AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Regions and Marginal Loss Factors: FY 2021-22

April 2021-22

A report for the National Electricity Market

Important notice

Purpose

This document has been prepared by AEMO as the 'Regions Publication' under clause 2A.1.3 of the National Electricity Rules (Rules), and to inform Registered Participants of the 2021-22 inter-regional loss equations under clause 3.6.1 of the Rules and 2021-22 intra-regional loss factors under clause 3.6.2 of the Rules. This document has effect only for the purposes set out in the Rules. The National Electricity Law (Law) and the Rules prevail over this document to the extent of any inconsistency.

Disclaimer

The calculation of the loss factors presented in this document incorporates information and forecasts from third parties. AEMO has made every reasonable effort to ensure the quality of the information in this publication but cannot guarantee that any information, forecasts and assumptions are accurate, complete or appropriate for your circumstances.

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Version control

Version	Release date	Changes
1	2/3/2021	Draft 2021-22 MLFs published.
2	1/4/2021	Final 2021-22 MLFs published.
3	7/7/2021	• July 2021 including the following new and revised connection points: • NSW Generation: Bango 999 Wind Farm, Junee Solar Farm, Wagga North Solar Farm, Gunnedah Solar Farm • NSW Load: Finley 132kV

Version	Release date	Changes
		• QLD Generation: Gangarri Solar Farm, Kennedy Energy Park (Battery, Solar, Wind), Wandoan BESS • VIC Generation: Winton Solar Farm, Bulgana BESS • SA Generation: Adelaide Desalination Plant PV, Adelaide Desalination Plant Battery, revised generator description of Morphett Vale East 66 to Temporary Generation South (TGS) Lonsdale, revised generator description of Para 66 to Temporary Generation North.
4	26/11/2021	• November 2021 including the following new and revised connection points: • NSW Generation: Suntop Solar Farm, Hillston Solar Farm, Wallgrove BESS, Sebastopol Solar Farm, Junee Solar Farm • QLD Generation: Western Downs Solar Farm • VIC Generation: Stockyard Hill Wind Farm, Victorian Big Battery, Diapur Wind Farm, Kiata Wind Farm • SA Generation: Mannum-Adelaide Pipeline Pumping Station No 2 Solar Farm, Adelaide Desalination Plant PV2, Adelaide Desalination Plant PV3, Adelaide Desalination Plant Hydro, Bolivar Wastewater Treatment Plant PV, Bolivar Wastewater Treatment Plant Reserve BESS, Bolivar Wastewater Treatment Plant Reserve Diesel
5	13/03/2022	March 2022 including the following new and revised connection points: • NSW Load: Brandy Hill (Essential Energy), Macquarie Park 11, Macquarie Park 33, Metz Solar Farm • NSW Generation: Hunter Economic Zone • QLD Generation: Bluegrass Solar Farm • Victoria Generation: Murra Warra Wind Farm - stage 2 • Victoria Load: Malvern (CitiPower) • SA Generation: Port Augusta Renewable Energy Park – Wind, Lincoln Gap Wind Farm, Lincoln Gap Wind Farm (Stage 2), Murray Bridge - Hahndorf Pipeline 2 – Dual MLF (Generation), Murray Bridge - Hahndorf Pipeline 2 – Dual MLF (Load) - Snapper Point PS • SA Load: Murray Bridge - Hahndorf Pipeline 2 – Dual MLF (Generation), Murray Bridge - Hahndorf Pipeline 2 – Dual MLF (Load) • TAS Load: St Leonards Scheduled Load, Fisher 220 DNSP
6	11/07/2022	June 2022 including the following new and revised connection points: • QLD Generation: Columboola Solar Farm, Woolooga Solar Farm • SA Generation: Happy Valley BESS, Happy Valley Solar Farm, Mannum-Adelaide Pipeline Pumping Station No 3 Solar Farm • ACT Generation: Mugga lane Landfill • VIC Generation: Mortlake South Wind Farm

Introduction

This document sets out the 2021-22 National Electricity Market (NEM) intra-regional loss factors, commonly referred to as marginal loss factors (MLFs), calculated under clause 3.6.2 of the National Electricity Rules (Rules). MLFs represent electrical transmission losses within each of the five regions in the NEM – Queensland, New South Wales, Victoria, South Australia, and Tasmania.

As well as the MLFs, this document provides the following information for the 2021-22 financial year:

- Connection point transmission node identifiers (TNIs),
- Virtual transmission nodes (VTNs),
- NEM inter-regional loss factor equations and loss equations calculated under clause 3.6.1 of the Rules.

This document also serves as the Regions Publication under clause 2A.1.3 of the Rules, providing the following information for the 2021-22 financial year:

- Regions.
- Regional reference nodes (RRNs).
- Region boundaries.

Loss factors apply for 2021-22 only, and should not be relied on as an indicator for future years.

Context

In recent years, supply and demand patterns in the NEM have been changing at an increasing rate, driven by new technology and a changing generation mix. This has led to large year-on-year changes in MLFs, particularly in areas of high renewable penetration that are electrically weak and remote from load centres.

The large year-on-year changes in MLFs demonstrate the ongoing need for comprehensive planning of both generation and transmission to minimise costs to consumers. All-of-system planning documents, such as the Integrated System Plan (ISP)[1], are critical in the provision of information to participants regarding the needs of, and changes to, the power system.

Forward Looking Loss Factor Methodology review

In 2020 AEMO commenced a formal review of the Forward Looking Loss Factor Methodology[2] (Methodology), focusing on implementing changes that would be viable for incorporation into the 2021-22 MLF study. The review was completed and a revised Methodology[3] published in December 2020.

The core changes to the Methodology were:

- Further clarification and revision of existing definitions.

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[1] The 2020 ISP is published at https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp.

[2] Forward Looking Transmission Loss Factors Consultation, at https://aemo.com.au/consultations/current-and-closed-consultations/forward-looking-transmission-loss-factors.

[3] Forward Looking Loss Factor Methodology 8.0, at https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/loss_factors_and_regional_boundaries/forward-looking-loss-factor-methodology.pdf?la=en.

- Revised process for forecasting future generation.
- Parallel AC and DC interconnector treatment.
- Revised dual MLF threshold.
- Generation capacities.
- Intra-regional limits.

Impact of COVID-19

AEMO has determined MLFs in accordance with the Methodology as revised in December 2020, using regional and connection point demand forecasts available in February 2021. In accordance with the Rules and the Methodology, AEMO considered historical demand profiles from the 'reference year', being 2019-20 for the 2021-22 MLF studies. However, COVID-19 and associated control measures by various governments have impacted historical demand within the reference year (2019-20).

To identify historical demand profiles with a material impact from COVID-19, profiles were divided into pre-COVID-19 (July 2019 to March 2020) and COVID-19 (April 2020 to July 2020) samples. These samples were individually compared against the same periods for 2018-19 to ascertain year-on-year growth ratios. Where growth in the COVID-19 sample comparison was <95% of the growth observed in the pre-COVID-19 sample, the connection point was flagged for review.

The reviews highlighted several connection points of concern, in particular load connection points within close proximity to the Melbourne CBD. Where historical data was identified as being unrepresentative of expected future demand conditions, corrections were implemented during the forecasting process to minimise the impact of COVID-19 and the associated control measures on the 2021-22 MLF outcomes.

Quality control

AEMO applied a number of quality assurance steps when calculating the 2021-22 MLFs. These included engaging an independent consultant to review the quality and accuracy of the MLF calculation process. The consultant is satisfied that AEMO is appropriately applying the published Methodology based on the data provided by registered participants, historical market data, and AEMO's electricity consumption forecasts, and a review of the process applied to the calculation of MLF values.

Changes since draft report

AEMO published a draft report on 2021-22 MLFs on 2 March 2021, and sought feedback from stakeholders.

AEMO made a number of minor improvements to modelling compared to the study used for the draft report, as part of the quality assurance steps undertaken. This has resulted in a small number of connection points having a material change in MLF value compared to the draft report.

Observations and trends

Changes between the 2020-21 MLFs and the 2021-22 MLFs are mainly due to changes in projected power flow over the transmission network.

The key drivers for these changes are:

- New generation capacity, primarily in Victoria, New South Wales, and Queensland.

- Generation that commenced operation in 2020-21 being commercially operational for entirety of 2021-22.
- Variations in historical generator behaviour between reference years for 2020-21 and 2021-22 MLF studies.
- Incorporation of revised intra-regional limits based on revised limit advice.

The main changes in regional MLFs from 2020-21 to 2021-22 are, in summary:

- A decrease in MLFs at connection points in southern Queensland, and an increase in MLFs at connection points in northern and central Queensland.
- In general, a decrease in MLFs at connection points in all sub-regions within New South Wales. Certain generator MLFs in south-west New South Wales have increased, as generation output in this area is reduced by network limitations.
- An increase in MLFs at connection points in northern and north-western Victoria, and a small decrease in MLFs at connection points for western Victoria.
- A decrease in MLFs at connection points in Riverland in South Australia and an increase in the south-east of South Australia due to imports on Murraylink and increased exports on Heywood respectively.
- A mild decrease in MLFs at connection points across Tasmania.

The impact on MLFs of increased output from new renewable generation has been partially offset by network limitations. System strength limits in north-west Victoria and south-west New South Wales (collectively referred to as West Murray), and in northern Queensland, have been included in the MLF study, to better reflect the forecast operating conditions of impacted generators.

Contents

Tables

Figures

1 Marginal loss factors by region

This section shows the intra-regional loss factors, commonly known as marginal loss factors (MLFs), for financial year 2021-22, for every existing load or generation transmission connection point (identified by transmission node identifier [TNI] or dispatchable unit identifier [DUID]) in each NEM region. As required by clause 3.6.2 of the National Electricity Rules (Rules), these MLFs have been calculated in accordance with AEMO's published Forward Looking Loss Factor Methodology (Methodology).

The generation profiles for committed but not yet NEM registered projects are included in the MLF calculation, however AEMO does not publish MLFs for connection points relating to projects whose registration has not been completed as at the date of publication. On registration, AEMO will publish MLFs for those connection points. MLF updates and additions that are developed throughout the year will be included in the "2021-22 MLF Applicable from 1 July 2021" spreadsheet, which is also published on AEMO's website[4].

1.1 Queensland marginal loss factors

Table 1 Queensland loads

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Abermain	33	QABM	1.0001	1.0019
Abermain	110	QABR	1.0010	1.0027
Alan Sherriff	132	QASF	1.0039	0.9676
Algester	33	QALG	1.0134	1.0161
Alligator Creek	132	QALH	0.9883	0.9649
Alligator Creek	33	QALC	0.9961	0.9710
Ashgrove West	33	QAGW	1.0154	1.0166
Ashgrove West	110	QCBW	1.0135	1.0142
Belmont	110	QBMH	1.0083	1.0115
Belmont Wecker Road	33	QBBS	1.0097	1.0131
Biloela	66/11	QBIL	0.9348	0.9141
Blackstone	110	QBKS	0.9975	0.9995
Blackwater	66/11	QBWL	0.9791	0.9618
Blackwater	132	QBWH	0.9745	0.9546
Bluff	132	QBLF	0.9759	0.9570
Bolingbroke	132	QBNB	0.9751	0.9509
Bowen North	66	QBNN	0.9776	0.9492
Boyne Island	275	QBOH	0.9696	0.9490
Boyne Island	132	QBOL	0.9663	0.9463
Braemar – Kumbarilla Park	275	QBRE	0.9739	0.9758
Bulli Creek (Essential Energy)	132	QBK2	0.9731	0.9746

[4] At https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Loss-factor-and-regional-boundaries.

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Bulli Creek (Waggamba)	132	QBLK	0.9731	0.9746
Bundamba	110	QBDA	0.9997	1.0016
Burton Downs	132	QBUR	0.9812	0.9618
Cairns	22	QCRN	1.0090	0.9661
Cairns City	132	QCNS	0.9995	0.9581
Callemondah (Rail)	132	QCMD	0.9580	0.9375
Calliope River	132	QCAR	0.9558	0.9351
Cardwell	22	QCDW	1.0052	0.9731
Chinchilla	132	QCHA	0.9863	0.9715
Clare	66	QCLR	1.0101	0.9633
Collinsville Load	33	QCOL	0.9706	0.9433
Columboola	132	QCBL	0.9849	0.9917
Columboola 132 (Bellevue LNG load)	132	QCBB	0.9857	0.9928
Coppabella (Rail)	132	QCOP	0.9865	0.9721
Dan Gleeson	66	QDGL	1.0031	0.9724
Dingo (Rail)	132	QDNG	0.9540	0.9344
Duaringa	132	QDRG	0.9567	0.9376
Dysart	66/22	QDYS	0.9849	0.9728
Eagle Downs Mine	132	QEGD	0.9816	0.9671
Edmonton	22	QEMT	1.0189	0.9791
Egans Hill	66	QEGN	0.9453	0.9228
El Arish	22	QELA	1.0146	0.9833
Garbutt	66	QGAR	1.0090	0.9740
Gin Gin	132	QGNG	0.9792	0.9637
Gladstone South	66/11	QGST	0.9602	0.9426
Goodna	33	QGDA	1.0030	1.0055
Goonyella Riverside Mine	132	QGYR	0.9979	0.9808
Grantleigh (Rail)	132	QGRN	0.9572	0.9358
Gregory (Rail)	132	QGRE	0.9591	0.9353
Ingham	66	QING	1.0664	0.9853
Innisfail	22	QINF	1.0199	0.9788
Invicta Load	132	QINV	0.9272	0.9274
Kamerunga	22	QKAM	1.0208	0.9775
Kemmis	66	QEMS	0.9820	0.9602
King Creek	132	QKCK	0.9781	0.9484
Lilyvale	66	QLIL	0.9585	0.9414
Lilyvale (Barcaldine)	132	QLCM	0.9515	0.9478
Loganlea	33	QLGL	1.0117	1.0148
Loganlea	110	QLGH	1.0083	1.0111
Mackay	33	QMKA	0.9866	0.9603

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Middle Ridge (Energex)	110	QMRX	0.9796	0.9821
Middle Ridge (Ergon)	110	QMRG	0.9796	0.9821
Mindi (Rail)	132	QMND	0.9680	0.9448
Molendinar	110	QMAR	1.0087	1.0120
Molendinar	33	QMAL	1.0082	1.0115
Moranbah (Mine)	66	QMRN	0.9949	0.9842
Moranbah (Town) - Dual MLF (Generation)	11	QMRL	0.9877	0.9624
Moranbah (Town) - Dual MLF (Load)	11	QMRL	0.9852	0.9624
Moranbah South (Rail)	132	QMBS	0.9861	0.9702
Moranbah Substation	132	QMRH	0.9870	0.9721
Moura	66/11	QMRA	0.9527	0.9349
Mt McLaren (Rail)	132	QMTM	0.9773	0.9688
Mudgeeraba	33	QMGL	1.0088	1.0106
Mudgeeraba	110	QMGB	1.0079	1.0102
Murarrie (Belmont)	110	QMRE	1.0090	1.0124
Nebo	11	QNEB	0.9675	0.9430
Newlands	66	QNLD	1.0042	0.9837
North Goonyella	132	QNGY	0.9937	0.9836
Norwich Park (Rail)	132	QNOR	0.9754	0.9599
Oakey	110	QOKT	0.9765	0.9809
Oonooie (Rail)	132	QOON	0.9902	0.9658
Orana LNG	275	QORH	0.9767	0.9795
Palmwoods	132	QPWD	1.0091	1.0046
Pandoin	132	QPAN	0.9479	0.9251
Pandoin	66	QPAL	0.9484	0.9257
Peak Downs (Rail)	132	QPKD	0.9925	0.9794
Pioneer Valley	66	QPIV	0.9953	0.9676
Proserpine	66	QPRO	1.0061	0.9766
Queensland Alumina Ltd (Gladstone South)	132	QQAH	0.9652	0.9455
Queensland Nickel (Yabulu)	132	QQNH	0.9887	0.9593
Raglan	275	QRGL	0.9492	0.9280
Redbank Plains	11	QRPN	1.0035	1.0057
Richlands	33	QRLD	1.0127	1.0152
Rockhampton	66	QROC	0.9506	0.9291
Rocklands (Rail)	132	QRCK	0.9401	0.9182
Rocklea (Archerfield)	110	QRLE	1.0044	1.0058
Ross	132	QROS	0.9929	0.9650
Runcorn	33	QRBS	1.0142	1.0171
South Pine	110	QSPN	1.0052	1.0048
Stony Creek	132	QSYC	0.9830	0.9594

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Sumner	110	QSUM	1.0052	1.0068
Tangkam (Dalby) - Dual MLF (Generation)	110	QTKM	0.9774	0.9798
Tangkam (Dalby) - Dual MLF (Load)	110	QTKM	0.9774	0.9843
Tarong	66	QTRL	0.9725	0.9731
Teebar Creek	132	QTBC	0.9918	0.9843
Tennyson	33	QTNS	1.0083	1.0093
Tennyson (Rail)	110	QTNN	1.0065	1.0079
Townsville East	66	QTVE	1.0026	0.9591
Townsville South	66	QTVS	1.0043	0.9625
Townsville South (KZ)	132	QTZS	1.0019	0.9899
Tully	22	QTLL	1.0521	0.9710
Turkinje	66	QTUL	1.0291	0.9942
Turkinje (Craiglie)	132	QTUH	1.0376	1.0028
Wandoan South	132	QWSH	0.9982	1.0035
Wandoan South (NW Surat)	275	QWST	0.9970	1.0026
Wandoo (Rail)	132	QWAN	0.9730	0.9506
Wivenhoe Pump	275	QWIP	0.9974	0.9969
Woolooga (Energex)	132	QWLG	0.9928	0.9841
Woolooga (Ergon)	132	QWLN	0.9928	0.9841
Woree	132	QWRE	1.0075	0.9677
Wotonga (Rail)	132	QWOT	0.9864	0.9699
Wycarbah	132	QWCB	0.9480	0.9260
Yarwun – Boat Creek (Ergon)	132	QYAE	0.9579	0.9380
Yarwun – Rio Tinto	132	QYAR	0.9545	0.9333

Table 2 Queensland generation

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Baking Board Solar Farm (Chinchilla Solar Farm)	132	BAKING1	QCHS1C	QCHS	0.9886	0.9743
Barcaldine PS – Lilyvale	132	BARCALDN	QBCG	QBCG	0.9064	0.9025
Barcaldine Solar at Lilyvale (132)	132	BARCSF1	QLLV1B	QLLV	0.9267	0.8889
Barron Gorge Power Station (PS) Unit 1	132	BARRON-1	QBGH1	QBGH	0.9832	0.9356
Barron Gorge PS Unit 2	132	BARRON-2	QBGH2	QBGH	0.9832	0.9356
Bluegrass Solar Farm	132	BLUEGSF1	QCBS1B	QCBS	0.9549	
Braemar PS Unit 1	275	BRAEMAR1	QBRA1	QBRA	0.9629	0.9609
Braemar PS Unit 2	275	BRAEMAR2	QBRA2	QBRA	0.9629	0.9609
Braemar PS Unit 3	275	BRAEMAR3	QBRA3	QBRA	0.9629	0.9609
Braemar Stage 2 PS Unit 5	275	BRAEMAR5	QBRA5B	QBRA	0.9629	0.9609
Braemar Stage 2 PS Unit 6	275	BRAEMAR6	QBRA6B	QBRA	0.9629	0.9609
Braemar Stage 2 PS Unit 7	275	BRAEMAR7	QBRA7B	QBRA	0.9629	0.9609

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Browns Plains Landfill Gas PS	110	BPLANDF1	QLGH3B	QLGH	1.0083	1.0111
Callide A PS Unit 4	132	CALL_A_4	QCAA4	QCAA	0.9266	0.9066
Callide A PS Unit 4 Load	132	CALLNL4	QCAA2	QCAA	0.9266	0.9066
Callide B PS Unit 1	275	CALL_B_1	QCAB1	QCAB	0.9251	0.9086
Callide B PS Unit 2	275	CALL_B_2	QCAB2	QCAB	0.9251	0.9086
Callide C PS Unit 3	275	CPP_3	QCAC3	QCAC	0.9274	0.9076
Callide C PS Unit 4	275	CPP_4	QCAC4	QCAC	0.9274	0.9076
Callide PS Load	132	CALLNL1	QCAX	QCAX	0.9257	0.9048
Childers Solar Farm	132	CHILDSF1	QTBS1C	QTBS	0.9797	0.9608
Clare Solar Farm	132	CLARESF1	QCLA1C	QCLA	0.9197	0.8647
Clermont Solar Farm	132	CLERMSF1	QLLV3C	QLLV	0.9267	0.8889
Collinsville Solar Farm	33	CSPVPS1	QCOS1C	QCOS	0.9247	0.8738
Columboola – Condamine PS	132	CPSA	QCND1C	QCND	0.9825	0.9884
Columboola Solar Farm	132	COLUMSF1	QCBR1C	QCBR	0.9846	
Coopers Gap Wind Farm	275	COOPGWF1	QCPG1C	QCPG	0.9683	0.9681
Daandine PS - Dual MLF (Generation)	110	DAANDINE	QTKM1	QTKM	0.9774	0.9798
Daandine PS - Dual MLF (Load)	110	DAANDINE	QTKM1	QTKM	0.9774	0.9843
Darling Downs PS	275	DDPS1	QBRA8D	QBRA	0.9629	0.9609
Darling Downs Solar Farm	275	DDSF1	QBRS1D	QBRS	0.9762	0.9825
Daydream Solar Farm	33	DAYDSF1	QCCK1D	QCCK	0.9268	0.8825
Emerald Solar Farm	66	EMERASF1	QLIS1E	QLIS	0.9237	0.8820
Gangarri Solar Farm	132	GANGARR1	QWSS1G	QWSS	0.9959	0.9992
German Creek Generator	66	GERMCRK	QLIL2	QLIL	0.9585	0.9414
Gladstone PS (132 kV) Unit 3	132	GSTONE3	QGLD3	QGLL	0.9470	0.9288
Gladstone PS (132 kV) Unit 4	132	GSTONE4	QGLD4	QGLL	0.9470	0.9288
Gladstone PS (132kV) Load	132	GLADNL1	QGLL	QGLL	0.9470	0.9288
Gladstone PS (275 kV) Unit 1	275	GSTONE1	QGLD1	QGLH	0.9519	0.9285
Gladstone PS (275 kV) Unit 2	275	GSTONE2	QGLD2	QGLH	0.9519	0.9285
Gladstone PS (275 kV) Unit 5	275	GSTONE5	QGLD5	QGLH	0.9519	0.9285
Gladstone PS (275 kV) Unit 6	275	GSTONE6	QGLD6	QGLH	0.9519	0.9285
Grosvenor PS At Moranbah 66 No 1	66	GROSV1	QMRN2G	QMRV	0.9844	0.9696
Grosvenor PS At Moranbah 66 No 2	66	GROSV2	QMRV1G	QMRV	0.9844	0.9696
Hamilton Solar Farm	33	HAMISF1	QSLD1H	QSLD	0.9239	0.8743
Haughton Solar Farm	275	HAUGHT11	QHAR1H	QHAR	0.9356	0.8765
Hayman Solar Farm	33	HAYMSF1	QCCK2H	QCCK	0.9268	0.8825
Hughenden Solar Farm	132	HUGSF1	QROG2H	QROG	0.9395	0.8907
Invicta Sugar Mill	132	INVICTA	QINV1I	QINV	0.9272	0.9274
Isis CSM	132	ICSM	QGNG1I	QTBC	0.9918	0.9843
Kareeya PS Unit 1	132	KAREEYA1	QKAH1	QKYH	0.9656	0.9465
Kareeya PS Unit 2	132	KAREEYA2	QKAH2	QKYH	0.9656	0.9465

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Kareeya PS Unit 3	132	KAREEYA3	QKAH3	QKYH	0.9656	0.9465
Kareeya PS Unit 4	132	KAREEYA4	QKAH4	QKYH	0.9656	0.9465
Kennedy Energy Park Battery (Generation)	132	KEPBG1	QROW3K	QROW	0.9912	0.9581
Kennedy Energy Park Battery (Load)	132	KEPBL1	QROW4K	QROW	0.9912	0.9581
Kennedy Energy Park Solar Farm	132	KEPSF1	QROW2K	QROW	0.9912	0.9581
Kennedy Energy Park Wind Farm	132	KEPWF1	QROW1K	QROW	0.9912	0.9581
Kidston Solar Farm	132	KSP1	QROG1K	QROG	0.9395	0.8907
Kogan Creek PS	275	KPP_1	QBRA4K	QWDN	0.9694	0.9735
Koombooloomba	132	KAREEYA5	QKYH5	QKYH	0.9656	0.9465
Lilyvale Solar Farm	33	LILYSF1	QBDR1L	QBDR	0.9276	0.8904
Longreach Solar Farm	132	LRSF1	QLLV2L	QLLV	0.9267	0.8889
Mackay GT	33	MACKAYGT	QMKG	QMKG	0.9549	0.8893
Maryorough Solar Farm (Brigalow Solar Farm)	110	MARYRSF1	QMRY2M	QMRY	0.9789	0.9851
Middlemount Sun Farm	66	MIDDLSF1	QLIS2M	QLIS	0.9237	0.8820
Millmerran PS Unit 1	330	MPP_1	QBCK1	QMLN	0.9733	0.9763
Millmerran PS Unit 2	330	MPP_2	QBCK2	QMLN	0.9733	0.9763
Moranbah Generation - Dual MLF (Generation)	11	MORANBAH	QMRL1M	QMRL	0.9877	0.9624
Moranbah Generation - Dual MLF (Load)	11	MORANBAH	QMRL1M	QMRL	0.9852	0.9624
Moranbah North PS	66	MBAHNTH	QMRN1P	QMRN	0.9949	0.9842
Mount Emerald Wind farm	275	MEWF1	QWKM1M	QWKM	0.9835	0.9550
Mt Stuart PS Unit 1	132	MSTUART1	QMSP1	QMSP	0.9286	0.9229
Mt Stuart PS Unit 2	132	MSTUART2	QMSP2	QMSP	0.9286	0.9229
Mt Stuart PS Unit 3	132	MSTUART3	QMSP3M	QMSP	0.9286	0.9229
Oakey 1 Solar Farm	110	OAKEY1SF	QTKS1O	QTKS	0.9711	0.9783
Oakey 2 Solar Farm	110	OAKEY2SF	QTKS2O	QTKS	0.9711	0.9783
Oakey PS Unit 1	110	OAKEY1	QOKY1	QOKY	0.9536	0.9591
Oakey PS Unit 2	110	OAKEY2	QOKY2	QOKY	0.9536	0.9591
Oaky Creek 2	66	OAKY2	QLIL3O	QLIL	0.9585	0.9414
Oaky Creek Generator	66	OAKYCREK	QLIL1	QLIL	0.9585	0.9414
Racecourse Mill PS 1 – 3	66	RACOMIL1	QMKA1R	QPIV	0.9953	0.9676
Rocky Point Gen (Loganlea 110kV)	110	RPCG	QLGH2	QLGH	1.0083	1.0111
Roma PS Unit 7 – Columboola	132	ROMA_7	QRMA7	QRMA	0.9679	0.9761
Roma PS Unit 8 – Columboola	132	ROMA_8	QRMA8	QRMA	0.9679	0.9761
Ross River Solar Farm	132	RRSF1	QROG3R	QROG	0.9395	0.8907
Rugby Run Solar Farm	132	RUGBYR1	QMPL1R	QMPL	0.9156	0.8886
Stanwell PS Load	132	STANNL1	QSTX	QSTX	0.9463	0.9216
Stanwell PS Unit 1	275	STAN-1	QSTN1	QSTN	0.9338	0.9120
Stanwell PS Unit 2	275	STAN-2	QSTN2	QSTN	0.9338	0.9120
Stanwell PS Unit 3	275	STAN-3	QSTN3	QSTN	0.9338	0.9120
Stanwell PS Unit 4	275	STAN-4	QSTN4	QSTN	0.9338	0.9120

