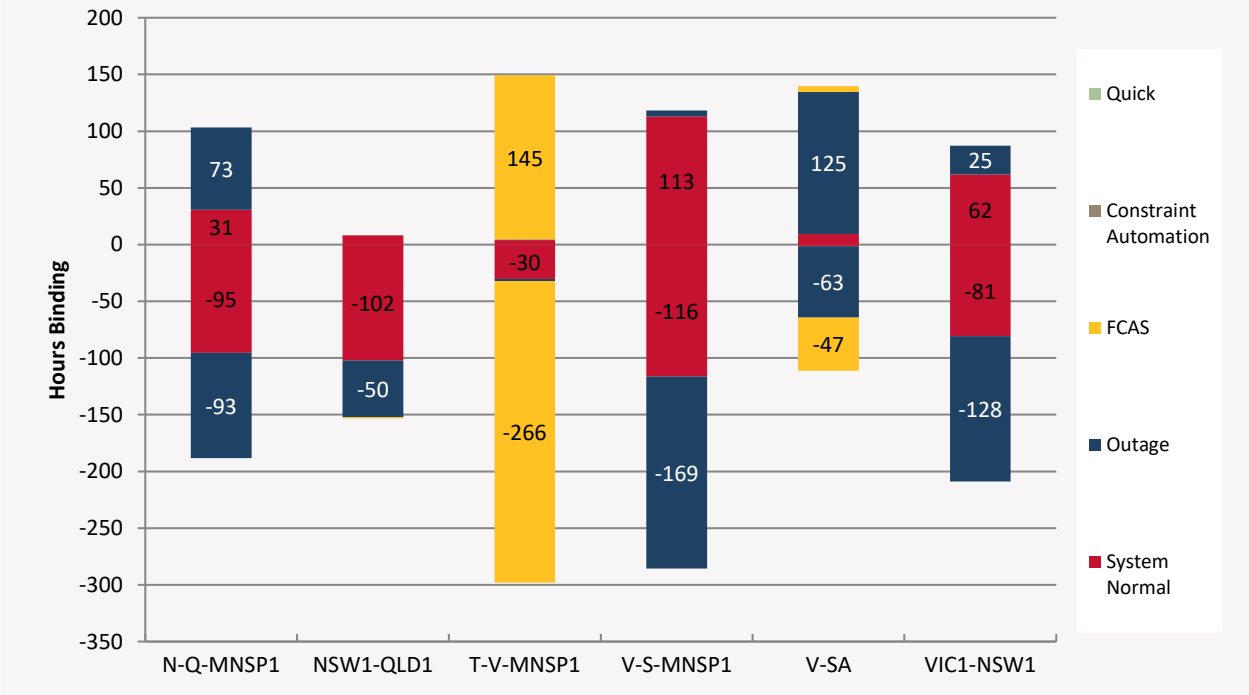
CA_SYDS_5590C0E2: Constraint automation equation was invoked and binding. CA_SYDS_5590C0E2 was built after CA violations were observed. Constraint equation reduced flows on of ARTS – CWTS 220 kV line. CA_SYDS_5590C0E2 was revoked at 1530 hrs after constraint equation V>>NIL_CWAR_KGBE was built to manage this thermal issue in the future.

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.

