Victorian Transfer Limit Advice – System Normal

AUGUST 2022

A report for the National Electricity Market on transfer limits in the Victorian region.

Important notice

Purpose

This publication has been prepared by AEMO to provide information about the transfer limit equations for flows to, from and inside Victoria for voltage, transient or constraint equation performance and related issues, as at the date of publication.

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Version control

Version	Release date	Changes
26	29 August 2022	Added South West Victoria Voltage Stability Limit
25	16 August 2022	Updated Victorian export voltage stability limit for loss of both APD potlines
24	August 2022	Minor tweaks to the new AEMO template
23	31 March 2022	Updated to latest AEMO template, added section on update process for limits, Updated VIC-NSW transient stability limit equations.
22	11 Nov 2021	Updated Kerang voltage collapse limit- Bendigo 66 kV capacitors term added
21	16 August 2021	Updated Kerang voltage collapse limit
20	17 March 2021	Added new Kerang voltage collapse Hard limit
19	10 Feb 2021	Updated Victorian export voltage stability limit for loss of both APD potlines, minor editing corrections
18	1 Dec 2020	Update to definition of SW_NSW_GEN for VIC import voltage limits for Loss of Largest Vic Generator (Latrobe Valley studies) and loss of the Ballarat – Waubra-Ararat 220kV line and up to 800 MW of generation (North West Victoria)
17	8 October 2020	Updated Victorian export voltage stability limit for loss of both APD potlines, minor editing corrections and updates to URLs.
16	25 May 2020	Updated section 3.2 with new Victorian voltage stability import limit.
15	1 May 2020	Removed the output and inverter limits of Broken Hill SF, Bannerton SF, Gannawarra SF, Karadoc SF and Wemen SF
14	24 January 2020	Updated Victorian voltage stability import limit
13	8 January 2020	Added north-west Victoria voltage collapse limit.
12	8 November 2019	Updated Victorian export voltage stability limit on Murraylink for the loss of either the Darlington Point to Balranald or Balranald to Buronga 220 kV lines. Added 100 MW offset to NSW to Victoria voltage stability limit.
11	19/09/2019	Added Victorian export voltage stability limit on Murraylink for the loss of the Bendigo to Kerang 220 kV line. Updated Definitions to include new generators. Added voltage oscillation limits for solar farms for north-west Vic and south-west NSW.
10	15/03/2019	Updated Voltage Stability Import limit, NILV and NILS Transient Stability Export limits
9	23/11/2018	Updated Voltage Stability Import limit & applied new template
8	23/07/2018	Updated Voltage Stability Import limit with additional terms to reflect impact of Victorian hydro (Kiewa scheme), Guthega, Jindabyne and additional reactive plant in southern NSW.
7	14/12/2017	Updated Voltage Stability Import limit, removed reference to Hazelwood Power Station and Victorian synchronous condenser terms. Updated disclaimer.
6	31/01/2017	Updated disclaimer and added offset for decommissioned synchronous condensers in Victoria in the voltage collapse limit
5	22/12/2016	Updated for Heywood Upgrade post series caps (system normal). Edits to document text. Added Heywood voltage collapse limit.
4	10/04/2016	Converted to new AEMO template. Updated for third transformer at Heywood (system normal). Edits to document text
3	16/05/2014	Added Victorian import limit equation and updated to new AEMO template
2	14/11/2013	Fixed table formatting issues, corrected definitions, Updated Equation, with term for Mount Mercer Wind Farm (MMWF) megawatt (MW) output
1	23/11/2012	Initial version

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1 Introduction

AEMO is responsible for calculating the maximum transient and voltage stability limits into and out of Victoria (National Electricity Rules (NER) S5.1.2.3) in accordance with Power System Stability Guidelines[1]. This document describes the values for these transfer limits for system normal conditions (that is, when all transmission elements are in service) in Victoria.

This limits advice document also describes the methodology used by AEMO to determine the transient and voltage stability limits.

The limit equations for cases where one or more transmission elements are out of service are described in separate documents[2]:

- Victorian Transient Limit Advice – Outages.
- Victorian Transfer Limit Advice – Multiple Outages.
- Victorian Transfer Limit Advice – Outages in Adjacent Regions.

1.1 Other AEMO publications

Other limit advice documents are located at https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource/limits-advice.

1.2 Calculating transient and voltage stability limits

Transfer limit equations are developed for power transfers into and out of Victoria (known as import and export limits respectively). Maximum export is limited by transient stability, whereas maximum import is determined by voltage stability.

Transient stability limit equations are derived from a large number of transient stability studies. Stability studies are based on the application of a 2-phase to ground fault at the most critical fault location.

Voltage stability limit equations are derived from a large number of load flow studies. Studies consider the trip of a large generator, the loss of Basslink when exporting from Tasmania (Tas) to Victoria (Vic), and where appropriate the fault and trip of a critical transmission line or transformer.

1.2.1 Methodology

The methodology for calculating voltage and transient stability limits is:

1. Generate a set of Power System Simulator for Engineering (PSS/E) cases to represent a wide range of operating conditions.

[1] AEMO, *Power System Stability Guidelines*, Available at: https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource, Viewed on: 6 October 2020.

[2] Available at: https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource/limits-advice.