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Stapylton	110	STAPYLTON1	QLGH4S	QLGH	1.0083	1.0111
Sun Metals Solar Farm	132	SMCSF1	QTZS1S	QTZS	1.0019	0.9899
Sunshine Coast Solar Farm	132	VALDORA1	QPWD1S	QPWD	1.0091	1.0046
Susan River Solar Farm	132	SRSF1	QTBS2S	QTBS	0.9797	0.9608
Swanbank E GT	275	SWAN_E	QSWE	QSWE	0.9971	0.9997
Tarong North PS	275	TNPS1	QTNT	QTNT	0.9723	0.9720
Tarong PS Unit 1	275	TARONG#1	QTRN1	QTRN	0.9719	0.9721
Tarong PS Unit 2	275	TARONG#2	QTRN2	QTRN	0.9719	0.9721
Tarong PS Unit 3	275	TARONG#3	QTRN3	QTRN	0.9719	0.9721
Tarong PS Unit 4	275	TARONG#4	QTRN4	QTRN	0.9719	0.9721
Ti Tree BioReactor	33	TITREE	QABM1T	QABM	1.0001	1.0019
Wandoan BESS (Generation)	132	WANDBG1	QWSB1W	QWSB	0.9764	
Wandoan BESS (Load)	132	WANDBL1	QWSB2W	QWSB	1.0054	
Warwick Solar Farm 1	110	WARWSF1	QMRY3W	QMRY	0.9789	0.9851
Warwick Solar Farm 2	110	WARWSF2	QMRY4W	QMRY	0.9789	0.9851
Western Downs Green Power Hub	275	WDGPH1	QWDR1W	QWDR	0.9704	
Whitsunday Solar Farm	33	WHITSF1	QSLS1W	QSLS	0.9231	0.8743
Windy Hill Wind Farm	66	WHILL1	QTUL	QTUL	1.0291	0.9942
Wivenhoe Generation Unit 1	275	W/HOE#1	QWIV1	QWIV	0.9903	0.9919
Wivenhoe Generation Unit 2	275	W/HOE#2	QWIV2	QWIV	0.9903	0.9919
Wivenhoe Pump 1	275	PUMP1	QWIP1	QWIP	0.9974	0.9969
Wivenhoe Pump 2	275	PUMP2	QWIP2	QWIP	0.9974	0.9969
Wivenhoe Small Hydro	110	WIVENSH	QABR1	QABR	1.0010	1.0027
Woolooga Solar Farm	132	WOOLGSF1	QWLS1W	QWLS	0.9951	
Yabulu PS	132	YABULU	QTYP	QTYP	0.9661	0.9268
Yabulu Steam Turbine (Garbutt 66kV)	66	YABULU2	QGAR1	QYST	0.9755	0.9196
Yarranlea Solar Farm	110	YARANSF1	QMRY1Y	QMRY	0.9789	0.9851
Yarwun PS	132	YARWUN_1	QYAG1R	QYAG	0.9544	0.9324

1.2 New South Wales marginal loss factors[5]

Table 3 New South Wales loads

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Alexandria	33	NALX	1.0048	1.0031
Albury	132	NALB	0.9591	0.9702
Armidale	66	NAR1	0.9474	0.9671
Australian Newsprint Mill	132	NANM	0.9456	0.9828

[5] The New South Wales region includes the Australian Capital Territory (ACT). ACT generation and load are detailed separately for ease of reference.

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Balranald	22	NBAL	0.8921	0.9014
Beaconsfield North	132	NBFN	1.0044	1.0029
Beaconsfield South	132	NBFS	1.0044	1.0030
Belmore Park	132	NBM1	1.0045	1.0031
Beryl	66	NBER	0.9723	0.9794
BHP (Waratah)	132	NWR1	0.9921	0.9908
Boambee South	132	NWST	0.9833	0.9946
Boggabri East	132	NBGE	0.9956	1.0117
Boggabri North	132	NBGN	0.9990	1.0109
Brandy Hill	11	NBHL	0.9963	0.9943
Brandy Hill (Essential Energy)	11	NBHX	0.9963	
Broken Hill	22	NBKG	0.8580	0.8734
Broken Hill	220	NBKH	0.8423	0.8644
Bunnerong - Dual MLF (Generation)	132	NBG1	1.0040	1.0041
Bunnerong - Dual MLF (Load)	132	NBG1	1.0045	1.0041
Bunnerong	33	NBG3	1.0066	1.0055
Buronga	220	NBRG	0.7477	0.8127
Burrinjuck	132	NBU2	0.9698	0.9825
Campbell Street	11	NCBS	1.0057	1.0047
Campbell Street	132	NCS1	1.0047	1.0038
Canterbury	33	NCTB	1.0168	1.0170
Carlingford	132	NCAR	1.0010	1.0010
Casino	132	NCSN	0.9912	1.0107
Charmhaven	11	NCHM	0.9952	0.9935
Coffs Harbour	66	NCH1	0.9789	0.9886
Coleambally	132	NCLY	0.9258	0.9561
Cooma	66	NCMA	0.9673	0.9809
Cooma (AusNet Services)	66	NCM2	0.9673	0.9809
Croydon	11	NCRD	1.0135	1.0168
Cowra	66	NCW8	0.9721	1.0009
Dapto (Endeavour Energy)	132	NDT1	0.9929	0.9967
Dapto (Essential Energy)	132	NDT2	0.9929	0.9967
Darlington Point	132	NDNT	0.9397	0.9575
Deniliquin	66	NDN7	0.9704	0.9843
Dorrigo	132	NDOR	0.9684	0.9846
Drummoyne	11	NDRM	1.0136	1.0187
Dunoon	132	NDUN	0.9883	1.0059
Far North VTN		NEV1	0.9755	0.9775
Finley - Dual MLF (Load)	132	NFN2	0.8465	
Finley - Dual MLF (Generation)	132	NFN2	0.9904	
Finley	66	NFNY	0.9686	0.9537

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Forbes	66	NFB2	0.9986	1.0148
Gadara	132	NGAD	0.9795	0.9951
Glen Innes	66	NGLN	0.9365	0.9579
Gosford	66	NGF3	1.0037	1.0019
Gosford	33	NGSF	1.0043	1.0026
Grafton East 132	132	NGFT	0.9832	0.9925
Green Square	11	NGSQ	1.0073	1.0054
Griffith	33	NGRF	0.9688	0.9888
Gunnedah	66	NGN2	0.9972	1.0064
Haymarket	132	NHYM	1.0046	1.0031
Heron's Creek	132	NHNC	1.0396	1.0419
Holroyd	132	NHLD	1.0022	1.0024
Holroyd (Ausgrid)	132	NHLX	1.0022	1.0024
Hurstville North	11	NHVN	1.0057	1.0045
Homebush Bay	11	NHBB	1.0166	1.0168
Ilford	132	NLFD	0.9610	0.9754
Ingleburn	66	NING	0.9987	0.9983
Inverell	66	NNVL	0.9482	0.9603
Kemps Creek	330	NKCK	0.9955	0.9949
Kempsey	66	NKS2	1.0101	1.0155
Kempsey	33	NKS3	1.0158	1.0223
Koolkhan	66	NKL6	0.9969	1.0061
Kurnell	132	NKN1	1.0030	1.0017
Kogarah	11	NKOG	1.0077	1.0065
Lake Munmorah	132	NMUN	0.9821	0.9787
Lane Cove	132	NLCV	1.0136	1.0138
Leichhardt	11	NLDT	1.0135	1.0169
Liddell	33	NLD3	0.9652	0.9673
Lismore	132	NLS2	1.0080	1.0432
Liverpool	132	NLP1	1.0015	1.0012
Macarthur	132	NMC1	0.9951	0.9955
Macarthur	66	NMC2	0.9973	0.9975
Macksville	132	NMCV	0.9981	1.0090
Macquarie Park (effective prior to 13/02/2022)	11	NMQP	1.0187	1.0184
Macquarie Park (effective from 13/02/2022)	11	NMQP	1.0183	
Macquarie Park	33	NMQS	1.0122	
Manildra	132	NMLD	1.0083	1.0099
Marrickville	11	NMKV	1.0097	1.0078
Marulan (Endeavour Energy)	132	NMR1	1.0122	1.0103
Marulan (Essential Energy)	132	NMR2	1.0122	1.0103
Mason Park	132	NMPK	1.0140	1.0140

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Meadowbank	11	NMBK	1.0173	1.0175
Molong	132	NMOL	1.0292	1.0216
Moree	66	NMRE	0.9847	0.9913
Morven	132	NMVN	0.9514	0.9731
Mt Piper	66	NMP6	0.9757	0.9774
Mudgee	132	NMDG	0.9699	0.9817
Mullumbimby	11	NML1	0.9898	1.0073
Mullumbimby	132	NMLB	0.9805	0.9898
Munmorah STS 33	33	NMU3	0.9917	0.9899
Munyang	11	NMY1	0.9762	0.9865
Munyang	33	NMYG	0.9762	0.9865
Murrumbateman	132	NMBM	0.9681	0.9791
Murrumburrah	66	NMRU	0.9723	0.9894
Muswellbrook	132	NMRK	0.9764	0.9784
Nambucca Heads	132	NNAM	0.9923	1.0059
Narrabri	66	NNB2	1.0050	1.0212
Newcastle	132	NNEW	0.9917	0.9907
North of Broken Bay VTN		NEV2	0.9949	0.9932
Orange	66	NRGE	1.0478	1.0376
Orange North	132	NONO	1.0454	1.0364
Ourimbah	33	NORB	1.0010	0.9986
Ourimbah	132	NOR1	0.9994	0.9976
Ourimbah	66	NOR6	1.00003	0.9982
Panorama	66	NPMA	1.0291	1.0229
Parkes	66	NPK6	1.0007	1.0095
Parkes	132	NPKS	0.9909	1.0040
Peakhurst	33	NPHT	1.0045	1.0035
Potts Hill 11	11	NPHL	1.0081	1.0033
Potts Hill 132	132	NPO1	1.0049	1.0004
Pt Macquarie	33	NPMQ	1.0344	1.0382
Pyrmont	33	NPT3	1.0065	1.0063
Pyrmont	132	NPT1	1.0045	1.0035
Queanbeyan 132	132	NQBY	0.9953	0.9976
Raleigh	132	NRAL	0.9857	0.9982
Ravine	330	NRVN	0.9483	0.9820
Regentville	132	NRGV	0.9983	0.9983
Rockdale (Ausgrid)	11	NRKD	1.0069	1.0056
Rookwood Road	132	NRWR	1.0049	1.0002
Rose Bay	11	NRSB	1.0061	1.0051
Rozelle	132	NRZH	1.0135	1.0151
Rozelle	33	NRZL	1.0135	1.0154

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Snowy Adit	132	NSAD	0.9623	0.9721
Somersby	11	NSMB	1.0049	1.0031
South of Broken Bay VTN		NEV3	1.0056	1.0052
St Peters	11	NSPT	1.0081	1.0063
Strathfield South	11	NSFS	1.0106	1.0090
Stroud	132	NSRD	1.0109	1.0084
Sydney East	132	NSE2	1.0068	1.0058
Sydney North (Ausgrid)	132	NSN1	1.0042	1.0035
Sydney North (Endeavour Energy)	132	NSN2	1.0042	1.0035
Sydney South	132	NSYS	1.0015	1.0009
Sydney West (Ausgrid)	132	NSW1	1.0010	1.0010
Sydney West (Endeavour Energy)	132	NSW2	1.0010	1.0010
Tamworth	66	NTA2	0.9703	0.9760
Taree (Essential Energy)	132	NTR2	1.0453	1.0438
Tenterfield	132	NTTF	0.9603	0.9763
Terranora	110	NTNR	0.9947	1.0056
Tomago	330	NTMG	0.9926	0.9908
Tomago (Ausgrid)	132	NTME	0.9952	0.9926
Tomago (Essential Energy)	132	NTMC	0.9952	0.9926
Top Ryde	11	NTPR	1.0163	1.0163
Tuggerah	132	NTG3	0.9956	0.9940
Tumut	66	NTU2	0.9838	0.9913
Tumut 66 (AusNet DNSP)	66	NTUX	0.9838	0.9913
Vales Pt.	132	NVP1	0.9893	0.9884
Vineyard	132	NVYD	1.0000	0.9997
Wagga	66	NWG2	0.9492	0.9686
Wagga North	132	NWGN	0.9491	0.9754
Wagga North	66	NWG6	0.9485	0.9729
Wallerawang (Endeavour Energy)	132	NWW6	0.9765	0.9776
Wallerawang (Essential Energy)	132	NWW5	0.9765	0.9776
Wallerawang 66 (Essential Energy)	66	NWW4	0.9772	0.9779
Wallerawang 66	66	NWW7	0.9772	0.9779
Wallerawang 330 PS Load	330	NWWP	0.9759	0.9770
Waverley	11	NWAV	1.0058	1.0047
Wellington	132	NWL8	0.9903	0.9887
West Gosford	11	NGWF	1.0054	1.0035
Williamsdale (Essential Energy) (Bogong)	132	NWD1	0.9379	0.9795
Wyong	11	NWYG	0.9979	0.9961
Yanco	33	NYA3	0.9473	0.9683
Yass	66	NYS6	0.9677	0.9799
Yass	132	NYS1	0.9082	0.9392

Table 4 New South Wales generation

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
AGL Sita Landfill 1	132	AGLSITA1	NLP13K	NLP1	1.0015	1.0012
Appin Power Station	66	APPIN	NAPP1A	NAPP	0.9975	0.9978
Bango 973 Wind Farm	132	BANGOWF1	NBA21B	NBA2	0.9134	0.9690
Bango 999 Wind Farm	132	BANGOWF2	NBB21B	NBB2	0.9294	0.9782
Bayswater PS Unit 1	330	BW01	NBAY1	NBAY	0.9622	0.9625
Bayswater PS Unit 2	330	BW02	NBAY2	NBAY	0.9622	0.9625
Bayswater PS Unit 3	500	BW03	NBAY3	NBYW	0.9620	0.9633
Bayswater PS Unit 4	500	BW04	NBAY4	NBYW	0.9620	0.9633
Beryl Solar Farm	66	BERYLSF1	NBES1B	NBES	0.9184	0.9348
Blowering	132	BLOWERNG	NBLW8	NBLW	0.9444	0.9580
Boco Rock Wind Farm	132	BOCORWF1	NCMA3B	NBCO	0.9359	0.9536
Bodangora Wind Farm	132	BODWF1	NBOD1B	NBOD	0.9581	0.9659
Bomen Solar Farm	132	BOMENSF1	NWGS1B	NWGS	0.8875	0.9417
Broadwater PS	132	BWTR1	NLS21B	NLS2	1.0080	1.0432
Broken Hill GT 1	22	GB01	NBKG1	NBKG	0.8580	0.8734
Broken Hill Solar Farm	22	BROKENH1	NBK11B	NBK1	0.7953	0.7844
Brown Mountain	66	BROWNMT	NCMA1	NCMA	0.9673	0.9809
Burrendong Hydro PS	132	BDONGHYD	NWL81B	NWL8	0.9903	0.9887
Burrinjuck PS	132	BURRIN	NBUK	NBUK	0.9653	0.9848
Campbelltown WSLC	66	WESTCBT1	NING1C	NING	0.9987	0.9983
Capital Wind Farm	330	CAPTL_WF	NCWF1R	NCWF	0.9563	0.9674
Coleambally Solar Farm	132	COLEASF1	NCLS1C	NCLS	0.8478	0.9002
Collector Wind Farm	330	COLWF01	NCLW1C	NCLW	0.9588	0.9786
Colongra PS Unit 1	330	CG1	NCLG1D	NCLG	0.9851	0.9819
Colongra PS Unit 2	330	CG2	NCLG2D	NCLG	0.9851	0.9819
Colongra PS Unit 3	330	CG3	NCLG3D	NCLG	0.9851	0.9819
Colongra PS Unit 4	330	CG4	NCLG4D	NCLG	0.9851	0.9819
Condong PS	110	CONDONG1	NTNR1C	NTNR	0.9947	1.0056
Copeton Hydro PS	66	COPTNHYD	NNVL1C	NNVL	0.9482	0.9603
Corowa Solar Farm	132	CRWASF1	NAL11C	NAL1	0.8813	0.9497
Crookwell 2 Wind Farm	330	CROOKWF2	NCKW1C	NCKW	0.9616	0.9716
Crudine Ridge Wind Farm	132	CRURWF1	NCDS1C	NCDS	0.9246	0.9462
Cullerin Range Wind Farm	132	CULLRGWF	NYS11C	NYS1	0.9082	0.9392
Darlington Point Solar Farm	132	DARLSF1	NDNS1D	NDNS	0.8587	0.9160
Eastern Creek	132	EASTCRK	NSW21	NSW2	1.0010	1.0010
Eastern Creek 2	132	EASTCRK2	NSW23L	NSW2	1.0010	1.0010
Eraring 330 BS UN (GT)	330	ERGT01	NEP35B	NEP3	0.9849	0.9835
Eraring 330 PS Unit 1	330	ER01	NEPS1	NEP3	0.9849	0.9835

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Eraring 330 PS Unit 2	330	ER02	NEPS2	NEP3	0.9849	0.9835
Eraring 500 PS Unit 3	500	ER03	NEPS3	NEPS	0.9858	0.9845
Eraring 500 PS Unit 4	500	ER04	NEPS4	NEPS	0.9858	0.9845
Eraring PS Load	500	ERNL1	NEPSL	NNEW	0.9917	0.9907
Finley Solar Farm	132	FINLYSF1	NFNS1F	NFNS	0.8432	0.8800
Glenbawn Hydro PS	132	GLBWNHYD	NMRK2G	NMRK	0.9764	0.9784
Glenn Innes (Pindari PS)	66	PINDARI	NGLN1	NGLN	0.9365	0.9579
Glennies Creek PS	132	GLENNCRK	NMRK3T	NMRK	0.9764	0.9784
Grange Avenue	132	GRANGEAV	NVYD1	NVYD	1.0000	0.9997
Griffith Solar Farm	33	GRIFSF1	NGG11G	NGG1	0.8547	0.9001
Goonumbla Solar Farm	66	GOONSF1	NPG12G	NPG1	0.8918	0.9259
Gullen Range Solar Farm	330	GULLRSF1	NGUR2G	NGUR	0.9595	0.9708
Gullen Range 1 Wind Farm	330	GULLRWF1	NGUR1G	NGUR	0.9595	0.9708
Gullen Range 2 Wind Farm	330	GULLRWF2	NGUR3G	NGUR	0.9595	0.9708
Gunnedah Solar Farm	132	GNNDHSF1	NGNE1G	NGNE	0.8960	0.8960
Gunning Wind Farm	132	GUNNING1	NYS12A	NYS1	0.9082	0.9392
Guthega	132	GUTHEGA	NGUT8	NGUT	0.9006	0.9125
Guthega Auxiliary Supply	11	GUTHNL1	NMY11	NMY1	0.9762	0.9865
Hillston Solar Farm	132	HILLSTN1	NDNH1H	NDNH	0.8593	
Hume (New South Wales Share)	132	HUMENSW	NHUM	NHUM	0.8989	0.9471
Hunter Economic Zone	132	HEZ1	NNEE1H	NNEE	0.9897	
Jemalong Solar Farm	66	JEMALNG1	NFBS1J	NFBS	0.8956	0.9220
Jindabyne Generator	66	JNDABNE1	NCMA2	NCMA	0.9673	0.9809
Jounama PS	66	JOUNAMA1	NTU21J	NTU2	0.9838	0.9913
Junee Solar Farm (effective prior to 02/11/2021)	132	JUNEESF1	NWGJ1J	NWGJ	0.8887	0.9645
Junee Solar Farm (effective from 02/11/2021)	132	JUNEESF1	NWGJ1J	NWGJ	0.8799	
Kangaroo Valley – Bendeela (Shoalhaven) Generation – Dual MLF (Generation)	330	SHGEN	NSHL	NSHN	0.9763	0.9809
Kangaroo Valley (Shoalhaven) Pumps – Dual MLF (Load)	330	SHPUMP	NSHP1	NSHN	0.9919	1.0007
Keepit	66	KEEPIT	NKPT	NKPT	0.9972	1.0064
Kincumber Landfill	66	KINCUM1	NGF31K	NGF3	1.0037	1.0019
Liddell 33 – Hunter Valley GTs	33	HVGTS	NLD31	NLD3	0.9652	0.9673
Liddell 330 PS Load	330	LIDDNL1	NLDPL	NLDP	0.9628	0.9631
Liddell 330 PS Unit 1	330	LD01	NLDP1	NLDP	0.9628	0.9631
Liddell 330 PS Unit 2	330	LD02	NLDP2	NLDP	0.9628	0.9631
Liddell 330 PS Unit 3	330	LD03	NLDP3	NLDP	0.9628	0.9631
Liddell 330 PS Unit 4	330	LD04	NLDP4	NLDP	0.9628	0.9631
Limondale Solar Farm 1	220	LIMOSF11	NBSF1L	NBSF	0.8070	0.7907
Limondale Solar Farm 2	22	LIMOSF21	NBL21L	NBL2	0.7985	0.7926
Liverpool 132 (Jacks Gully)	132	JACKSGUL	NLP11	NSW2	1.0010	1.0010

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Lower Tumut – Dual MLF (Generation)	330	TUMUT3	NLTS8	NLTS	0.9195	0.9246
Lower Tumut Pipeline Auxiliary	66	TUMT3NL3	NTU2L3	NTU2	0.9838	0.9913
Lower Tumut Pumps – Dual MLF (Load)	330	SNOWYP	NLTS3	NLTS	0.9525	0.9942
Lower Tumut T2 Auxiliary	66	TUMT3NL1	NTU2L1	NTU2	0.9838	0.9913
Lower Tumut T4 Auxiliary	66	TUMT3NL2	NTU2L2	NTU2	0.9838	0.9913
Lucas Heights II Power Plant	132	LUCASHGT	NSYS2G	NSYS	1.0015	1.0009
Lucas Heights Stage 2 Power Station	132	LUCAS2S2	NSYS1	NSYS	1.0015	1.0009
Manildra Solar Farm	132	MANSLR1	NMLS1M	NMLS	0.9333	0.9542
Metz Solar Farm	132	METZSF1	NMTZ1M	NMTZ	0.9208	
Molong Solar Farm	66	MOLNGSF1	NMOS1M	NMOS	0.9541	0.9634
Moree Solar Farm	66	MOREESF1	NMR41M	NMR4	0.8931	0.8950
Mt Piper PS Load	330	MPNL1	NMPPL	NMTP	0.9726	0.9745
Mt Piper PS Unit 1	330	MP1	NMTP1	NMTP	0.9726	0.9745
Mt Piper PS Unit 2	330	MP2	NMTP2	NMTP	0.9726	0.9745
Narromine Solar Farm	132	NASF1	NWLS1N	NWLS	0.9444	0.9471
Nevertire Solar Farm	132	NEVERSF1	NWLS3N	NWLS	0.9444	0.9471
Nine Willoughby	132	NINEWIL1	NSE21R	NSE2	1.0068	1.0058
Nyngan Solar Farm	132	NYNGAN1	NWL82N	NWL8	0.9903	0.9887
Parkes Solar Farm	66	PARSF1	NPG11P	NPG1	0.8918	0.9259
Sapphire Wind Farm	330	SAPHWF1	NSAP1S	NSAP	0.9426	0.9553
Sebastopol Solar Farm	132	SEBSF1	NWGJ2S	NWGJ	0.8799	
Silverton Wind Farm	220	STWF1	NBKW1S	NBKW	0.8456	0.8496
Sithe (Holroyd Generation)	132	SITHE01	NSYW1	NHD2	1.0017	1.0025
South Keswick Solar Farm	132	SKSF1	NWLS2S	NWLS	0.9444	0.9471
St George Leagues Club	33	STGEORG1	NPHT1E	NPHT	1.0045	1.0035
Sunraysia Solar Farm	220	SUNRSF1	NBSF2S	NBSF	0.8070	0.7907
Suntop Solar Farm	132	SUNTPSF1	NWLW1S	NWLW	0.9159	
Tahmoor PS	132	TAHMOOR1	NLP12T	NLP1	1.0015	1.0012
Tallawarra PS	132	TALWA1	NDT13T	NTWA	0.9912	0.9913
Taralga Wind Farm	132	TARALGA1	NMR22T	NMR2	1.0122	1.0103
Teralba Power Station	132	TERALBA	NNEW1	NNEW	0.9917	0.9907
The Drop Power Station	66	THEDROP1	NFNY1D	NFNY	0.9686	0.9537
Tower Power Plant	132	TOWER	NLP11T	NLP1	1.0015	1.0012
Upper Tumut	330	UPPTUMUT	NUTS8	NUTS	0.9335	0.9468
Uranquinty PS Unit 11	132	URANQ11	NURQ1U	NURQ	0.8625	0.8570
Uranquinty PS Unit 12	132	URANQ12	NURQ2U	NURQ	0.8625	0.8570
Uranquinty PS Unit 13	132	URANQ13	NURQ3U	NURQ	0.8625	0.8570
Uranquinty PS Unit 14	132	URANQ14	NURQ4U	NURQ	0.8625	0.8570
Vales Point 330 PS Load	330	VPNL1	NVPPL	NVPP	0.9872	0.9857
Vales Point 330 PS Unit 5	330	VP5	NVPP5	NVPP	0.9872	0.9857

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Vales Point 330 PS Unit 6	330	VP6	NVPP6	NVPP	0.9872	0.9857
Wagga North Solar Farm	66	WAGGNSF1	NWGG1W	NWGG	0.8869	0.9639
Wallgrove BESS (Generation)	132	WALGRVG1	NSWB1W	NSWG	1.0011	
Wallgrove BESS (Load)	132	WALGRVL1	NSWB2W	NSWB	1.0010	
Wellington Solar Farm	132	WELLSF1	NWLS4W	NWLS	0.9444	0.9471
West Nowra	132	AGLNOW1	NDT12	NDT1	0.9929	0.9967
Wests Illawara Leagues Club	132	WESTILL1	NDT14E	NDT1	0.9929	0.9967
White Rock Solar Farm	132	WRSF1	NWRK2W	NWRK	0.8708	0.8801
White Rock Wind Farm	132	WRWF1	NWRK1W	NWRK	0.8708	0.8801
Wilga Park A	66	WILGAPK	NNB21W	NNB2	1.0050	1.0212
Wilga Park B	66	WILGB01	NNB22W	NNB2	1.0050	1.0212
Woodlawn Bioreactor	132	WDLNGN01	NMR21W	NMR2	1.0122	1.0103
Woodlawn Wind Farm	330	WOODLWN1	NCWF2W	NCWF	0.9563	0.9674
Woy Woy Landfill	66	WOYWOY1	NGF32W	NGF3	1.0037	1.0019
Wyangala A PS	66	WYANGALA	NCW81A	NCW8	0.9721	1.0009
Wyangala B PS	66	WYANGALB	NCW82B	NCW8	0.9721	1.0009

Table 5 ACT loads

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Angle Crossing	132	AAXG	0.9397	0.9722
Belconnen	132	ABCN	0.9673	0.9804
City East	132	ACTE	0.9684	0.9839
Civic	132	ACVC	0.9663	0.9823
East lake	132	AELK	0.9669	0.9836
Gilmore	132	AGLM	0.9682	0.9839
Gold Creek	132	AGCK	0.9708	0.9804
Latham	132	ALTM	0.9696	0.9795
Telopea Park	132	ATLP	0.9681	0.9839
Theodore	132	ATDR	0.9716	0.9803
Wanniassa	132	AWSA	0.9695	0.9810
Woden	132	AWDN	0.9680	0.9815
ACT VTN	132	AAVT	0.9683	0.9819
Queanbeyan (ACTEW)	66	AQB1	0.9882	0.9982
Queanbeyan (Essential Energy)	66	AQB2	0.9882	0.9982

The Regional Reference Node (RRN) for ACT load and generation is the Sydney West 330 kV node.

