Regions and Marginal Loss Factors: FY 2020-21

April 2020

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 2020-21 inter-regional loss equations under clause 3.6.1 of the Rules and 2020-21 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.

Explanatory information in this document does not constitute legal or business advice, and should not be relied on as a substitute for obtaining detailed and specific advice about the Law, the Rules, any other applicable laws, procedures or policies or the future development of the National Electricity Market power system.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

COPYRIGHT

VERSION CONTROL

Version	Release date	Changes
1	4/3/2020	Draft 2020-21 MLFs published.
2	1/4/2020	Final 2020-21 MLFs published.

Introduction

This document sets out the 2020-21 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 2020-21 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 2020-21 financial year:

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

Loss factors apply for 2020-21 only, and should not be relied on as an indicator for future years. AEMO continues to work with participants and the Australian Energy Market Commission (AEMC) to identify efficient short-term and longer-term solutions to manage the impact of potentially volatile MLFs in the rapidly changing NEM, in the interests of electricity consumers.

Impact of COVID-19

AEMO has determined MLFs in accordance with the Forward Looking Loss Factor Methodology, using regional and connection point demand forecasts available in February 2020.

The coronavirus disease 2019 (COVID-19) is expected to have significant short term and at this time uncertain longer term impact on electricity demand that will impact the 2020-21 financial year, as a result of changes to consumption patterns and the potential ongoing impact of economic downturn. At the time of determining MLFs, there is significant uncertainty about the magnitude of this impact, and whether it would have a material impact on MLFs. Given the lack of certainty, AEMO considers it appropriate to continue to determine and publish MLFs in accordance with the Forward Looking Loss Factor Methodology and Rules.

As part of a review of the Forward Looking Loss Factor Methodology, AEMO is open to considering more flexible arrangements which can better adapt to significant changes in inputs and assumptions.

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 that applied between 2017/18 the 2019/20 financial years calculated under the current regulatory framework and methodology, particularly in areas of high renewable penetration that are electrically weak and remote from load centres. The changes in MLF between the 2019/20 and 2020/21 financial years are small compared to the preceding years, driven by the smaller changes in generation mix and the emergence of new generation limits.

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

2020 Integrated System Plan (ISP)[1], are critical in the provision of information to participants regarding the needs of, and changes to, the power system.

The AEMC recently made a final rule determination on Transmission Loss Factors[2], which incorporates a number of minor amendments to the framework for loss factors. These changes have not directly impacted the determination of MLFs for 2020-21, but will be incorporated into subsequent determinations following a review of the Forward Looking Loss Factor Methodology.

Improving transparency

AEMO is committed to improving the transparency of MLFs, providing earlier insights that may assist in understanding the potential direction and extent of movement in MLFs year-on-year. This report on 2020-21 MLFs was preceded by an indicative report on November 2019, and a draft report in March 2020. For future periods, AEMO will continue this approach to publishing indicative reports, and will endeavour to publish a report in September and December of the preceding year.

AEMO is also committed to a review of the Forward Looking Loss Factor Methodology, to incorporate changes made in the recent rule determination, but also to address aspects of the methodology that are no longer fit for purpose, and to consider practical improvements to the process.

Quality control

AEMO applied a number of quality assurance steps when calculating the 2020-21 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 Forward Looking Loss Factor 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.

Observations and trends

Changes between the 2019-20 MLFs and the 2020-21 MLFs are mainly due to changes in projected power flow over the transmission network. The key driver for these changes is an increase in projected output from new renewable generation coming online across the NEM, particularly in Victoria, New South Wales, and Queensland.

The main changes in regional MLFs from 2019-20 to 2020-21 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.
- An increase in MLFs at connection points in northern and south-west New South Wales, and a decrease for remaining areas of New South Wales. Generation 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 Victoria, and a decrease in MLFs at connection points for western Victoria. Generation MLFs in north-west Victoria have continued to decline, while load MLFs in this area have increased.
- A decrease in MLFs at connection points in the south-east and Riverland area in South Australia.
- A general decrease in MLFs at connection points in Tasmania.