2. Execute a binary search algorithm to search for limiting interconnector power transfer.
3. Linear regression and statistical limit determination.

1.2.2 Updates

Updates to the Victorian transfer limits are triggered due to:

- generation or transmission or control scheme changes
- issues are raised from online monitoring tool results or from regular stability limit benchmarking that AEMO performs
- revised generator models

Generally major "clean sheet" reviews to the Victorian limit equations occur every 4-5 years – these are detailed in section 1.2.3. Normally generator or network changes can be updated by performing smaller studies and reviewing and updating the regression analysis.

1.2.3 Limit equation major updates

Table 1 Limit Equation major updates

Equation	Section	Last Major update
Vic to NSW – loss of Hazelwood – South Morang line	2	March 2022
Vic to NSW – loss of APD	3.4	May 2019
NSW to Vic– loss of largest gen / Basslink	3.1	March 2020
NSW to Vic – loss of largest gen in NW Vic	3.2	May 2020
Vic to SA Heywood Capacitor	3.3	March 2016
Murraylink voltage collapse – BEKG	3.5	July 2019
Murraylink voltage collapse – X3/X5	3.6	September 2019
Kerang voltage collapse	3.7	August 2021

1.3 Conversion to constraint equations

This document does not describe how AEMO implements these limit equations as constraint equations in the National Electricity Market (NEM) market systems. That is covered in the Constraint Formulation Guidelines, Constraint Naming Guidelines and Constraint Implementation Guidelines. These documents are located in the Congestion Information Resource on the AEMO website, at: https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource.

2 System Normal Transient Stability Limits

There are two system normal Vic-NSW export transient stability limit equations to prevent angle separation of Victoria (Vic), Queensland (Qld), and South Australian (SA) generators for a fault on one Hazelwood to South Morang 500 kilovolt (kV) line. These are referred to as NIL_V, and NIL_O. decelerating equations.

NIL_V manages conditions when rotor angles of Victoria synchronous machines accelerate ahead of rotor angles of synchronous machines of all the other states. The NIL_O manages conditions when rotor angles of the synchronous machines in states other than Victoria accelerating or decelerating against the rotor angles of synchronous machines in all the other states.

Table 2 System normal transient stability limits

Equation	Description of Limit
NIL_V	Victorian transient stability export limit on the Vic to NSW interconnectors for the two phase to ground fault and trip of Hazelwood – South Morang 500 kV line where instability occurs due to rotor angles of Vic synchronous machines accelerating away from the rotor angles of synchronous machines of all the other regions.
NIL_O	Victorian transient stability export limit on the Vic to NSW interconnectors for the two phase to ground fault and trip of Hazelwood – South Morang 500 kV line where instability occurs due to rotor angles of synchronous machines in regions other than Victoria accelerating or decelerating away from the rotor angles of synchronous machines in all the other states.

The transfer limit between Vic and NSW is the minimum megawatt (MW) transfer of all enabled limits at a given point in time and depends on system conditions and plant parameters.

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Each limit equation is of the form:

Victoria to NSW ≤ Sum [Term Values * Coefficients]

2.1 NIL_V

Table 3 NIL_V export limit equation coefficients

Term	Coefficient
Basslink	0.3978
Vic to SA (Heywood)	-0.4780
Vic to SA (Heywood)^2	-0.0002605
Vic to SA (Murraylink)	-0.4918
LV 220 Gen	0.3604
Murray Gen	0.7863
Kiewa Gen	0.8963
Vic Demand - State Grid Load - APD Load	-0.3394
APD Load	-0.6054
State Grid Load North	-0.3671
State Grid Load South	-0.8245
Vic Wind & Solar	0.4320
STH_NSW_WIND_SOLAR_GEN	-0.1173
EPS Inertia	15.47
MOPS Inertia	7.085
Vic Metro Gen Inertia	6.995
SNOWY Inertia	3.253
LV 500 Inertia	7.953
LOY_YANG_PS_UNITS	39.73
Intercept	970.6
Confidence Level (95%) offset	-129

2.2 NIL_O

Table 4 NIL_O export limit equation coefficients

Term	Coefficient
Basslink	0.3192
Vic to SA (Heywood)	-0.3544
Vic to SA (Murraylink)	-0.5389
LV 220 Gen	0.3111
Kiewa Gen	0.9475
Murray Gen	0.7631
Vic Demand - State Grid Load - APD Load	-0.2514
State Grid Load North	-0.4889
State Grid Load South	-0.6331
Vic Wind & Solar	0.3577
STH_NSW_WIND_SOLAR_GEN	-0.2363
EPS Inertia	8.3487
Vic Metro Gen Inertia	6.6200
LV 500 Inertia	7.3391
MOPS Inertia	4.4303
SNOWY Inertia	3.2105
APD Load	-0.2801
LTUM3SC	22.80
Intercept	929.7
Confidence Level (95%) offset	-158.7

3 System Normal Voltage Stability Limits

S5.1.8 in the NER specifies the requirements for voltage stability as:

- N-1 QV curve knee point must be greater than 1% of the bus three phase fault level in MVA.
- The bus voltage after the contingency must be between 0.90 – 1.10 p.u.