Table 6 ACT generation

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Capital East Solar Farm	66	CESF1	AQB21C	AQB2	0.9882	0.9982
Mugga Lane Solar Farm	132	MLSP1	ACA12M	AMS1	0.9440	0.9731
Mugga Lane Landfill	132	MLLFGEF1	AGLM1M	AAVT	0.9683	
Royalla Solar Farm	132	ROYALLA1	ACA11R	ARS1	0.9436	0.9725

The RRN for ACT load and generation is the Sydney West 330 kV node.

1.3 Victoria marginal loss factors

Table 7 Victoria loads

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Altona	66	VATS	1.0086	1.0065
Altona	220	VAT2	0.9936	0.9910
Ballarat	66	VBAT	0.9699	0.9711
Bendigo	66	VBE6	1.0101	1.0022
Bendigo	22	VBE2	1.0101	1.0090
BHP Western Port	220	VJLA	0.9915	0.9907
Brooklyn (Jemena)	22	VBL2	1.0005	0.9989
Brooklyn (Jemena)	66	VBL6	1.0062	1.0037
Brooklyn (POWERCOR)	22	VBL3	1.0005	0.9989
Brooklyn (POWERCOR)	66	VBL7	1.0062	1.0037
Brunswick (CitiPower)	22	VBT2	0.9977	0.9976
Brunswick (Jemena)	22	VBTS	0.9977	0.9976
Brunswick 66 (CitiPower)	66	VBT6	0.9971	0.9969
Cranbourne	220	VCB2	0.9905	0.9899
Cranbourne (AusNet Services)	66	VCBT	0.9921	0.9918
Cranbourne (United Energy)	66	VCB5	0.9921	0.9918
Deer Park	66	VDPT	0.9992	0.9982
East Rowville (AusNet Services)	66	VER2	0.9944	0.9948
East Rowville (United Energy)	66	VERT	0.9944	0.9948
Fishermens Bend (CITIPOWER)	66	VFBT	0.9995	0.9993
Fishermens Bend (POWERCOR)	66	VFB2	0.9995	0.9993
Fosterville	220	VFVT	1.0057	1.0041
Geelong	66	VGT6	0.9918	0.9914
Glenrowan	66	VGNT	1.0299	1.0274
Heatherton	66	VHTS	0.9965	0.9967
Heywood	22	VHY2	0.9862	0.9865
Horsham	66	VHOT	0.9328	0.9269
Keilor (Jemena)	66	VKT2	0.9977	0.9969
Keilor (POWERCOR)	66	VKTS	0.9977	0.9969

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Kerang	22	VKG2	1.0156	1.0104
Kerang	66	VKG6	1.0234	1.0096
Khancoban	330	NKHN	1.0422	1.0318
Loy Yang Substation	66	VLY6	0.9764	0.9763
Malvern	22	VMT2	0.9947	0.9946
Malvern	66	VMT6	0.9938	0.9935
Malvern (CitiPower)	66	VMT7	0.9938	
Morwell Power Station Units 1 to 3	66	VMWG	0.9736	0.9726
Morwell PS (G4&5)	11	VMWP	0.9777	0.9777
Morwell TS	66	VMWT	0.9936	0.9955
Mt Beauty	66	VMBT	1.0292	1.0235
Portland	500	VAPD	0.9908	0.9913
Red Cliffs	22	VRC2	0.9721	0.9516
Red Cliffs	66	VRC6	0.9730	0.9406
Red Cliffs (Essential Energy)	66	VRCA	0.9730	0.9406
Richmond	22	VRT2	0.9978	0.9969
Richmond (CITIPOWER)	66	VRT7	0.9978	0.9980
Richmond (United Energy)	66	VRT6	0.9978	0.9980
Ringwood (AusNet Services)	22	VRW3	0.9968	0.9978
Ringwood (AusNet Services)	66	VRW7	0.9988	1.0011
Ringwood (United Energy)	22	VRW2	0.9968	0.9978
Ringwood (United Energy)	66	VRW6	0.9988	1.0011
Shepparton	66	VSHT	1.0346	1.0289
South Morang (Jemena)	66	VSM6	0.9956	0.9954
South Morang (AusNet Services)	66	VSMT	0.9956	0.9954
Springvale (CITIPOWER)	66	VSVT	0.9957	0.9984
Springvale (United Energy)	66	VSV2	0.9957	0.9984
Templestowe (CITIPOWER)	66	VTS2	0.9987	0.9991
Templestowe (Jemena)	66	VTST	0.9987	0.9991
Templestowe (AusNet Services)	66	VTS3	0.9987	0.9991
Templestowe (United Energy)	66	VTS4	0.9987	0.9991
Terang	66	VTGT	1.0035	1.0079
Thomastown (Jemena)	66	VTTS	1.0000	1.0000
Thomastown (AusNet Services)	66	VTT2	1.0000	1.0000
Tyabb	66	VTBT	0.9930	0.9921
Wemen 66 (Essential Energy)	66	VWEA	0.9472	0.9345
Wemen TS	66	VWET	0.9472	0.9345
West Melbourne	22	VWM2	0.9984	0.9995
West Melbourne (CITIPOWER)	66	VWM7	0.9982	0.9978
West Melbourne (Jemena)	66	VWM6	0.9982	0.9978
Wodonga	22	VWO2	1.0411	1.0303

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Wodonga	66	VWO6	1.0393	1.0263
Yallourn	11	VYP1	0.9639	0.9581

Table 8 Victoria generation

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Ararat Wind Farm	220	ARWF1	VART1A	VART	0.8987	0.8983
Bairnsdale Power Station	66	BDL01	VMWT2	VBDL	0.9874	0.9899
Bairnsdale Power Station Generator Unit 2	66	BDL02	VMWT3	VBDL	0.9874	0.9899
Bald Hills Wind Farm	66	BALDHWF1	VMWT9B	VMWT	0.9936	0.9955
Ballarat BESS - Generation	22	BALBG1	VBA21B	VBA2	0.9573	0.9643
Ballarat BESS - Load	22	BALBL1	VBA22B	VBA2	0.9573	0.9630
Ballarat Health Services	66	BBASEHOS	VBAT1H	VBAT	0.9699	0.9711
Banimboola	220	BAPS	VDPS2	VDPS	0.9861	0.9854
Bannerton Solar Farm	66	BANN1	VWES1B	VWES	0.8633	0.8096
Basslink (Loy Yang Power Station Switchyard) Tasmania to Victoria	500	BLNKVIC	VLYP13	VTBL	0.9735	0.9620
Basslink (Loy Yang Power Station Switchyard) Victoria to Tasmania	500	BLNKVIC	VLYP13	VTBL	0.9803	0.9620
Berrybank Wind Farm	220	BRYB1WF1	VBBT1B	VBBT	0.9431	0.9482
Broadmeadows Power Plant	66	BROADMDW	VTTS2B	VTTS	1.0000	1.0000
Brooklyn Landfill & Recycling Facility	66	BROOKLYN	VBL61	VBL6	1.0062	1.0037
Bulgana BESS (Generation)	220	BULBESG1	VBGT2B	VBGT	0.8949	
Bulgana BESS (Load)	220	BULBESL1	VBGT3B	VBGT	0.8949	
Bulgana Green Power Hub	220	BULGANA1	VBGT1B	VBGT	0.8949	0.8988
Challicum Hills Wind Farm	66	CHALLHWF	VHOT1	VBAT	0.9699	0.9711
Chepstowe Wind Farm	66	CHPSTWF1	VBAT3C	VBAT	0.9699	0.9711
Cherry Tree Wind Farm	66	CHYTWF1	VSM71C	VSM7	0.9959	0.9958
Clayton Landfill Gas Power Station	66	CLAYTON	VSV21B	VSV2	0.9957	0.9984
Clover PS	66	CLOVER	VMBT1	VMBT	1.0292	1.0235
Codrington Wind Farm	66	CODRNGTON	VTGT2C	VTGT	1.0035	1.0079
Cohuna Solar Farm	66	COHUNSF1	VKGS2C	VKGS	0.9127	0.8863
Coonooer Bridge Wind Farm	66	CBWF1	VBE61C	VBE6	1.0101	1.0022
Corio LFG PS	66	CORIO1	VGT61C	VGT6	0.9918	0.9914
Crowlands Wind Farm	220	CROWLWF1	VCWL1C	VCWL	0.8985	0.9026
Dartmouth PS	220	DARTM1	VDPS	VDPS	0.9861	0.9854
Diapur Wind Farm	66	DIAPURWF1	VHOG2D	VHOG	0.9005	
Dundonnell Wind Farm 1	500	DUNDWF1	VM051D	VM05	0.9789	0.9790
Dundonnell Wind Farm 2	500	DUNDWF2	VM052D	VM05	0.9789	0.9790
Dundonnell Wind Farm 3	500	DUNDWF3	VM053D	VM05	0.9789	0.9790
Eildon Hydro PS	66	EILDON3	VTT22E	VSMT	0.9956	0.9954

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Eildon PS Unit 1	220	EILDON1	VEPS1	VEPS	0.9995	0.9903
Eildon PS Unit 2	220	EILDON2	VEPS2	VEPS	0.9995	0.9903
Elaine Wind Farm	220	ELAINWF1	VELT3E	VELT	0.9459	0.9501
Ferguson North Wind Farm	66	FNWF1	VTGT6F	VTGT	1.0035	1.0079
Ferguson South Wind Farm	66	FSWF1	VTGT7F	VTGT	1.0035	1.0079
Gannawarra BESS (Generation)	66	GANNBG1	VKGB1G	VKGB	0.9773	0.9793
Gannawarra BESS (Load)	66	GANNBL1	VKGB2G	VKGL	0.9933	0.9823
Gannawarra Solar Farm	66	GANNSF1	VKGS1G	VKGS	0.9127	0.8863
Glenmaggie Hydro PS	66	GLENMAG1	VMWT8G	VMWT	0.9936	0.9955
Glenrowan West Sun Farm	66	GLRWNSF1	VGNS1G	VGNS	0.9976	0.9815
Hallam Mini Hydro	66	HLMSEW01	VER21H	VCBT	0.9921	0.9918
Hallam Road Renewable Energy Facility	66	HALAMRD1	VER22L	VER2	0.9944	0.9948
Hepburn Community Wind Farm	66	HEPWIND1	VBAT2L	VBAT	0.9699	0.9711
Hume (Victorian Share)	66	HUMEV	VHUM	VHUM	0.9933	0.9833
Jeeralang A PS Unit 1	220	JLA01	VJLGA1	VJLG	0.9755	0.9734
Jeeralang A PS Unit 2	220	JLA02	VJLGA2	VJLG	0.9755	0.9734
Jeeralang A PS Unit 3	220	JLA03	VJLGA3	VJLG	0.9755	0.9734
Jeeralang A PS Unit 4	220	JLA04	VJLGA4	VJLG	0.9755	0.9734
Jeeralang B PS Unit 1	220	JLB01	VJLGB1	VJLG	0.9755	0.9734
Jeeralang B PS Unit 2	220	JLB02	VJLGB2	VJLG	0.9755	0.9734
Jeeralang B PS Unit 3	220	JLB03	VJLGB3	VJLG	0.9755	0.9734
Jindabyne pump at Guthega	132	SNOWYGJP	NGJP	NGJP	1.1350	1.1231
Karadoc Solar Farm	66	KARSF1	VRCS1K	VRCS	0.8673	0.8045
Kiamal Solar Farm	220	KIAMSF1	VKMT1K	VKMT	0.8504	0.8043
Kiata Wind Farm (effective prior to 28/09/2021)	66	KIATAWF1	VHOG1K	VHOG	0.9016	0.8974
Kiata Wind Farm (effective from 28/09/2021)	66	KIATAWF1	VHOG1K	VHOG	0.9005	
Laverton PS (LNGS1)	220	LNGS1	VAT21L	VAT2	0.9936	0.9910
Laverton PS (LNGS2)	220	LNGS2	VAT22L	VAT2	0.9936	0.9910
Longford	66	LONGFORD	VMWT6	VMWT	0.9936	0.9955
Loy Yang A PS Load	500	LYNL1	VLYPL	VLYP	0.9759	0.9760
Loy Yang A PS Unit 1	500	LYA1	VLYP1	VLYP	0.9759	0.9760
Loy Yang A PS Unit 2	500	LYA2	VLYP2	VLYP	0.9759	0.9760
Loy Yang A PS Unit 3	500	LYA3	VLYP3	VLYP	0.9759	0.9760
Loy Yang A PS Unit 4	500	LYA4	VLYP4	VLYP	0.9759	0.9760
Loy Yang B PS Unit 1	500	LOYYB1	VLYP5	VLYP	0.9759	0.9760
Loy Yang B PS Unit 2	500	LOYYB2	VLYP6	VLYP	0.9759	0.9760
MacArthur Wind Farm	500	MACARTH1	VTRT1M	VTRT	0.9753	0.9757
Maroona Wind Farm	66	MAROOWF1	VBAT5M	VBAT	0.9699	0.9711
McKay Creek / Bogong PS	220	MCKAY1	VMKP1	VT14	0.9726	0.9650
Moorabool Wind Farm	220	MOORAWF1	VELT2M	VELT	0.9459	0.9501

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Mortlake Unit 1	500	MORTLK11	VM0P1O	VM0P	0.9865	0.9845
Mortlake Unit 2	500	MORTLK12	VM0P2O	VM0P	0.9865	0.9845
Mortlake South Wind Farm	220	MRTLSWF1	VTG21M	VTG2	0.9768	
Mortons Lane Wind Farm	66	MLWF1	VTGT4M	VTGT	1.0035	1.0079
Mt Gellibrand Windfarm	66	MTGELWF1	VGTW1M	VGTW	0.9862	0.9850
Mt Mercer Windfarm	220	MERCER01	VELT1M	VELT	0.9459	0.9501
Murra Warra Wind Farm	220	MUWAWF1	VMRT1M	VMRT	0.8883	0.8885
Murra Warra Wind Farm - stage 2	220	MUWAWF2	VMRT2M	VMRT	0.8883	
Murray	330	MURRAY	NMUR8	NMUR	0.9966	0.9674
Murray (Geehi Tee off Auxiliary)	330	MURAYNL3	NMURL3	NMUR	0.9966	0.9674
Murray Power Station M1 Auxiliary	330	MURAYNL1	NMURL1	NMUR	0.9966	0.9674
Murray Power Station M2 Auxiliary	330	MURAYNL2	NMURL2	NMUR	0.9966	0.9674
Newport PS	220	NPS	VNPS	VNPS	0.9926	0.9914
Numurkah Solar Farm	66	NUMURSF1	VSHS1N	VSHS	0.9963	0.9945
Oaklands Hill Wind Farm	66	OAKLAND1	VTGT3A	VTGT	1.0035	1.0079
Rubicon Mountain Streams Station	66	RUBICON	VTT21R	VSMT	0.9956	0.9954
Salt Creek Wind Farm	66	SALTCRK1	VTG61S	VTG6	0.9515	0.9588
Shepparton Waste Gas	66	SHEP1	VSHT2S	VSHT	1.0346	1.0289
Somerton Power Station	66	AGLSOM	VTTS1	VSOM	0.9932	0.9924
Springvale Power Plant	66	SVALE1	VSV22S	VSV2	0.9957	0.9984
Stockyard Hill Wind Farm	500	STOCKYD1	VHGT1S	VHGT	0.9782	
Tatura Unit 1	66	TATURA01	VSHT1	VSHT	1.0346	1.0289
Timboon West Wind Farm	66	TIMWEST	VTGT5T	VTGT	1.0035	1.0079
Toora Wind Farm	66	TOORAWF	VMWT5	VMWT	0.9936	0.9955
Traralgon NSS	66	TGNSS1	VMWT1T	VMWT	0.9936	0.9955
Valley Power Unit 1	500	VPGS1	VLYP07	VLYP	0.9759	0.9760
Valley Power Unit 2	500	VPGS2	VLYP08	VLYP	0.9759	0.9760
Valley Power Unit 3	500	VPGS3	VLYP09	VLYP	0.9759	0.9760
Valley Power Unit 4	500	VPGS4	VLYP010	VLYP	0.9759	0.9760
Valley Power Unit 5	500	VPGS5	VLYP011	VLYP	0.9759	0.9760
Valley Power Unit 6	500	VPGS6	VLYP012	VLYP	0.9759	0.9760
Victorian Big Battery - Generation	220	VBBG1	VMLB1V	VMLB	0.9820	
Victorian Big Battery - Load	220	VBBL1	VMLB2V	VMLB	0.9864	
Waubra Wind Farm	220	WAUBRAWF	VWBT1A	VWBT	0.9221	0.9228
Wemen Solar Farm	66	WEMENSF1	VWES2W	VWES	0.8633	0.8096
West Kiewa PS Unit 1	220	WKIEWA1	VWKP1	VWKP	1.0096	1.0024
West Kiewa PS Unit 2	220	WKIEWA2	VWKP2	VWKP	1.0096	1.0024
William Hovell Hydro PS	66	WILLHOV1	VW061W	VGNT	1.0299	1.0274
Winton Solar Farm	66	WINTSF1	VGNS2W	VGNS	0.9976	0.9815
Wollert Renewable Energy Facility	66	WOLLERT1	VSMT1W	VSMT	0.9956	0.9954

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Wonthaggi Wind Farm	66	WONWP	VMWT7	VMWT	0.9936	0.9955
Yallourn W PS 220 Load	220	YWNL1	VYP2L	VYP2	0.9596	0.9549
Yallourn W PS 220 Unit 1	220	YWPS1	VYP21	VYP3	0.9663	0.9660
Yallourn W PS 220 Unit 2	220	YWPS2	VYP22	VYP2	0.9596	0.9549
Yallourn W PS 220 Unit 3	220	YWPS3	VYP23	VYP2	0.9596	0.9549
Yallourn W PS 220 Unit 4	220	YWPS4	VYP24	VYP2	0.9596	0.9549
Yaloak South Wind Farm	66	YSWF1	VBAT4Y	VBAT	0.9699	0.9711
Yambuk Wind Farm	66	YAMBUKWF	VTGT1	VTGT	1.0035	1.0079
Yarrawonga Hydro PS	66	YWNGAHYD	VSHT3Y	VSHT	1.0346	1.0289
Yatpool Solar Farm	66	YATSF1	VRCS2Y	VRCS	0.8673	0.8045
Yawong Wind Farm	66	YAWWF1	VBE62Y	VBE6	1.0101	1.0022
Yendon Wind Farm	66	YENDWF1	VBAW1Y	VBAW	0.9422	0.9474

1.4 South Australia marginal loss factors

Table 9 South Australia loads

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Angas Creek	33	SANC	1.0113	1.0119
Ardrossan West	33	SARW	0.9485	0.9493
Back Callington	11	SBAC	1.0099	1.0139
Baroota - Dual MLF (Generation)	33	SBAR	0.9670	1.0018
Baroota - Dual MLF (Load)	33	SBAR	0.9946	1.0018
Berri	66	SBER	1.0072	1.0932
Berri (POWERCOR)	66	SBE1	1.0072	1.0932
Blanche	33	SBLA	1.0333	1.0107
Blanche (POWERCOR)	33	SBL1	1.0333	1.0107
Brinkworth	33	SBRK	0.9918	0.9951
Bungama Industrial	33	SBUN	0.9868	0.9908
Bungama Rural	33	SBUR	0.9958	1.0013
City West	66	SACR	1.0067	1.0075
Clare North	33	SCLN	0.9884	0.9922
Dalrymple	33	SDAL	0.9128	0.9141
Davenport	275	SDAV	0.9841	0.9939
Davenport	33	SDAW	0.9874	0.9960
Dorrien	33	SDRN	1.0051	1.0068
East Terrace	66	SETC	1.0021	1.0022
Happy Valley	66	SHVA	1.0052	1.0046
Hummocks	33	SHUM	0.9640	0.9663
Kadina East	33	SKAD	0.9745	0.9738

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Kanmantoo	11	SKAN	1.0128	1.0141
Keith	33	SKET	1.0263	1.0165
Kilburn	66	SKLB	1.0008	1.0008
Kincraig	33	SKNC	1.0258	1.0093
Lefevre	66	SLFE	1.0003	1.0003
Leigh Creek South	33	SLCS	1.0579	1.0200
Magill	66	SMAG	1.0041	1.0041
Mannum	33	SMAN	1.0169	1.0162
Mannum – Adelaide Pipeline 1	3.3	SMA1	1.0206	1.0209
Mannum – Adelaide Pipeline 2 – dual MLF (Generation)	3.3	SMA2	1.0016	1.0185
Mannum – Adelaide Pipeline 2 – dual MLF (Load)	3.3	SMA2	1.0182	1.0185
Mannum – Adelaide Pipeline 3 – dual MLF (Generation)	3.3	SMA3	1.0012	
Mannum – Adelaide Pipeline 3 – dual MLF (Load)	3.3	SMA3	1.0178	
Mannum – Adelaide Pipeline 3	3.3	SMA3	1.0179	1.0183
Middleback	33	SMDL	0.9997	1.0116
Middleback	132	SMBK	1.0003	1.0106
Millbrook	132	SMLB	1.0041	1.0041
Mobilong	33	SMBL	1.0140	1.0137
Morgan Whyalla Pump Station 1 PV	3.3	SMW1	1.0271	1.0211
Morgan Whyalla Pump Station 2 PV - Dual MLF (Generation)	3.3	SMW2	0.9664	1.0113
Morgan Whyalla Pump Station 2 PV - Dual MLF (Load)	3.3	SMW2	0.9994	1.0113
Morgan Whyalla Pump Station 3 PV - Dual MLF (Generation)	3.3	SMW3	0.9719	1.0005
Morgan Whyalla Pump Station 3 PV - Dual MLF (Load)	3.3	SMW3	0.9927	1.0005
Morgan Whyalla Pump Station 4 PV - Dual MLF (Generation)	3.3	SMW4	0.9751	0.9935
Morgan Whyalla Pump Station 4 PV - Dual MLF (Load)	3.3	SMW4	0.9874	0.9935
Morphett Vale East	66	SMVE	1.0055	1.0050
Mount Barker South	66	SMBS	1.0063	1.0061
Mt Barker	66	SMBA	1.0049	1.0053
Mt Gambier	33	SMGA	1.0356	1.0134
Mt Gunson South	132	SMGS	0.9947	1.1561
Mt Gunson	33	SMGU	0.9939	1.0121
Munno Para	66	SMUP	0.9992	1.0000
Murray Bridge – Hahndorf Pipeline 1	11	SMH1	1.0198	1.0158
Murray Bridge – Hahndorf Pipeline 2 (effective prior to 11/01/2022)	11	SMH2	1.0209	1.0172

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Murray Bridge – Hahndorf Pipeline 2 (effective from 11/01/2022) – Dual MLF (Generation)	11	SMH2	1.0058	
Murray Bridge – Hahndorf Pipeline 2 (effective from 11/01/2022) – Dual MLF (Load)	11	SMH2	1.0205	
Murray Bridge – Hahndorf Pipeline 3	11	SMH3	1.0169	1.0150
Neuroodla	33	SNEU	1.0190	1.0102
New Osborne	66	SNBN	1.0005	1.0005
North West Bend	66	SNWB	0.9982	1.0402
Northfield	66	SNFD	1.0027	1.0027
Para	66	SPAR	1.0012	1.0016
Parafield Gardens West	66	SPGW	1.0011	1.0012
Penola West 33	33	SPEN	1.0236	1.0016
Pimba	132	SPMB	1.0015	1.0176
Playford	132	SPAA	0.9828	0.9923
Port Lincoln	33	SPLN	0.9813	0.9851
Port Pirie	33	SPPR	0.9912	0.9983
Roseworthy	11	SRSW	1.0082	1.0109
Snuggery Industrial	33	SSNN	1.0358	0.9723
Snuggery Rural	33	SSNR	1.0030	0.9859
South Australian VTN		SJP1	1.0003	1.0045
Stony Point	11	SSPN	0.9904	0.9997
Tailem Bend	33	STAL	1.0173	1.0127
Templers	33	STEM	1.0029	1.0048
Torrens Island	66	STSY	1.0000	1.0000
Waterloo	33	SWAT	0.9821	0.9864
Whyalla Central Substation	33	SWYC	0.9909	0.9994
Whyalla Terminal BHP	33	SBHP	0.9902	1.0004
Woomera	132	SWMA	0.9956	1.0169
Wudina	66	SWUD	1.0001	1.0055
Yadnarie	66	SYAD	0.9864	0.9913