The impact on MLFs of increased output from new renewable generation has been partially offset by several emerging network limits being identified. 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.

---

[1] At https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp.

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

Contents

Tables

1. Marginal loss factors by region

This section shows the intra-regional loss factors, commonly known as marginal loss factors (MLFs), for financial year 2020-21, for every existing load or generation transmission connection point (identified by TNI) in each NEM region. As required by clause 3.6.2 of the NER, these MLFs have been calculated in accordance with AEMO's published Forward Looking Loss Factor 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 "2020-21 MLF Applicable from 1 July 2020" spreadsheet, which is also published on AEMO's website[3].

1.1 Queensland marginal loss factors

Table 1 Queensland loads

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Abermain	33	QABM	1.0019	1.0027
Abermain	110	QABR	1.0027	1.0043
Alan Sherriff	132	QASF	0.9676	0.9612
Algester	33	QALG	1.0161	1.0164
Alligator Creek	132	QALH	0.9649	0.9560
Alligator Creek	33	QALC	0.9710	0.9641
Ashgrove West	33	QAGW	1.0166	1.0152
Ashgrove West	110	QCBW	1.0142	1.0128
Belmont	110	QBMH	1.0115	1.0121
Belmont Wecker Road	33	QBBS	1.0131	1.0111
Belmont Wecker Road	11	QMOB	1.0125	1.0356
Biloela	66/11	QBIL	0.9141	0.9100
Blackstone	110	QBKS	0.9995	1.0006
Blackwater	66/11	QBWL	0.9618	0.9536
Blackwater	132	QBWH	0.9546	0.9525
Bluff	132	QBLF	0.9570	0.9517
Bolingbroke	132	QBNB	0.9509	0.9456
Bowen North	66	QBNN	0.9492	0.9411
Boyne Island	275	QBOH	0.9490	0.9371
Boyne Island	132	QBOL	0.9463	0.9355

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

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Braemar – Kumbarilla Park	275	QBRE	0.9758	0.9786
Bulli Creek (Essential Energy)	132	QBK2	0.9746	0.9800
Bulli Creek (Waggamba)	132	QBLK	0.9746	0.9800
Bundamba	110	QBDA	1.0016	1.0020
Burton Downs	132	QBUR	0.9618	0.9501
Cairns	22	QCRN	0.9661	0.9581
Cairns City	132	QCNS	0.9581	0.9525
Callemondah (Rail)	132	QCMD	0.9375	0.9263
Calliope River	132	QCAR	0.9351	0.9257
Cardwell	22	QCDW	0.9731	0.9642
Chinchilla	132	QCHA	0.9715	0.9844
Clare	66	QCLR	0.9633	0.9755
Collinsville Load	33	QCOL	0.9433	0.9405
Columboola	132	QCBL	0.9917	0.9879
Columboola 132 (Bellevue LNG load)	132	QCBB	0.9928	0.9909
Coppabella (Rail)	132	QCOP	0.9721	0.9623
Dan Gleeson	66	QDGL	0.9724	0.9628
Dingo (Rail)	132	QDNG	0.9344	0.9417
Duaringa	132	QDRG	0.9376	0.9476
Dysart	66/22	QDYS	0.9728	0.9594
Eagle Downs Mine	132	QEGD	0.9671	0.9555
Edmonton	22	QEMT	0.9791	0.9753
Egans Hill	66	QEGN	0.9228	0.9140
El Arish	22	QELA	0.9833	0.9771
Garbutt	66	QGAR	0.9740	0.9643
Gin Gin	132	QGNG	0.9637	0.9557
Gladstone South	66/11	QGST	0.9426	0.9301
Goodna	33	QGDA	1.0055	1.0059
Goonyella Riverside Mine	132	QGYR	0.9808	0.9697
Grantleigh (Rail)	132	QGRN	0.9358	0.9213
Gregory (Rail)	132	QGRE	0.9353	0.9286
Ingham	66	QING	0.9853	1.0375
Innisfail	22	QINF	0.9788	0.9695
Invicta Load	132	QINV	0.9274	0.9045
Kamerunga	22	QKAM	0.9775	0.9852
Kemmis	66	QEMS	0.9602	0.9631
King Creek	132	QKCK	0.9484	0.9469
Lilyvale	66	QLIL	0.9414	0.9335
Lilyvale (Barcaldine)	132	QLCM	0.9478	0.9658
Loganlea	33	QLGL	1.0148	1.0142
Loganlea	110	QLGH	1.0111	1.0117
Mackay	33	QMKA	0.9603	0.9466
Middle Ridge (Energex)	110	QMRX	0.9821	0.9858

