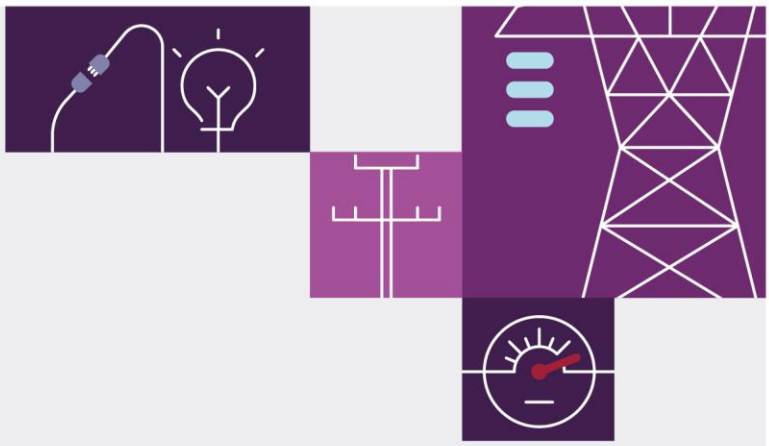
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Monthly Constraint Report

February 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 February 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^N-LS_SVC	Out= Lismore SVC O/S or reactive power control mode,avoid Voltage collapse on TL 87/89 trip;[Swamped for 3 DLK cables are O/S Or when ECS is enabled with DLK is exporting to QLD,sets DLK to -29 MW for -29< DLK FLOW<0, checks ETS status & unswamps if O/S)	3460 (288.33)	Voltage Stability
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	2965 (247.08)	Thermal
V^^V_NIL_KGTS	Out= Nil, avoid voltage collapse for loss of Horsham - Murra Warra - Kiamal 220kV line. Murraylink VFRB disabled. Swamp if Murraylink VFRB enabled.	2928 (244.0)	Voltage Stability
N>NIL_94T	Out= Nil, avoid O/L Molong to Orange North (94T) on trip of Nil, Feedback	2531 (210.91)	Thermal
N>>NIL_970_051	Out= NIL, avoid O/L Burrinjuck to Yass (970) on trip of Wagga to Lower Tumut (051) line, Feedback	2319 (193.25)	Thermal
N>NIL_969	Out= Nil, avoid O/L Gunnedah to Tamworth (969) on trip of Nil, Feedback. Metering is used as specified in OM520 [Note: swamped with 96M or 9UJ or 9UH is O/S]	2072 (172.66)	Thermal
N>NIL_9R6_991	Out= Nil, avoid O/L Wagga North to Wagga (9R6) 132kV line on trip of Wagga North to Murrumburrah (991) 132kV line, Feedback	2045 (170.41)	Thermal
Q_STR_7C0K_HASF_2	No limit to Haughton Solar Farm if Stan>=2+Stan+Cal>=3+Glad>=2+ (Stan+Cal+Glad) >=7, NQLD>250&270(AVG),Ross_FN>100&120(AVG),Haughton Syncon is ON, Zero otherwise.	1555 (129.58)	System Strength
Q>NIL_EMCM_6056	Out= NIL, avoid thermal overload on Emerald to Comet (6056) 66 kV Feeder	1194 (99.5)	Thermal
N>NIL_PKTX_LV	Out= Nil, avoid O/L either Parkes 132kV/66kV Transformer on NIL trip, Feedback.	1060 (88.33)	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-G_0	Discretionary upper limit for Dalrymple Battery (generation component) of 0 MW	5,760,200	Unit Zero
N>>NIL_970_051	Out= NIL, avoid O/L Burrinjuck to Yass (970) on trip of Wagga to Lower Tumut (051) line, Feedback	4,736,347	Thermal
N>NIL_94T	Out= Nil, avoid O/L Molong to Orange North (94T) on trip of Nil, Feedback	3,528,151	Thermal
V^^V_NIL_KGTS	Out= Nil, avoid voltage collapse for loss of Horsham - Murra Warra - Kiamal 220kV line. Murraylink VFRB disabled. Swamp if Murraylink VFRB enabled.	2,330,152	Voltage Stability
N>NIL_969	Out= Nil, avoid O/L Gunnedah to Tamworth (969) on trip of Nil, Feedback. Metering is used as specified in OM520 [Note: swamped with 96M or 9UJ or 9UH is O/S]	2,108,691	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	1,937,961	Thermal
N>NIL_9R5_9R6_N	Out= NIL, avoid O/L Wagga330 to Wagga North (9R5) 132kV line on trip of Wagga132 to Wagga North (9R6) 132kV line, Feedback	1,606,776	Thermal
N>NIL_9R6_991	Out= Nil, avoid O/L Wagga North to Wagga (9R6) 132kV line on trip of Wagga North to Murrumburrah (991) 132kV line, Feedback	1,604,698	Thermal
N>NIL_94K_1	Out= Nil, avoid O/L Suntop Tee to Wellington (94K/1) on trip of Nil, Feedback	618,287	Thermal
S>NIL_HUWT_STBG3	Out = Nil; Limit Snowtown WF generation to avoid Snowtown - Bungama line OL on loss of Hummocks - Waterloo line.[Note: Constraint Swamped when Wattle PT when generating >=60 MW)	611,372	Thermal