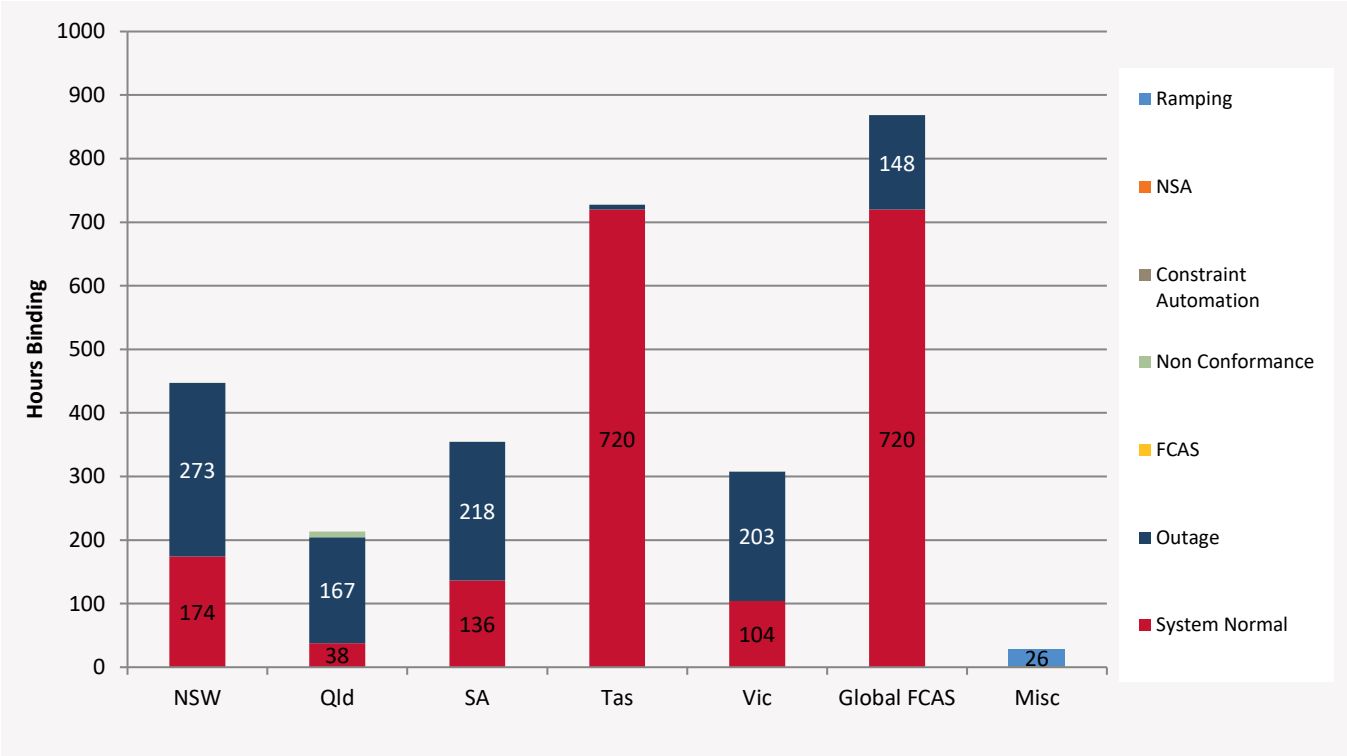
In the following graph the export binding hours are indicated as positive numbers and import with negative values.

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.