Table 10 South Australia generation

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Adelaide Desalination Plant Battery (Generation)	66	ADPBA1G	SMVE4D	SMVE	1.0055	1.0038
Adelaide Desalination Plant Battery (Load)	66	ADPBA1L	SMVE5D	SMVE	1.0055	1.0038
Adelaide Desalination Plant Hydro	66	ADPMH1	SMVE9D	SMVE	1.0055	
Adelaide Desalination Plant PV1	66	ADPPV1	SMVE6D	SMVE	1.0055	1.0038

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Adelaide Desalination Plant PV2	66	ADPPV2	SMVE7D	SMVE	1.0055	
Adelaide Desalination Plant PV3	66	ADPPV3	SMVE8D	SMVE	1.0055	
Angaston Power Station	33	ANGAST1	SDRN1	SANG	1.0020	1.0079
Barker Inlet PS	275	BARKIPS1	SBPS1B	SBPS	0.9997	0.9998
Bolivar WWT Plant	66	BOLIVAR1	SPGW1B	SPGW	1.0011	1.0012
Bolivar Wastewater Treatment Plant PV	66	BOWWPV1	SPGW2B	SPGW	1.0011	
Bolivar Wastewater Treatment Plant Reserve Diesel	66	BOWWDG1	SPGW5B	SPGW	1.0011	
Bolivar Wastewater Treatment Plant Reserve BESS (Generation)	66	BOWWBA1G	SPGW3B	SPGW	1.0011	
Bolivar Wastewater Treatment Plant Reserve BESS (Load)	66	BOWWBA1L	SPGW4B	SPGW	1.0011	
Bungala One Solar Farm	132	BNGSF1	SBEM1B	SBEM	0.9597	0.9744
Bungala Two Solar Farm	132	BNGSF2	SBEM2B	SBEM	0.9597	0.9744
Canunda Wind Farm	33	CNUNDAWF	SSNN1	SCND	0.9944	0.9702
Cathedral Rocks Wind Farm	132	CATHROCK	SCRK	SCRK	0.9166	0.9324
Clements Gap Wind Farm	132	CLEMGPWF	SCGW1P	SCGW	0.9564	0.9597
Cummins Lonsdale PS	66	LONSDALE	SMVE1	SMVE	1.0055	1.0050
Dalrymple North BESS (Generation)	33	DALNTH01	SDAN1D	SDAM	0.9212	0.9193
Dalrymple North BESS (Load)	33	DALNTHL1	SDAN2D	SDAN	0.9073	0.9249
Dry Creek PS Unit 1	66	DRYCGT1	SDCA1	SDPS	1.0002	1.0011
Dry Creek PS Unit 2	66	DRYCGT2	SDCA2	SDPS	1.0002	1.0011
Dry Creek PS Unit 3	66	DRYCGT3	SDCA3	SDPS	1.0002	1.0011
Hallet 2 Wind Farm	275	HALLWF2	SMOK1H	SMOK	0.9606	0.9710
Hallett 1 Wind Farm	275	HALLWF1	SHPS2W	SHPS	0.9630	0.9666
Hallett PS	275	AGLHAL	SHPS1	SHPS	0.9630	0.9666
Happy Valley BESS (Generation)	66	HVWWBA1G	SHVA1H	SHVA	1.0052	
Happy Valley BESS (Load)	66	HVWWBA1L	SHVA2H	SHVA	1.0052	
Happy Valley Solar	66	HVWWPV1	SHVA3H	SHVA	1.0052	
Hornsdale Battery – Dual MLF (Generation)	275	HPRG1	SMTL1H	SMTL	0.9772	0.9838
Hornsdale Battery – Dual MLF (Load)	275	HPRL1	SMTL2H	SMTL	0.9693	0.9790

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Hornsdale Wind Farm Stage 1	275	HDWF1	SHDW1H	SHDW	0.9518	0.9595
Hornsdale Wind Farm Stage 2	275	HDWF2	SHDW2H	SHDW	0.9518	0.9595
Hornsdale Wind Farm Stage 3	275	HDWF3	SHDW3H	SHDW	0.9518	0.9595
Ladbroke Grove PS Unit 1	132	LADBROK1	SPEW1	SPEW	0.9883	0.9685
Ladbroke Grove PS Unit 2	132	LADBROK2	SPEW2	SPEW	0.9883	0.9685
Lake Bonney BESS - Dual MLF (Generation)	33	LBBG1	SLBB1L	SLBB	1.0022	0.9741
Lake Bonney BESS – Dual MLF (Load)	33	LBBL1	SLBB2L	SLBB	1.0094	0.9925
Lake Bonney Wind Farm	33	LKBONNY1	SMAY1	SMAY	0.9803	0.9587
Lake Bonney Wind Farm Stage 2	33	LKBONNY2	SMAY2	SMAY	0.9803	0.9587
Lake Bonney Wind Farm Stage 3	33	LKBONNY3	SMAY3W	SMAY	0.9803	0.9587
Lincoln Gap Wind Farm (effective prior to 14/12/2021)	275	LGAPWF1	SLGW1L	SLGW	0.9667	0.9779
Lincoln Gap Wind Farm (effective from 14/12/2021)	275	LGAPWF1	SLGW1L	SLGW	0.9644	
Lincoln Gap Wind Farm (Stage 2)	275	LGAPWF2	SLGW4L	SLGW	0.9644	
Mannum-Adelaide Pipeline Pumping Station No 2 Solar Farm – dual MLF (Generation)	3.3	MAPS2PV1	SMA21M	SMA2	1.0016	1.0185
Mannum-Adelaide Pipeline Pumping Station No 2 Solar Farm – dual MLF (Load)	3.3	MAPS2PV1	SMA21M	SMA2	1.0182	1.0185
Mannum-Adelaide Pipeline Pumping Station No 3 Solar Farm – dual MLF (Generation)	3.3	MAPS3PV1	SMA31M	SMA3	1.0012	
Mannum-Adelaide Pipeline Pumping Station No 3 Solar Farm – dual MLF (Load)	3.3	MAPS3PV1	SMA31M	SMA3	1.0178	
Mintaro PS	132	MINTARO	SMPS	SMPS	0.9865	0.9907
Morgan Whyalla Pump Station 1 PV	3.3	MWPS1PV1	SMW11M	SMW1	1.0271	1.0211
Morgan Whyalla Pump Station 2 PV - Dual MLF (Generation)	3.3	MWPS2PV1	SMW21M	SMW2	0.9664	1.0113
Morgan Whyalla Pump Station 2 PV - Dual MLF (Load)	3.3	MWPS2PV1	SMW21M	SMW2	0.9994	1.0113

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Morgan Whyalla Pump Station 3 PV - Dual MLF (Generation)	3.3	MWPS3PV1	SMW31M	SMW3	0.9719	1.0005
Morgan Whyalla Pump Station 3 PV - Dual MLF (Load)	3.3	MWPS3PV1	SMW31M	SMW3	0.9927	1.0005
Morgan Whyalla Pump Station 4 PV - Dual MLF (Generation)	3.3	MWPS4PV1	SMW41M	SMW4	0.9751	0.9935
Morgan Whyalla Pump Station 4 PV - Dual MLF (Load)	3.3	MWPS4PV1	SMW41M	SMW4	0.9874	0.9935
Temporary Generation South (TGS) Lonsdale	66	SATGS1	SMVG1L	SMVG	1.0021	0.9972
Mt Millar Wind Farm	33	MTMILLAR	SMTM1	SMTM	0.9287	0.9355
Murray Bridge – Hahndorf Pipeline 2 (effective from 11/01/2022) – Dual MLF (Generation)	11	MBPS2PV1	SMH21M	SMH2	1.0058	
Murray Bridge – Hahndorf Pipeline 2 (effective from 11/01/2022) – Dual MLF (Load)	11	MBPS2PV1	SMH21M	SMH2	1.0205	
North Brown Hill Wind Farm	275	NBHWF1	SBEL1A	SBEL	0.9571	0.9661
O.C.P.L. Unit 1	66	OSB-AG	SNBN1	SOCP	0.9999	0.9998
Temporary Generation North	66	SATGN1	SPAG1E	SPAG	1.0018	0.9963
Pelican Point PS	275	PPCCGT	SPPT	SPPT	0.9987	0.9987
Port Augusta Renewable Energy Park - Wind	275	PAREPW1	SDAP1P	SDAP	0.9728	
Port Lincoln 3	33	POR03	SPL31P	SPL3	0.9467	0.9916
Port Lincoln PS	132	POR01	SPLN1	SPTL	0.9505	0.9886
Pt Stanvac PS	66	PTSTAN1	SMVE3P	SMVE	1.0055	1.0050
Quarantine PS Unit 1	66	QPS1	SQPS1	SQPS	0.9858	0.9854
Quarantine PS Unit 2	66	QPS2	SQPS2	SQPS	0.9858	0.9854
Quarantine PS Unit 3	66	QPS3	SQPS3	SQPS	0.9858	0.9854
Quarantine PS Unit 4	66	QPS4	SQPS4	SQPS	0.9858	0.9854
Quarantine PS Unit 5	66	QPS5	SQPS5Q	SQPS	0.9858	0.9854
Snapper Point PS	275	SNPT1S	SNAPPER1	SNPT	0.9990	
Snowtown Wind Farm	33	SNOWTWN1	SNWF1T	SNWF	0.9134	0.9165
Snowtown Wind Farm Stage 2 – North	275	SNOWNTH1	SBLWS1	SBLW	0.9678	0.9717
Snowtown Wind Farm Stage 2 – South	275	SNOWSTH1	SBLWS2	SBLW	0.9678	0.9717
Snuggery PS Units 1 to 3	132	SNUG1	SSGA1	SSPS	0.9533	0.9518

Generator	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Starfish Hill Wind Farm	66	STARHLWF	SMVE2	SMVE	1.0055	1.0050
Tailem Bend Solar Farm	132	TBSF1	STBS1T	STBS	1.0113	1.0013
Tatiara Meat Co	33	TATIARA1	SKET1E	SKET	1.0263	1.0165
The Bluff wind Farm	275	BLUFF1	SBEL2P	SBEL	0.9571	0.9661
Torrens Island PS A Unit 1	275	TORRA1	STSA1	STPS	0.9999	0.9998
Torrens Island PS A Unit 3	275	TORRA3	STSA3	STPS	0.9999	0.9998
Torrens Island PS B Unit 1	275	TORRB1	STSB1	STPS	0.9999	0.9998
Torrens Island PS B Unit 2	275	TORRB2	STSB2	STPS	0.9999	0.9998
Torrens Island PS B Unit 3	275	TORRB3	STSB3	STPS	0.9999	0.9998
Torrens Island PS B Unit 4	275	TORRB4	STSB4	STPS	0.9999	0.9998
Torrens Island PS Load	66	TORNL1	STSYL	STSY	1.0000	1.0000
Waterloo Wind Farm	132	WATERLWF	SWLE1R	SWLE	0.9594	0.9665
Wattle Point Wind Farm	132	WPWF	SSYP1	SSYP	0.8110	0.8200
Willogoleche Wind Farm	275	WGWF1	SWGL1W	SWGL	0.9583	0.9693
Wingfield 1 LFG PS	66	WINGF1_1	SKLB1W	SKLB	1.0008	1.0008
Wingfield 2 LFG PS	66	WINGF2_1	SNBN2W	SNBN	1.0005	1.0005

1.5 Tasmania marginal loss factors

Table 11 Tasmania loads

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Arthurs Lake	6.6	TAL2	0.9815	0.9703
Avoca	22	TAV2	1.0023	0.9982
Boyer SWA	6.6	TBYA	1.0003	1.0081
Boyer SWB	6.6	TBYB	1.0092	1.0174
Bridgewater	11	TBW2	1.0154	1.0219
Burnie	22	TBU3	0.9781	0.9786
Chapel St.	11	TCS3	1.0001	1.0085
Comalco	220	TCO1	1.0006	1.0006
Creek Road	33	TCR2	1.0009	1.0092
Derby	22	TDE2	0.9483	0.9527
Derwent Bridge	22	TDB2	0.9117	0.9155
Devonport	22	TDP2	0.9785	0.9824
Electrona	11	TEL2	1.0157	1.0239

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Emu Bay	11	TEB2	0.9746	0.9761
Fisher (Rowallan)	220	TFI1	0.9561	0.9587
Fisher 220 DNSP	220	TFI2	0.9561	
George Town	22	TGT3	1.0020	1.0018
George Town (Basslink)	220	TGT1	1.0000	1.0000
Gordon	22	TGO2	0.9710	0.9859
Greater Hobart Area VTN		TVN1	1.0027	1.0106
Hadspen	22	THA3	0.9902	0.9893
Hampshire	110	THM2	0.9736	0.9750
Huon River	11	THR2	1.0189	1.0256
Kermandie	11	TKE2	1.0203	1.0310
Kingston	33	TK13	1.0067	1.0145
Kingston	11	TKI2	1.0114	1.0198
Knights Road	11	TKR2	1.0176	1.0265
Lindisfarne	33	TLF2	1.0039	1.0110
Meadowbank	22	TMB2	0.9829	0.9913
Mornington	33	TMT2	1.0051	1.0125
Mowbray	22	TMY2	0.9896	0.9885
New Norfolk	22	TNN2	0.9954	1.0043
Newton	22	TNT2	0.9524	0.9633
Newton	11	TNT3	0.9369	0.9454
North Hobart	11	TNH2	0.9996	1.0077
Norwood	22	TNW2	0.9882	0.9873
Palmerston	22	TPM3	0.9728	0.9714
Port Latta	22	TPL2	0.9480	0.9479
Que	22	TQU2	0.9612	0.9746
Queenstown	11	TQT3	0.9437	0.9484
Queenstown	22	TQT2	0.9434	0.9517
Railton	22	TRA2	0.9783	0.9829
Risdon	33	TRI4	1.0042	1.0120
Risdon	11	TRI3	1.0046	1.0142
Rokeby	11	TRK2	1.0094	1.0163
Rosebery	44	TRB2	0.9505	0.9611
Savage River	22	TSR2	0.9876	0.9942
Scottsdale	22	TSD2	0.9639	0.9649
Smithton	22	TST2	0.9330	0.9326
Sorell	22	TSO2	1.0264	1.0306
St Leonard	22	TSL2	0.9882	0.9878
St Leonards Scheduled Load	22	TSL3	0.9888	
St. Marys	22	TSM2	1.0153	1.0175
Starwood	110	TSW1	1.0006	1.0007

Location	Voltage (kV)	TNI code	2021-22 MLF	2020-21 MLF
Tamar Region VTN		TVN2	0.9908	0.9899
Temco	110	TTE1	1.0032	0.9998
Trevallyn	22	TTR2	0.9901	0.9891
Triabunna	22	TTB2	1.0300	1.0387
Tungatinah	22	TTU2	0.9142	0.9191
Ulverstone	22	TUL2	0.9772	0.9779
Waddamana	22	TWA2	0.9395	0.9354
Wayatinah	11	TWY2	0.9802	0.9865
Wesley Vale	22	TWV2	0.9753	0.9794

Table 12 Tasmania generation

Generator description	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Basslink (George Town)	220	BLNKTAS	TGT11	TGT1	1.0000	1.0000
Bastyan	220	BASTYAN	TFA11	TFA1	0.9286	0.9301
Bell Bay No.3	110	BBTHREE1	TBB11	TBB1	0.9982	0.9975
Bell Bay No.3	110	BBTHREE2	TBB12	TBB1	0.9982	0.9975
Bell Bay No.3	110	BBTHREE3	TBB13	TBB1	0.9982	0.9975
Bluff Point and Studland Bay Wind Farms	110	WOOLNTH1	TST11	TST1	0.8794	0.8777
Butlers Gorge	110	BUTLERSG	TBG11	TBG1	0.9049	0.9101
Catagunya	220	LI_WY_CA	TLI11	TLI1	0.9789	0.9817
Cethana	220	CETHANA	TCE11	TCE1	0.9512	0.9545
Cluny	220	CLUNY	TCL11	TCL1	0.9798	0.9855
Devils gate	110	DEVILS_G	TDG11	TDG1	0.9566	0.9618
Fisher	220	FISHER	TFI11	TFI1	0.9561	0.9587
Gordon	220	GORDON	TGO11	TGO1	0.9280	0.9491
Granville Harbour Wind Farm	220	GRANWF1	TGH11G	TGH1	0.9314	0.9408
John Butters	220	JBUTTERS	TJB11	TJB1	0.9258	0.9230
Lake Echo	110	LK_ECHO	TLE11	TLE1	0.9133	0.9173
Lemonthyme	220	LEM_WIL	TSH11	TSH1	0.9608	0.9626
Liapootah	220	LI_WY_CA	TLI11	TLI1	0.9789	0.9817
Mackintosh	110	MACKNTSH	TMA11	TMA1	0.9158	0.9178
Meadowbank	110	MEADOWBK	TMB11	TMB1	0.9830	0.9773
Midlands PS	22	MIDLDPS1	TAV21M	TAV2	1.0023	0.9982
Musselroe	110	MUSSELR1	TDE11M	TDE1	0.8999	0.9024
Paloona	110	PALOONA	TPA11	TPA1	0.9587	0.9604
Poatina	220	POAT220	TPM11	TPM1	0.9691	0.9715
Poatina	110	POAT110	TPM21	TPM2	0.9512	0.9561
Reece No.1	220	REECE1	TRCA1	TRCA	0.9193	0.9202
Reece No.2	220	REECE2	TRCB1	TRCB	0.9147	0.9183

Generator description	Voltage (kV)	DUID	Connection point ID	TNI code	2021-22 MLF	2020-21 MLF
Repulse	220	REPULSE	TCL12	TCL1	0.9798	0.9855
Rowallan	220	ROWALLAN	TFI12	TFI1	0.9561	0.9587
Tamar Valley CCGT	220	TVCC201	TTV11A	TTV1	1.0000	1.0000
Tamar Valley OCGT	110	TVPP104	TBB14A	TBB1	0.9982	0.9975
Tarraleah	110	TARRALEA	TTA11	TTA1	0.9106	0.9167
Trevallyn	110	TREVALLN	TTR11	TTR1	0.9848	0.9805
Tribute	220	TRIBUTE	TTI11	TTI1	0.9133	0.9183
Tungatinah	110	TUNGATIN	TTU11	TTU1	0.8859	0.8920
Wayatinah	220	LI_WY_CA	TLI11	TLI1	0.9789	0.9817
Wild Cattle Hill Wind Farm	220	CTHLWF1	TWC11C	TWC1	0.9809	0.9850
Wilmot	220	LEM_WIL	TSH11	TSH1	0.9608	0.9626

2 Changes in marginal loss factors

2.1 Marginal loss factors in the NEM

The MLF for a connection point represents the marginal electrical transmission losses in electrical power flow between that connection point and the RRN for the region in which the connection point is located.

An MLF below 1 indicates that an incremental increase in power flow from the connection point to the RRN would increase total losses in the network. An MLF above 1 indicates the opposite.

According to the current NEM design, the difference between the cost of electricity at a connection point remote from the RRN and the cost of electricity at the RRN is directly proportional to the MLF for the connection point. If the MLF for a connection point is 0.9, then the effective values of electricity purchased or sold at that connection point will be 90% of the regional reference price. Consequently, a fall in MLF at a connection point is likely to have a positive impact on customers and a negative impact on generators.

More information on the treatment of electricity losses in the NEM is available on AEMO's website[6].

2.2 Reasons why marginal loss factors change

There are three main reasons why the MLF for a connection point changes from year to year:

1. Changes to projected power flows over the transmission network caused by projected changes to power system generation and demand, including building new generation, retirement of power stations, and revised electricity consumption forecasts.
   - If the projected power flow from a connection point towards the RRN increases, then the MLF for that connection point would be expected to decrease. Conversely, if the projected power flow from a connection point towards the regional reference node decreases, then the MLF for that connection point would be expected to increase.
2. Forecast variations in seasonal patterns, diurnal patterns, intra-year commencement of operation, intra-year cessation of operation.
   - As MLF outcomes are volume weighted, year-on-year variations in patterns of either consumption or export (load and generation respectively) can result in material variations in MLF outcomes. For further detail on the impact of volume weighting on MLF outcomes, please refer to Appendix A3.
3. Changes to the impedance of the transmission network caused by augmentation of the transmission network, such as building new transmission lines.
   - If augmentations decrease the impedance of the transmission network between a connection point and the RRN, then the MLF for the connection point would be expected to move closer to 1.

[6] AEMO, Treatment of Loss Factors in the National Electricity Market,1 July 2012, at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2016/Treatment_of_Loss_Factors_in_the_NEM.pdf.

The location of new generation projects and load developments on the transmission and distribution network has a significant impact on the MLFs in an area. As more generation is connected to electrically weak areas of the network that are remote from the RRN, MLFs in these areas will continue to decline.

2.3 Changes between preliminary 2021-22 MLFs and draft/final 2021-22 MLFs

In December 2020, AEMO published a preliminary report containing indicative MLFs for 2021-22. While the preliminary report is intended to provide stakeholders with early insight into possible future MLF outcomes, there are several variances between the input data utilised in the preliminary and draft/final MLF studies. Table 13 provides a high level summary of these differences.

Table 13 Preliminary vs draft/final study variations

Item	Preliminary	Draft/final
Methodology review	The previous Methodology (version 7.0) was followed for production of preliminary MLFs, other than the items listed below.	The Methodology (version 8.0) followed for production of final MLFs.
New generation projects	Inclusion based on generator project status in July 2020 Generation Information page [A]. Projects are included where the status is COM or COM* [B].	Inclusion based on generator project status in January 2021 Generation Information page. Projects are included where the status is COM or COM*.
Load profiles	Historical load profiles from 2019-20.	Forecast load profiles for 2021-22.
Network model	2020-21 MLF study network model.	Revised network model incorporating future augmentations that are committed.
Intra-regional limit management	Intra-regional limits as identified and incorporated into the 2020-21 MLF study.	Intra-regional limits reviewed for 2021-22, revised and incorporated into the 2021-22 MLF study.

A. The Generation Information page provides stakeholders with information on the capacity of existing, withdrawn, committed, and proposed generation projects in the NEM. See https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information.

B. Committed (COM) projects meet all five of AEMO's commitment criteria (relating to site, components, planning, finance, and date). Committed* (COM*) projects are classified as Advanced, have commenced construction or installation, and meet AEMO's site, finance, and date criteria, but are required to meet only one of the components or planning criteria.

2.4 Changes between draft 2021-22 MLFs and final 2021-22 MLFs

AEMO published a draft report on 2021-22 MLFs on 2 March 2021, and sought feedback from stakeholders.

AEMO made a number of minor improvements to modelling compared to the study used for the draft report, as part of the quality assurance steps undertaken. This has resulted in a small number of connection points having a material change in MLF value compared to the draft report.

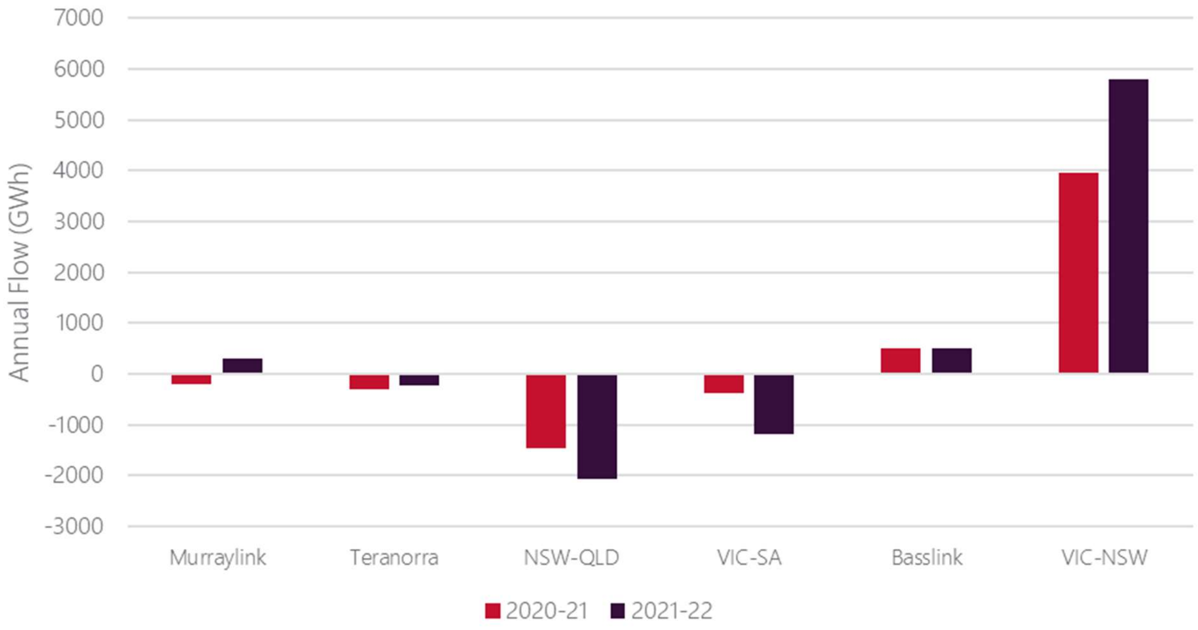
2.5 Changes between 2020-21 MLFs and 2021-22 MLFs

This section summarises the changes in MLFs for 2021-22 compared to the 2020-21 MLFs at a zone level, and the general trends driving the changes. Appendix A2 provides more detailed information on the inputs, methodology, and assumptions for the 2021-22 calculations, and key changes from 2020-21.

For further details on how MLFs are calculated, refer to Section A1.2.

Figure 1 shows the annual projected gigawatt-hours (GWh) flows for all interconnectors within the NEM for both the 2020-21 and 2021-22 MLF studies.

Figure 1 2020-21 vs 2021-22 MLF interconnector flow projections



2.5.1 Changes to marginal loss factors in Queensland

Figure 2 shows a geographical representation of MLF variations at Queensland connection points between 2020-21 and 2021-22. Table 14 shows the average sub-regional year-on-year MLF variations between 2020-21 and 2021-22.

The primary drivers of change in Queensland are variations in projected generation within Queensland between 2020-21 and 2021-22.

The north and central Queensland sub-region MLFs have increased by an average of 3.52% and 2.05% respectively. For 2021-22, these are primarily driven by a projected decrease of generation within these sub-regions between 2020-21 and 2021-22.

The south-west and south-east Queensland sub-regions MLFs on average have decreased, with reductions of less than 0.25% despite increased exports to New South Wales, primarily driven by a projected increase of generation within these sub-regions between 2020-21 and 2021-22. Of note is that the projected increase in generation within these sub-regions is more than the projected increase in exports to New South Wales.