[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
N>NIL_9R5_9R6_N	Out= NIL, avoid O/L Wagga330 to Wagga North (9R5) 132kV line on trip of Wagga132 to Wagga North (9R6) 132kV line, Feedback	29 (2.41)	Thermal
NRM_QLD1_NSW1	Negative Residue Management constraint for QLD to NSW flow	22 (1.83)	Negative Residue
N>NIL_9R6_9R5_N	Out= NIL, avoid O/L Wagga132 to Wagga North (9R6) 132kV line on trip of Wagga330 to Wagga North (9R5) 132kV line, Feedback	17 (1.41)	Thermal
V>>NIL_DDSM_DDSM_SIP	Out = Nil, avoid O/L either Dederang to South Morang 330 kV line (flow South) for trip of the parallel line, 5 min line rating, feedback. Swamp if SIPS not available	13 (1.08)	Thermal
V>>NIL_MLGT_MLGT_R2	Out = NIL, avoid O/L Moorabool to Geelong #1 or #2 on trip of other Moorabool to Geelong line, Yallourn W Unit 1 in 220 kV mode, Feedback	12 (1.0)	Thermal
V>>NIL_MLGT_MLGT_R5	Out = NIL, avoid O/L Moorabool to Geelong #1 or #2 on trip of other Moorabool to Geelong line, Yallourn W Unit 1 in 500 kV mode, Feedback	12 (1.0)	Thermal
T>T_NIL_BL_IMP_5F	Out = Nil, avoid O/L Hadspen to Georgetown No. 1 220 kV line (flow to North) for trip of the Hadspen to Georgetown No. 2 220 kV line with no SPS action, feedback	12 (1.0)	Thermal
T>T_X_FA_BUS_FASH_1	Out = Farrell 220 kV bus and one Farrell - Sheffield 220 kV line, both Farrell 220/110 kV txfmrs in service, West Coast 110/220 kV parallel closed, avoid O/L Farrell to Que to Waratah Tee 110 kV lines for loss of remaining FA-SH 220 kV line	9 (0.75)	Thermal
V>>NIL_EPTT_DDSM_SIP	Out= Nil, avoid O/L Eildon to Thomastown 220kV line on trip of one Dederang to South Morang 330kV line, 5 min line rating, Feedback. Swamp if SIPS not available	7 (0.58)	Thermal
F_T+RREG_0050	Tasmania Raise Regulation Requirement greater than 50 MW	5 (0.41)	FCAS

