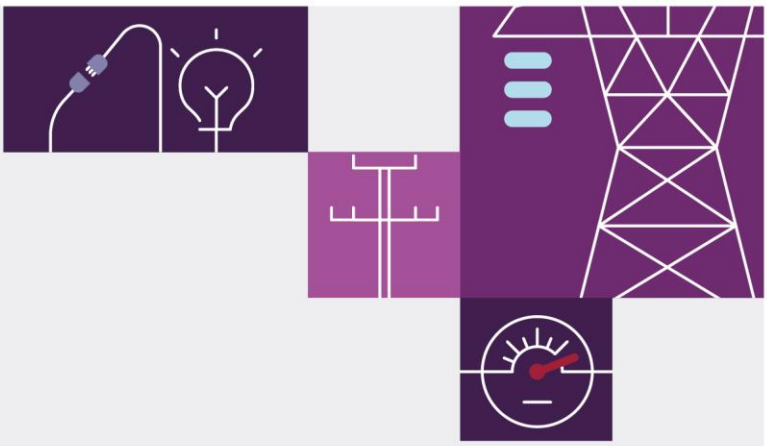
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Monthly Constraint Report

September 2023

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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Contents

Tables

Figures

1 Introduction

This report details constraint equation performance and transmission congestion related issues for September 2023. 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
SVML_ZERO	SA to Vic on ML upper transfer limit of 0 MW	7496 (624.66)	Interconnector Zero
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)	2994 (249.5)	Voltage Stability
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.	2697 (224.75)	Transient Stability
V^^V_MLNK_KGTS	Out= Murraylink, avoid voltage collapse for loss of Horsham - Murra Warra - Kiamal 220kV line	2612 (217.66)	Voltage Stability
N>NIL_94T	Out= Nil, avoid O/L Molong to Orange North (94T) on trip of Nil, Feedback	2390 (199.16)	Thermal
N>NIL_94K_1	Out= Nil, avoid O/L Suntop Tee to Wellington (94K/1) on trip of Nil, Feedback	2082 (173.5)	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]	2037 (169.75)	Thermal
Q>CMTX	Out = Clermont T1 or T2 132/66 kV transformer, limit to Clermont Solar Farm to 30MW to prevent overload on remaining transformer	1660 (138.33)	Thermal
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	1386 (115.5)	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	1356 (113.0)	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
N>NIL_94T	Out= Nil, avoid O/L Molong to Orange North (94T) on trip of Nil, Feedback	3,079,941	Thermal
V^^V_MLNK_KGTS	Out= Murraylink, avoid voltage collapse for loss of Horsham - Murra Warra - Kiamal 220kV line	2,542,057	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]	1,985,584	Thermal
N>NIL_94K_1	Out= Nil, avoid O/L Suntop Tee to Wellington (94K/1) on trip of Nil, Feedback	1,638,095	Thermal
Q>NIL_YLMR	Out= Nil, avoid overload on 110kV feeders between Yarranlea and Middle Ridge(733/1 and 734/1), Feedback	1,125,249	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	1,086,957	Thermal
SVML_ZERO	SA to Vic on ML upper transfer limit of 0 MW	721,964	Interconnector Zero
N>>NIL_970_051	Out= NIL, avoid O/L BurJK to Yass (970) on trip of Wagga to Lower Tumut (051) line, Feedback	623,532	Thermal
S>>PARB_RBTU_WTTP	Out=Para-Robertstown 275kV line, avoid O/L Waterloo-Templers 132kV line on trip of Robertstown-Tungkillo 275kV line, Feedback	586,696	Thermal
Q_STR_7C2K_KBWF_5	Limit to Kaban Wind Farm 1% if Stan>=2+Stan+Cal>=3+Glad>=2+ (Stan+Cal+Glad) >=7,Kareeya >=2, NQLD>250&270(AVG),Ross_FN>100&120(AVG), 80% limit if NQLD>350&370(AVG),Ross_FN>150&170(AVG)and Haughton syncon ON or at night, Zero otherwise.	563,709	System Strength

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

[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.