Figure 2 Queensland changes compared to 2020-21 MLFs

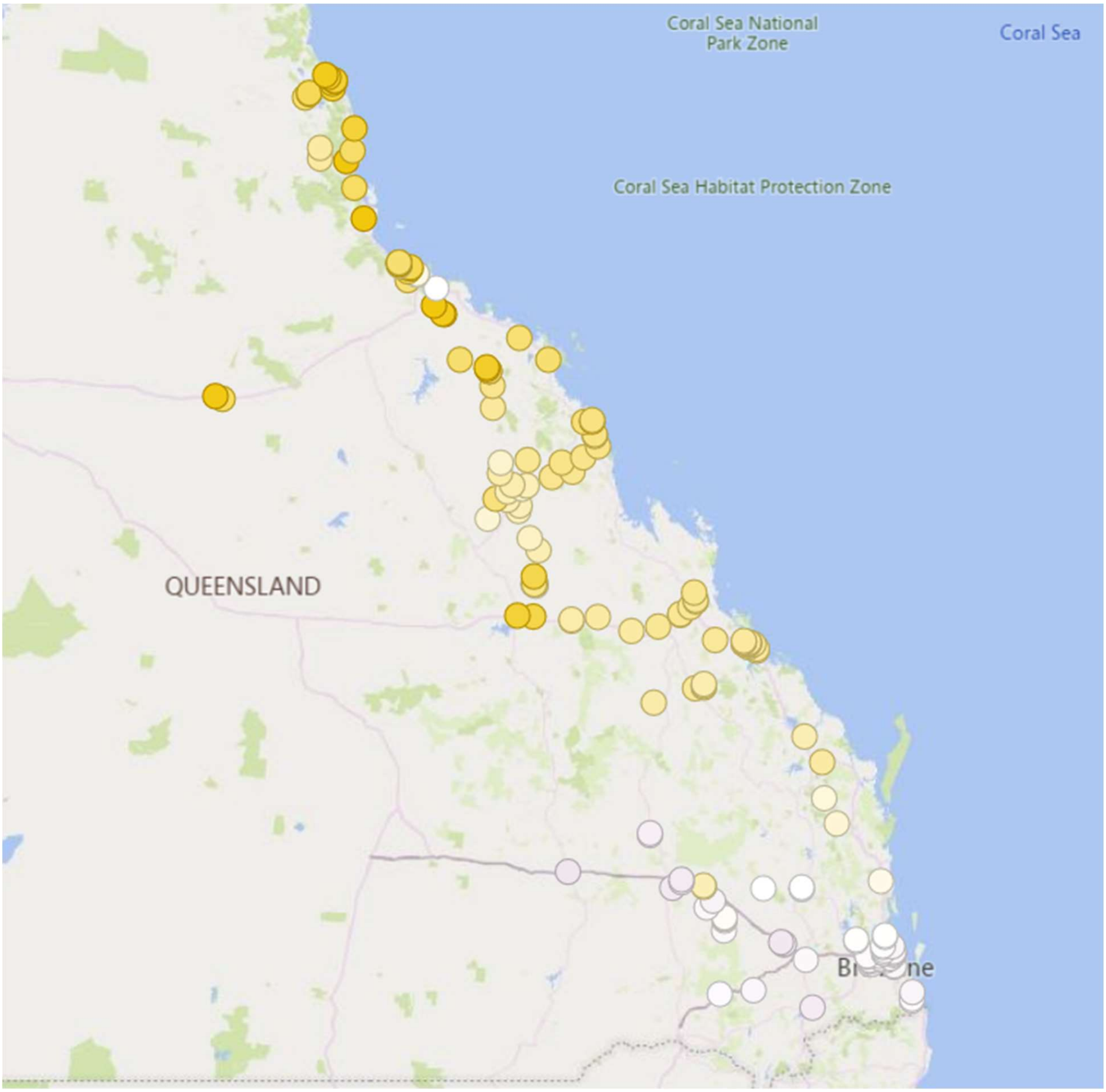


Table 14 Queensland sub-region year-on-year average MLF variation

Sub-region	Year-on-year variation (%)
Central	2.05%
North	3.52%
South-east	-0.17%
South-west	-0.24%

2.5.2 Changes to marginal loss factors in New South Wales

Figure 3 shows a geographical representation of MLF variations at New South Wales connection points between 2020-21 and 2021-22. Table 15 shows the average sub-regional year on year MLF variations between 2020-21 and 2021-22.

The primary drivers of change in New South Wales are variations in projected imports from both Victoria and Queensland as well as a projected increase in remote generation and decrease in centralised generation between 2020-21 and 2021-22.

The north New South Wales sub-region MLFs decreased on average by 1.05%, primarily driven by a projected increase in imports from Queensland.

The Hunter sub-region MLFs have seen little year-on-year variation, while projected imports from Queensland have increased, projected generation within this sub-region has decreased materially resulting in largely static outcomes between 2020-21 and 2021-22.

The west, Australian Capital Territory (ACT), Snowy and south-west sub-regions have all seen material reductions in MLFs, with the ACT and south-west sub-regions having the largest reductions of 1.63% and 1.97% respectively. These reductions are primarily driven by a projected increase in imports from Victoria and a projected increase in generation in all four sub-regions between 2020-21 and 2021-22.

Figure 3 New South Wales changes compared to 2020-21 MLFs

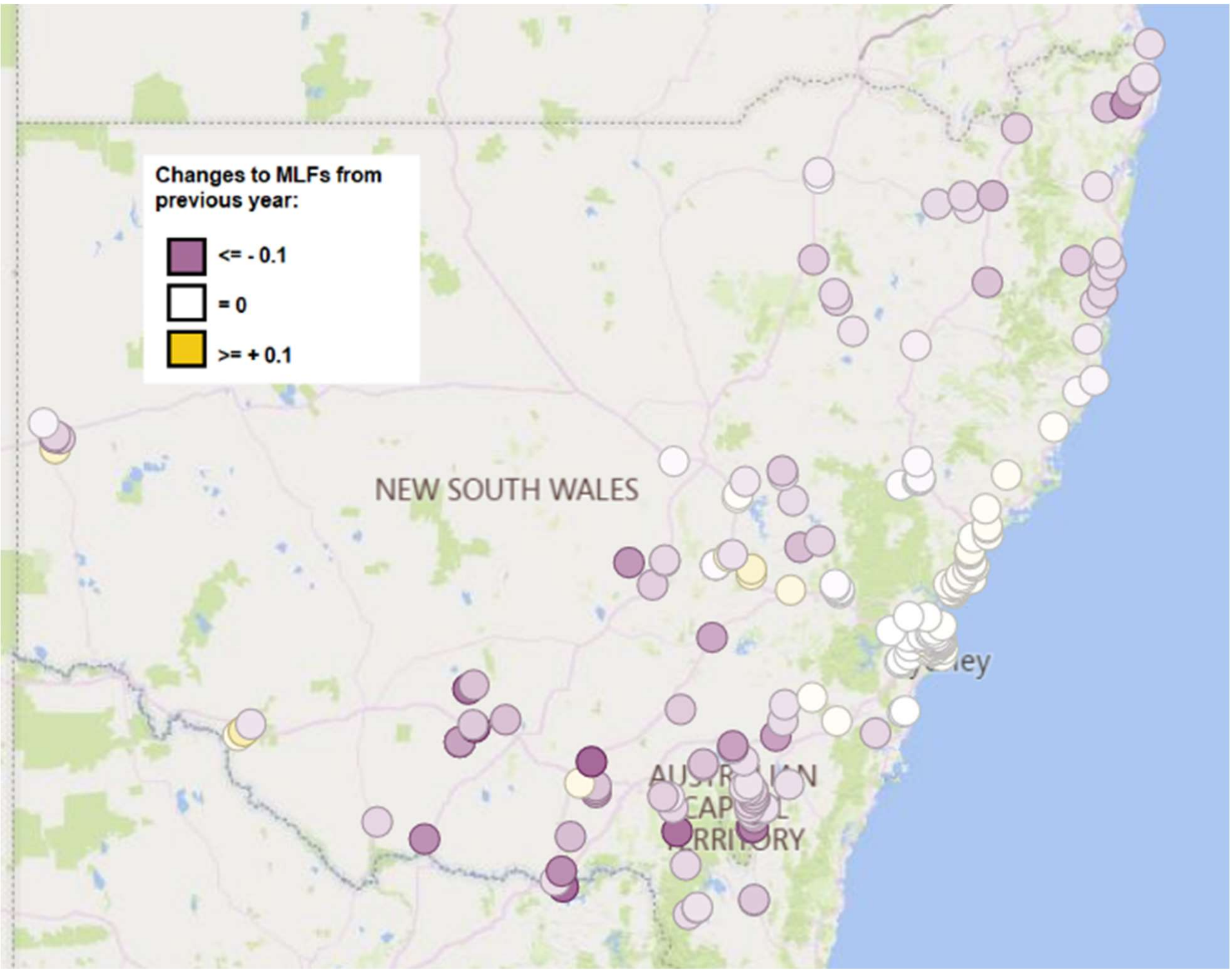


Table 15 New South Wales sub-region year-on-year average MLF variation

Sub-region	Year-on-year variation (%)
ACT	-1.63%
Hunter	0.05%
North	-1.05%
South-west	-1.97%
Snowy	-1.10%
Sydney	0.02%
West	-0.90%

2.5.3 Changes to marginal loss factors in Victoria

Figure 4 shows a geographical representation of MLF variations at Victorian connection points between 2020-21 and 2021-22. Table 16 shows the average sub-regional year on year MLF variations between 2020-21 and 2021-22.

The primary drivers of change in Victoria are variations in projected exports to New South Wales, projected imports from Heywood, and projected exports from Murraylink between 2020-21 and 2021-22. Of note is that the projection of circular flows on Heywood and Murraylink has resulted in projected net imports from South Australia being less than the projected gross imports via Heywood for 2021-22.

The north and north-west sub-regions MLFs increased on average by 0.98% and 2.21% respectively, primarily driven by a projected increase in exports to New South Wales between 2020-21 and 2021-22.

The central sub-region MLFs have decreased on average by 0.2%, primarily driven by a projected increase in generation within this sub-region and a projected increase in imports from South Australian via Heywood between 2020-21 and 2021-22.

The west sub-region MLFs have decreased on average by 0.22%, primarily driven by a projected increase in imports from South Australia vis Heywood between 2020-21 and 2021-22.

Figure 4 Victoria changes compared to 2020-21 MLFs

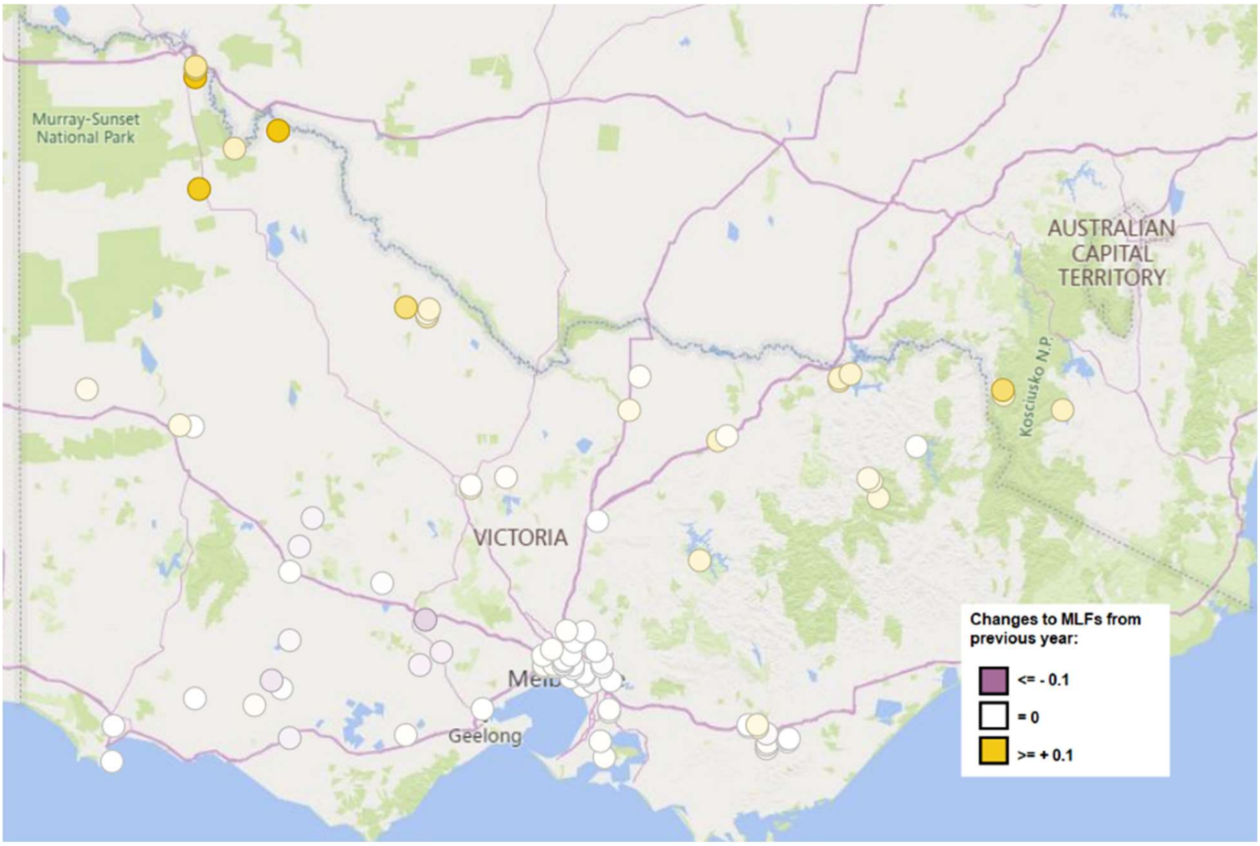


Table 16 Victoria sub-region year-on-year average MLF variation

Sub-region	Year-on-year variation (%)
Central	-0.20%
Latrobe Valley	-0.01%
Melbourne	0.03%
North	0.98%
North-west	2.21%
West	-0.22%

2.5.4 Changes to marginal loss factors in South Australia

Figure 5 shows a geographical representation of MLF variations at South Australian connection points between 2020-21 and 2021-22. Table 17 shows the average sub-regional year on year MLF variations between 2020-21 and 2021-22.

The primary drivers of change in South Australia are projected variations in projected exports to Victoria via Heywood and a projected reversal of flows on Murraylink resulting in a gross import via Murraylink despite South Australia being a net exporter between 2020-21 and 2021-22.

The Riverland sub-region MLFs decreased on average by 2.43%, primarily driven by the projected reversal of flows on Murraylink resulting in a gross import and a projected increase in generation within this sub-region between 2020-21 and 2021-22.

The south-east sub-region MLFs increased on average by 3.73%, primarily driven by a projected increase in exports to Victoria via Heywood between 2020-21 and 2021-22.

The north sub-region MLFs decreased on average by 0.86%, primarily driven by load transfer from a remote section of the shared transmission network to a more central section of the shared transmission network within this sub-region between 2020-21 and 2021-22.

Figure 5 South Australia changes to 2020-21 MLFs

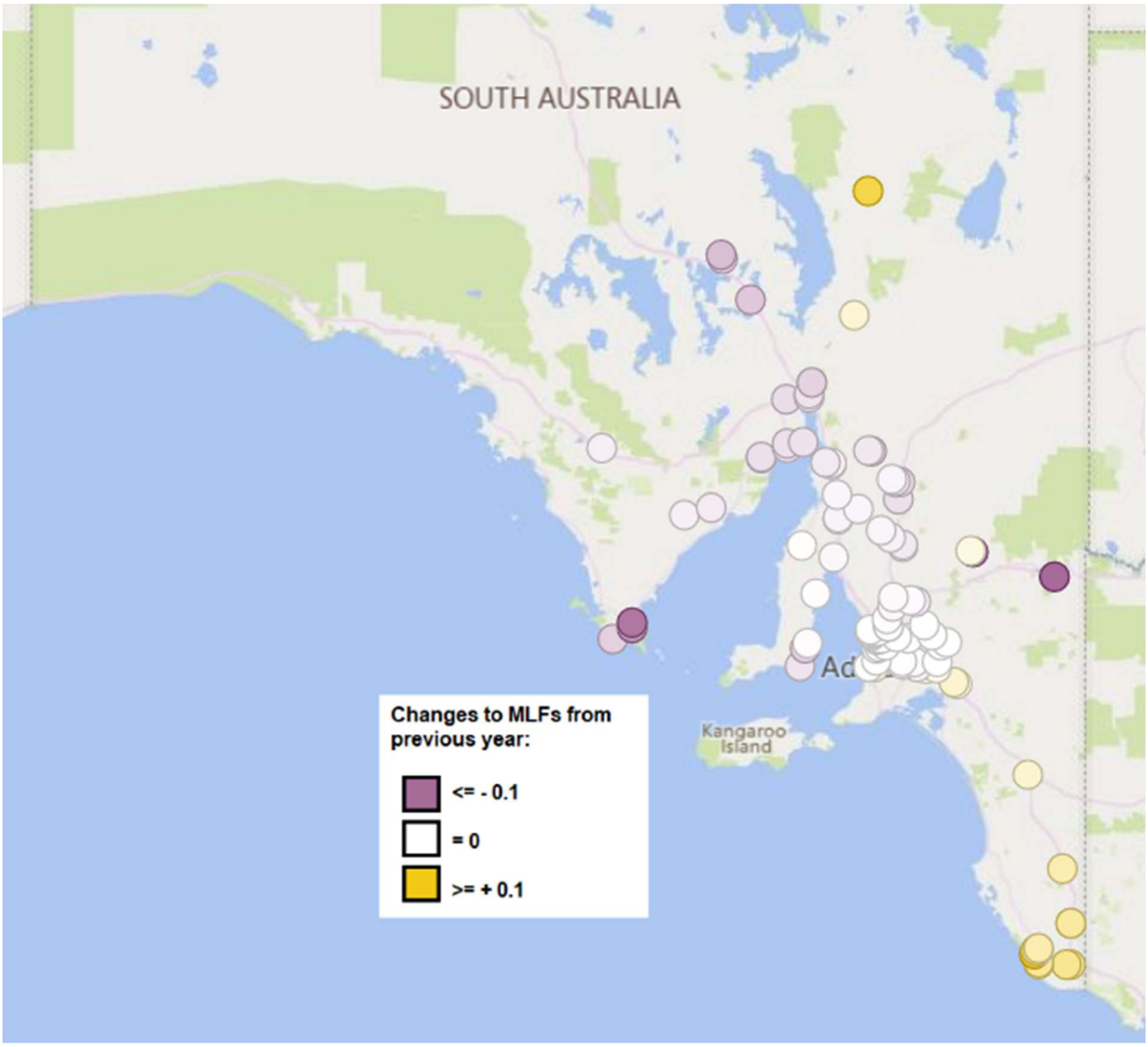


Table 17 South Australia sub-region year-on-year average MLF variation

Sub-region	Year-on-year variation (%)
Adelaide	-0.01%
North	-0.86%
Riverland	-2.43%
South-east	3.73%

2.5.5 Changes to marginal loss factors in Tasmania

Figure 6 shows a geographical representation of MLF variations at Tasmanian connection points between 2020-21 and 2021-22. Table 18 shows the average sub-regional year on year MLF variations between 2020-21 and 2021-22.

The primary drivers of change in Tasmania are projected increases in generation in the west coast and south sub-regions between 2020-21 and 2021-22.

The south and west coast sub-region MLFs on average decreased by 0.67% and 0.58% respectively, primarily driven by a projected increase in generation within these sub-regions between 2020-21 and 2021-22.

Figure 6 Tasmania changes to 2020-21 MLFs

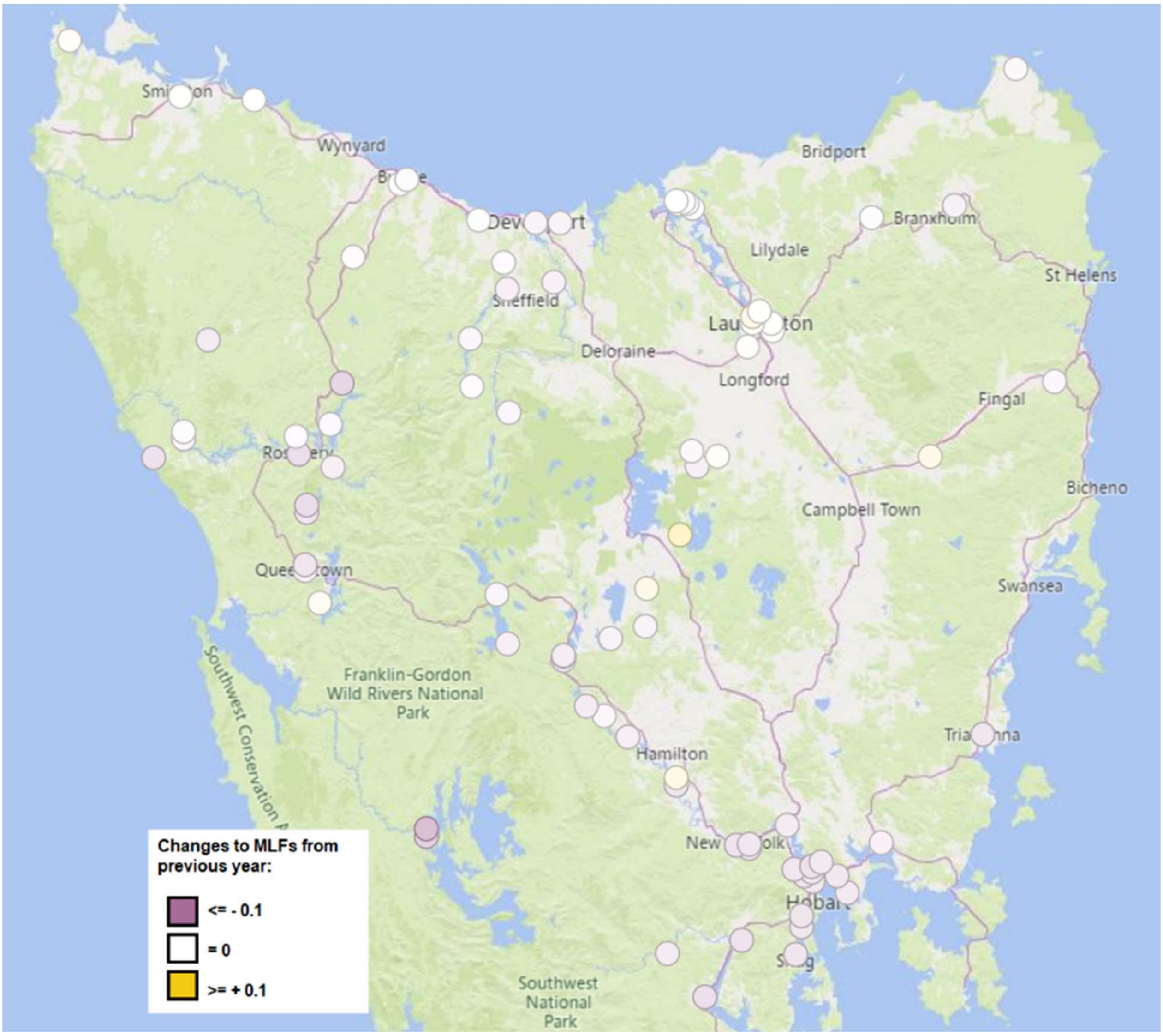


Table 18 Tasmania sub-region year-on-year average MLF variation

Sub-region	Year-on-year variation (%)
Georgetown	0.02%
North-west	-0.22%
North	0.05%
South	-0.67%
West coast	-0.58%

3 Inter-regional loss factor equations

This section describes the inter-regional loss factor equations.

Inter-regional loss factor equations describe the variation in loss factor at one RRN with respect to an adjacent RRN. These equations are necessary to cater for the large variations in loss factors that may occur between RRNs as a result of different power flow patterns. This is important in minimising the distortion of economic dispatch of generating units.