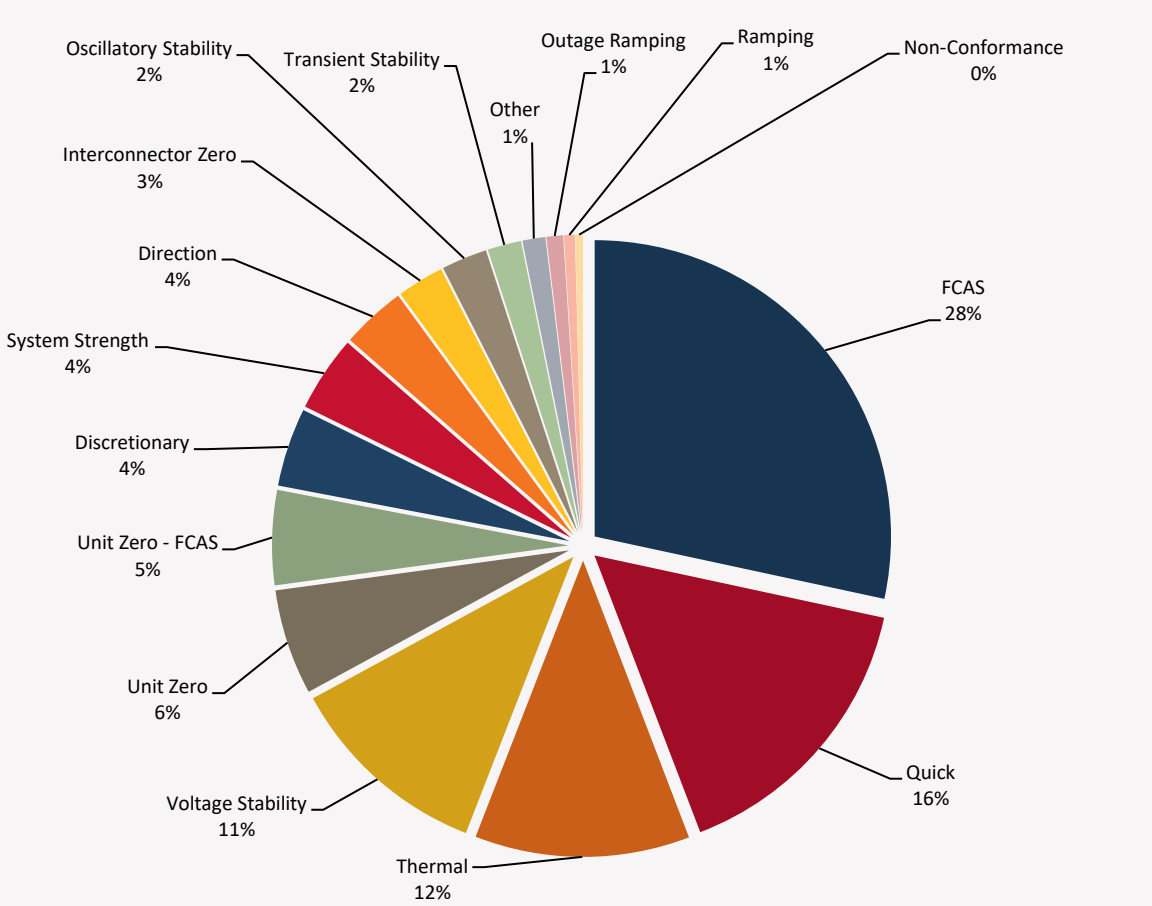
Figure 2 Regional binding dispatch hours



2.7 Binding Constraint Equations by Limit Type

The following pie charts show the percentage of dispatch intervals for June 2024 that the different types of constraint equations bound.