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Middle Ridge (Ergon)	110	QMRG	0.9821	0.9858
Mindi (Rail)	132	QMND	0.9448	0.9372
Molendinar	110	QMAR	1.0120	1.0137
Molendinar	33	QMAL	1.0115	1.0132
Moranbah (Mine)	66	QMRN	0.9842	0.9700
Moranbah (Town)	11	QMRL	0.9624	0.9639
Moranbah South (Rail)	132	QMBS	0.9702	0.9569
Moranbah Substation	132	QMRH	0.9721	0.9592
Moura	66/11	QMRA	0.9349	0.9419
Mt McLaren (Rail)	132	QMTM	0.9688	0.9625
Mudgeeraba	33	QMGL	1.0106	1.0124
Mudgeeraba	110	QMGB	1.0102	1.0121
Murarrie (Belmont)	110	QMRE	1.0124	1.0133
Nebo	11	QNEB	0.9430	0.9346
Newlands	66	QNLD	0.9837	0.9721
North Goonyella	132	QNGY	0.9836	0.9721
Norwich Park (Rail)	132	QNOR	0.9599	0.9464
Oakey	110	QOKT	0.9809	0.9833
Oonooie (Rail)	132	QOON	0.9658	0.9614
Orana LNG	275	QORH	0.9795	0.9805
Palmwoods	132	QPWD	1.0046	1.0021
Pandoin	132	QPAN	0.9251	0.9160
Pandoin	66	QPAL	0.9257	0.9168
Peak Downs (Rail)	132	QPKD	0.9794	0.9671
Pioneer Valley	66	QPIV	0.9676	0.9724
Proserpine	66	QPRO	0.9766	0.9680
Queensland Alumina Ltd (Gladstone South)	132	QQAH	0.9455	0.9337
Queensland Nickel (Yabulu)	132	QQNH	0.9593	0.9515
Raglan	275	QRGL	0.9280	0.9191
Redbank Plains	11	QRPN	1.0057	1.0061
Richlands	33	QRLD	1.0152	1.0155
Rockhampton	66	QROC	0.9291	0.9174
Rocklands (Rail)	132	QRCK	0.9182	0.9103
Rocklea (Archerfield)	110	QRLE	1.0058	1.0059
Ross	132	QROS	0.9650	0.9521
Runcorn	33	QRBS	1.0171	1.0175
South Pine	110	QSPN	1.0048	1.0042
Stony Creek	132	QSYC	0.9594	0.9621
Sumner	110	QSUM	1.0068	1.0072
Tangkam (Dalby) - Dual MLF Generation	110	QTKM	0.9798	0.9848
Tangkam (Dalby) - Dual MLF Load	110	QTKM	0.9843	0.9848
Tarong	66	QTRL	0.9731	0.9756
Teebar Creek	132	QTBC	0.9843	0.9728