Loss factor equation (South Pine 275 referred to Sydney West 330)

= 0.9217 + 1.8976E-04*NQt + 1.7446E-05*Qd - 7.6790E-07*Nd

Loss factor equation (Sydney West 330 referred to Thomastown 66)

= 1.0629 + 1.8194E-04*VNt - 8.7387E-06*Vd + 4.9559E-06*Nd -4.9680E-05*Sd

Loss factor equation (Torrens Island 66 referred to Thomastown 66)

= 1.0121 + 3.5511E-04*VSAt - 4.5341E-07*Vd - 6.1623E-06*Sd

Where:

Qd = Queensland demand

Vd = Victorian demand

Nd = New South Wales demand

Sd = South Australian demand

NQt = transfer from New South Wales to Queensland

VNt = transfer from Victoria to New South Wales

VSAt = transfer from Victoria to South Australia

Figure 7 MLF (South Pine 275 referred to Sydney West 330)

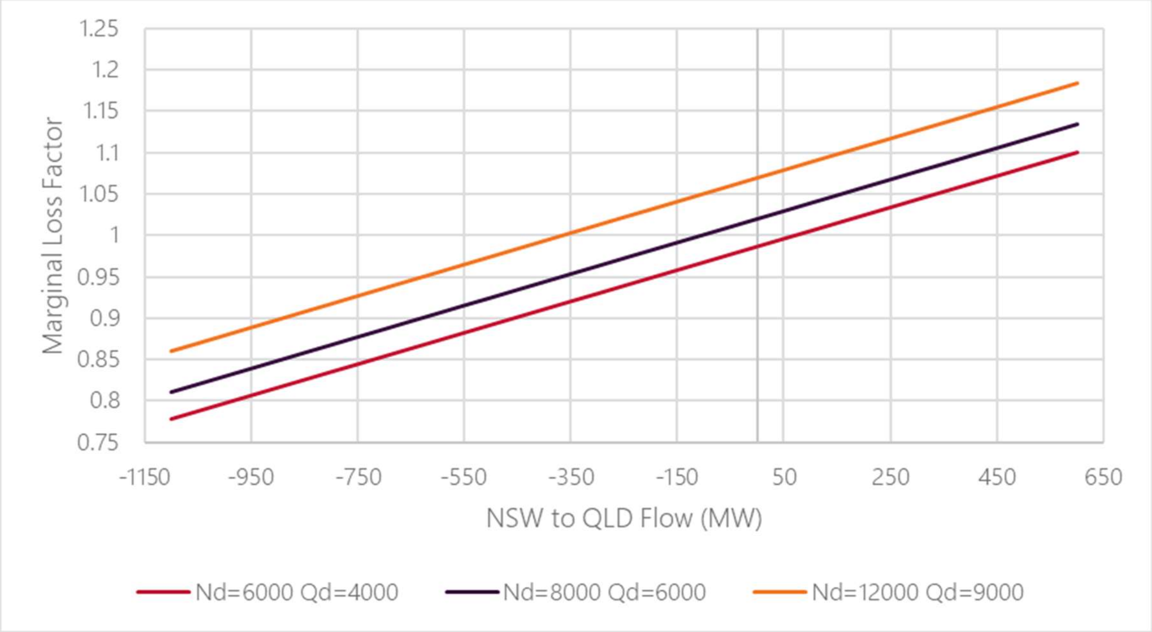


Table 19 South Pine 275 referred to Sydney West 330 MLF versus New South Wales to Queensland flow coefficient statistics

Coefficient	Qd	Nd	NQt	Constant
Coefficient value	1.7446E-05	-7.6790E-07	1.8976E-04	0.9217

Figure 8 MLF (Sydney West 330 referred to Thomastown 66)

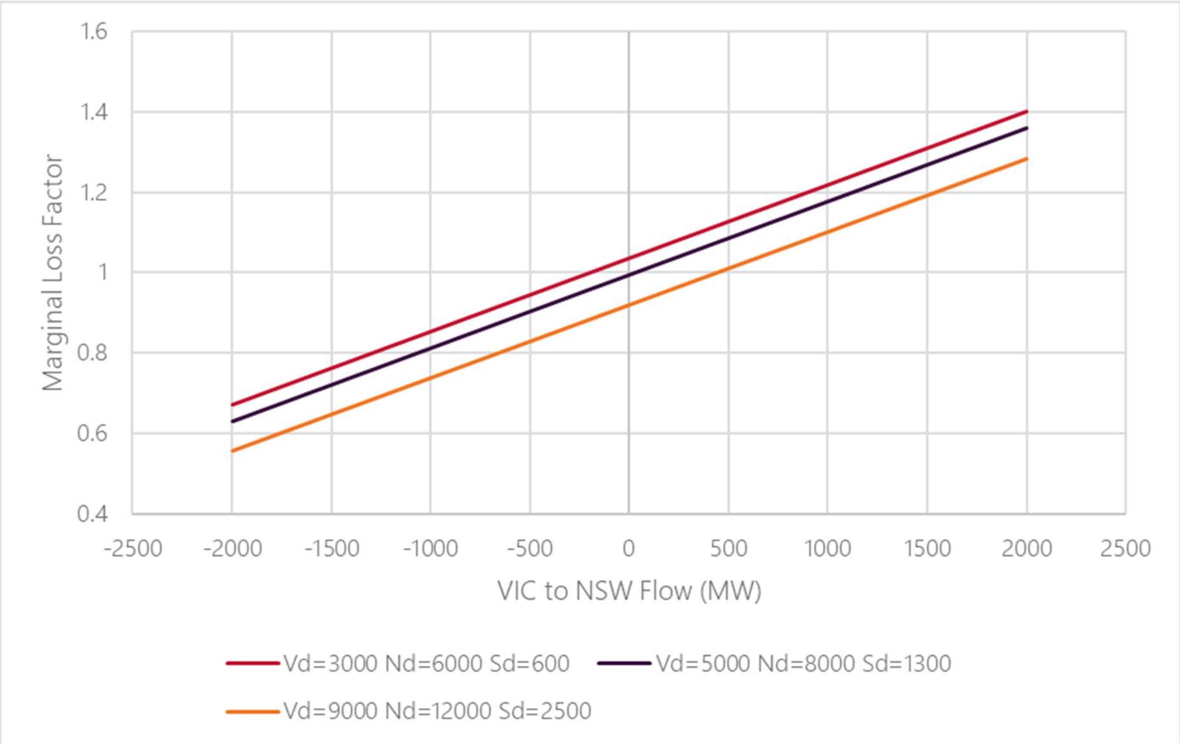


Table 20 Sydney West 330 referred to Thomastown 66 MLF versus Victoria to New South Wales flow coefficient statistics

Coefficient	Sd	Nd	Vd	VNt	Constant
Coefficient value	-4.9680E-05	4.9559E-06	-8.7387E-06	1.8194E-04	1.0629

Figure 9 MLF (Torrens Island 66 referred to Thomastown 66)

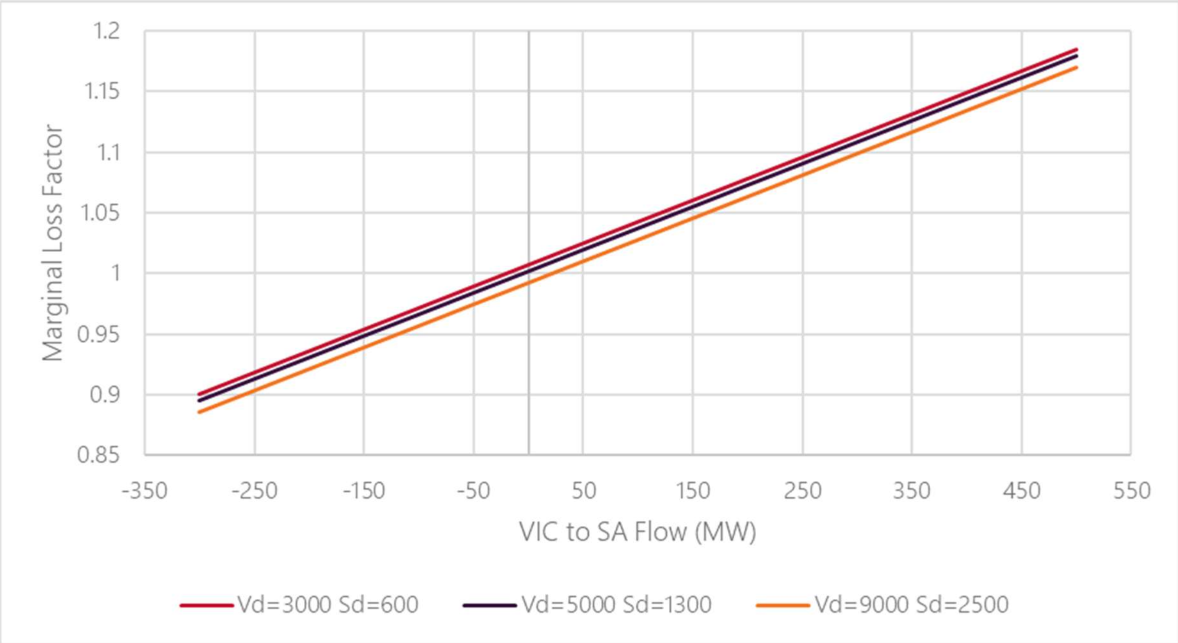


Table 21 Torrens Island 66 referred to Thomastown 66 MLF versus Victoria to South Australia flow coefficient statistics

Coefficient	Sd	Vd	VSAt	Constant
Coefficient value	-6.1623E-06	-4.5341E-07	3.5511E-04	1.0121

4 Inter-regional loss equations

This section describes how inter-regional loss equations are derived.

Inter-regional loss equations are derived by integrating the equation (Loss factor – 1) with respect to the interconnector flow, i.e.:

$$\text{Losses} = \int (\text{Loss factor} - 1)\, d\text{Flow}$$

South Pine 275 referred to Sydney West 330 notional link average losses

$= (-0.0783 + 1.7446E\text{-}05{*}Qd - 7.6790E\text{-}07{*}Nd){*}NQt + 9.4882E\text{-}05{*}(NQt)^2$

Sydney West 330 referred to Thomastown 66 notional link average losses

$= (0.0629 - 8.7387E\text{-}06{*}Vd + 4.9559E\text{-}06{*}Nd - 4.9680E\text{-}05{*}Sd){*}VNt + 9.0971E\text{-}05{*}(VNt)^2$

Torrens Island 66 referred to Thomastown 66 notional link average losses

$= (0.0121 - 4.5341E\text{-}07{*}Vd - 6.1623E\text{-}06{*}Sd){*}VSAt + 1.7755E\text{-}04{*}(VSAt)^2$

Where:

Qd = Queensland demand

Vd = Victorian demand

Nd = New South Wales demand

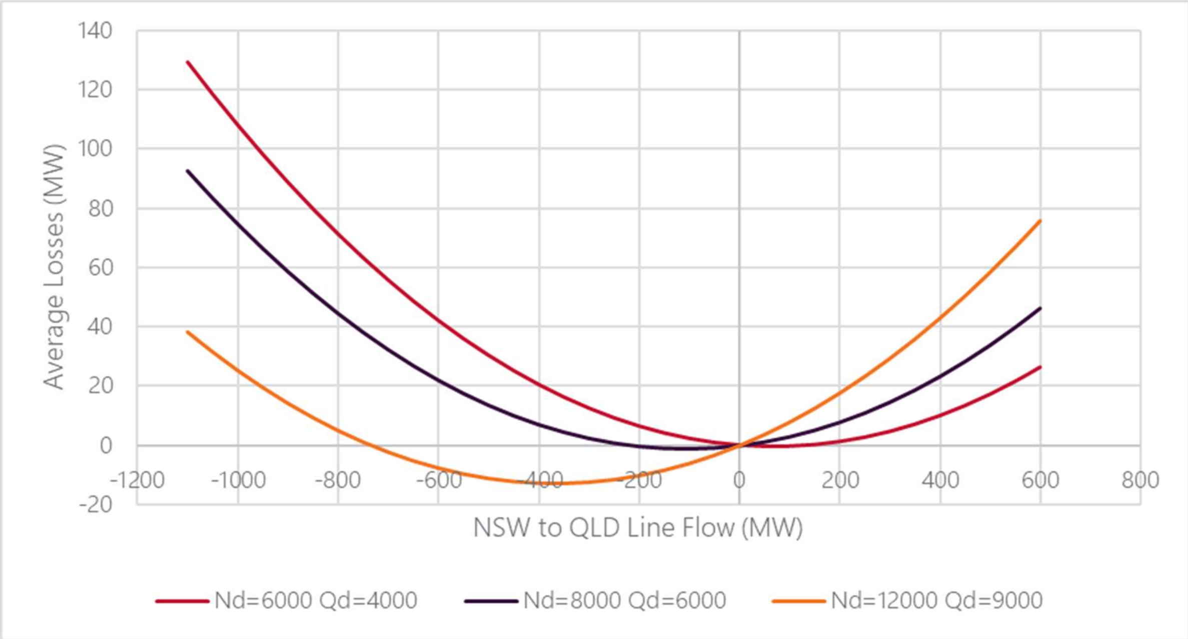
Sd = South Australia demand

NQt = transfer from New South Wales to Queensland

VNt = transfer from Victoria to New South Wales

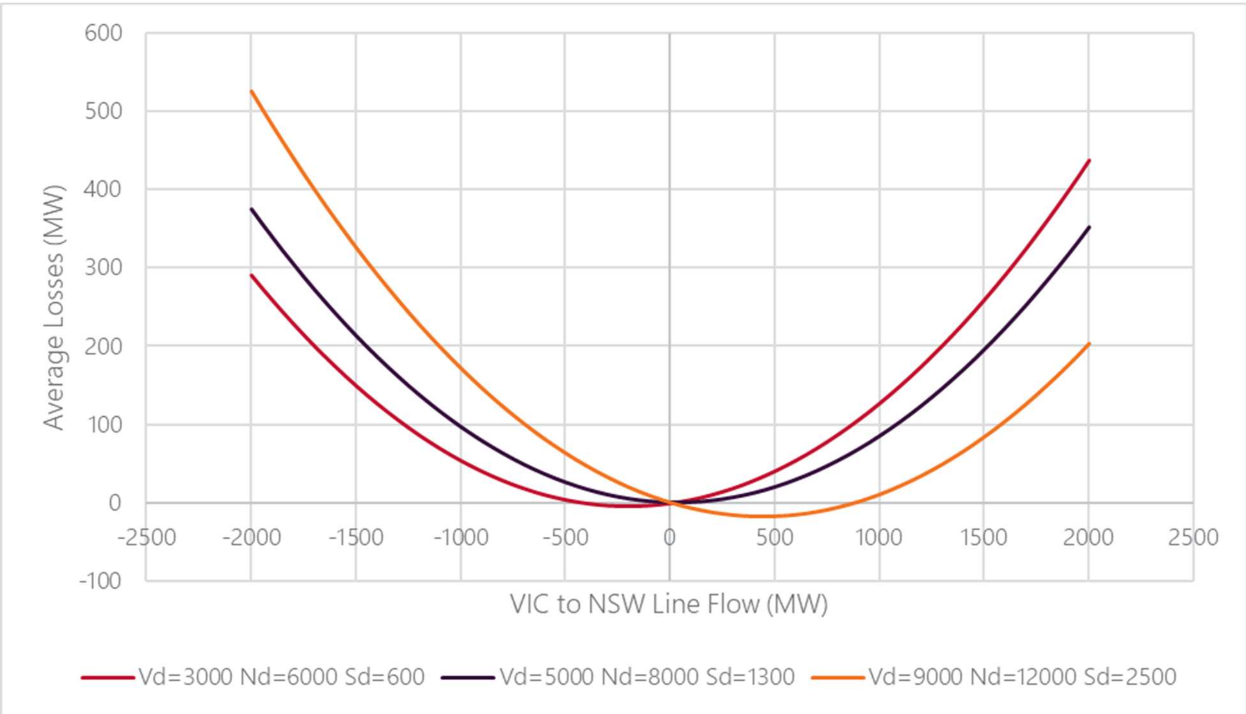
VSAt = transfer from Victoria to South Australia

Figure 10 Average losses for New South Wales – Queensland notional link



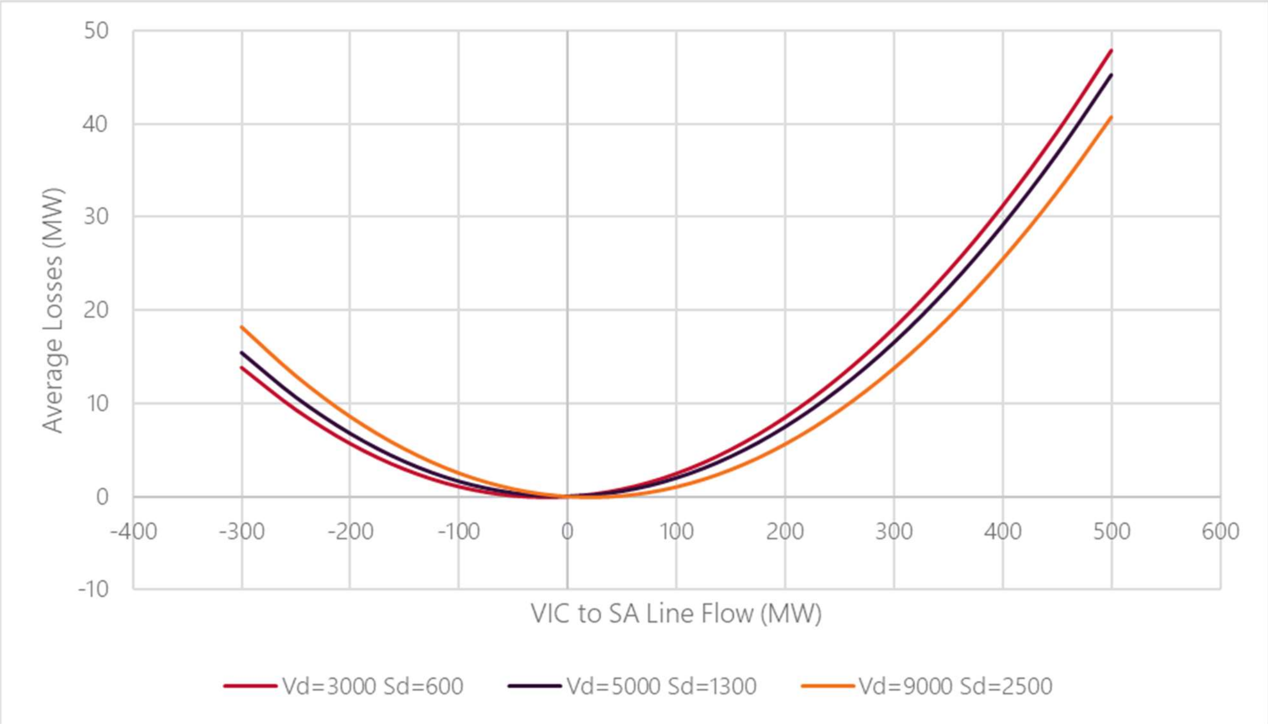
New South Wales to Queensland notional link losses versus New South Wales to Queensland notional link flow

Figure 11 Average losses for Victoria - New South Wales notional link



Victoria to New South Wales notional link losses versus Victoria to New South Wales notional link flow

Figure 12 Average losses for Victoria – South Australia notional link



Victoria to South Australia notional link losses versus Victoria to South Australia notional link flow

5 Basslink, Murraylink, Terranora loss equations

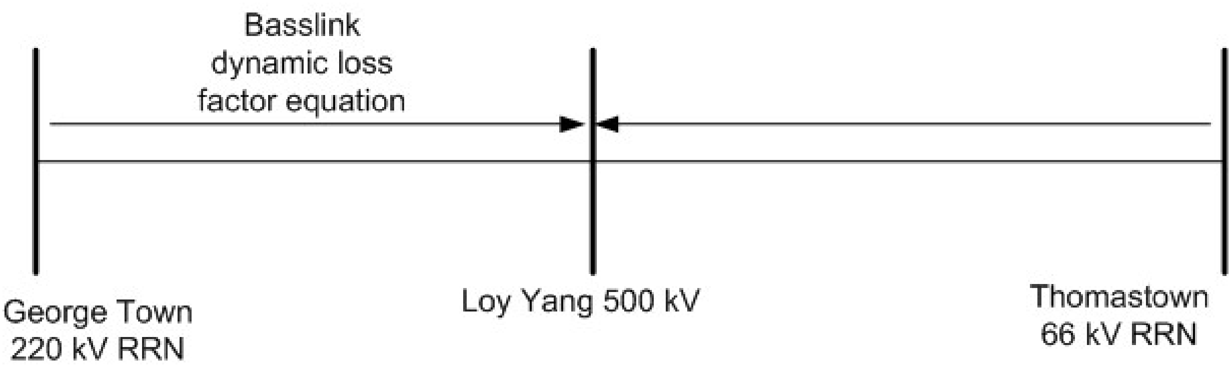
This section describes the loss equations for the DC interconnectors.

5.1 Basslink

The loss factor model for Basslink is made up of the following parts:

- George Town 220 kV MLF referred to Tasmania RRN = 1.0000
- Basslink (Loy Yang PS Switchyard) 500 kV MLF referred to Victorian RRN is 0.9803 when exporting power to Tasmania and 0.9735 when importing power from Tasmania.
- Receiving end dynamic loss factor referred to the sending end = 0.99608 + 2.0786 * 10-4 * P(receive), where P(receive) is the Basslink flow measured at the receiving end.

Figure 13 Basslink loss factor model



The equation describing the losses between the George Town 220 kV and Loy Yang 500 kV connection points can be determined by integrating the (loss factor equation – 1), giving:

$$P(send) = P(receive) + [(-3.92\times10^{-3}) * P(receive) + (1.0393\times10^{-4}) * P(receive)^2 + 4]$$

where:

P(send): Power in megawatts (MW) measured at the sending end,

P(receive): Power in MW measured at the receiving end.

The model is limited from 40 MW to 630 MW. When the model falls below 40 MW, this is within the ±50 MW ‘no-go zone’ requirement for Basslink operation.

5.2 Murraylink

Murraylink is a regulated interconnector. In accordance with clause 3.6.1(a) of the Rules, the Murraylink loss model consists of a single dynamic MLF from the Victorian RRN to the South Australian RRN.

The measurement point is the 132 kV connection to the Monash converter, which effectively forms part of the boundary between the Victorian and South Australian regions.

The losses between the Red Cliffs 220 kV and Monash 132 kV connection points are given by the following equation:

$$Losses = (0.0039 * Flow_t + 2.8177 * 10^{-4} * Flow_t^2)$$

AEMO determined the following Murraylink MLF model using regression analysis:

$$Murraylink\ MLF\ (Torrens\ Island\ 66\ referred\ to\ Thomastown\ 66)\ 0.9505 + 1.4168E\text{-}03 * Flow_t$$

This model, consisting of a constant and a Murraylink flow coefficient, is suitable because most of the loss is due to variations in the Murraylink flow, and other potential variables do not improve the model.

The regression statistics for this Murraylink loss factor model are presented in the following table:

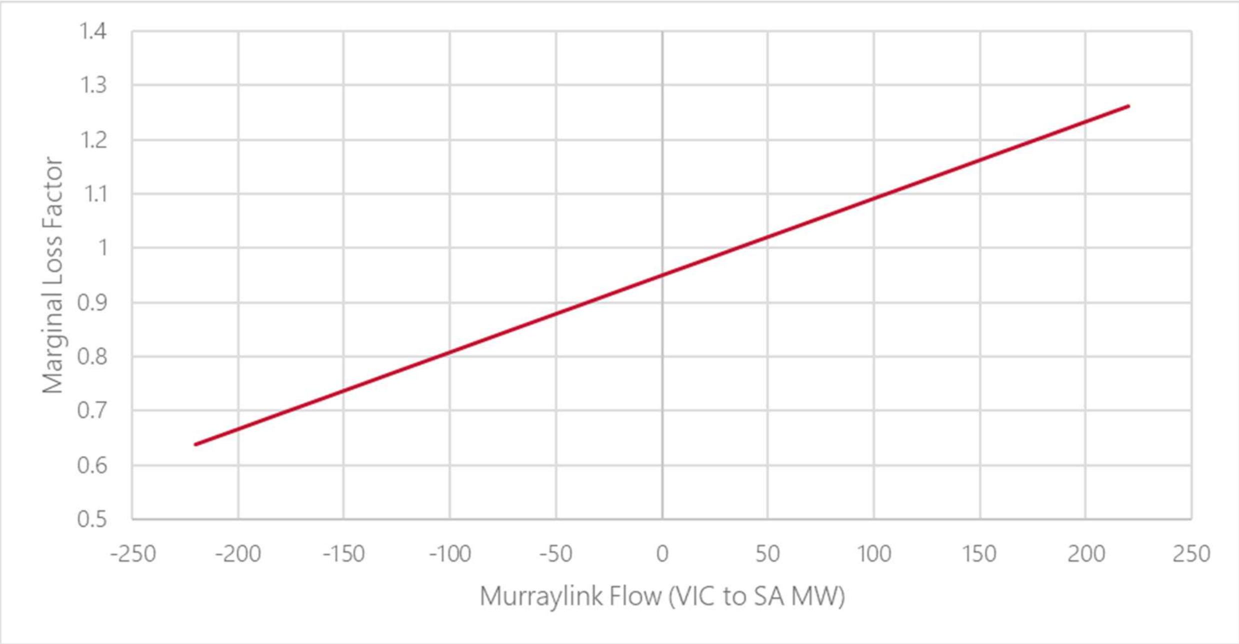
Table 22 Regression statistics for Murraylink

Coefficient	Murraylink flow	Constant
Coefficient Value	1.4168E-03	0.9505

The loss model for a regulated Murraylink interconnector can be determined by integrating (MLF-1), giving:

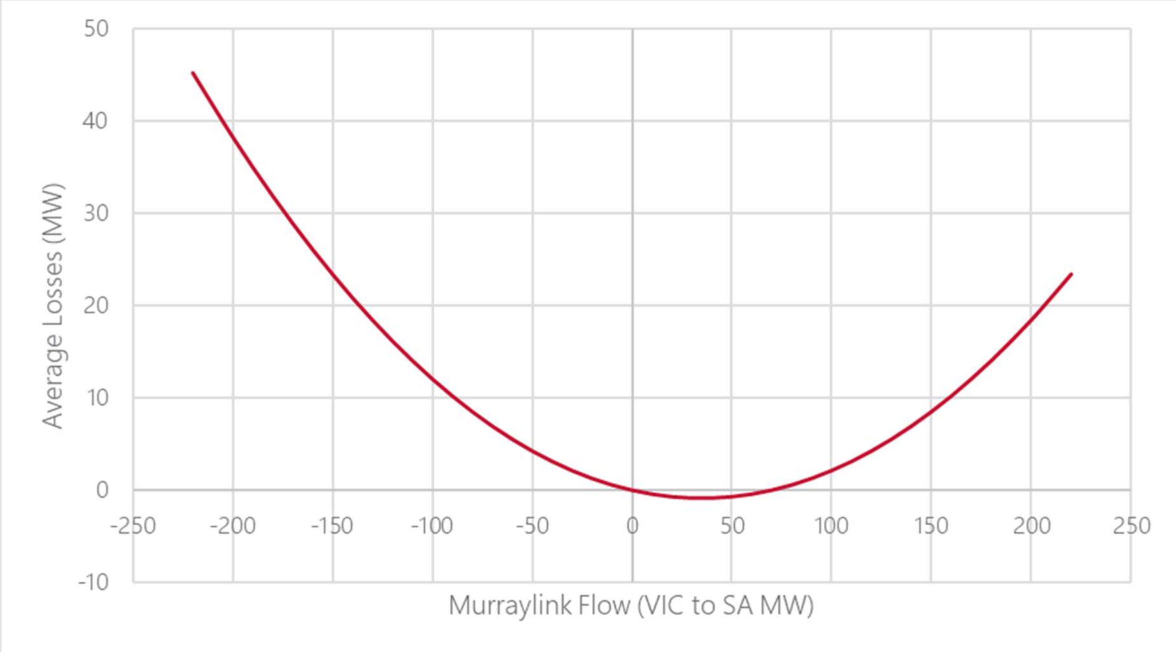
$$Murraylink\ loss = -0.0495 * Flow_t + 7.0840E\text{-}04 * (Flow_t)^2$$

Figure 14 Murraylink MLF (Torrens Island 66 referred to Thomastown 66)



Torrens Island 66 referred to Thomastown 66 versus Murraylink interconnector flow (Victoria to South Australia).

Figure 15 Average losses for Murraylink interconnector (Torrens Island 66 referred to Thomastown 66)



Murraylink notional link losses versus Murraylink flow (Victoria to South Australia).

5.3 Terranora

Terranora is a regulated interconnector. In accordance with clause 3.6.1(a) of the Rules, the Terranora loss model consists of a single dynamic MLF from the New South Wales RRN to the Queensland RRN.

The measurement point is 10.8 km north from Terranora on the two 110 kV lines between Terranora and Mudgeeraba, which effectively forms part of the boundary between the New South Wales and Queensland regions.

The losses between the Mullumbimby 132 kV and Terranora 110 kV connection points are given by the following equation:

$$Losses = (-0.0013 * Flow_t + 2.7372 * 10^{-4} * Flow_t^2)$$

AEMO determined the following Terranora MLF model using regression analysis:

Terranora interconnector MLF (South Pine 275 referred to Sydney West 330)

$$= 1.0518 + 3.0754E\text{-}03 * Flow_t$$

This model consisting of a constant and a Terranora flow coefficient is suitable because most of the loss is due to variations in the Terranora flow and other potential variables do not improve the model.