2.3.1 Reasons for constraint equation violations

Table 4 Reasons for constraint equation violations

Constraint Equation ID (System Normal Bold)	Description
N>NIL_9R5_9R6_N	Constraint equation violated for 29 non-consecutive DIs on 4/02/2024 1830 hrs to 29/02/2024 1855 hrs with a max violation degree of 25.12 MW occurring at 22/02/2024 1835 hrs. Constraint equation violated due to Uranquinty GT units 1, 2, 3 and 4 being limited by their ramp down rate.
NRM_QLD1_NSW1	Constraint equation violated for 6 consecutive DIs on 23/02/2024 1735 hrs to 1800 hrs, and an additional 16 non-consecutive DIs on 2/02/2024 1900 hrs to 26/2/2024 1800 hrs with a max violation degree of 116.26 MW occurring on 23/02/2024 1815 hrs. Constraint equation violated due to competing requirement on the export limits of QNI set by N>>NIL_33_34, and export limits of DirectLink set by N^N-LS_SVC.
N>NIL_9R6_9R5_N	Constraint equation violated for 17 non-consecutive DIs on 4/02/2024 1830 hrs to 29/02/2024 1855 hrs with a max violation degree of 21.85 MW occurring on 22/02/2024 1835 hrs. Constraint equation violated due to Uranquinty GT units 1, 2, 3 and 4 being limited by their ramp down rate.
V>>NIL_DDSM_DDSM_SIP	Constraint equation violated for 13 consecutive DIs on 13/02/2024 from 1320 hrs to 1425 hrs with a max violation degree of 478.63 MW occurring on 13/02/2024 1325 hrs. Constraint equation violated due to a major power system event involving the loss of largest power station in Victoria, and trip of Moorabool to Sydenham 500 kV Line 1 and Line 2. To maintain supply in Victoria, imports via VNI, Heywood and Basslink increased to a level where flows on the Dederang to South Morang 330 kV Line 1 or Line 2 exceeded its post-contingency MVA limit.
V>>NIL_MLGT_MLGT_R2	Constraint equation violated for 12 consecutive DIs on 13/02/2024 1320 hrs to 1430 hrs with a max violation degree of 1261.63 MW occurring on 13/02/2024 1415 hrs. Constraint equation violated for the same reason as V>>NIL_DDSM_DDSM_SIP. In addition, constraint violation was caused by competing requirements on export limits of Heywood interconnector set by V::S_BLKRG_MAXG_2, export limits on Murraylink interconnector set by V^^SML_NSWRB_2, and export limits on VNI set by V>>N_NIL_65_66.
V>>NIL_MLGT_MLGT_R5	Constraint equation violated for 12 non-consecutive DIs on 13/02/2024 1320 hrs to 13/02/2024 1430 hrs with a max violation degree of 1261.63 MW occurring on 13/02/2024 1415 hrs. Constraint equation violated for the same reason as V>>NIL_DDSM_DDSM_SIP. Imports via VNI, Heywood and Basslink increased to a level where flows on the Moorabool to Geelong 220 kV Line 1 or Line 2 exceeded its post-contingency MVA limit.
T>T_NIL_BL_IMP_5F	Constraint equation violated for 9 consecutive DIs on 13/02/2024 from 1340 hrs to 1340 hrs to 1420 hrs, and an additional 3 non-consecutive DIs on 13/02/2024 1320 hrs, 1325 hrs and 1330 hrs with a max violation degree of 1.14 MW occurring on 13/02/2024 1355 hrs. Constraint equation violated due to Hadspen to Georgetown 220 kV Line 1 exceeding its post-contingency MVA limit to support increased Basslink Flows.
T>T_X_FA_BUS_FASH_1	Constraint equation violated for 6 consecutive DIs on 13/02/2024 from 1400 hrs to 1425 hrs, and an additional 3 non-consecutive DIs on 13/02/2024 1325 hrs, 1330 hrs and 1340 hrs with a max violation degree of 32.14 MW occurring on 13/02/2024 1340 hrs. Constraint equation violated for the same reason as T>T_NIL_BL_IMP_5F.
V>>NIL_EPTT_DDSM_SIP	Constraint equation violated for 7 non-consecutive DIs on 13/02/2024 1320 hrs to 13/02/2024 1405 hrs with a max violation degree of 35.74 MW occurring on 13/02/2024 1325 hrs. Constraint equation violated for the same reason as V>>NIL_DDSM_DDSM_SIP. Imports via VNI, Heywood and Basslink increased to a level where flows on the Eildon to Thomastown 220 kV Line 1 exceeded its post-contingency MVA limit.
F_T+RREG_0050	Constraint equation violated for 5 non-consecutive DIs on 13/02/2024 1320 hrs to 22/02/2024 1020 hrs with a max violation degree of 50 MW occurring on 13/02/2024 1320 hrs and 13/02/2024 1340 hrs. Constraint equation violated due to Tasmania's raise regulation service availability being less than the requirement.