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Tennyson	33	QTNS	1.0093	1.0096
Tennyson (Rail)	110	QTNN	1.0079	1.0082
Townsville East	66	QTVE	0.9591	0.9548
Townsville South	66	QTVS	0.9625	0.9599
Townsville South (KZ)	132	QTZS	0.9899	1.0037
Tully	22	QTLL	0.9710	1.0051
Turkinje	66	QTUL	0.9942	0.9846
Turkinje (Craiglie)	132	QTUH	1.0028	0.9867
Wandoan South	132	QWSH	1.0035	0.9977
Wandoan South (NW Surat)	275	QWST	1.0026	0.9966
Wandoo (Rail)	132	QWAN	0.9506	0.9442
Wivenhoe Pump	275	QWIP	0.9969	0.9976
Woolooga (Energex)	132	QWLG	0.9841	0.9769
Woolooga (Ergon)	132	QWLN	0.9841	0.9769
Woree	132	QWRE	0.9677	0.9624
Wotonga (Rail)	132	QWOT	0.9699	0.9590
Wycarbah	132	QWCB	0.9260	0.9137
Yarwun – Boat Creek (Ergon)	132	QYAE	0.9380	0.9269
Yarwun – Rio Tinto	132	QYAR	0.9333	0.9230

Table 2 Queensland generation

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Baking Board Solar Farm (Chinchilla Solar Farm)	132	BAKING1	QCHS1C	QCHS	0.9743	0.9862
Barcaldine PS – Lilyvale	132	BARCALDN	QBCG	QBCG	0.9025	0.8873
Barcaldine Solar at Lilyvale (132)	132	BARCSF1	QLLV1B	QLLV	0.8889	0.8735
Barron Gorge Power Station (PS) Unit 1	132	BARRON-1	QBGH1	QBGH	0.9356	0.9144
Barron Gorge PS Unit 2	132	BARRON-2	QBGH2	QBGH	0.9356	0.9144
Braemar PS Unit 1	275	BRAEMAR1	QBRA1	QBRA	0.9609	0.9702
Braemar PS Unit 2	275	BRAEMAR2	QBRA2	QBRA	0.9609	0.9702
Braemar PS Unit 3	275	BRAEMAR3	QBRA3	QBRA	0.9609	0.9702
Braemar Stage 2 PS Unit 5	275	BRAEMAR5	QBRA5B	QBRA	0.9609	0.9702
Braemar Stage 2 PS Unit 6	275	BRAEMAR6	QBRA6B	QBRA	0.9609	0.9702
Braemar Stage 2 PS Unit 7	275	BRAEMAR7	QBRA7B	QBRA	0.9609	0.9702
Browns Plains Landfill Gas PS	110	BPLANDF1	QLGH3B	QLGH	1.0111	1.0117
Callide A PS Unit 4	132	CALL_A_4	QCAA4	QCAA	0.9066	0.9022
Callide A PS Unit 4 Load	132	CALLNL4	QCAA2	QCAA	0.9066	0.9022
Callide B PS Unit 1	275	CALL_B_1	QCAB1	QCAB	0.9086	0.9050
Callide B PS Unit 2	275	CALL_B_2	QCAB2	QCAB	0.9086	0.9050
Callide C PS Unit 3	275	CPP_3	QCAC3	QCAC	0.9076	0.9025
Callide C PS Unit 4	275	CPP_4	QCAC4	QCAC	0.9076	0.9025
Callide PS Load	132	CALLNL1	QCAX	QCAX	0.9048	0.9024