Table 5 System normal voltage stability limits

Equation	Description of Limit
NIL_VI_BLVG	Vic voltage stability import limit from NSW to Vic for trip of Basslink or the largest Vic generator.
NIL_VI_ARWBBA	Vic voltage stability import limit from NSW to Vic for trip of the Ararat to Waubra to Ballarat 220 kV line
V^S_HYCP	Vic voltage stability export limit from Vic to SA via Heywood for fault and trip of a 500kV circuit between Moorabool and Heywood.
V^N_2xAPD	Vic voltage stability export limit from Vic to NSW for fault and trip of both APD potlines.
V^SML_BEKG	Vic voltage stability export limit from Vic to SA via Murraylink for trip of the Bendigo to Kerang 220 kV line.
V^SML_X5_X3	Vic voltage stability export limit from Vic to SA via Murraylink for trip of either the Darlington Point to Balranald or Balranald to Buronga 220 kV lines.
NIL_KERANG	Vic voltage stability limit from Wemen to Kerang 220 kV line flow for the trip of Crowlands to Bulgana to Horsham or Horsham to Murra Warra to Kiamal 220kV line.

3.1 NIL_VI_BLVG

For NSW to Vic transfers, a single limit equation is required under system normal conditions to prevent voltage collapse in southern NSW and northern Vic following the loss of Basslink or the loss of the largest Vic generator.

Voltage collapse under import conditions is observed to predominately occur in Southern NSW.

The limit equation for NSW to Vic is of the form:

NSW to Victoria ≤ -1 * Sum [Term Values * Coefficients]

Table 6 NIL_VI_BLVG coefficients

Term	Coefficient
Intercept	-1313
Vic to SA (Murraylink)	-0.1187
Contingent MW	0.4875
STH_NSW	0.4709
SE_NSW_WND_SOL_GEN	-0.1179
SW_NSW_GEN – UQT_GEN	-0.3798
UTUM1SC+UTUM2SC	-13.6
LTUM3SC	-67.5
MSS2SC	-50.1
WOTSCap	-0.3496
DD220Cap	-0.3179
DD330Cap	-0.2133
WAGGACap	-0.1299
CANCap	-0.2367
YASSCap	-0.291
DLPT220	-0.1097
MSSReac	-0.2668
YASSReac	-0.1927
BANReac	-0.08229
U_TUMUT_Gen	-0.5976
L_TUMUT_Gen	-0.3895
Murray Gen	0.4834
UQT Gen	-0.491
BKNH GEN + SILVERTON WF MW	-.7145
Num. MSS1 on	-23.99
GEN BOPS on	-31.77
GEN WKPS on	-5.022
BOPS+MKPS GEN	0.2452
Confidence Level (95%) offset	89

3.2 NIL_VI_ARWBBA

On a trip of the Ballarat to Waubra to Ararat 220 kV line the Ararat, Bulgana, Crowlands, Murra Warra and Waubra wind farms are also tripped. A single limit equation is required under system normal conditions to prevent voltage collapse in southern NSW following the loss of Ballarat to Waubra to Ararat 220 kV line and subsequentially trip of the above wind farms.

The limit equation for NSW to Vic is of the form:

NSW to Victoria ≤ Sum [Term Values * Coefficients]

Table 7 NIL_VI_ARWBBA coefficients

Term	Coefficient
STH_NSW	-0.468
SW_NSW_GEN	0.5024
SE_NSW_WND_SOL_GEN	0.0901
L_TUMUT_Gen	0.3918
Murray Gen	-0.3065
U_TUMUT_Gen	0.4359
BRKNHLSF_SilvWF	1.0075
ROTS_SVC_MVAR	0.7543
MSSReac	0.3315
Q2-BURNGA 220	1.1904
DLPT220	4.4586
Q2-DENILQ_132	7.0319
YASSCap	0.3292
YASSReac	0.9406
LTUM3SC	51.5951
MSS2SC	43.2052
NW_VIC_WF_cont	-0.867
Intercept	1910
Confidence Level (95%) offset	-170

3.3 V^S_HYCP

For Vic to SA transfers, a single limit equation is required under system normal conditions to prevent voltage collapse in the vicinity of Heywood following the loss of a 500 kV circuit between Moorabool and Heywood.

Six buses were monitored for determination of this limit equation: Moorabool 500 kV, Moorabool 220 kV, Heywood 500 kV, South East 275 kV, Tailem Bend 275 kV, and Alcoa Portland (APD) 500 kV. Voltage-dependent load models were used when determining this transfer limit.

The limit equation for Vic to SA is of the form:

Victoria to SA ≤ Sum [Term Values * Coefficients]

Table 8 V^S_HYCP coefficients

Term	Coefficient
Intercept	-3998
HYTS_CAP_STATUS	130.9
APD–HYTS_MW	0.3551
APD–HYTS_MVAR	0.749
V_MLTS5	9.928
Confidence Level (95%) offset	-45.144

3.4 V^N_2xAPD

For VIC to NSW transfers, a single limit equation is required under system normal conditions to prevent voltage collapse in the Murray region following the loss of both APD potlines.