The regression statistics for this Terranora loss factor model are presented in the following table:

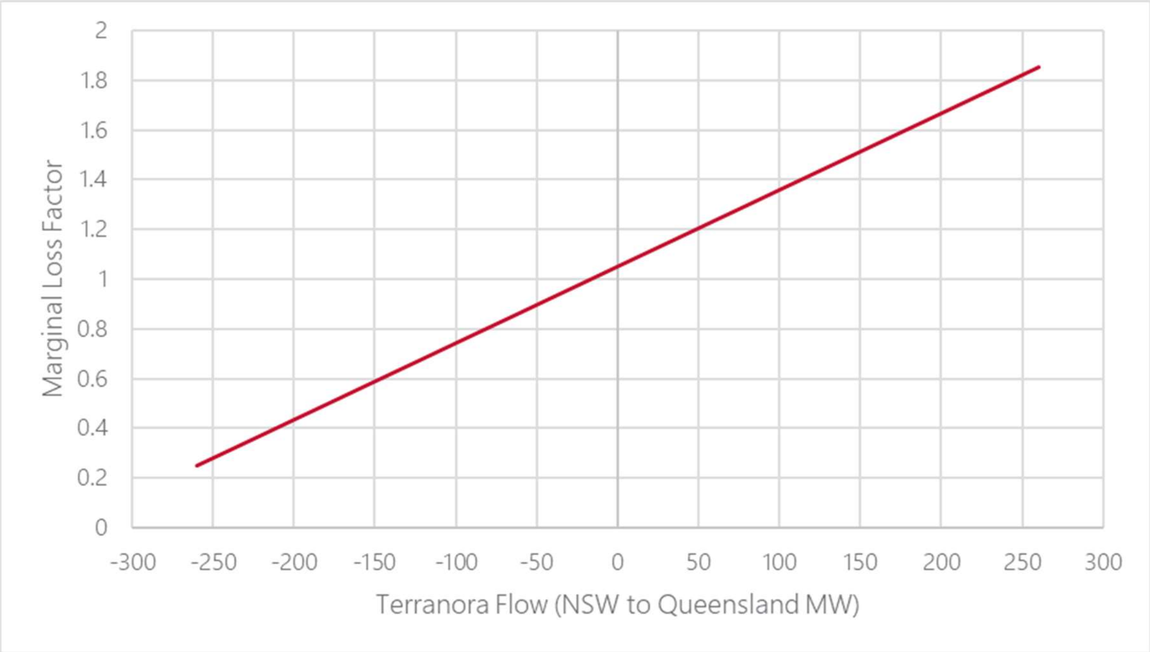
Table 23 Regression statistics for Terranora

Coefficient	Terranora Flow	Constant
Coefficient Value	3.0754E-03	1.0518

The loss model for a regulated Terranora interconnector can be determined by integrating (MLF-1), giving:

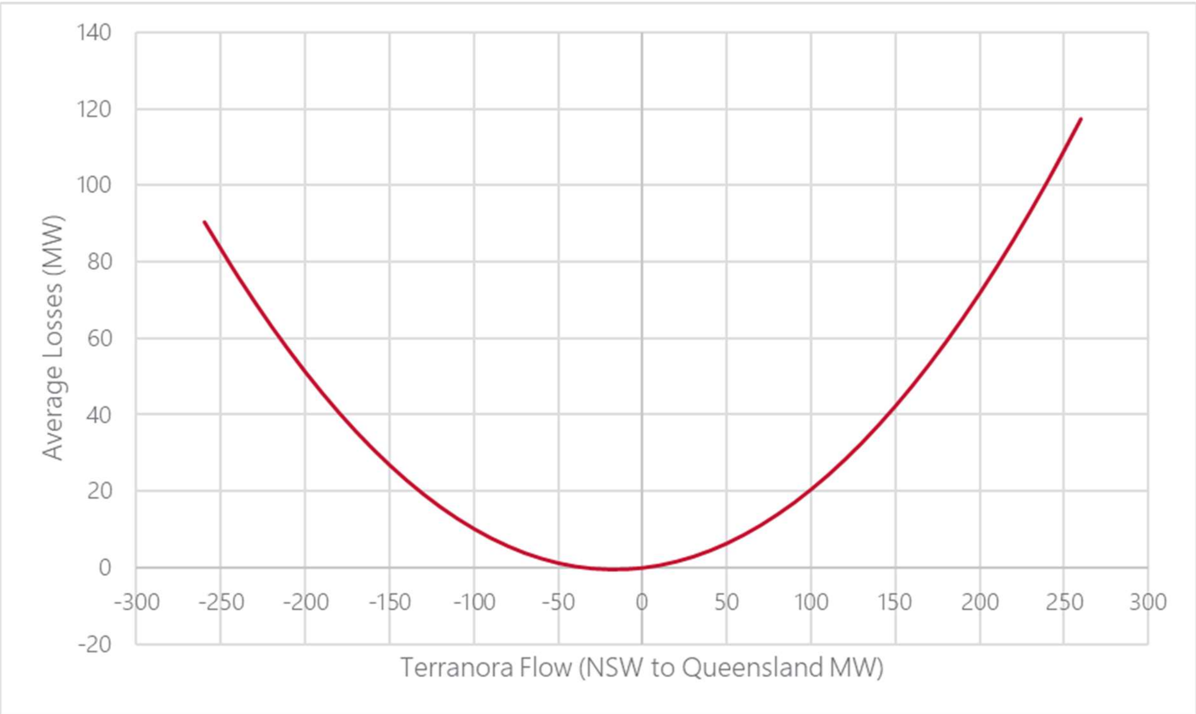
$$\text{Terranora loss} = 0.0518*\text{Flow}_t + 1.5377\text{E-03}*(\text{Flow}_t)^2$$

Figure 16 Terranora interconnector MLF (South Pine 275 referred to Sydney West 330)



South Pine 275 referred to Sydney West 330 MLF versus Terranora interconnector flow (New South Wales to Queensland).

Figure 17 Average losses for Terranora interconnector (South Pine 275 referred to Sydney West 330)



Terranora interconnector notional link losses versus flow (New South Wales to Queensland)

6 Proportioning of inter-regional losses to regions

This section details how the inter-regional losses are proportioned by the National Electricity Market Dispatch Engine (NEMDE).

NEMDE implements inter-regional loss factors by allocating the inter-regional losses to the two regions associated with a notional interconnector.

The proportioning factors are used to portion the inter-regional losses to two regions by an increment of load at one RRN from the second RRN. The incremental changes to the inter-regional losses in each region are found from changes to interconnector flow and additional generation at the second RRN.

The average proportion of inter-regional losses in each region constitutes a single static loss factor.

The following table provides the factors used to portion inter-regional losses to the associated regions for the 2021-22 financial year:

Table 24 Factors for inter-regional losses

Notional interconnector	Proportioning factor	Applied to
Queensland – New South Wales (QNI)	0.5275	New South Wales
Queensland – New South Wales (Terranora Interconnector)	0.5297	New South Wales
Victoria – New South Wales	0.3438	Victoria
Victoria – South Australia (Heywood)	0.6571	Victoria
Victoria – South Australia (Murraylink)	0.7231	Victoria

7 Regions and regional reference nodes

This section describes the NEM regions, the RRN for each region and regional boundaries.

7.1 Regions and regional reference nodes

Table 25 Regions and regional reference nodes

Region	Regional Reference Node
Queensland	South Pine 275kV node
New South Wales	Sydney West 330kV node
Victoria	Thomastown 66kV node
South Australia	Torrens Island PS 66kV node
Tasmania	George Town 220 kV node

7.2 Region boundaries

Physical metering points defining the region boundaries are at the following locations.

7.2.1 Between the Queensland and New South Wales regions

- At Dumaresq Substation on the 8L and 8M Dumaresq to Bulli Creek 330kV lines7.
- 10.8 km north of Terranora on the two 110kV lines between Terranora and Mudgeeraba (lines 757 & 758). Metering at Mudgeeraba adjusted for that point.

7.2.2 Between the New South Wales and Victoria regions

- At Wodonga Terminal Station (WOTS) on the 060 Wodonga to Jindera 330kV line.
- At Red Cliffs Terminal Station (RCTS) on the Red Cliffs to Buronga 220kV line.
- At Murray Switching Station on the MSS to UTSS 330kV lines.
- At Murray Switching Station on the MSS to LTSS 330kV line.
- At Guthega Switching Station on the Guthega to Jindabyne PS 132kV line.
- At Guthega Switching Station on the Guthega to Geehi Dam Tee 132kV line.

7.2.3 Between the Victoria and South Australia regions

- At South East Switching Station (SESS) on the SESS to Heywood 275kV lines.
- At Monash Switching Station (MSS) on the Berri (Murraylink) converter 132kV line.

[7] The metering at Dumaresq is internally scaled to produce an equivalent flow at the New South Wales/Queensland State borders.

7.2.4 Between the Victoria and Tasmania regions

Basslink is not a regulated interconnector, it has the following metering points:

- At Loy Yang 500 kV PS.
- At George Town 220 kV Switching Station.

8 Virtual transmission nodes

This section describes the configuration of the different virtual transmission nodes (VTNs), that have been advised to AEMO at time of publication.

VTNs are aggregations of transmission nodes for which a single MLF is applied. AEMO has considered the following VTNs which have been approved by the Australian Energy Regulator (AER).

8.1 New South Wales virtual transmission nodes

Table 26 New South Wales virtual transmission nodes

VTN TNI code	Description	Associated transmission connection points (TCPs)
NEV1	Far North	Muswellbrook 132 and Liddell 33
NEV2	North of Broken Bay	Brandy Hill 11, Charmhaven 11, Gosford 66, Gosford 33, West Gosford 11, Munmorah STS 33, Lake Munmorah 132, Newcastle 132, Ourimbah 132, Ourimbah 66, Ourimbah 33, Somersby 11, Tomago 132, Tuggerah 132, Vales Point 132, Waratah 132 and Wyong 11
NEV3	South of Broken Bay	Alexandria 33, Beaconsfield North 132, Beaconsfield South 132, Bunnerong 132, Bunnerong 33, Belmore Park 132, Campbell Street 11, Campbell Street 132, Croydon 11, Canterbury 33, Drummoyne 11, Green Square 11, Holroyd 132, Homebush Bay 11, Hurstville North 11, Haymarket 132, Kurnell 132, Kogarah 11, Lane Cove 132, Leichhardt 11, Meadowbank 11, Marrickville 11, Mason Park 132, Peakhurst 33, Pyrmont 132, Pyrmont 33, Macquarie Park 11, Potts Hill 11, Potts Hill 132, Rockdale 11, Rookwood Road 132, Rose Bay 11, Rozelle 33, Rozelle 132, Sydney East 132, Sydney North 132, St Peters 11, Sydney West 132, Sydney South 132, Top Ryde 11, Waverley 11
AAVT	ACT	Angle Crossing 132, Belconnen 132, City East 132, Civic 132, East Lake 132, Gilmore 132, Gold Creek 132, Latham 132, Telopea Park 132, Theodore 132, Wanniassa 132, Woden 132

8.2 South Australia virtual transmission nodes

The SJP1 VTN for South Australia includes all South Australian load transmission connection points, excluding:

- Snuggery Industrial, as nearly its entire capacity services an industrial facility at Millicent.
- Whyalla MLF, as its entire capacity services an industrial plant in Whyalla.

8.3 Tasmania virtual transmission nodes

Table 27 Tasmania virtual transmission nodes

VTN TNI code	Description	Associated transmission connection points (TCPs)
TVN1	Greater Hobart Area	Chapel Street 11, Creek Road 33, Lindisfarne 33, Mornington 33, North Hobart 11, Risdon 33 and Rokeby 11.
TVN2	Tamar Region	Hadspen 22, Mowbray 22, Norwood 22, St Leonards 22, Trevallyn 22, George Town 22

A1. Background to marginal loss factors

This section summarises the method AEMO uses to account for electricity losses in the NEM. It also specifies AEMO's Rules responsibilities related to regions, calculation of MLFs, and calculation of inter-regional loss factor equations.

The NEM uses marginal costs to set electricity prices that need to include pricing of transmission electrical losses.

For electricity transmission, electrical losses are a transport cost that needs to be recovered. A feature of electrical losses is that they also increase with an increase in the electrical power transmitted. That is, the more a transmission line is loaded, the higher the percentage losses. Thus, the price differences between the sending and receiving ends is not determined by the average losses, but by the marginal losses of the last increment of electrical power delivered.

Electrical power in the NEM is traded through the spot market managed by AEMO. The central dispatch process schedules generation to meet demand to maximise the value of trade.

Static MLFs represent intra-regional electrical losses of transporting electricity between a connection point and the RRN. In the dispatch process, generation prices within each region are adjusted by MLFs to determine dispatch of generation.

Dynamic inter-regional loss factor equations calculate losses between regions. Depending on flows between regions, inter-regional losses also adjust the prices in determining generation dispatch to meet demand.

AEMO calculates the Regional Reference Price (RRP) for each region, which is then adjusted by reference to the MLFs between customer connection points and the RRN.

A1.1 Rules requirements

Clause 2A.1.3 of the Rules requires AEMO to establish, maintain, review and publish by 1 April each year a list of regions, RRNs, and the market connection points (represented by TNIs) in each region.

Rule 3.6 of the Rules requires AEMO to calculate the inter-regional loss factor equations (clause 3.6.1) and intra-regional loss factors (MLFs) (clause 3.6.2) by 1 April each year that will apply for the next financial year.

Clauses 3.6.1, 3.6.2 and 3.6.2A specify the requirements for calculating the inter-regional loss factor equations and MLFs, and the data used in the calculation.

The Rules require AEMO to calculate and publish a single, volume-weighted average, intra-regional MLF for each connection point. The Rules also require AEMO to calculate and publish dual MLFs for connection points where one MLF does not satisfactorily represent transmission network losses for active energy generation and consumption.

A1.2 Application of marginal loss factors

Under marginal pricing, the spot price for electricity is the incremental cost of additional generation (or demand reduction) for each spot market trading interval.

Consistent with this, the marginal losses are the incremental increase in total losses for each incremental additional unit of electricity. The MLF of a connection point represents the marginal losses to deliver electricity to that connection point from the RRN.

The tables in Section 1 show the MLFs for each region. The price of electricity at a TNI is the price at the RRN multiplied by the MLF. Depending on network and loading configurations MLFs vary, ranging from below 1.0 to above 1.0.

A1.2.1 Marginal loss factors greater than 1.0

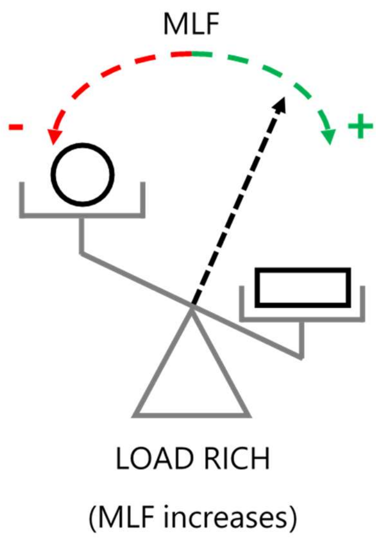
At any instant at a TNI, the marginal value of electricity will equal the cost of generating additional electrical power at the RRN and transmitting it to that point. Any increase or decrease in total losses is then the marginal loss associated with transmitting electricity from the RRN to this TNI. If the marginal loss is positive, less power can be taken from this point than at the RRN, the difference having been lost in the network. In this case, the MLF is above 1.0. This typically applies to loads but would also apply to generation in areas where the local load is greater than the local level of generation.

For example, a generating unit supplying an additional 1 MW at the RRN may find that a customer at a connection point can only receive an additional 0.95 MW. Marginal losses are 0.05 MW, or 5% of generation, resulting in an MLF of 1.05.

Marginal loss factors greater than 1.0 - simplified

Figure 18 shows this effect in a simple manner using a scale as an analogy. While this is an oversimplification of the underlying drivers of MLF outcomes, thinking of changes as being driven by localised shifts in load/generation balance can be a helpful way to understand MLF outcomes. In particular, expanding this thinking to interconnector behaviour where an interconnector exporting can be thought of as ‘load’ and importing as ‘generation’ can help with understanding year-on-year variations in MLF outcomes at connection points in close proximity to interconnectors.

Figure 18 MLFs greater than 1.0 simplified



A1.2.2 Marginal loss factors less than 1.0

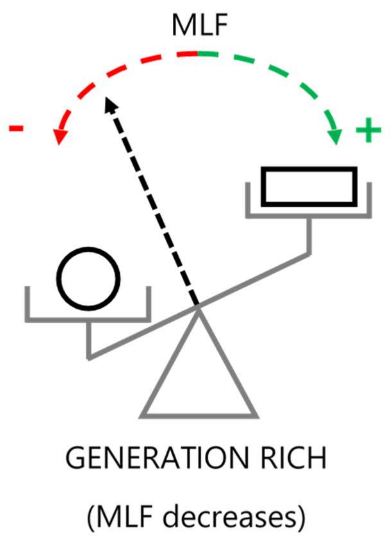
Losses increase with distance, so the greater the distance between the RRN and a connection point, the higher the MLF. However additional line flow only raises total losses if it moves in the same direction as existing net flow. At any instant, when additional flow is against net flow, total network losses are reduced. In this case, the MLF is below 1.0. This typically applies to generation but would also apply to loads in areas where the local generation level is greater than local load.

Using the example above, if net flow is in the direction from the connection point to the RRN, a generating unit at the RRN is only required to supply an additional 0.95 MW to meet an additional load of 1 MW at the connection point. Marginal losses are then -0.05 MW, or 5% reduction in generation, resulting in an MLF of 0.95.

Marginal loss factors less than 1.0 – simplified

Figure 19 shows this effect in a simple manner using a scale as an analogy. While this is an oversimplification of the underlying drivers of MLF outcomes, thinking of changes as being driven by localised shifts in load/generation balance can be a helpful way to understand MLF outcomes. In particular, expanding this thinking to interconnector behaviour where an interconnector exporting can be thought of as 'load' and importing as 'generation' can help with understanding year-on-year variations in MLF outcomes at connection points in close proximity to interconnectors

Figure 19 MLFs less than 1.0 simplified



A1.2.3 Marginal loss factors impact on National Electricity Market settlements

For settlement purposes, the value of electricity purchased or sold at a connection point is multiplied by the connection point MLF. For example:

A **Market Customer** at a connection point with an MLF of 1.05 purchases $1,000 of electricity. The MLF of 1.05 multiplies the purchase value to 1.05 x 1,000 = $1,050. The higher purchase value covers the cost of the electrical losses in transporting electricity to the Market Customer's connection point from the RRN.

A **Market Generator** at a connection point with an MLF of 0.95 sells $1,000 of electricity. The MLF of 0.95 multiplies the sales value to 0.95 x 1,000 = $950. The lower sales value covers the cost of the electrical losses in transporting electricity from the Market Generator's connection point to the RRN.

Therefore, it follows that in the settlements process:

- Higher MLFs tend to advantage, and lower MLFs tend to disadvantage, generation connection points.
- Higher MLFs tend to disadvantage, and lower MLFs tend to advantage, load connection points.

A2. Methodology, inputs, and assumptions

This section outlines the principles underlying the MLF calculation, the load and generation data inputs AEMO obtains and uses for the calculation, and how AEMO checks the quality of this data. It also explains how networks and interconnectors are modelled in the MLF calculation.

A2.1 Forward-looking transmission loss factors calculation methodology

AEMO uses a forward-looking loss factor (FLLF) methodology (Methodology)[8] for calculating MLFs. The Methodology uses the principle of "minimal extrapolation". The high level steps in this Methodology are:

- Develop a load flow model of the transmission network that includes committed augmentations for the year that the MLFs will apply.
- Obtain connection point demand forecasts for the year that the MLFs will apply.
- Estimate the output of committed new generating units.
- Adjust the dispatch of new and existing generating units to restore the supply-demand balance in accordance with section 5.5 of the Methodology.
- Calculate the MLFs using the resulting power flows in the transmission network.

A2.1.1 2020 Methodology review

In 2020, AEMO completed a formal review[9] of the Methodology, with publication of a revised methodology in December 2020. This review focused on several key objectives:

- Clarifying the methodology to better align with current operational practices.
- Incorporating changes into the methodology resulting from the Australian Energy Market Commission's (AEMC's) final determination and rule on Transmission Loss Factors[10].
- Identifying any areas of improvement that can be incorporated into the methodology in the short term.

At a high level the revisions were:

- Further clarification and revision of existing definitions, including consistency with the implementation of Five-Minute Settlement.
- Revised process for forecasting future generation.
- Revised treatment of parallel alternating (AC) and direct current (DC) interconnectors.
- Revised dual MLF threshold.

[8] Forward Looking Transmission Loss Factors (Version 8), at https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/loss_factors_and_regional_boundaries/forward-looking-loss-factor-methodology.pdf?la=en.

[9] Forward-Looking Transmission Loss Factors Consultation: https://aemo.com.au/en/consultations/current-and-closed-consultations/forward-looking-transmission-loss-factors.

[10] AEMC Transmission Loss Factors rule change: https://www.aemc.gov.au/rule-changes/transmission-loss-factors.

- Change to incorporate typical summer capacities for generators.
- Clarifying the approach to reflecting intra-regional limits.

A2.2 Load data requirements for the marginal loss factors calculation

The annual energy targets used in load forecasting for the 2021-22 MLF calculation and the 2020-21 MLF calculation are shown in Table 28.

Table 28 Forecast demand for 2021-22 vs forecast demand for 2020-21

Region	2021-22 forecast operational demand (GWh)[A]	2020-21 forecast operational demand (GWh)[A]
New South Wales	65,567	65,579
Victoria	38,724	41,492
Queensland	50,078	50,940
South Australia	11,264	12,261
Tasmania	10,333	10,234

A. Forecast operational demand sourced from Electricity Statement of Opportunities (ESOO) – 2021-22 is based on ESOO 2020, and 2020-21 is based on ESOO 2019, available at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo

A2.2.1 Historical data accuracy and due diligence of the forecast data

AEMO regularly verifies the accuracy of historical connection point data.

AEMO calculates the losses using this historical data, by adding the summated generation values to the interconnector flow and subtracting the summated load values. These transmission losses are used to verify that no large errors occur in the data.

AEMO also performs due diligence checks of connection point load traces to ensure:

- The demand forecast is consistent with the latest updated Electricity Statement of Opportunities (ESOO).
- Load profiles are reasonable, and that the drivers for load profiles that have changed from the historical data are identifiable.
- The forecast for connection points includes any relevant embedded generation.
- Industrial and auxiliary type loads are not scaled with residential drivers.

A2.3 Generation data requirements for marginal loss factors calculation

AEMO obtains historical real power (MW) and reactive power (megavolt amperes reactive [MVAr]) data for each trading interval (half-hour) covering every generation connection point in the NEM from 1 July 2019 to 30 June 2020 from its settlements database. AEMO also obtains the following data:

- Generation capacity data from Generation Information Page published in January 2021[11].
- Historical generation availability, as well as on-line and off-line status data from AEMO's Electricity Market Management System (EMMS).

[11] At https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.

- Future generation availability based on most recent Medium Term Projected Assessment of System Adequacy (MT PASA) data, as of 1 January 2021[12], as a trigger for initiating discussions with participants with the potential to use an adjusted generation profile for the loss factor calculation.

A2.3.1 New generating units

The new generation included is taken from the Generation Information Page as published on 29 January 2021. Projects listed as committed (Committed/Committed*) and with a target commercial operation date that implies generation within the target year are included. These generating systems are incorporated into the network model and forecast generation profiles are created.

For new solar and wind projects, AEMO created half-hourly profiles based on nameplate capacity and the Full Commercial Use Date detailed on the Generation Information Page, using the reference year 2019-20 weather data. Default hold point schedules were applied to these profiles prior to their full commercial operating date. In general, the following default hold point schedules were applied (noting that these may change subject to plant and network considerations):

- Wind farms – linear ramp of capacity for nine months.
- Solar farms:
  - Cap of 33.3% of maximum capacity for four weeks.
  - Cap of 66.6% of maximum capacity for four weeks.
  - 100% thereafter.

Relevant proponents for each project were consulted during the process to provide feedback or propose their own generation profile. Where applicable, adjustments based on the feedback received were made or the proponent modelled profiles were implemented where deemed appropriate.

For new thermal generation, the relevant proponents were requested to provide forecasts. For new storage projects, the relevant proponents were requested to provide forecasts; where forecasts were not provided, the data utilised has been based on historical data.

The following committed but not yet registered generation was included in the modelling, but AEMO does not publish MLFs for connections that are not yet registered.

Queensland new generating units

- Kennedy Energy Park Battery.
- Kennedy Energy Park Solar Farm.
- Kennedy Energy Park Wind Farm.
- Gangarri Solar Farm.
- Western Downs Green Power Hub.

[12] At https://www.aemo.com.au/energy-systems/electricity/wholesale-electricity-market-wem/data-wem/projected-assessment-of-system-adequacy-pasa/medium-term-pasa-reports.

New South Wales and ACT new generating units

- Bango 999 Wind Farm.
- Junee Solar Farm.
- Sebastopol Solar Farm.
- Wagga North Solar Farm.

Victoria new generating units

- Murra Warra Wind Farm - stage 2.
- Stockyard Hill Wind Farm.
- Victorian Big Battery.
- Winton Solar Farm.

South Australia new generating units

- Port Augusta Renewable Energy Park – Solar.
- Port Augusta Renewable Energy Park – Wind.

Tasmania new generating units

- None.

A2.3.2 Registered unit forecasts

AEMO created half-hourly profiles for registered solar and wind projects that did not operate at full capacity for the entire reference year or where historical generation data does not represent generation in the target year (i.e. due to unit specific constraints). Forecast generation profiles for registered units are modelled using the reference year 2019-20 weather data and the registered maximum capacity for the project. Where applicable, profiles were adjusted for the current year 2020-21 distribution loss factor (DLF), provided it was lower than 0.99. Historical data from the reference year was incorporated into the profile where available.

Relevant proponents for each project were consulted during the process to provide feedback or propose their own generation profile. Where applicable, adjustments based on the feedback received were made or the proponent modelled profiles were implemented where deemed appropriate.

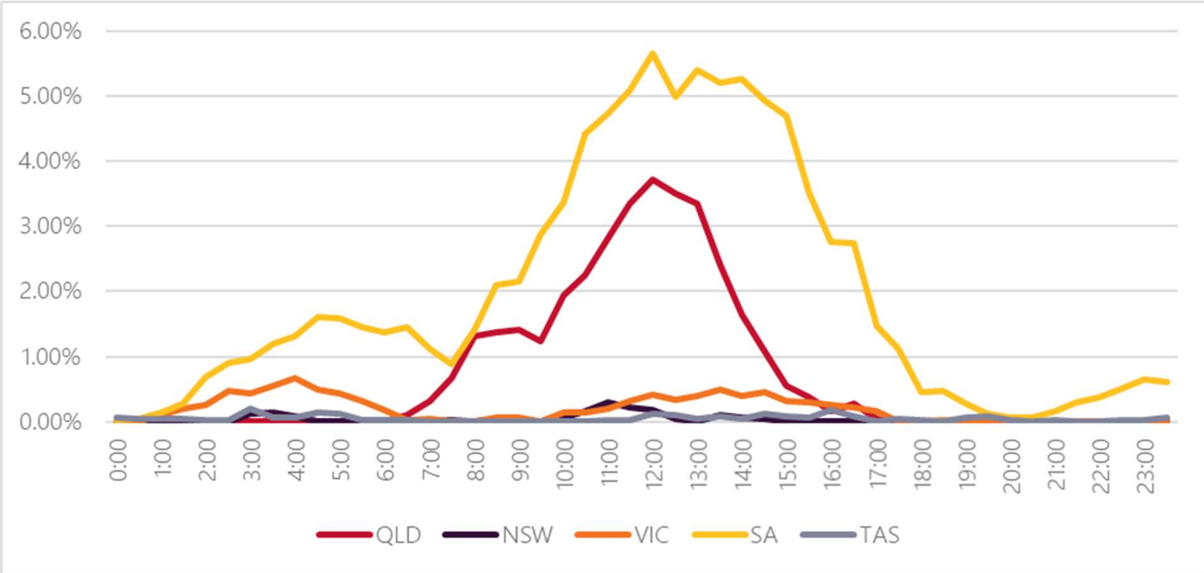
For registered thermal and storage projects where not operational at full capacity for the entire reference year, relevant proponents were requested to provide forecasts. Where forecasts were not provided, the data utilised has been based on historical data.