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Childers Solar Farm	132	CHILDSF1	QTBS1C	QTBS	0.9608	0.9532
Clare Solar Farm	132	CLARESF1	QCLA1C	QCLA	0.8647	0.8596
Clermont Solar Farm	132	CLERMSF1	QLLV3C	QLLV	0.8889	0.8735
Collinsville Solar Farm	33	CSPVPS1	QCOS1C	QCOS	0.8738	0.8585
Columboola – Condamine PS	132	CPSA	QCND1C	QCND	0.9884	0.9888
Coopers Gap Wind Farm	275	COOPGWF1	QCPG1C	QCPG	0.9681	0.9705
Daandine PS - Dual MLF (Generation)	110	DAANDINE	QTKM1	QTKM	0.9798	0.9848
Daandine PS - Dual MLF (Load)	110	DAANDINE	QTKM1	QTKM	0.9843	0.9848
Darling Downs PS	275	DDPS1	QBRA8D	QBRA	0.9609	0.9702
Darling Downs Solar Farm	275	DDSF1	QBRS1D	QBRS	0.9825	0.9822
Daydream Solar Farm	33	DAYDSF1	QCCK1D	QCCK	0.8825	0.8494
Emerald Solar Farm	66	EMERASF1	QLIS1E	QLIS	0.8864	0.8712
German Creek Generator	66	GERMCRK	QLIL2	QLIL	0.9414	0.9335
Gladstone PS (132 kV) Unit 3	132	GSTONE3	QGLD3	QGLL	0.9288	0.9203
Gladstone PS (132 kV) Unit 4	132	GSTONE4	QGLD4	QGLL	0.9288	0.9203
Gladstone PS (132kV) Load	132	GLADNL1	QGLL	QGLL	0.9288	0.9203
Gladstone PS (275 kV) Unit 1	275	GSTONE1	QGLD1	QGLH	0.9285	0.9223
Gladstone PS (275 kV) Unit 2	275	GSTONE2	QGLD2	QGLH	0.9285	0.9223
Gladstone PS (275 kV) Unit 5	275	GSTONE5	QGLD5	QGLH	0.9285	0.9223
Gladstone PS (275 kV) Unit 6	275	GSTONE6	QGLD6	QGLH	0.9285	0.9223
Grosvenor PS At Moranbah 66 No 1	66	GROSV1	QMRN2G	QMRV	0.9696	0.9567
Grosvenor PS At Moranbah 66 No 2	66	GROSV2	QMRV1G	QMRV	0.9696	0.9567
Hamilton Solar Farm	33	HAMISF1	QSLD1H	QSLD	0.8743	0.8573
Haughton Solar Farm	275	HAUGHT11	QHAR1H	QHAR	0.8765	0.8701
Hayman Solar Farm	33	HAYMSF1	QCCK2H	QCCK	0.8825	0.8494
Hughenden Solar Farm	132	HUGSF1	QROG2H	QROG	0.8907	0.8678
Invicta Sugar Mill	132	INVICTA	QINV1I	QINV	0.9274	0.9045
Isis CSM	132	ICSM	QGNG1I	QTBC	0.9843	0.9728
Kareeya PS Unit 1	132	KAREEYA1	QKAH1	QKYH	0.9465	0.9296
Kareeya PS Unit 2	132	KAREEYA2	QKAH2	QKYH	0.9465	0.9296
Kareeya PS Unit 3	132	KAREEYA3	QKAH3	QKYH	0.9465	0.9296
Kareeya PS Unit 4	132	KAREEYA4	QKAH4	QKYH	0.9465	0.9296
Kidston Solar Farm	132	KSP1	QROG1K	QROG	0.8907	0.8678
Kogan Creek PS	275	KPP_1	QBRA4K	QWDN	0.9735	0.9711
Koombooloomba	132	KAREEYA5	QKYH5	QKYH	0.9465	0.9296
Lilyvale Solar Farm	33	LILYSF1	QBDR1L	QBDR	0.8904	0.8692
Longreach Solar Farm	132	LRSF1	QLLV2L	QLLV	0.8889	0.8735
Mackay GT	33	MACKAYGT	QMKG	QMKG	0.8893	0.9062
Maryorough Solar Farm (Brigalow Solar Farm)	110	MARYRSF1	QMRY2M	QMRY	0.9851	0.9872
Millmerran PS Unit 1	330	MPP_1	QBCK1	QMLN	0.9763	0.9797
Millmerran PS Unit 2	330	MPP_2	QBCK2	QMLN	0.9763	0.9797
Moranbah Generation	11	MORANBAH	QMRL1M	QMRL	0.9624	0.9639