The limit equation for VIC to NSW is of the form:

Victoria to NSW ≤ Sum [Term Values * Coefficients]

Table 9 V^N_2xAPD coefficients

Term	Coefficient
Intercept	1500
Vic to SA (Murraylink)	-0.1921
VIC_G1__MW	0.4731
JBE Pump	0.8977
MSS2SC	63
MSSReac	0.3771
NSW_G1_ MW	-0.0510
LTUM PUMP MW	-0.2267
LTUM3SC	35
NSW_ASG1	-0.0620
Q_SS_YASS	0.1268
NSW_G2	-0.4719
NSW_ASG2	-0.5502
QC_SH2	0.3718
NSW_ASG3	-0.5631
VIC_ASGZ2	0.1873
Confidence Level (95%) offset	-110

3.5 V^SML_BEKG

For VIC to SA transfers on Murraylink, a limit equation is required under system normal conditions to prevent voltage collapse at Red Cliffs following the loss of the Bendigo to Kerang 220kV line.

The limit equation for VIC to SA is of the form:

Victoria to SA on Murraylink ≤ Sum [Term Values * Coefficients]

Table 10 V^SML_BEKG coefficients

Term	Coefficient
Intercept	397.22
KGTSreac	0.625
HOTS+KGTS_SVC_MVAR	0.0311
KGTS Load	-1.394
RCTS_TX1-4_MW	-1.076
WETS_TX1_TX2 MW	-0.771
WETS_TX1_TX2 MVAR	-0.975
Silverton WF MW	0.437
RCTS66Caps	0.216
X4_line+BRK_TX1	-0.797
Upper_NW_VIC_Gen_MW	-0.180
HOTS_TX1_TX2 MW	-0.294
HOTS_TX1_TX2 MVAR	-0.294
Confidence Level (95%) offset	-22.68

3.6 V^SML_X5_X3

For VIC to SA transfers on Murraylink, a limit equation is required under system normal conditions to prevent voltage collapse at Red Cliffs following the loss of either the Darlington Point to Balranald or Balranald to Buronga 220kV lines.

The limit equation for VIC to SA is of the form:

Victoria to SA on Murraylink ≤ Sum [Term Values * Coefficients]

Table 11 V^SML_X5_X3 coefficients

Term	Coefficient
Intercept	399.9
KGTSreac	0.4580
HOTS+KGTS_SVC_MVAR	0.0607
KGTS Load	-1.010
RCTS_TX1-4_MW	-1.123
WETS_TX1_TX2 MW	-0.6507
WETS_TX1_TX2 MVAR	-1.205
Silverton WF MW	0.5708
Silverton WF MVAR	.5205
X4_line+BRK_TX1	-0.5819
Upper_NW_VIC_Gen_MW	-0.3528
HOTS_TX1_TX2 MW	-0.5821
HOTS_TX1_TX2 MVAR	-0.3922
Confidence Level (95%) offset	-25.68

3.7 NIL_KERANG

To prevent voltage collapse at Kerang or Wemen a limit equation is required under system normal conditions following the loss of the Crowlands to Bulgana to Horsham or Horsham to Murra Warra to Kiamal 220kV line.

The limit equation is of the form:

Flow from Wemen to Kerang ≤ Sum [Term Values * Coefficients]

Table 12 NIL_KERANG

Term	Coefficient
Intercept	249
KGTS SVC Status	12.20
RCTS-MLK_MVAR	-0.1769
Vic to SA (Murraylink)	-0.1446
Q3-KERANG 66	0.2026
WETS Load	-1.211
BETS Load	0.2544
Q3-BENDIGO 66	0.1
Confidence Level (95%) offset	-41.3325

3.8 V^^V_NIL_SWVIC

A limit equation is required to limit the power flow from South West Victoria to Moorabool under system normal conditions to prevent voltage instability arising from the contingency, trip of Haunted Gully – Moorabool 500kV line and both APD potlines.

The limit equation is of the form:

Flow from South West Victoria to Moorabool ≤ Sum [Term Values * Coefficients]

Table 13 V^^V_NIL_SWVIC

Term	Coefficient
QC_MLTS_220kV	0.11417
VIC_MELB_LOAD_MW	-0.00639
QRC_SHUNTS_3	0.52047
Vic to SA (Heywood)	-0.07602
QC_HYTS_275kV	0.32664
Intercept	1084.3
Confidence Level (95%) offset	-88.97

A1. Measures and Definitions

A1.1 Units of Measure

kV	Kilovolt
MVA	Megavolt amperes
MVAR	Megavolt amperes reactive
MW	A Megawatt (MW) is one million watts. A watt (W) is a measure of power and is defined as one joule per second and it measures the rate of energy conversion or transfer.
MW.sec	Megawatt seconds – a measure of the inertia of a generating unit.
kV	kilovolt