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^N-LS_SVC	N-Q-MNSP1 Export	Out= Lismore SVC O/S or reactive power control mode,avoid Voltage collapse on TL 87/89 trip;[Swamped for 3 DLK cables are O/S Or when ECS is enabled with DLK is exporting to QLD,sets DLK to -29 MW for -29< DLK FLOW<0, checks ETS status & unswamps if O/S)	3346 (278.83)	-67.05 (93.26)
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	2955 (246.25)	169.77 (219.06)
V^^V_NIL_KGTS	V-S-MNSP1 Import	Out= Nil, avoid voltage collapse for loss of Horsham - Murra Warra - Kiamal 220kV line. Murraylink VFRB disabled. Swamp if Murraylink VFRB enabled.	2281 (190.08)	157.37 (-139.21)
N>>NIL_970_051	VIC1-NSW1 Export	Out= NIL, avoid O/L Burrinjuck to Yass (970) on trip of Wagga to Lower Tumut (051) line, Feedback	2134 (177.83)	-120.34 (1036.07)
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	1849 (154.08)	-435.85 (-478.0)
F_MAIN++LREG_0210	T-V-MNSP1 Import	Mainland Lower Regulation Requirement greater than 210 MW, Basslink able transfer FCAS	1121 (93.42)	-428.66 (-478.0)
F_MAIN++BIP_ML_L1	T-V-MNSP1 Import	Out = Nil, Lower 1 sec requirement for a Mainland Load Event, for loss of the largest Boyne Island potline, Basslink able transfer FCAS. Requirement capped at 125 MW	969 (80.75)	-442.83 (-478.0)
V>>X_MLSY_MLTS_TX	V-SA Export	Out = Both Moorabool - Sydenham (MLTS - SYTS) 500kV lines, EMTT disabled, Limit total flow on both Moorabool A1 and A2 txfmrs to <= 250 MW. Feedback	907 (75.58)	-51.72 (455.64)
NRM_NSW1_VIC1	VIC1-NSW1 Import	Negative Residue Management constraint for NSW to VIC flow	746 (62.17)	-85.65 (-838.42)
N>>NIL_33_34	NSW1-QLD1 Export	Out= Nil, avoid Bayswater to Liddell (33 or 34) O/L on loss of other Bayswater to Liddell (34 or 33), Feedback	606 (50.5)	242.12 (626.47)

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_BRIS_54E840BA	21/02/2024 18:35 to 22/02/2024 11:55	CA_BRIS_54E840BA was created to manage the overloading of Deerpark to Keilor 220 kV Line 2 for the trip of Bendigo to Shepparton 220 kV Line.
CA_BRIS_54F2ABFD	29/02/2024 16:15 to 01/03/2024 18:30	CA_BRIS_54F2ABFD was built to manage the overloading of 3L Line for NIL trip.
CA_SYDS_54DD76EB	13/02/2024 14:10 to 13/02/2024 15:05	CA_SYDS_54DD76EB was created to manage the overloading of Dederang to South Morang 330 kV 1 Line for the trip of Dederang to South Morang 330 kV 2 Line.
CA_SYDS_54F10C1F	28/02/2024 10:40 to 28/02/2024 11:30	CA_SYDS_54F10C1F was built to manage the overloading of Deerpark to Geelong 220 kV Line, Geelong to Kerang No.1 and No.3 220 kV Lines for the trip of Moorabool to Sydenham No.1 500 kV Line.
CA_BRIS_54F2D1C0	29/02/2024 18:55 to 01/03/2024 17:10	CA_BRIS_54F2D1C0 was built to manage the overloading of 7 Line for the loss of 3 Line.

2.5.1 Further Investigation

CA_BRIS_54E840BA: Constraint automation equation was invoked and binding. CA_BRIS_54E840BA reduced flows around Dederang terminal station. Constraint automation equation was revoked after new constraint V>>MLSY_KTDPT_KTGT was built to manage future violation issues.

CA_BRIS_54F2ABFD: Constraint automation equation was invoked and binding. CA_BRIS_54F2ABFD was built due to the base case showing >100% violation for 3L Line, coupled with an unsuccessful rerating of 3L Line due to high daily temperatures. Constraint automation equation was revoked with the constraint N>>NIL_3L built to manage future violation issues.

CA_SYDS_54DD76EB: Constraint automation equation was invoked and binding. During the event, the constraint automation equation did not clear all security violations and required existing constraints to be modified to accommodate the unique technical requirements following the trip of Moorabool to Sydenham 500 kV Line 1 and Line 2. Constraint automation equation was revoked at 13/02/2024 1505 hrs, and constraint equations in the set V-X_MLSY were modified to manage future violation issues.

CA_SYDS_54F10C1F: Constraint automation equation was invoked and binding. CA_SYDS_54F10C1F was revoked at 1130 hrs following investigation that Dundonnell Wind Farm Generator Fast Trip Scheme, and Stockyard Hill Wind Farm Generator Fast Trip Scheme would alleviate the overloading. The constraint equations V>>MLSY_GTDPT_MLSY and V>>MLSY_GTKT_MLSY were built, with Dundonnell Wind Farm, and Stockyard Hill Wind Farm terms removed from the LHS to manage future violation issues.