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Moranbah North PS	66	MBAHNTH	QMRN1P	QMRN	0.9842	0.9700
Mount Emerald Wind farm	275	MEWF1	QWKM1M	QWKM	0.9550	0.9440
Mt Stuart PS Unit 1	132	MSTUART1	QMSP1	QMSP	0.9229	0.9037
Mt Stuart PS Unit 2	132	MSTUART2	QMSP2	QMSP	0.9229	0.9037
Mt Stuart PS Unit 3	132	MSTUART3	QMSP3M	QMSP	0.9229	0.9037
Oakey 1 Solar Farm	110	OAKEY1SF	QTKS1O	QTKS	0.9783	0.9824
Oakey 2 Solar Farm	110	OAKEY2SF	QTKS2O	QTKS	0.9783	0.9824
Oakey PS Unit 1	110	OAKEY1	QOKY1	QOKY	0.9591	0.9589
Oakey PS Unit 2	110	OAKEY2	QOKY2	QOKY	0.9591	0.9589
Oaky Creek 2	66	OAKY2	QLIL3O	QLIL	0.9414	0.9335
Oaky Creek Generator	66	OAKYCREK	QLIL1	QLIL	0.9414	0.9335
Racecourse Mill PS 1 – 3	66	RACOMIL1	QMKA1R	QPIV	0.9676	0.9724
Rochedale Renewable Energy Plant	110	ROCHEDAL	QBMH2	QBMH	1.0115	1.0121
Rocky Point Gen (Loganlea 110kV)	110	RPCG	QLGH2	QLGH	1.0111	1.0117
Roma PS Unit 7 – Columboola	132	ROMA_7	QRMA7	QRMA	0.9761	0.9759
Roma PS Unit 8 – Columboola	132	ROMA_8	QRMA8	QRMA	0.9761	0.9759
Ross River Solar Farm	132	RRSF1	QROG3R	QROG	0.8907	0.8678
Rugby Run Solar Farm	132	RUGBYR1	QMPL1R	QMPL	0.8886	0.8709
Stanwell PS Load	132	STANNL1	QSTX	QSTX	0.9216	0.9054
Stanwell PS Unit 1	275	STAN-1	QSTN1	QSTN	0.9120	0.9060
Stanwell PS Unit 2	275	STAN-2	QSTN2	QSTN	0.9120	0.9060
Stanwell PS Unit 3	275	STAN-3	QSTN3	QSTN	0.9120	0.9060
Stanwell PS Unit 4	275	STAN-4	QSTN4	QSTN	0.9120	0.9060
Stapylton	110	STAPYLTON1	QLGH4S	QLGH	1.0111	1.0117
Sun Metals Solar Farm	132	SMCSF1	QTZS1S	QTZS	0.9899	1.0037
Sunshine Coast Solar Farm	132	VALDORA1	QPWD1S	QPWD	1.0046	1.0021
Susan River Solar Farm	132	SRSF1	QTBS2S	QTBS	0.9608	0.9532
Swanbank E GT	275	SWAN_E	QSWE	QSWE	0.9997	1.0010
Tarong North PS	275	TNPS1	QTNT	QTNT	0.9720	0.9745
Tarong PS Unit 1	275	TARONG#1	QTRN1	QTRN	0.9721	0.9748
Tarong PS Unit 2	275	TARONG#2	QTRN2	QTRN	0.9721	0.9748
Tarong PS Unit 3	275	TARONG#3	QTRN3	QTRN	0.9721	0.9748
Tarong PS Unit 4	275	TARONG#4	QTRN4	QTRN	0.9721	0.9748
Ti Tree BioReactor	33	TITREE	QABM1T	QABM	1.0019	1.0027
Whitsunday Solar Farm	33	WHITSF1	QSLS1W	QSLS	0.8743	0.8573
Whitwood Rd Renewable Energy Plant	110	WHIT1	QSBK1	QBKS	0.9995	1.0006
Windy Hill Wind Farm	66	WHILL1	QTUL	QTUL	0.9942	0.9846
Wivenhoe Generation Unit 1	275	W/HOE#1	QWIV1	QWIV	0.9919	0.9936
Wivenhoe Generation Unit 2	275	W/HOE#2	QWIV2	QWIV	0.9919	0.9936
Wivenhoe Pump 1	275	PUMP1	QWIP1	QWIP	0.9969	0.9976
Wivenhoe Pump 2	275	PUMP2	QWIP2	QWIP	0.9969	0.9976
Wivenhoe Small Hydro	110	WIVENSH	QABR1	QABR	1.0027	1.0043
Yabulu PS	132	YABULU	QTYP	QTYP	0.9268	0.9156