A1.2 Parameter Definitions

Abbreviation	Definition
220 kV Caps	MVAR output from capacitors connected at 220 kV busbars (i.e. Altona, Brooklyn, Dederang, Fishermans Bend, Keilor, Moorabool, Rowville, Ringwood, Templestowe and Thomastown)
330 kV Caps	MVAR output from capacitors connected at 330 kV busbars (i.e. Dederang and Wodonga).
APD–HYTS_MVAR	Alcoa Portland smelter (APD) reactive power export (measured at 500 kV feeders). A negative value indicates that APD is importing MVAr.
APD–HYTS_MW	APD real power export (measured at 500 kV feeders. A negative value indicates that APD is importing MW).
APD Load	APD MW load at 33 kV and 22 kV
BANReac	MVAR output of Bannaby reactors. Values associated with this term are negative.
Basslink	MW flow on the Basslink interconnector (measured at the receiving end)
BETS Load	BETS Load Bendigo (BETS) customer load (MW)
Both TAIL-SESS Series Caps Out	Both Tailem Bend – South East series caps out of service (1= Both series caps are out of service)
BKNH GEN	MW output from Broken Hill Generation
BOPS+MKPS GEN	MW output from Bogong and McKay Power Station [BOPS & MKPS].
BRKNHLSF_SilvWF	MW output from Broken Hill SF and Silverton WF
CANCap	MVAR output of Canberra 220 kV capacitor banks. Values associated with this term are positive.
CMACap	MVAR output of Cooma capacitor banks. Values associated with this term are positive.
Contingent MW	Maximum of: a) MW Transfer from Tas to Vic via Basslink (measured at Loy Yang). Values associated with this term are positive for flows from Tas to Vic. b) MW output of a single generating unit in Vic (MW associated with the contingency: Loss of the Largest Generator). Values associated with this term are positive.
CUECap	MVAR output of Queanbeyan capacitor banks. Values associated with this term are positive.
DD220Cap	MVAR output of Dederang 220 kV capacitor banks. Values associated with this term are positive.
DD330Cap	MVAR output of Dederang 330 kV capacitor banks. Values associated with this term are positive.
DLPT220	MVAR output of Darlington Point 220 kV reactors. Values associated with this term are negative.
DLPTshunt	MVAR output of Darlington Point shunt devices. Values associated with this term can be positive or negative

Abbreviation	Definition
DPS GEN	MW output from Dartmouth Power Station [DPS].
EPS Inertia	Inertia from Eildon Power Station (EPS). Inertia is on a 100 MVA base (MW.sec / 100 MVA) as per EMS.
GEN EPS on	Number of Eildon Power station (EPS) units online.
GEN DPS on	Number of Dartmouth Power station units online [DPS].
GEN BOPS on	Number of Bogong Power station units online [BOPS].
GEN MKPS on	Number of McKay Power station units online [MKPS].
GEN WKPS on	Number of West Kiewa Power station units online [WKPS].
Guthega GEN	MW output from Guthega Power Station [GGA].
Guthega Inertia	Inertia from Guthega Power Station [GGA]. Inertia is on a 100 MVA base (MW.sec / 100 MVA) as per EMS.
HOTS+KGTS_SVC_MVAR	MVAR contribution from Horsham and Kerang SVCs.
HOTS_TX1_TX2 MW	Sum of MW flow on Horsham B2 and B3 220/66 kV transformers. Positive value indicates power flow from HV to LV side.
HOTS_TX1_TX2 MVAR	Sum of MVAR flow on Horsham B2 and B3 220/66 kV transformers. Positive value indicates power flow from HV to LV side.
HUME GEN	MW output from Hume Power station (Victorian and NSW connection)
HUME NSW GEN	MW output from Hume Power station (NSW connection)
HYTS_CAP_Status	Heywood capacitor status (1 = capacitor in service).
JBE Pump	MW at Jindabyne Power Station [JBE]. Values associated with this term are negative.
KGTSreac	MVAR contribution from Kerang terminal station 66 kV reactors. Values associated with this term are negative.
KGTS Load	MW load at Kerang terminal station.
KGTS SVC Status	Kerang SVC status. This term is equal to 1 when the SVC is in service, and equal to 0 when the SVC is out of service.
Kiewa Gen	MW output from Kiewa hydro scheme generators (Bogong, Clover, Dartmouth, Mckay and West Kiewa).
Kiewa Inertia	Inertia from Kiewa hydro scheme generators (Bogong, Clover, Dartmouth, McKay and West Kiewa). Inertia is on a 100 MVA base (MW.sec / 100 MVA).
LOY_YANG_PS_UNITS	Number of generators in service in Loy Yang A and B power stations.
LTUM GEN MW	MW output from Lower Tumut 3 power station when generating (LTSS). Values associated with this term are positive.
L_TUMUT_Gen	MW output from Lower Tumut 3 power station (LTSS). Values associated with this term can be positive or negative due to the ability of Lower Tumut units to operate in pumping mode
LTUM PUMP MW	MW output from at Lower Tumut 3 when in pump mode [LTUM]. Values associated with this term are negative.
LTUM3SC	Number of generator units operating as synchronous condensers at Lower Tumut.
LV 220 Gen	MW output from Latrobe Valley generation on the 220 kV network (Yallourn W2, 3, and 4, and Yallourn unit 1 when connected to the 220 kV network).
LV 220 Inertia	Inertia associated with Latrobe Valley generation on the 220 kV network (Yallourn W2, 3, and 4, and Yallourn unit 1 when connected to the 220 kV network).
LV 500 Inertia	Inertia associated with Latrobe Valley generation on the 500 kV network (Loy Yang (A, B, and Valley Power), Jeeralang, Bairnsdale, and Yallourn W unit 1 when connected to the 500 kV network).
MBTS Gen	Generation connected at Mount Beauty. This includes Clover, Dartmouth, MacKay Creek, Bogong and West Kiewa.
MOPS Inertia	Inertia from Mortlake Power Station (MOPS). Inertia is on a 100 MVA base (MW.sec / 100 MVA) as per EMS.
MSS2SC	Number of generator units operating as synchronous condensers at Murray 2.