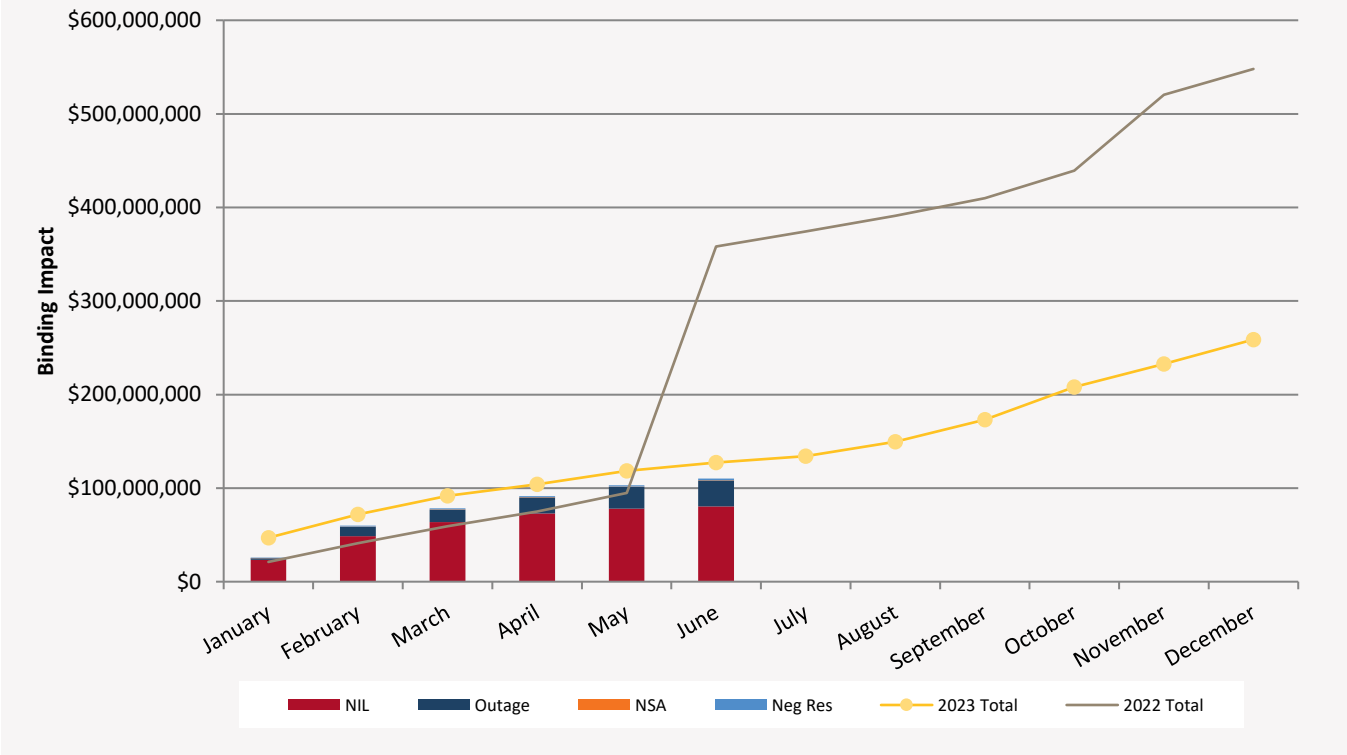
Figure 3 Binding by limit type



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 0.

Table 6 Top 10 largest Dispatch / Pre-dispatch differences

Constraint Equation ID (System Normal Bold)	Description	#DIs	% + Max Diff	% + Avg Diff
N>N_LSDU_9U6_1	Out= one of Lismore 132 to Dunoon 132kV line (9U6 or 9U7), avoid O/L the remaining 132kV line, NSW to Qld limit	16	16,469% (68.75)	1,171% (45.46)
N^^V_BURC_1	Out = Buronga to Red Cliffs (0X1) 220kV line, avoid voltage collapse at Southern NSW for loss of the largest Vic generating unit or Basslink	4	2,503% (120.47)	684% (73.42)
V::N_HYSE_V1	Out = Heywood to South East 275kV line, prevent transient instability for fault and trip of a HWTS-SMTS 500 kV line, VIC accelerates, Yallourn W G1 on 220 kV.	6	2,058% (449.36)	1,032% (317.71)
N_X_MBTE_3A	Out= all three Directlink cables, Terranora_I/C_import <= Terranora_Load	133	1,060% (28.2)	69.15% (6.67)
N_X_MBTE_3B	Out= all three Directlink cables, Terranora_I/C_import <= Terranora_Load	138	940% (28.2)	93.4% (7.68)
V::N_NIL_O1	Out = NIL, prevent transient instability for fault and trip of a HWTS-SMTS 500 kV line, Other than VIC accelerates. Yallourn W G1 on 220kV.	42	937% (461.25)	89.11% (125.94)
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	9	915% (46.88)	156% (31.23)
V::N_HYSE_V2	Out = Heywood to South East 275kV line, prevent transient instability for fault and trip of a HWTS-SMTS 500 kV line, VIC accelerates, Yallourn W G1 on 500 kV.	4	795% (405.41)	363% (311.03)
V::N_NIL_O2	Out = NIL, prevent transient instability for fault and trip of a HWTS-SMTS 500 kV line, Other than VIC accelerates. Yallourn W G1 on 500kV.	39	682% (436.22)	91.39% (136.73)

2.9.1 Further Investigation

The following constraint equation(s) have been investigated:

N>N_LSDU_9U6_1: Under investigation and will be improved if possible.

N^^V_BURC_1: Investigated and no improvement can be made to the constraint equation at this stage.

V::N_NIL_O1: Investigated and no improvement can be made to the constraint equation at this stage.

V::N_NIL_O2: Investigated and no improvement can be made to the constraint equation at this stage.

N_X_MBTE_3A: 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_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.

V^SML_BUDP_3: Investigated and no improvement can be made to the constraint equation at this stage.

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

N>NIL_94T_947:

V^^SML_NIL_3: Investigated and no improvement can be made to the constraint equation at this stage.

S>NIL_NWRB2_NWRB1: Under investigation and will be improved if possible.