(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)	Limit Type
NC_Q_HAUGHT11	Non Conformance Constraint for HAUGHTON SOLAR FARM	12 (1.0)	Non-Conformance
N_NEWENSF1+2_201-INV	Constraint to violate if New Engliand Solar Farm 1 and 2 inverter availability greater than 201. Dispatch only. swamped out otherwise. DS only.	9 (0.75)	System Strength
Q_STR_7C8C_KBWF	Limit Kaban Wind Farm output depends on the number units online in Stanwell, Callide B, Callide C, Gladstone and Kareeya generators, Zero if it does not meet minimum generator online.	8 (0.66)	System Strength
Q_STR_7C2K_KBWF_5	Limit to Kaban Wind Farm 1% if Stan>=2+Stan+Cal>=3+Glad>=2+ (Stan+Cal+Glad) >=7,Kareeya >=2, NQLD>250&270(AVG),Ross_FN>100&120(AVG), 80% limit if NQLD>350&370(AVG),Ross_FN>150&170(AVG)and Haughton syncon ON or at night, Zero otherwise.	6 (0.5)	System Strength
Q_STR_7C2K_SMSF_5	No limit to Sun Metals Solar Farm if Stan>=2+(Stan+Cal)>=3+Glad>=2+ (Stan+Cal+Glad) >=7+Kar>=2,NQLD>350&370(AVG),Ross_FN>150&170(AVG)(80% if Haughton Syncon is OFF),25%(40% if Haughton Syncon ON)NQLD>250&270(AVG),Ross_FN>100&120(AVG),Zero otherwise	6 (0.5)	System Strength
N_MOREESF1_35INV	Constraint to violate if Moree Solar Farm inverter availability greater than 35. Constraint swamp out otherwise. DS only	5 (0.41)	System Strength
N_MOREESF1_40INV	Constraint to violate if Moree Solar Farm inverter availability greater than 40. Constraint swamp out otherwise. DS only	5 (0.41)	System Strength
T^T_LIPM_1	Out = Liapootah to Waddamana to Palmerston 220 kV line, avoid voltage instability or violations for loss of the other Liapootah to Waddamana to Palmerston line	5 (0.41)	Voltage Stability
N_AVLSF1_47INV	Constraint to violate if Avonlie Solar Farm inverter availability greater than 47. Constraint swamp out otherwise. DS only	5 (0.41)	System Strength
Q_STR_32282_MEWF	Limit 50% to Mt Emerald WF if Stan>=3+Cal>=2+Glad>=2+ (Stan+Cal+Glad) >=8, Kareeya>=2,NQLD>450&470(AVG),Ross_FN>250&270(AVG), Strathmore SVC IS. Zero otherwise.	5 (0.41)	System Strength

2.3.1 Reasons for constraint equation violations

Table 4 Reasons for constraint equation violations

Constraint Equation ID (System Normal Bold)	Description
NC_Q_HAUGHT11	Constraint equation violated for 12 non-consecutive DIs on 13/09/2023 at 0930 hrs to 13/09/2023 at 1115 hrs with a max violation degree of 0.77 MW occurring on 13/09/2023 at 1015 hrs. Constraint equation violated due to non-conformance of Haughton Solar Farm.
N_NEWENSF1+2_201-INV	Constraint equation violated for 9 non-consecutive DIs on 25/09/2023 at 0825 hrs to 25/09/2023 at 1400 hrs with a max violation degree of 0.21 MW occurring on 25/09/2023 at 1350 hrs. Constraint equation violated due to New England Solar Farm 1 and 2 exceeding their inverter limit.
Q_STR_7C8C_KBWF	Constraint equation violated for 8 non-consecutive DIs on 06/09/2023 at 1450 hrs to 15/09/2023 at 1405 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Kanban Wind Farm exceeding its MVar limit.
Q_STR_7C2K_KBWF_5	Constraint equation violated for 6 consecutive DIs on 06/09/2023 from 1450 hrs to 1515 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Kanban Wind Farm exceeding its MVar limit.