Abbreviation	Definition
MSSReac	MVAR output of Murray reactors. Values associated with this term are negative.
Murray Gen	MW output from Murray Power Station (Murray 1 and Murray 2).
Num. LTUM3 on	Number of generator units operating at Lower Tumut.
Num. MSS1 on	Number of generator units operating at Murray 1.
Num. MSS2 on	Number of generator units operating at Murray 2.
Num. ROTS SVC	Number of Static Var Compensators (SVCs) at Rowville in service.
Num. SESS SVC	Number of SVCs at South East in service.
Num. UTUM1+2 on	Number of generator units operating at upper Tumut 1 and 2.
NSWd- SW_NSW	NSW demand (customer load + losses) minus the load in southern NSW.
NSW_ASG1	MW output (Positive) from the following farms: BANGO__WF, BOCO_R__WF, CAPITL__WF, COLLEC_WF, CROOKW__WF, CULERN__WF, GUNNING_WF, GULLEN__WF, GULLEN__SF, BIALA__WF, TARALG___WF, WOODLN__WF
NSW_ASG2	MW output (Positive) from the following farms: BOMEN__SF, COLEMB__SF, COROWS_GEN, DARLIN__SF, FINLYS__SF, GRIFTH__SF, HILLST__SF, JEMALO__SF, JUNEE__SF, SEBAST_GEN, WAGGAN__SF
NSW_ASG3	MW output (Positive) from the following farms: BRKNHL__SF, LIMON __SF, SILVER___WF, SUNRAY__SF
NSW CAN LOAD pos	Load in Canberra is the sum of customer load at the following (Zone 7) bulk supply points: Lower Tumut (LTPG1-6, LTP-330), Upper Tumut (UTP_G1-8), East Lake (EST-132), Belconnen (BLC-132), Causeway (CAU-132), Cooma (CMA-66, CMA-132), City East (CITI-132), Civic (CIV-132), Gilmore (GIL-132), Gold Creek (GCR-132), Latham (LAT-132), Geehi Dam (GEE-132), Queanbeyan (QUE-66, QUE-132), Theodore (THE-132), Wanniassa (WAI-132), Woden (WOD-132), Munyang (MNY-66).
NSW_G1_ MW	MW output (Positive) from the following generators. Note that unit should be operating as a generator. BLOWRG, BURNJK , JOUNAM, KANGVL, BENDLA, LWTUMT, TALLAW, UPTUMT
NSW_G2	MW output (Positive) from the following generators: HUMEPS (connected to its VIC or NSW connection point), URANQU
NSW Sth East Gen	Generation in south eastern NSW. Values associated with this term are positive. Generation in this region: Boco Rock WF, Capital WF, Crookwell WF, Gullen Range WF, Gullen SF, Taralga WF and Woodlawn WF
NW_VIC_WF_cont	MW Output of Ararat WF, Bulgana WF, Crowlands WF, Waubra WF and Murra Warra WF. Values associated with this term are positive
Upper_NW_VIC_Gen_MW	Sum of generation for Kiata WF, Wemen SF, Bannerton SF, Gannawarra SF, Gannawarra Battery (gen), Karadoc SF, Gannawarra Battery (Gannawarra load is considered as negative generation) and Yatpool SF
NW_Vic_Gen_MW	Sum of generation in north-west Victoria. Generation in this region: Ararat WF, Bannerton SF, Bulgana WF, Challicum Hills WF, Cohuna SF, Crowlands WF, Gannawarra SF, Gannawarra Battery (gen), Karadoc SF, Kiamal SF, Kiata WF, Murra Warra WF, Waubra WF, Wemen SF, Yaloak WF, Yatpool SF and Yendon WF
Q3-BENDIGO 66	MVAR output of Bendigo capacitor banks connected at 66kV. Values associated with this term are positive.
Q2-BURNGA 220	MVAR output of Buronga reactor. Values associated with this term are negative
Q2-DENILQ_132	MVAR output of DENILQ capacitor banks connected at 132kV. Values associated with this term are positive
Q3-KERANG 66	MVAR contribution from Kerang terminal station 66 kV reactors and capacitors. Values associated with this term are negative and positive.
QC_SH2	MVAR contribution from the capacitors (Values associated with caps are positive) connected at: BOMEN__33, COLEMB__33, DARLIN__33, FINLEY__33, HILLST__33, DAL_PT_132, DENILQ_132, FINLEY__66, GRIFIT__33, WAGGA1__66, WAGGA_132
QC_HYTS_275kV	Nominal reactive power generation (MVAr) of the Heywood 275 kV switched capacitor.