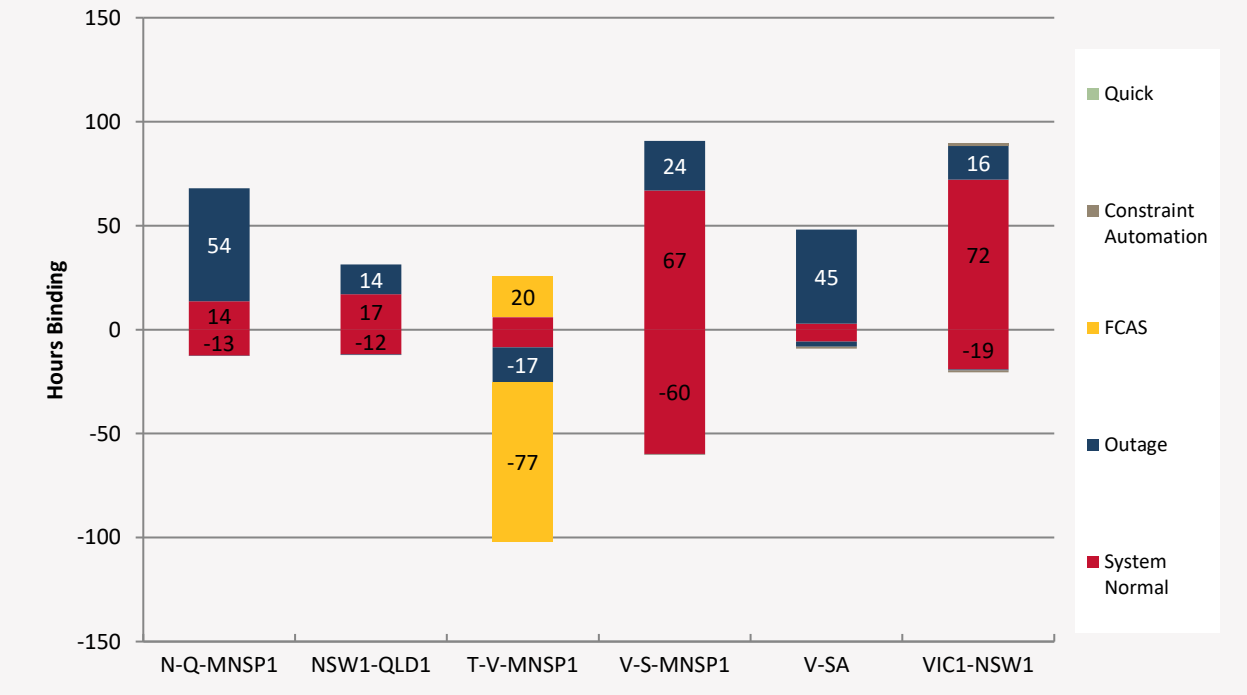
CA_BRIS_54F2D1C0: Constraint automation equation was invoked and binding. CA_BRIS_54F2D1C0 was revoked once the AEMO control room was advised no constraint changes were required.

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.

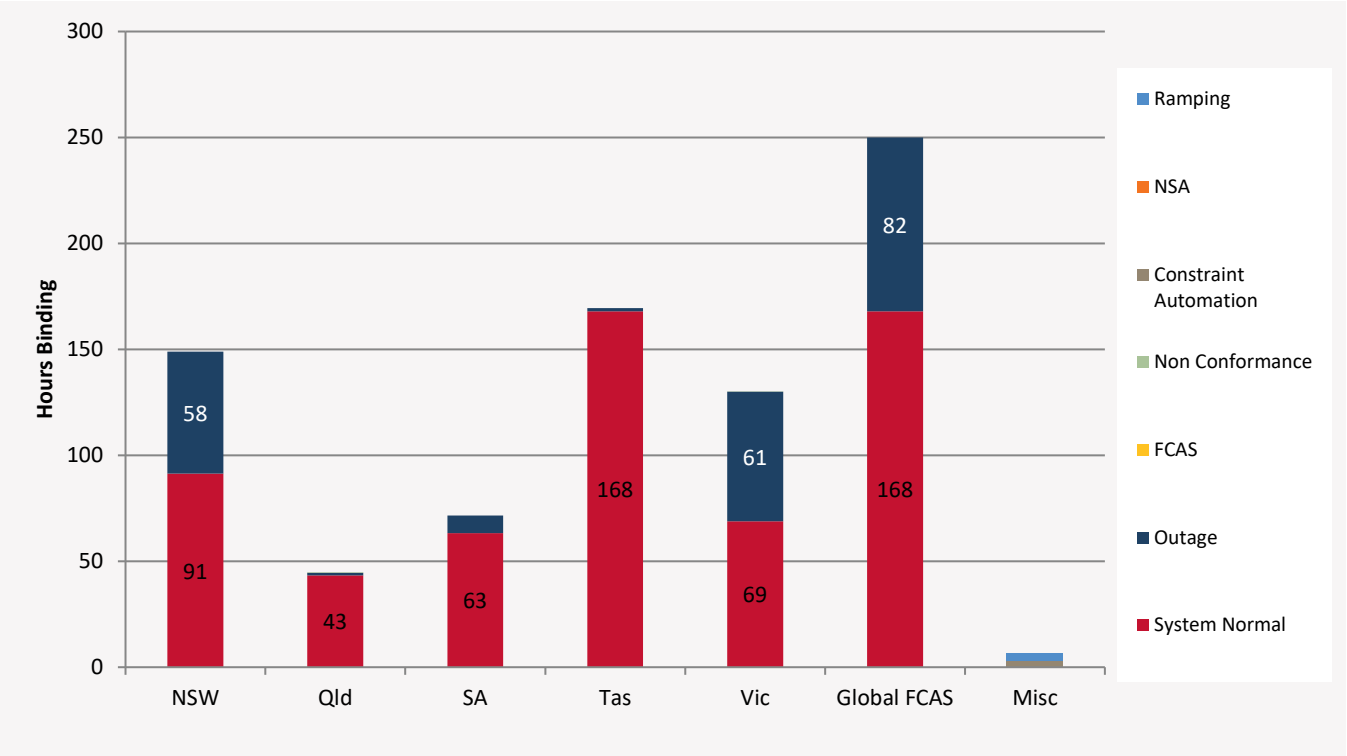
In the following graph the export binding hours are indicated as positive numbers and import with negative values.