Constraint Equation ID (System Normal Bold)	Description
Q_STR_7C2K_SMSF_5	Constraint equation violated for 6 consecutive DIs on 6/09/2023 from 1800 hrs to 1825 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Sun Metals Solar Farm exceeding its MVar limit.
N_MOREESF1_35INV	Constraint equation violated for 5 consecutive DIs on 16/09/2023 from 1605 hrs to 1625 hrs with a max violation degree of 19.43 MW occurring on 16/09/2023 at 1605 hrs. Constraint equation violated due to Moree Solar Farm exceeding its inverter limit.
N_MOREESF1_40INV	Constraint equation violated for 5 non-consecutive DIs on 26/09/2023 at 1805 hrs to 27/09/2023 at 0820 hrs with a max violation degree of 12.85 MW occurring on 27/09/2023 at 0805 hrs. Constraint equation violated due to Moree Solar Farm exceeding its inverter limit.
T^T_LIPM_1	Constraint equation violated for 5 non-consecutive DIs on 25/09/2023 at 1810 hrs to 25/09/2023 at 1835 hrs with a max violation degree of 5.73 MW occurring on 25/09/2023 at 1815 hrs. Constraint equation violated due to outage at Gordon Power Station.
N_AVLSF1_47INV	Constraint equation violated for 5 consecutive DIs on 27/09/2023 at 0805 hrs to 0825 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Avonlie Solar Farm exceeding its inverter limit.
Q_STR_32282_MEWF	Constraint equation violated for 5 consecutive DIs on 13/09/2023 from 1250 hrs to 1310 hrs with a violation degree of 0.001 MW. Constraint equation violated due to Mt Emerald Wind Farm exceeding its MVar limit.

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)
SVML_ZERO	V-S-MNSP1 Import	SA to Vic on ML upper transfer limit of 0 MW	5956 (496.33)	0.0 (0.0)
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)	2964 (247.0)	-38.77 (-29.0)
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	1377 (114.75)	-626.43 (-1181.75)
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	1363 (113.58)	-32.2 (-184.82)
V^^V_MLNK_KGTS	V-S-MNSP1 Import	Out= Murraylink, avoid voltage collapse for loss of Horsham - Murra Warra - Kiamal 220kV line	1205 (100.42)	0.0 (0.0)
V_T_NIL_FCSPS	T-V-MNSP1 Import	Basslink limit from Vic to Tas for load enabled for FCSPS	1038 (86.5)	-424.56 (-461.67)
F_MAIN++NIL_MG_R5	T-V-MNSP1 Export	Out = Nil, Raise 5 min requirement for a Mainland Generation Event, Basslink able transfer FCAS	980 (81.67)	334.05 (462.0)
V^^N_LTUT_1	VIC1-NSW1 Export	Out = Lower to Upper Tumut (64) 330kV line, avoid voltage collapse around Murray for loss of all APD potlines	913 (76.08)	1000.66 (1446.35)
N>>NIL_990_051	VIC1-NSW1 Export	Out= NIL, avoid O/L Wagga to Yass (990) on trip of Wagga to Lower Tumut (051) line, Feedback	801 (66.75)	4.02 (922.82)
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	733 (61.08)	358.78 (462.0)

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_540A554F	06/09/2023 10:50 to 06/09/2023 12:10	CA_BRIS_540A554F was created to manage the overload of Wagga132-Wagga North 9R6 132 kV line for loss of Yass-Murrumburrah 99M 132 kV line.
CA_BRIS_542A0DC2	30/09/2023 12:10 to 30/09/2023 12:45	CA_BRIS_542A0DC2 was created to manage post contingent overloads on Lismore – Koolkhan 967 132 kV line during a prior outage of Tenterfield – Lismore 96 L 132 kV line.
CA_BRIS_542A114F	30/09/2023 12:20 to 30/09/2023 12:45	CA_BRIS_542A114F was created to manage post contingent overloads on Lismore – Koolkhan 967 132 kV line during a prior outage of Tenterfield – Lismore 96 L 132 kV line.
CA_BRIS_542A136B	30/09/2023 12:30 to 01/10/2023 18:05	CA_BRIS_542A136B was created to manage post contingent overloads on Lismore – Koolkhan 967 132 kV line during a prior outage of Tenterfield – Lismore 96 L 132 kV line.

2.5.1 Further Investigation

CA_BRIS_540A554F: Constraint was invoked and binding. Constraint was revoked after a new constraint N>NIL_9R6_991 was built to manage ongoing and future violation issues.