A2.3.3 Economic curtailment

Economic curtailment was factored into the solar and wind forecast generation profiles, this was performed to ensure that the impact of economic curtailment of historical generation was also considered and reflected when producing forecasts of future generation. The intention is not for this process to replace the supply-demand balancing process (minimal extrapolation theory), but to ensure equality between historical and forecast generation data inputs.

AEMO calculated the time of day average curtailment by region for the reference year 2019-20. Forecast generation profiles were reduced by the time of day percentage of curtailment for the appropriate region. Where historical data was incorporated in the profile, the historical data was not adjusted.

Figure 20 Time of day average economic curtailment for 2019-20



A2.3.4 Abnormal generation patterns

AEMO replaced a number of historical generation profiles with adjusted profiles as an input to the 2021-22 MLF calculation process.

In accordance with section 5.5.7 of the Methodology, AEMO used adjusted generation profiles based on verifiable information, where it was satisfied that the reference year profile was clearly unrepresentative of the expected generation for 2021-22. Historical generation patterns were adjusted to backfill historical outages and incorporate future outages identified through MT PASA data submitted as of 1 January 2021. This was performed where outages longer than 30 days have been identified, and only if deemed practicable. For example, highly variable sources of generation such as ‘peakers’ would not be backfilled due to the inconsistent nature of the generation.

A2.4 Intra-regional limit management

When performing MLF calculations, AEMO has identified several high impact system normal intra-regional limits that are likely to have a material impact on MLFs for the target year. To minimise deviations between the MLF calculations and actual market outcomes, AEMO incorporated these limits by reducing local generation levels to ensure the limits are not exceeded.

Constraints were incorporated into the 2021-22 FLLF study using the approaches discussed below.

Limiting total output from relevant generators

When the total output of set of generators are defined as a limit the input profiles were reduced on a pro-rata basis (in line with FLLF supply/demand balance theory) to adhere to the limit. The constrained generation profiles are then utilised in the initial FLLF study to obtain results reflective of these limits. The following limits were applied in this way:

- Northwest Victoria voltage collapse limit (simplified to reflect previously invoked V^V_NIL_ARWBBA).
- North Queensland system strength limit[13].

Thermal/transfer Limit

When a thermal or transfer limit on a line or cutset is defined, this limit was first assessed using an unconstrainted study with the relevant line flows being observed. The input profiles of relevant generators (included based on significance of contribution to limit) was reduced on a pro-rata basis (in line with FLLF supply/demand balance theory). The constrained generation profiles are then utilised in a second FLLF study to obtain results reflective of the impact of these limits. The following limits were applied in this way:

- Balranald to Darlington Point voltage collapse limit (N^^N_NIL_3).
- Darlington Point to Wagga Wagga voltage collapse limit (N^^N_NIL_2).
- Waubra to Ballarat transfer limit (V>>V_NIL_9).
- Murray to Dederang transfer limit (V>>V_NIL_1A and V>>V_NIL_1B).

The following limits were assessed, but were not modelled due to the observed impact being negligible or insufficient information:

- Queensland Central to South transfer limit (Q^^NIL_CS).
- Victoria system strength limit.
- South Australia system strength limit[14].
- Wemen to Kerang voltage collapse limit (V^^V_NIL_KGTS)[15].

A2.5 Network representation in the marginal loss factors calculation

An actual network configuration recorded by AEMO’s Energy Management System (EMS) is used to prepare the NEM interconnected power system load flow model for the MLF calculation. This recording is referred to as a ‘snapshot’. AEMO reviews the snapshot and modifies it where necessary to accurately represent all normally connected equipment. AEMO also checks switching arrangements for the Victorian Latrobe Valley’s 220 kilovolt (kV) and 500 kV networks to ensure they reflect normal operating conditions.

AEMO adds relevant network augmentations that will occur in the 2021-22 financial year. The snapshot is thus representative of the 2021-22 normally operating power system.

[13] Based on limit advice available from: https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/congestion-information/nqld-system-strength-constraints.pdf?la=en.

[14] The commissioning of four synchronous condensers in South Australia from April 2021 onwards will potentially increase the level of non-synchronous generation for 2021-22, however AEMO is unable to quantify the impact compared to historical generation using currently available information.

[15] The limit was effective from 18 March 2021, with there being insufficient time to properly assess the impact.

A2.5.1 Network augmentation for 2021-22

Relevant Transmission Network Service Providers (TNSPs) advised of the following network augmentations to be completed in 2021-22.

Queensland network augmentations

Powerlink provided the following list of planned network augmentations in 2021-22 in Queensland:

- Rebuilding CP.01710 Gin Gin substation.
- Decommissioning of CP.01543 Mudgeeraba transformer 3.
- Replacement of CP.02462 Ingham South transformer.
- Decommissioning of OR.02252 Belmont 2T.
- Replacement of CP.02462 Ingham South transformer.
- Decommissioning of OR.02253 Belmont 3T.
- Replacement of CP.02356 Lilyvale transformer 3 and 4.
- Replacement of CP.02463 Dysart transformer.
- Installation of new CP.01561 Strathmore 2nd transformer.
- Retirement of Tarong 275/132kV transformer.
- Replacement of CP.02369 Blackwater - transformer 1 and 2
- Replacement of CP.02371 H010 Bouldercombe - transformer 1 and 2.

New South Wales network augmentations

New South Wales NSPs provided the following list of planned network augmentations in 2021-22 in New South Wales:

- Installation of two new two winding 132/11 kV transformers at North Leppington substation (Western Sydney Airport).
- Uprating P0010055 330 kV Transmission line No. 39 - Line deviation for Western Sydney Airport:
  - North Lepping-Bringelly T 132 kV line.
  - Bringelly Tee- Bringelly 132 kV line.
  - Bringelly Tee- Nepean 132 kV line.
  - Sydney West- North Lepping 132 kV line.
- Ballina transformer – Replacing 2 winding 132/66 kV transformers with 3 winding 132/66/11 kV transformers.
- Updated 132kV line 9RX from Darlington Point to Darlington Point SF.
- Uprating Kempscreek-Macarthur 330 kV line.
- Uprating Macarthur-Avon 330 kV line.
- Uprating 220kV line X3 and X5 from Balranald to Buronga.

- Decommissioning of 132kV line 94W/3 from Nevertire 94W Tee to Nyngan.
- Installation of 132kV line 94W/3 from Nevertire 94W Tee to Nevertire SF.
- Installation of 132kV line 9GX from Nevertire SF to Nyngan.
- Uprating 132kV 99T line from Darlington Point to Coleambally.
- Rookwood Rd txf. re-located to Sydney East– replacing 2-winding 330/132 kV transformers with 3-winding 330/132/11 kV transformers.
- T.2211 Stockdill 330 kV substation.
  - Installation of Stockdill 3-winding transformer.
  - Decommissioning of Canberra 2-winding transformers 2 and 3.
- Reconfiguration of 132 kV Avonlie-Yanco-Uranquinty.
- Crudine Ridge wind farm - substation cut into 132 kV 94M line, Mount Piper - Beryl tees Ilford and Mudgee.
- Installation of new Greenacre 132/11kV zone substation.
- Installation of new Macquarie 132/33kV substation.
- Installation of new Rozelle 33kV switchgear

Victoria network augmentations

AEMO's Victorian Planning Group provided the following list of planned network augmentations in 2021-22 in Victoria:

- SVTS Redevelopment - Replacing the B4 transformer (using RTS B6).
- Transmission augmentation to access renewable energy in western Victoria (1.1: MLTS-TGTS and BATS-TGTS ratings update).
- SVTS redevelopment - replacing B1,2,3 transformers.
- WMTS redevelopment - decommissioning transformer 4, Replacing B1, B2 (new data), B3 transformers.
- ERTS replacement of transformer B3.

South Australia network augmentations

ElectraNet provided the following list of planned network augmentations in 2021-22 in South Australia:

- Uprating 132 kV Riverland line.
- Main Grid System Strength Support – updating 2-winding transformers at Robertstown and Davenport (275/15kV).

Tasmania network augmentations

TasNetworks provided the following list of planned network augmentations in 2021-22 in Tasmania:

- Decommissioning of Waddamana–Bridgewater junction.

A2.5.2 Treatment of Basslink interconnector

Basslink consists of a controllable network element that transfers power between Tasmania and Victoria.

In accordance with sections 5.3.1 and 5.3.2 of the Methodology, AEMO calculates the Basslink connection point MLFs using historical data, adjusted if required to reflect any change in forecast generation in Tasmania. Section 5 outlines the loss model for Basslink.

A2.5.3 Treatment of Terranora interconnector

The Terranora interconnector is a regulated interconnector.

The boundary between Queensland and New South Wales between Terranora and Mudgeeraba is north of Directlink. The Terranora interconnector is in series with Directlink and, in the MLF calculation, AEMO manages the Terranora interconnector limit by varying the Directlink limit when necessary.

For the 2021-22 MLFs, AEMO has implemented a change to the treatment of DC interconnectors in parallel with AC interconnectors. Historically, the behaviour of these DC interconnectors was based on the relationship between the capacities of the two interconnectors. This relationship is now based on historical observations during the reference year rather than the ratio of the capacity ratings.

As Directlink resides entirely within New South Wales, considerations were made for load between Directlink and Terranora to ensure that the intended relationship between the Queensland – New South Wales Interconnector (QNI) and Terranora was achieved.

A2.5.4 Treatment of the Murraylink interconnector

The Murraylink interconnector is a regulated interconnector.

In accordance with section 5.3 of the Methodology, AEMO treats the Murraylink interconnector as a controllable network element in parallel with the regulated Heywood interconnector.

For the 2021-22 MLFs, AEMO has implemented a change to the treatment of DC interconnectors in parallel with AC interconnectors. Historically, the behaviour of these DC interconnectors was based on the relationship between the capacities of the two interconnectors. This relationship is now based on historical observations during the reference year rather than the ratio of the capacity ratings.

In recent times, Murraylink flows have been heavily impacted by constraints which have resulted in an increased trend of Murraylink flow being opposite in direction to Heywood flows. Both N^^N_NIL_2 and N^^N_NIL_3 result in forced westerly flows on Murraylink due to being constrained. Both constraints are high impact and have been identified as being in the top 10 binding constraints in recent monthly constraint reports[16].

As such AEMO is utilising more recent historical data to derive the relationship between Heywood and Murraylink flows. Additionally, as the impact of these constraints is highly diurnal in nature two relationships have been derived. One reflecting historical behaviour between 06:00 and 18:00 (day) and the second between 18:00 and 06:00 (night). These relationships are currently derived from historical data from October 2020 to January 2021 (inclusive).

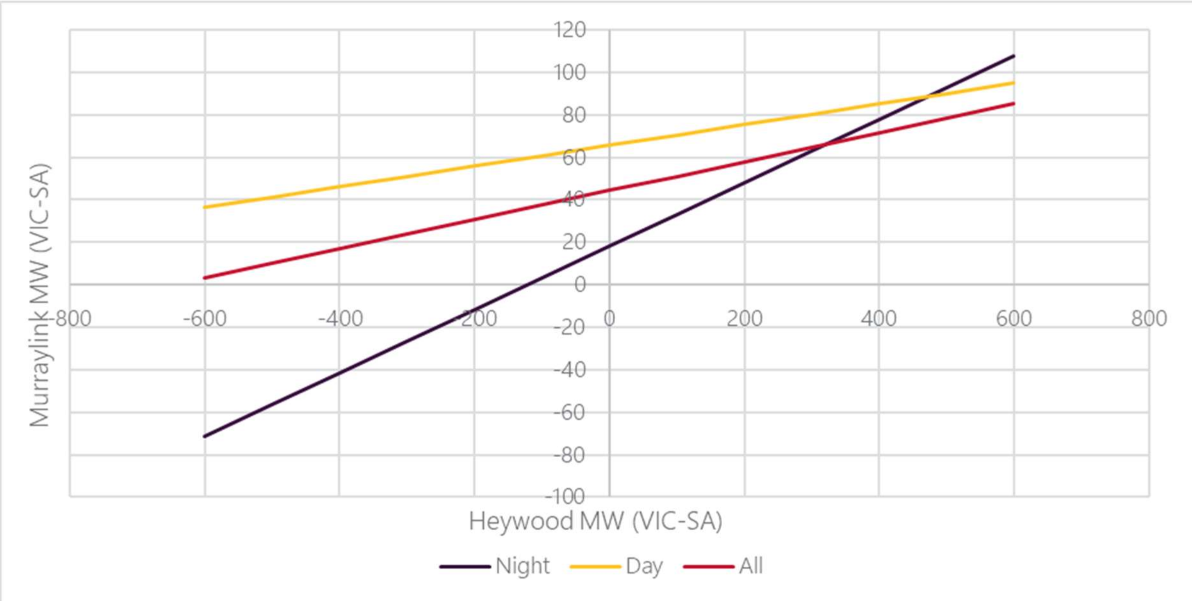
Figure 21 shows the derived relationships for day, night and all. As can be seen, the relationships derived for day and night are substantially different which is as mentioned above largely driven by the diurnal nature of N^^N_NIL_2 and N^^N_NIL_3. During the day, a strong offset can be observed forcing westerly flows on

[16] Monthly constraint reports can be obtained at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource/statistical-reporting-streams.

Murraylink. While the offset overnight also forces westerly flows, it is of a materially lower impact than the day offset.

Given the strength of the diurnal relationship between Heywood and Murraylink flows, AEMO believes the implementation of an average relationship is not appropriate and would likely lead to inappropriate MLF outcomes within close proximity to Murraylink. As such for the 2021-22 MLF study, AEMO has incorporated the day/night relationships shown in Figure 21.

Figure 21 Heywood vs Murraylink Relationship



A2.5.5 Treatment of Yallourn unit 1

Yallourn Power Station Unit 1 can be connected to either the 220 kV or 500 kV network in Victoria. AEMO modelled Yallourn Unit 1 at the two connection points (one at 220 kV and the other one at 500 kV) and calculated loss factors for each connection point. AEMO then calculated a single volume-weighted loss factor for Yallourn Unit 1 based on the individual loss factors at 220 kV and at 500 kV, and the output of the unit.

A2.6 Interconnector capacity

In accordance with section 5.5.4 of the Methodology, AEMO estimates nominal interconnector limits for summer peak, summer off-peak, winter peak and winter off-peak periods. These values are in the table below. AEMO also sought feedback from the relevant TNSPs as to whether there were any additional factors that might influence these limits.

Table 29 Interconnector capacity (MW)

From region	To region	Summer day (MW)[A]	Summer night (MW)[A]	Winter day (MW)[A]	Winter night (MW)[A]
Queensland	NSW[B]	1,078	1,078	1,078	1,078
NSW	Queensland[B]	400	550	400	550
NSW	Victoria[C]	1,700 minus Murray Generation	1,700 minus Murray Generation	1,700 minus Murray Generation	1,700 minus Murray Generation

From region	To region	Summer day (MW)[A]	Summer night (MW)[A]	Winter day (MW)[A]	Winter night (MW)[A]
Victoria	**NSW**	3,200 minus Upper & Lower Tumut Generation	3,000 minus Upper & Lower Tumut Generation	3,200 minus Upper & Lower Tumut Generation	3,000 minus Upper & Lower Tumut Generation
Victoria	**South Australia**	650	650	650	650
South Australia	**Victoria**	550	550	550	550
Victoria (Murraylink)	**South Australia (Murraylink)**	220	220	220	220
South Australia (Murraylink)	**Victoria (Murraylink)**	188 minus Northwest Bend & Berri loads	198 minus Northwest Bend & Berri loads	215 minus Northwest Bend & Berri loads	215 minus Northwest Bend & Berri loads
Queensland (Terranora)	**NSW (Terranora)**	224	224	224	224
NSW (Terranora)	**Queensland (Terranora)**	107	107	107	107
Tasmania (Basslink)	**Victoria (Basslink)[D]**	594	594	594	594
Victoria (Basslink)	**Tasmania (Basslink)**	478	478	478	478

A. The peak interconnector capability does not necessarily correspond to the network capability at the time of the maximum regional demand; it refers to average capability during daytime, which corresponds to 6.00 am to 6.00 pm (AEST) in MLF studies.
B. The "QNI Minor" upgrade is expected to increase the QNI interconnector prior to the 2022-23 summer, however any progressive increases during 2021-22 are not expected to have any material impact on MLF outcomes.
C. MLF studies have indicated that the change in interconnector capacity following the commissioning of the Victoria Big Battery has no material impact on MLF outcomes, as studies do not reflect peak demand conditions and regular strong southerly flows are not projected.
D. Limit referring to the receiving end.

A2.7 Calculation of marginal loss factors

AEMO uses the TPRICE[17] software to calculate MLFs using the following method:

- Convert the half-hourly forecast load and historical generation data, generating unit capacity and availability data together with interconnector data into a format suitable for input to TPRICE.
- Adjust the load flow case to ensure a reasonable voltage profile in each region at times of high demand.
- Convert the load flow case into a format suitable for use in TPRICE.
- Feed into TPRICE, one trading interval at a time, the half-hourly generation and load data for each connection point, generating unit capacity and availability data, with interconnector data. TPRICE allocates the load and generation values to the appropriate connection points in the load flow case.
- TPRICE iteratively dispatches generation to meet forecast demand and solves each half-hourly load flow case subject to the rules in section 5.5.2 of the Methodology, and calculates the loss factors appropriate to the load flow conditions.
- Refer the loss factors at each connection point in each region to the RRN.
- Average the loss factors for each trading interval and for each connection point using volume weighting.

[17] TPRICE is a transmission pricing software package. It is capable of running a large number of consecutive load flow cases quickly. The program outputs loss factors for each trading interval as well as averaged over a financial year using volume weighting.

Typically, the MLF calculation weights generation loss factors against generation output and load loss factors against load consumption. However, where load and generation are connected at the same connection point and individual metering is not available for the separate components, the same loss factor is calculated for both generation and load.

In accordance with section 5.6.1 of the Methodology, AEMO calculates dual MLF values at connection points where one MLF does not satisfactorily represent active power generation and consumption.

A2.7.1 Marginal loss factor calculation quality control

AEMO engaged external consultants to review the quality and accuracy of its MLF calculation process. The consultants performed the following work:

- An independent review of the relevant qualities of AEMO's prepared data inputs to the MLF calculation.
- A verification study using AEMO's input data to the MLF calculation to independently validate AEMO's calculation results. AEMO uses the verification study to ensure that AEMO's MLF calculation methods and results are accurate.

A3. Impact of technology on MLF outcomes

As discussed in Appendix A2.7, MLFs are calculated by simulating power flows on the network for every half-hour, in the next financial year, using forecast supply and demand values. The calculated raw loss factors for each half-hour are then weighted by the volume of energy at the TNI to calculate the MLF for that TNI.

Calculated raw marginal loss factors reflect the supply and demand at each half-hour, and as with supply and demand outcomes can drastically vary. In remote locations with material levels of grid connected PV capacity an increasingly stronger diurnal pattern in half-hourly MLFs is observed due to increased supply and low demand (driven by rooftop PV) during daylight hours. The combination of increased generation and reduced local demand results in the energy produced needing to travel longer distances to supply load resulting in increased losses over the transmission network and lower MLF outcomes for these generators.

While this diurnal volatility in underlying half-hourly MLFs does result in poor outcomes for grid connected PV, it can present potential opportunities for storage technologies which may be able to achieve a delta between load and generation MLFs that will compliment arbitrage behaviour.

As an hypothetical example, Figure 22 shows the time-of-day average raw MLFs and generation (% of capacity) for several technologies, all connected to the same location within the shared transmission network.

Table 30 shows the MLF outcomes for the different technologies shown in Figure 22, as can be seen despite all having the same underlying raw half-hourly MLFs the outcomes vary drastically.

- Solar farm.
  - The solar farm is generating into the middle of the day, when the underlying half-hourly MLFs are low which is reflective of generation at this location needing to travel long distances to serve load during these times. The result is the second lowest MLF outcome, given the lowest MLF outcome is the battery load the solar farm MLF outcome is the least favourable.
- Wind farm.
  - The wind farm weighting tends toward the evening peak, when the underlying half-hourly MLFs are high which is reflective of generation at this location not needing to travel long distances to serve load during these times. The result is the highest MLF outcome of all technologies, which is favourable.
- Battery – generation.
  - The battery is generating into both morning and evening peaks, when the underlying half hourly MLFs are above average which reflective of generation at this location not needing to travel long distances to serve load during these times. The result is the second highest MLF outcome of all technologies, which is favourable.
- Battery – load.
  - The battery is loading into the middle of the day, when the underlying half-hourly MLFs are low which is reflective of generation at this location needing to travel long distances to serve load during these times. As

the battery is increasing local load, this decreases the volume of energy that is required to travel long distances to serve load. The result is the lowest outcome of all technologies, which is favourable.

Figure 22 Time-of-day impact of technology on MLF outcomes

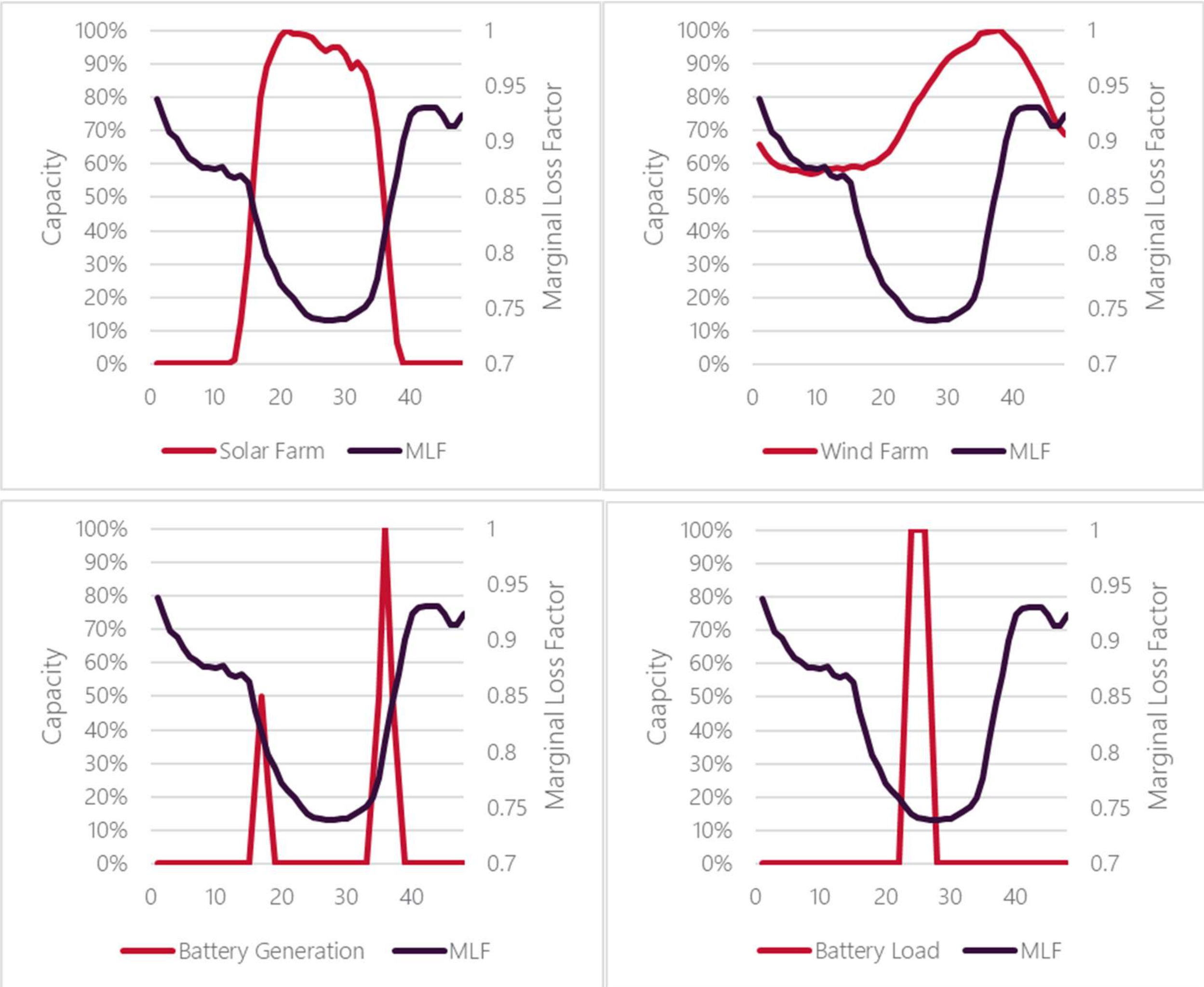


Table 30 Impact of technology on MLF outcomes

Technology	Indicative MLF
Solar farm	0.7657
Wind farm	0.8364
Battery (generation)	0.8130
Battery (load)	0.7431

Glossary

Term	Definition
AC	Alternating current
ACT	Australian Capital Territory
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BESS	Battery Energy Storage System
DC	Direct current
DLF	Distribution Loss Factor
DUID	Dispatchable Unit Identifier
ESOO	Electricity Statement of Opportunities
FLLF	Forward Looking Loss Factor
GWh	Gigawatt-hour
km	Kilometre
kV	Kilovolt
LNG	Liquefied natural gas
MLF	Marginal Loss Factor
Methodology	Forward-looking Loss Factor Methodology
MNSP	Market Network Service Provider
MVAr	Megavolt-ampere
MW	Megawatt
NEM	National Electricity Market
NEMDE	National Electricity Market Dispatch Engine
NSP	Network Service Provider
NSW	New South Wales
PS	Power station
RRN	Regional Reference Node
Rules	National Electricity Rules
ToD	Time of day
TNI	Transmission Node Identifier
TNSP	Transmission Network Service Provider
VTN	Virtual Transmission Node