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.

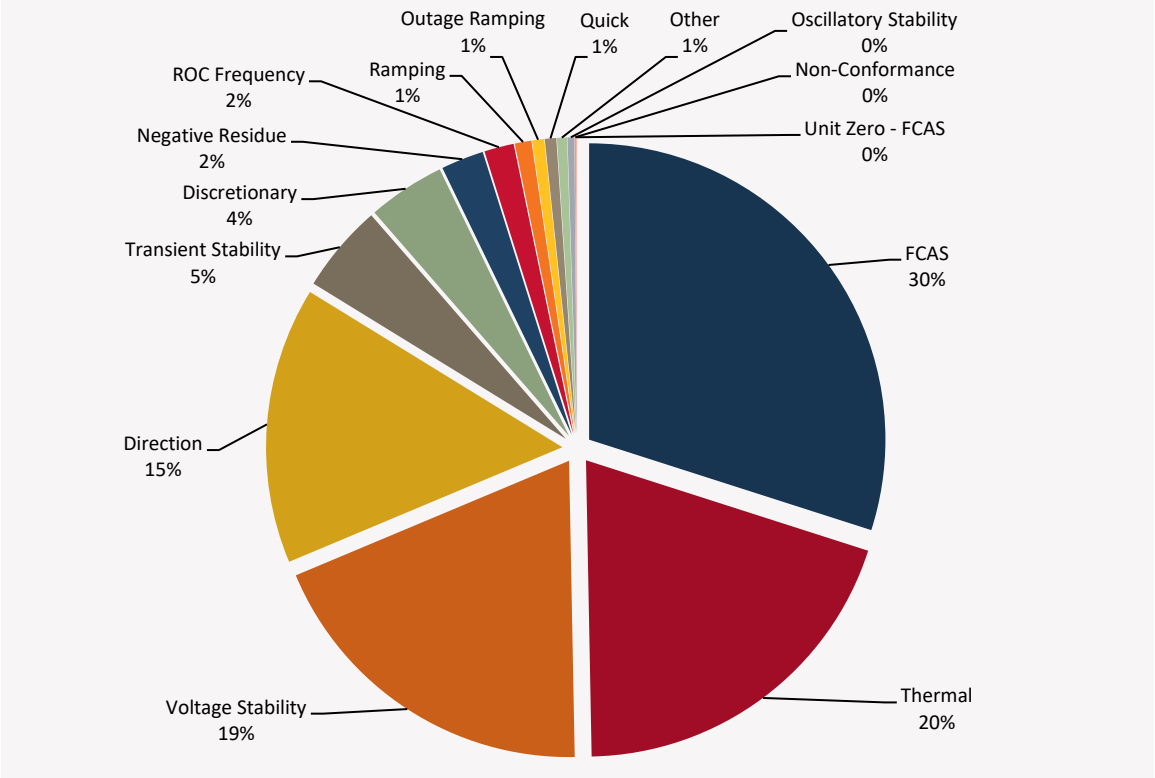
Figure 2 Regional binding dispatch hours