Abbreviation	Definition
QRC_SHUNTS_3	Nominal reactive power generation (MVAr) of the Ballarat 66kV and Horsham 66 kV switched shunts and Horsham 66 kV fixed reactor
QC_MLTS_220kV	Nominal reactive power generation (MVAr) by Moorabool 220 kV capacitors
RCTS-MLK_MVAR	RCTS-MLK_MVAR MVAR flow from Redcliff to Murraylink 220kV line. Measured at Redcliff. Flow is positive from Redcliff to Murraylink.
RCTS_TX1-4	Sum of MW flow on Red Cliffs 220/66 kV, 220/22 kV and 220/66/22 kV transformers. Positive value indicates power flow from HV to LV side.
ROTS_SVC_MVAR	MVAR output of Rowville SVC
SGVARS	State grid Vars, MVAR output of the shunt devices at the following locations: Ballarat (BAL-66), Bendigo (BEN_G1), Dederang (DED-220), Glenrowan (GLN-66), Horsham (HOR-66), Kerang (KER-66, KER-22), Red Cliffs (RED-66, RED-22), Shepparton (SHE_G1), Terang (TER-66).
Silverton WF MW	MW output from Silverton wind farm
Silverton WF MVAR	MVAR output from Silverton wind farm
SNOWY Inertia	Inertia from the Snowy area (Murray, Lower Tumut and Upper Tumut). Inertia is on a 100 MVA base (MW.sec / 100 MVA).
State Grid Load	Vic State Grid Load. This is the sum of the State Grid Load North (SGLN) and State Grid Load South (SGLS).
State Grid Load North	Vic State Grid Load north is the sum of load at the following bulk supply points: Bendigo (BETS), Fosterville (FVTS), Glenrowan (GNTS), Kerang (KGTS), Mt Beauty (MBTS), Red Cliffs (RCTS), Shepparton (SHTS), Wemen (WETS), and Wodonga (WOTS)
State Grid Load South	Vic State Grid Load south is the sum of load at the following bulk supply points: Ararat (ARTS), Ballarat (BATS), Horsham (HOTS), Stawell (STA) and Terang (TGTS).
SE_NSW_WND_SOL_GEN	Generation in South East NSW. Values associated with this term are positive. Generation in this region are Crookwell SF, Gullen Range WF, Gullen SF, Capital WF, Cullerin Range WF, Gunning WF, Taralga WF, Woodlawn WF.
STH_NSW	Load in Southern NSW is the sum of customer load at the following bulk supply points: Bega 66, Cooma 66, Gadara, Munyan 33, Steple 132, Belcon 132, Causeway 132,Citest 132, Civic 132,EastLk 132, Gilmore 132, Gold Creek 132, Latham 132, Queanbeyan 66, Theodore 132, Wanniassa 132, Woden 132, Fairfax 132, Goulburn 132, Yass 66, ANM 132, Coleambally 132, Corowa 132, Darlington point 132, Deniliquin 66, Finley 66, Griffith 33, Morven 132, Mulwala 132, Murrumburrah 132, Murrumburrah 66, Wagga 66, Wagga N 132, Wagga N 66, Yanco 33, Balranald 22
SW_NSW	Load in South West NSW is the sum of customer load at the following bulk supply points: Broken Hill (BKH_S1-22 and BKH-220), Gadara (GAD-11), Jounama (JOU-66), Darlington Point (DLP-132), Morven (MOR-132), Albury (ALB-132), AMN-132, Coleambally (CLY-132), Marulan (MRN-132, GOU-132), Wagga (WAN-132, WAN-66, WAW-132), Murrumburrah (MRU-66), Deniliquin (DNQ-66), Yass (YAS-66), Balranald (BRD-22), Finley (FNY-132), Griffith (GRF-132), Mulwala (MUL-132), Corowa (COR-132), and Yanco (YNC-33)
SW_NSW_GEN	Generation in South West NSW. Values associated with this term are positive. Generation in this region is Darlington Point SF, Coleambally SF, Limondale 1 and 2 SFs, Sunraysia SF, Finley SF, Griffith WF, Uranquinty,
STH_NSW_GEN	Generation in southern NSW. Values associated with this term are positive. Generation in this region is Gullen Range WF, Gullen SF, Capital WF, Cullerin Range WF, Gunning WF, Boco Rock WF, Taralga WF, Woodlawn WF, Burrinjuck Hydro, Blowering Hydro, Gadara, and Jounama Hydro Embedded generation
STH_NSW_WIND_SOLAR_GEN	MW output from NSW south wind and solar generation plant
UQT Gen	MW output from Uranquinty (UQT) Power Station.
U_TUMUT_Gen	MW output from Upper Tumut 1 and Upper Tumut 2 Power Station (UTSS).
UTUM1SC+UTUM2SC	Number of generator units operating as synchronous condensers at Upper Tumut 1 and Upper Tumut 2.
VIC_ASGZ2	MW output (Positive) from the following farms: BANNER__SF, COHUNS__SF, KARADO__SF, KIAMAL__SF, WEMEN__SF,YATPOO__SF GANAWR__SF, GANAWA_BAT
V_MLTS5	MLTS 500 kV voltage (typical values between 450 and 550 kV).