CA_BRIS_542A0DC2: Constraint was invoked and binding. Following its invocation, southernly flows were limited on Terranora interconnector from 128 MW to 120 MW. Auto constraint violation cleared from 1225 hrs when Terranora flow started binding on export limit of -29 MW due to the N^N-LS_SVC constraint. Import limit continued to be set by the auto constraint CA_BRIS_542A136B_1.

CA_BRIS_542A114F: Constraint was invoked and binding. Following its invocation, southernly flows were limited on Terranora interconnector to 99 MW. Auto constraint violation cleared from 1225 hrs when Terranora flow started binding on export limit of -29 MW due to the N^N-LS_SVC constraint. Import limit continued to be set by the auto constraint CA_BRIS_542A136B_1.

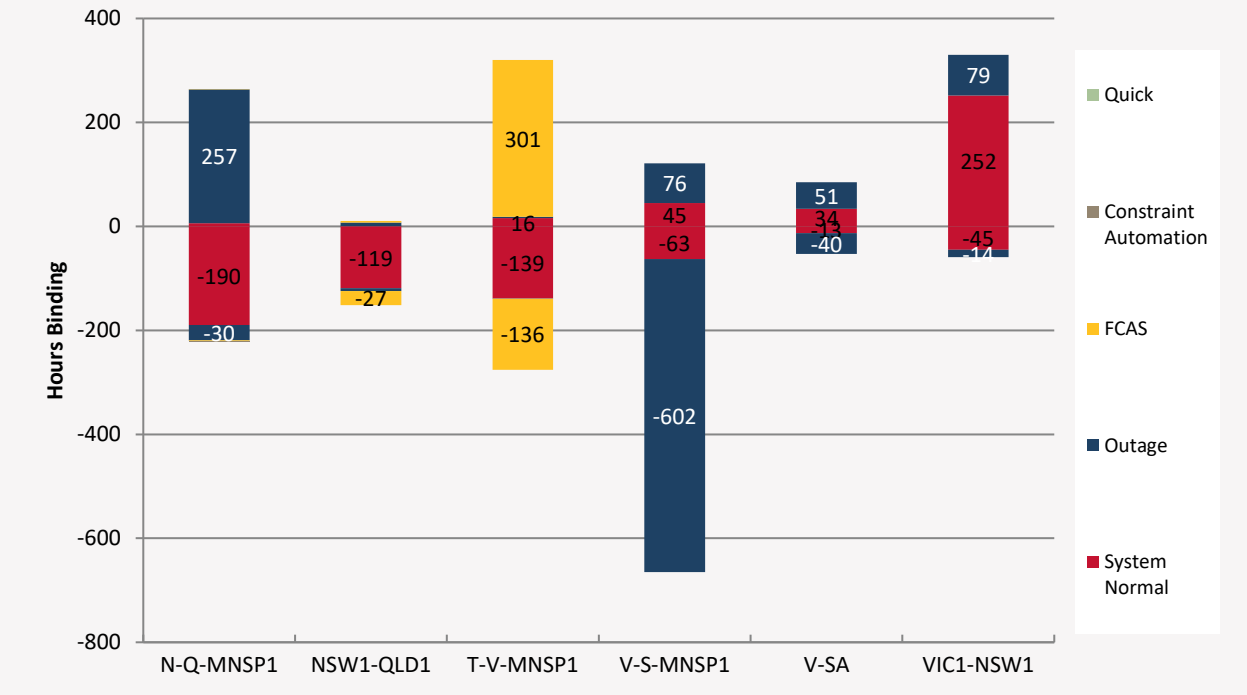
CA_BRIS_542A136B: Constraint was invoked and binding which restricted southernly flows on Terranora interconnector to 85 MW. Auto constraint was revoked when 96L returned to service. New constraint N>96L/96R_966/1_89_S was built to manage future violation issues.

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.