2.7 Binding Constraint Equations by Limit Type

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

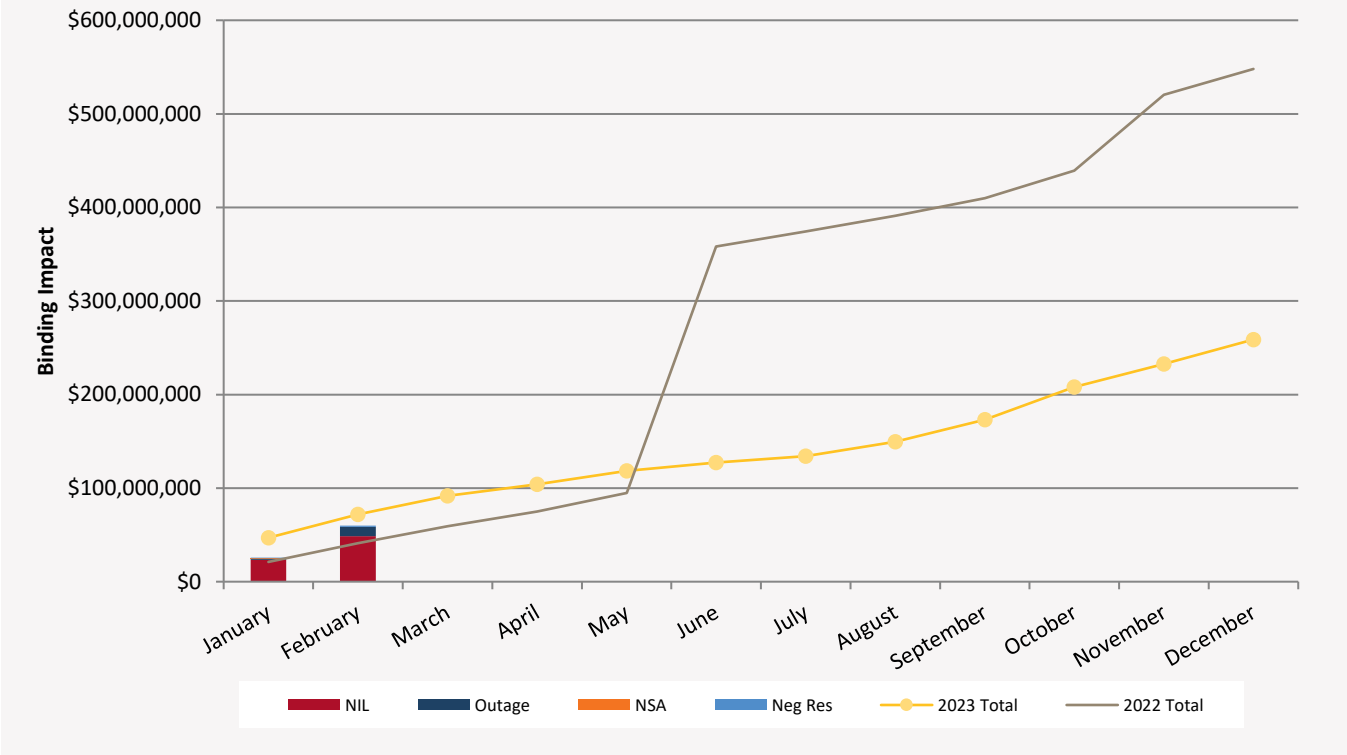
Figure 3 Binding by limit type



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
V::S_BLKRG_MAXG_2	Out = both Black Range series capacitors O/S; Vic to SA Transient Stability limit for loss of the largest generation block in SA.	3	62,289% (55.02)	20,813% (29.87)
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.	15	1,631% (9,422)	231% (1,297)
N>NIL_9R6_9R5_N	Out= NIL, avoid O/L Wagga132 to Wagga North (9R6) 132kV line on trip of Wagga330 to Wagga North (9R5) 132kV line, Feedback	5	679% (31.73)	166% (10.41)
V::N_MLSY_V1	Out = Moorabool to Sydenham 500kV line, prevent transient instability for fault and trip of a HWTS-SMTS 500 kV line, VIC accelerates. Yallourn W G1 on 220kV.	11	586% (116.95)	114.26% (52.83)
N^N-LS_SVC	Out= Lismore SVC O/S or reactive power control mode,avoid Voltage collapse on TL 87/89 trip;[Swamped for 3 DLK cables are O/S Or when ECS is enabled with DLK is exporting to QLD,sets DLK to -29 MW for -29< DLK FLOW<0, checks ETS status & unswamps if O/S)	402	463% (134.24)	77.11% (31.9)
N>NIL_9R5_9R6_N	Out= NIL, avoid O/L Wagga330 to Wagga North (9R5) 132kV line on trip of Wagga132 to Wagga North (9R6) 132kV line, Feedback	37	399% (40.14)	80.74% (13.71)
V>>MLSY_KTDPT_SYML	Out = Moorabool to Sydenham 500 kV line, Emergency Moorabool Transformer Tripping (EMTT) scheme disabled, avoid O/L Keilor to Deer Park 220 kV line on trip of remaining Moorabool to Sydenham 500 kV line, feedback	5	341% (679)	287% (595)
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.	81	277% (362.77)	71.85% (154.91)
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	127	160% (59.18)	51.18% (24.88)

2.9.1 Further Investigation

The following constraint equation(s) have been investigated:

N>NIL_9R5_9R6_N: Investigated and no improvement can be made to the constraint equation at this stage.