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Yabulu Steam Turbine (Garbutt 66kV)	66	YABULU2	QGAR1	QYST	0.9196	0.9197
Yarranlea Solar Farm	110	YARANSF1	QMRY1Y	QMRY	0.9851	0.9872
Yarwun PS	132	YARWUN_1	QYAG1R	QYAG	0.9324	0.9225

1.2 New South Wales marginal loss factors[4]

Table 3 New South Wales loads

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Alexandria	33	NALX	1.0031	1.0040
Albury	132	NALB	0.9702	0.9772
Alcan	132	NALC	0.9911	0.9915
Armidale	66	NAR1	0.9671	0.9395
Australian Newsprint Mill	132	NANM	0.9828	0.9817
Balranald	22	NBAL	0.9014	0.9078
Beaconsfield North	132	NBFN	1.0029	1.0034
Beaconsfield South	132	NBFS	1.0030	1.0034
Belmore Park	132	NBM1	1.0031	1.0036
Beresfield	33	NBRF	0.9912	0.9915
Beryl	66	NBER	0.9794	0.9710
BHP (Waratah)	132	NWR1	0.9908	0.9907
Boambee South	132	NWST	0.9946	0.9630
Boggabri East	132	NBGE	1.0117	0.9897
Boggabri North	132	NBGN	1.0109	0.9906
Brandy Hill	11	NBHL	0.9943	0.9940
Broken Hill	22	NBKG	0.8734	0.8538
Broken Hill	220	NBKH	0.8644	0.8349
Bunnerong	132	NBG1	1.0041	1.0032
Bunnerong	33	NBG3	1.0055	1.0056
Buronga	220	NBRG	0.8843	0.8698
Burrinjuck	132	NBU2	0.9825	0.9729
Canterbury	33	NCTB	1.0204	1.0120
Carlingford	132	NCAR	1.0010	1.0010
Casino	132	NCSN	1.0107	0.9599
Charmhaven	11	NCHM	0.9935	0.9949
Chullora	132	NCHU	1.0014	1.0021
Coffs Harbour	66	NCH1	0.9886	0.9592
Coleambally	132	NCLY	0.9561	0.9483
Cooma	66	NCMA	0.9809	0.9797
Cooma (AusNet Services)	66	NCM2	0.9809	0.9797
Croydon	11	NCRD	1.0168	1.0178