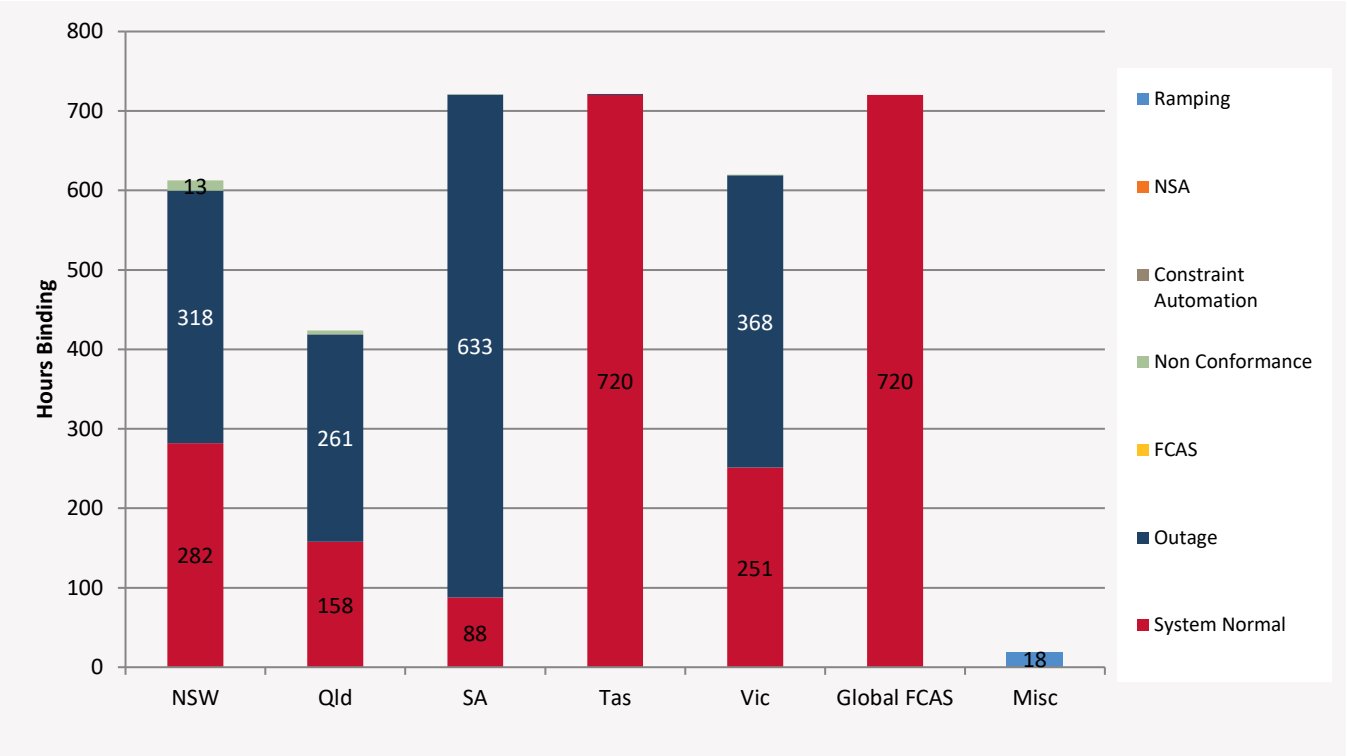
In the following graph the export binding hours are indicated as positive numbers and import with negative values.

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.