N>NIL_9R6_9R5: Under investigation and will be improved if possible.

S>NIL_MHNW1_MHNW2: Under investigation and will be improved if possible.

Q>MUTX_916_MUTX: Under investigation and will be improved if possible.

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

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

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

S>>TBTU_TUTB_TBT4: Investigated and no improvement can be made to the constraint equation at this stage.

Q>NIL_TV66: Investigated and no improvement can be made to the constraint equation at this stage.

N^^V_MLNK_1: Investigated and no improvement 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 June 2024.

Table 7 Generator and transmission changes

Project	Date	Region	Notes
H90 Tully South 275 kV Switching Station	1 June 2024	QLD	Network augmentation commissioned. Ross-Woree No. 8905 275 kV line has been replaced with H13 Ross-H90 Tully South 8905/1 275 kV line and H90 Tully South - H39 Woree 8905/2 275 kV line
H20 Broadsound 275 kV Bus Reactor 1	5 June 2024	QLD	Network augmentation commissioned
H90 Tully South – T048 Tully 7162 132kV line and **H90 Tully South No.1 275kV /132 kV transformer**	21 June 2024	QLD	Network augmentation commissioned

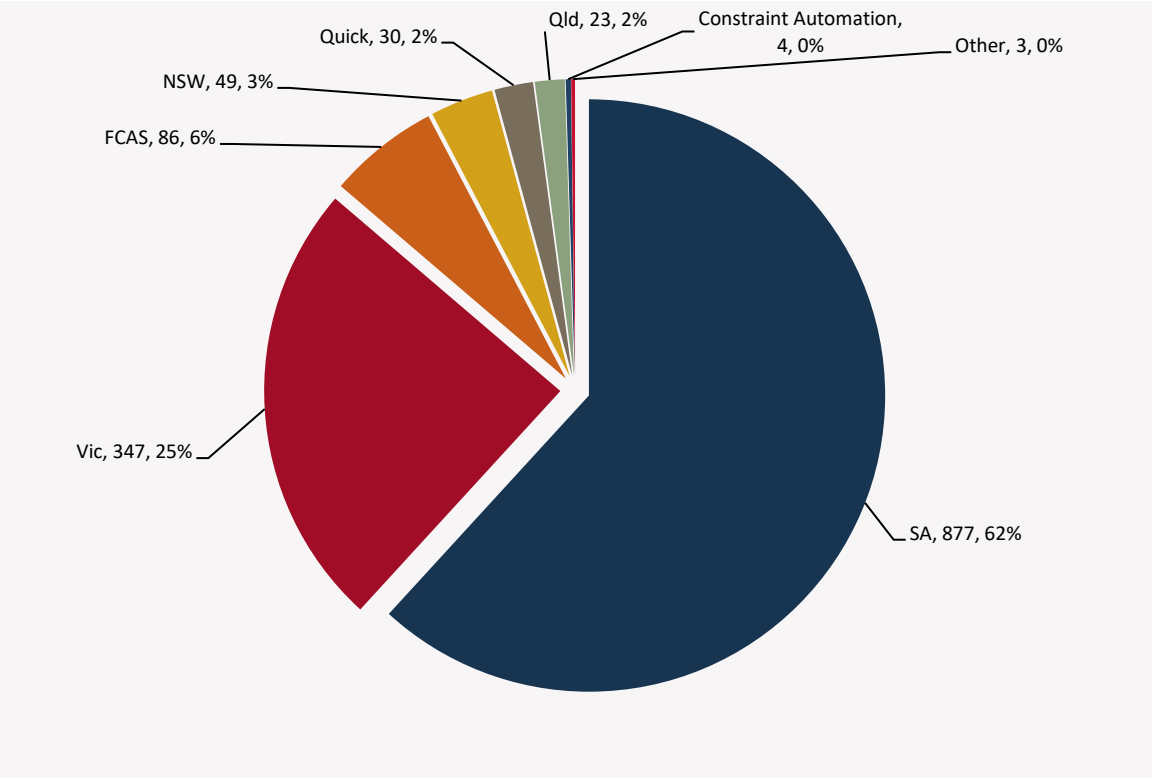
3.1 Constraint Equation Changes

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