N>NIL_94T: Investigated and no improvement can be made to the constraint equation at this stage.

V>>NIL_MLGT_MLGT_R2: Investigated and no improvement can be made to the constraint equation at this stage.

V>>NIL_MLGT_MLGT_R5: Investigated and no improvement can be made to the constraint equation at this stage.

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

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

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

N>NIL_9R5_9R6_N: Investigated and no improvement can be made to the constraint equation at this stage.

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

V::N_MLSY_O1: Investigated and no improvement can be made to the constraint equation at this stage.

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

V::S_BLKRG_MAXG_2: Investigated and no improvement can be made to the constraint equation at this stage.

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::N_MLSY_V1: Investigated and no improvement can be made to the constraint equation at this stage.

N^N-LS_SVC: Investigated and constraint equation was updated on 27/08 to improve PD performance.

T::T_NIL_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 February 2024.

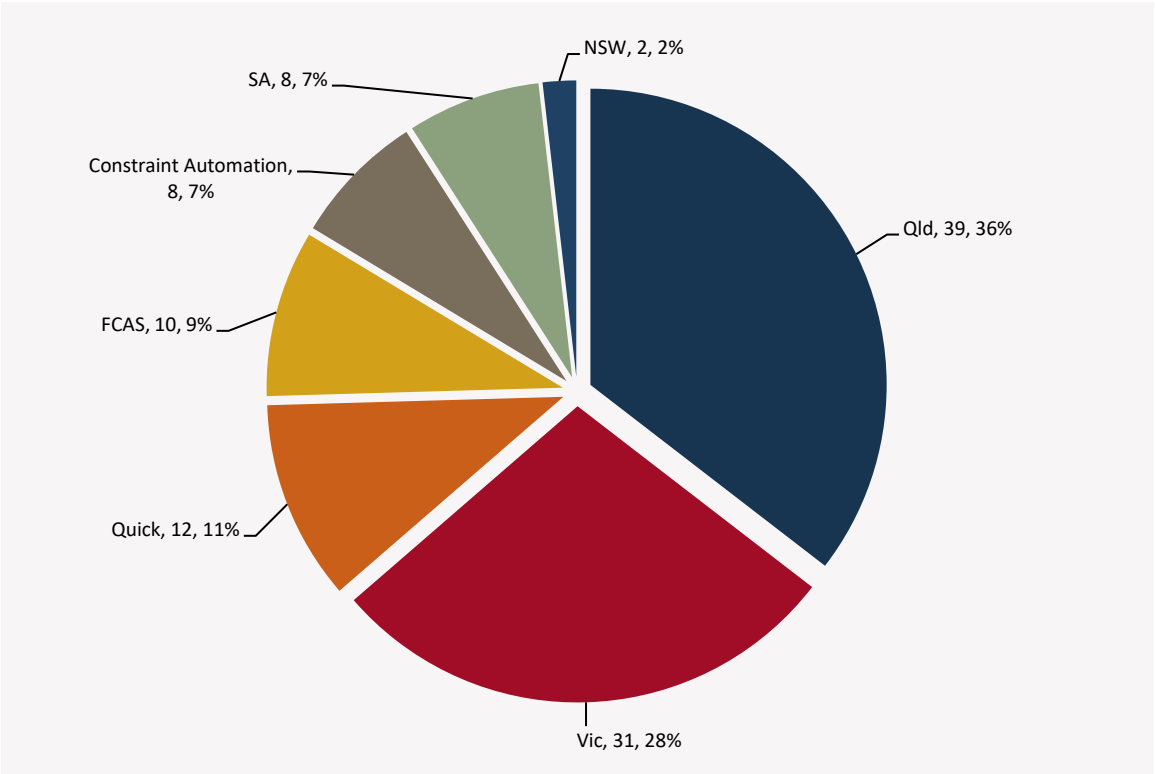
Table 7 Generator and transmission changes

Project	Date	Region	Notes
NIL			

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].

Figure 5 Constraint equation changes



[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

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