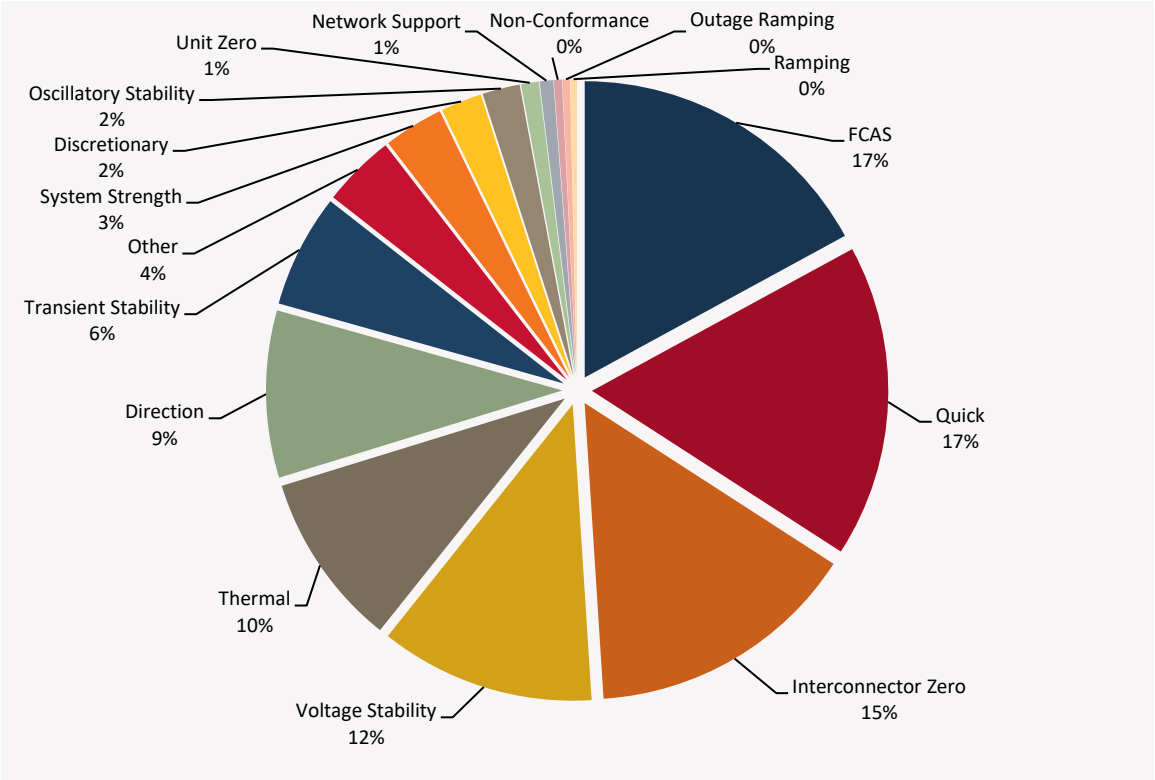
Figure 2 Regional binding dispatch hours



2.7 Binding Constraint Equations by Limit Type

The following pie charts show the percentage of dispatch intervals for September 2023 that the different types of constraint equations bound.