Abbreviation	Definition
Vic Demand	Vic MW demand (calculated as generation minus export).
VIC MEL LOAD pos	Load in Melbourne is the sum of customer load at the following (Zone 12) bulk supply points: Jeeralang A (JEA_G1-4), Jeeralang B (JEB_G1-3), Loy Yang A (LYA_G1-4), Loy Yang B (LYB_G1-2), Valley Power (VAL_G1), Mortlake (MRT_G1-2), Morwell (MOR_G1-3, MOW-66, MOW-22), Newport (NEW_G1), Somerton (SOM_G1-4, SEP-66), Yallourn (YPS_G1-4, YPS_T5, YPS-22), Altona (ALT-66), Richmond (RIC_G1, RIC-66, RIC-22), John Lysaght Aust. (JOH-220), Wonthaggi Diesel (WON-220), Altona Chemicals (ATC-66), Brooklyn (BRO-66, BRO-22), Brunswick (BRU-66, BRU-22), Cranbourne (CRA-66), East Rowville (EAS_G1, EAS-66), Fishermans Bend (FIS_G1), Geelong (GEE_G1, GEE-66), Heatherton (HEA_G1), Keilor (KEL_G1, KEL-66), Laverton North (LVN-66), Loy Yang (LOY-66), Malvern (MAL-66, MAL-22), Ringwood (RIN-66, RIN-22), South Morang (SOU-66), Springvale (SPR_G1, SPR-66), Tyabb (TYA-66), Templestowe (TEM_G1, TEM-66), Thomastown (THO_G1-2), West Melbourne (WML-66, WML-22), Toyota (TOY-66), Heywood (HEY-22).
VIC_MELB_LOAD_MW	Melbourne metropolitan region load [MW]
Vic to SA (Heywood)	MW transfer from Vic to SA via Heywood (measured at South East end). The interconnector direction and lines it consists of follow the NEM standard.
Vic to SA (Murraylink)	MW transfer from Vic to SA via Murraylink (measured at Red Cliffs end). Values associated with this term are positive for flows from Victoria to South Australia
Vic Demand - State Grid Load	Vic Demand (MW) minus Vic State Grid Load (SGL).
Vic Demand - State Grid Load - APD Load	Vic Demand (MW) minus Vic State Grid Load (SGL) minus APD load.
Vic Demand - State Grid Load North – APD Load	Vic Demand (MW) minus Vic State Grid Load North (SGLN) minus APD Load.
Vic Demand – APD Load	Vic Demand (MW) minus APD Load.
VIC_G1__MW	MW output (Positive) from the following generators: Note that unit should be operating as a generator. MURRAY, CLOVER, DARTMO, MKAYCK, WSTKWA, EILDON, GUTHGA
Vic Metro Gen	MW output from Vic metropolitan generators (Newport, Somerton, and Laverton North).
Vic Metro Gen Inertia	Inertia from Vic metropolitan generators (Newport, Somerton and Laverton North). Inertia is on a 100 MVA base (MW.sec / 100 MVA) as per EMS.
Vic Sth West Gen	MW Generation from Victorian generators in the south-west of Victoria. Generation in this region is: Elaine WF, Dundonnell WF, Macarthur WF, Moorabool WF, Mortlake PS, Morton WF, Mt Gellibrand WF, Mt Mercer WF, Oakhill WF, Portland WF, Salt Creek WF, Stockyard Hill WF and Yambuk WF
Vic Wind & Solar	MW Generation from Vic windfarms and solar plant (Ararat WF, Bald Hill WF, Ballarat Battery (Gen Component), Bannerton SF, Bulgana WF, Challicum Hills WF, Crowlands WF, Elain WF, Gannawarra Battery (Gen component), Gannawarra SF, Karadoc SF, Kiata WF, Macarthur WF, Moorabool WF, Mortons Lane WF, Mount Gelibrand WF, Mount Mercer WF, Murra Warra WF, Numurkah SF, Oaklands Hill WF, Portland WF, Salt Creek WF, Waubra WF, Wemen SF, Yaloak South WF, Yambuk WF, Yatpool SF and Yendon SF)
WAGGACap	MVAR output of Wagga Wagga capacitor banks. Values associated with this term are positive.
WAGGACap_66	MVAr output of Wagga 66 kV capacitor
WETS Load	WETS Load Wemen (WETS) customer load (MW)
WETS_TX1_TX2 MW	Sum of MW flow on Wemen B1 and B2 220/66 kV transformers. Positive value indicates power flow from HV to LV side.
WETS_TX1_TX2 MVAR	Sum of MVAR flow on Wemen B1 and B2 220/66 kV transformers. Positive value indicates power flow from HV to LV side.
WKPS GEN	MW output from West Kiewa Power Station [WKPS].
WOTSCap	MVAR output of Wodonga capacitor banks. Values associated with this term are positive.
X4_line+BRK_TX1	Sum of MW flow of X4 line (load), measured at Broken Hill and MW flow on Broken Hill B1 and B2 220/22 kV transformers. Positive value indicates power flow from HV to LV side.
Q_SS_YASS	MVAR output of Yass 330 kV reactor and Yass 132 capacitors. Values associated with reactor are negative and Values associated with caps are positive.
YASSCap	MVAR output of Yass capacitor banks. Values associated with this term are positive.

Glossary

This document uses many terms that have meanings defined in the National Electricity Rules (NER). The NER meanings are adopted unless otherwise specified.

Term	Definition
Constraint equation	These are the mathematical representations that AEMO uses to model power system limitations and FCAS requirements in National Electricity Market Dispatch Engine (NEMDE).
System normal	The configuration of the power system where: • All transmission elements are in service, or • The network is operating in its normal network configuration
TNSP	Transmission Network Service Provider