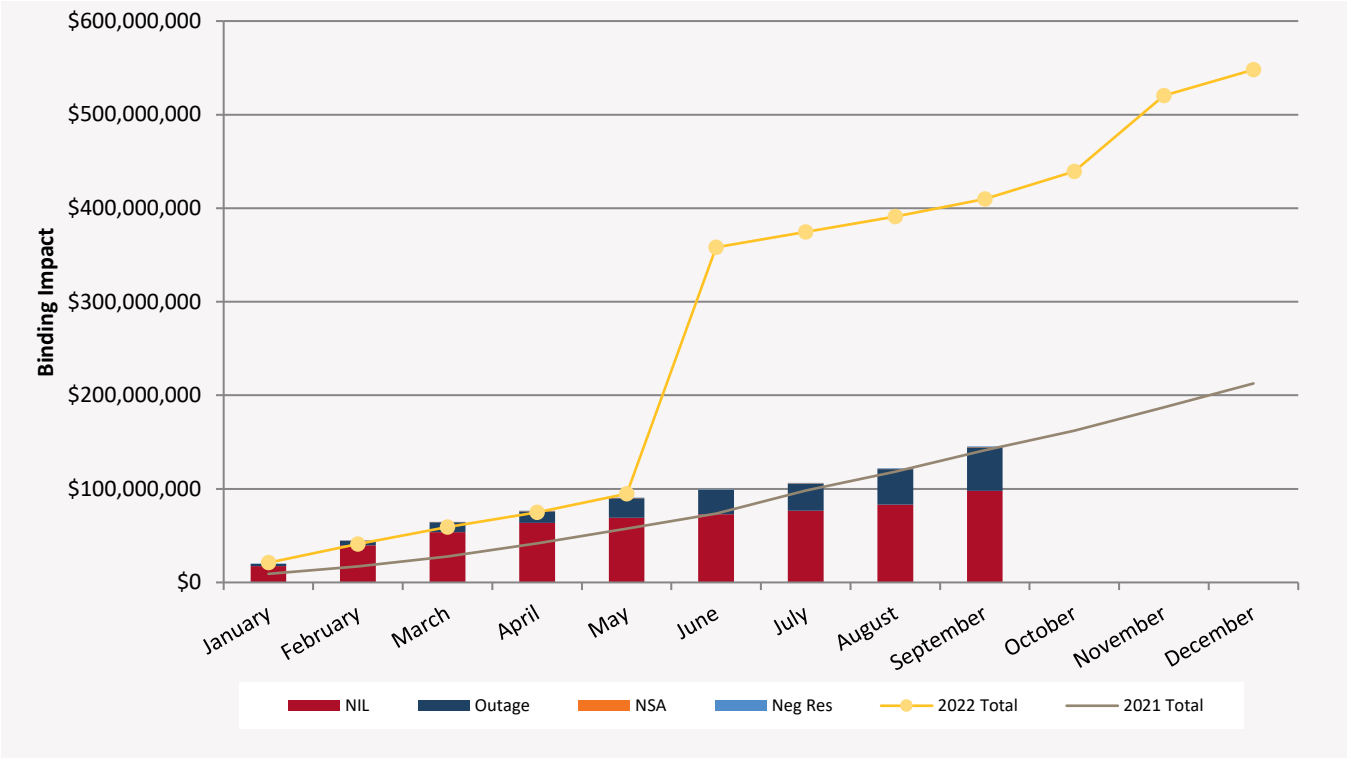
Figure 3 Binding by limit type



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 6 Top 10 largest Dispatch / Pre-dispatch differences

Constraint Equation ID (System Normal Bold)	Description	#DIs	% + Max Diff	% + Avg Diff
S^^V_SETB_1	Out= one South East to Tailem Bend 275kV line, voltage collapse equation Tailem Bend-Keith #2 132kV Line <=135 MW on trip of other Tailem Bend-South East 275kV line, Feedback (Note: with both SE series caps I/S or O/S)	11	843% (71.56)	326% (32.27)
S::V_TBSE_TBSE_2	Out = one Tailembend-South East 275kV line (Note: with both Black Range series caps O/S); SA to VIC Transient Stability limit for loss of other Tailembend-South East 275kV lines.	14	777% (13.7)	121.76% (4.92)
CA_BRIS_542A136B_1	Constraint Automation, O/L 967:L967:I:132@LISMORE@NSW for CTG LNPD on trip of COFFS-LISMORE 89 330KV LINE. Generated by STNET[NORCR1] Host BNEREGEEMP5(EMPBRI)	3	669% (175.04)	624% (170.55)

Constraint Equation ID (System Normal Bold)	Description	#DIs	% + Max Diff	% + Avg Diff
N::N_NIL_63	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	139	239% (1,856)	19.03% (153.59)
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)	188	127.7% (71.19)	40.87% (16.71)
V::N_NIL_V1	Out = NIL, prevent transient instability for fault and trip of a HWTS-SMTS 500 kV line, VIC accelerates. Yallourn W G1 on 220kV.	17	105.88% (114.13)	30.23% (43.67)
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.	39	100.75% (183.39)	19.97% (65.07)
Q_STR_7C2K_KBWF_5	Limit to Kaban Wind Farm 1% if Stan>=2+Stan+Cal>=3+Glad>=2+ (Stan+Cal+Glad) >=7,Kareeya >=2, NQLD>250&270(AVG),Ross_FN>100&120(AVG), 80% limit if NQLD>350&370(AVG),Ross_FN>150&170(AVG)and Haughton syncon ON or at night, Zero otherwise.	290	100.% (121.)	17.23% (94.78)
Q_STR_7C2K_MEWF_5	Limit Mt Emerald Windfarm to 80% if Stan>=2+(Stan+Cal)>=3+Glad>=2+ (Stan+Cal+Glad) >=7+Kar>=2,NQLD>350&370(AVG),Ross_FN>150&170(AVG),(100% at night),25%(40% if Haughton Synon ON)NQLD>250&270(AVG),Ross_FN>100&120(AVG),Zero otherwise Zero otherwise.	93	100.% (144.)	28.62% (138.76)

2.9.1 Further Investigation

The following constraint equation(s) have been investigated:

N^^V_MLNK_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.

Q_STR_7C2K_KBWF_5: Investigated and constraint equation was updated on 24/08 to improve PD performance.

Q_STR_7C8C_KBWF: Investigated and constraint equation was updated on 22/08 to improve PD performance.

Q_STR_7C2K_MEWF_5: Investigated and constraint equation was updated on 24/08 to improve PD performance.

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

Q_STR_7C0K_MEWF_2: Investigated and no improvement can be made to the constraint equation at this stage.

V:T_HAGT_BL_1: Investigated and no improvement can be made to the constraint equation at this stage.

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

N^N-X_LS_SVC+96R: Investigated and no improvement can be made to the constraint equation at this stage.

CA_BRIS_542A136B_1: Investigated and constraint equation N>96L/96R_966/1_89_S built on 03/10 to improve PD performance.

S::V_TBSE_TBSE_2: Investigated and no improvement can be made to the constraint equation at this stage.

N::N_NIL_63: Under investigation and will be improved if possible.

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

V::N_NIL_V1: Investigated and no improvement can be made to the constraint equation at this stage

Q_STR_7C8C_MEWF: 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 September 2023.

Table 7 Generator and transmission changes

Project	Date	Region	Notes
Para – Robertstown 275 kV Line	07/09/2023	SA	Line decommissioned
Tungkillo – Robertstown No. 2 275 kV Line	07/09/2023	SA	Line commissioned cutting in the decommissioned lines into Tungkillo.
Cherry Gardens South 275 kV Reactor	15/09/2023	SA	
Para – Tungkillo No. 2 275 kV Line	26/09/2023	SA	Line commissioned cutting in the decommissioned lines into Tungkillo.

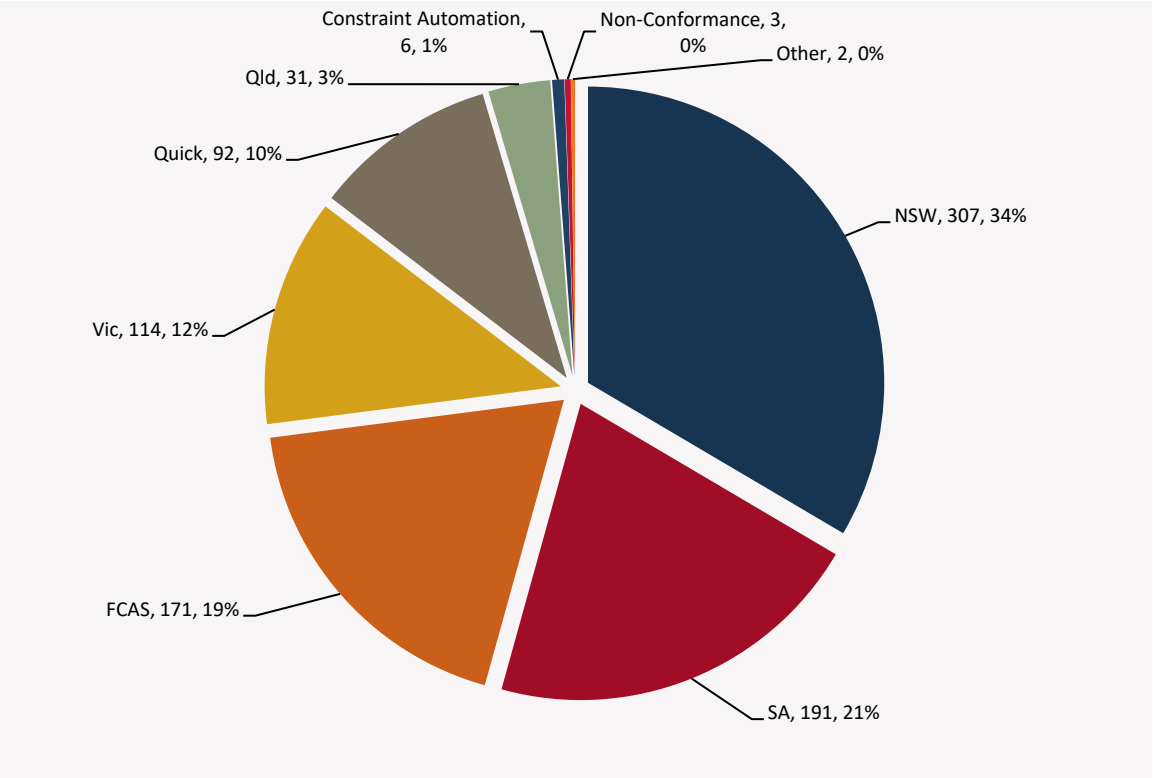
3.1 Constraint Equation Changes

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