[4] 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	2020/21 MLF	2019/20 MLF
Cowra	66	NCW8	1.0009	1.0314
Dapto (Endeavour Energy)	132	NDT1	0.9967	0.9929
Dapto (Essential Energy)	132	NDT2	0.9967	0.9929
Darlington Point	132	NDNT	0.9575	0.9596
Deniliquin	66	NDN7	0.9843	0.9788
Dorrigo	132	NDOR	0.9846	0.9573
Drummoyne	11	NDRM	1.0187	1.0204
Dunoon	132	NDUN	1.0059	0.9676
Far North VTN		NEV1	0.9775	0.9723
Finley	66	NFNY	0.9537	0.9895
Forbes	66	NFB2	1.0148	1.0437
Gadara	132	NGAD	0.9951	0.9827
Glen Innes	66	NGLN	0.9579	0.9205
Gosford	66	NGF3	1.0019	1.0036
Gosford	33	NGSF	1.0026	1.0043
Grafton East 132	132	NGFT	0.9925	0.9608
Green Square	11	NGSQ	1.0054	1.0059
Griffith	33	NGRF	0.9888	0.9757
Gunnedah	66	NGN2	1.0064	0.9866
Haymarket	132	NHYM	1.0031	1.0036
Heron's Creek	132	NHNC	1.0419	1.0120
Holroyd	132	NHLD	1.0024	1.0025
Holroyd (Ausgrid)	132	NHLX	1.0024	1.0025
Hurstville North	11	NHVN	1.0045	1.0040
Homebush Bay	11	NHBB	1.0168	1.0184
Ilford	132	NLFD	0.9754	0.9665
Ingleburn	66	NING	0.9983	0.9973
Inverell	66	NNVL	0.9603	0.9303
Kemps Creek	330	NKCK	0.9949	0.9944
Kempsey	66	NKS2	1.0155	0.9840
Kempsey	33	NKS3	1.0223	0.9934
Koolkhan	66	NKL6	1.0061	0.9738
Kurnell	132	NKN1	1.0017	1.0014
Kogarah	11	NKOG	1.0065	1.0062
Kurri	33	NKU3	0.9912	0.9916
Kurri	11	NKU1	0.9912	0.9915
Kurri	132	NKUR	0.9912	0.9916
Lake Munmorah	132	NMUN	0.9787	0.9880
Lane Cove	132	NLCV	1.0138	1.0151
Leichhardt	11	NLDT	1.0169	1.0173
Liddell	33	NLD3	0.9673	0.9654
Lismore	132	NLS2	1.0432	1.0107
Liverpool	132	NLP1	1.0012	1.0009

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Macarthur	132	NMC1	0.9955	0.9941
Macarthur	66	NMC2	0.9975	0.9957
Macksville	132	NMCV	1.0090	0.9794
Macquarie Park	11	NMQP	1.0184	1.0300
Manildra	132	NMLD	1.0099	1.0252
Marrickville	11	NMKV	1.0078	1.0089
Marulan (Endeavour Energy)	132	NMR1	1.0103	1.0086
Marulan (Essential Energy)	132	NMR2	1.0103	1.0086
Mason Park	132	NMPK	1.0140	1.0154
Meadowbank	11	NMBK	1.0175	1.0192
Molong	132	NMOL	1.0216	1.0275
Moree	66	NMRE	0.9913	0.9714
Morven	132	NMVN	0.9731	0.9740
Mt Piper	66	NMP6	0.9774	0.9729
Mudgee	132	NMDG	0.9817	0.9722
Mullumbimby	11	NML1	1.0073	0.9594
Mullumbimby	132	NMLB	0.9898	0.9559
Munmorah STS 33	33	NMU3	0.9899	0.9906
Munyang	11	NMY1	0.9865	0.9922
Munyang	33	NMYG	0.9865	0.9922
Murrumbateman	132	NMBM	0.9791	0.9793
Murrumburrah	66	NMRU	0.9894	0.9904
Muswellbrook	132	NMRK	0.9784	0.9728
Nambucca Heads	132	NNAM	1.0059	0.9764
Narrabri	66	NNB2	1.0212	1.0030
Newcastle	132	NNEW	0.9907	0.9907
North of Broken Bay VTN		NEV2	0.9932	0.9945
Orange	66	NRGE	1.0376	1.0303
Orange North	132	NONO	1.0364	1.0296
Ourimbah	33	NORB	0.9986	1.0004
Ourimbah	132	NOR1	0.9976	0.9991
Ourimbah	66	NOR6	0.9982	0.9998
Panorama	66	NPMA	1.0229	1.0167
Parkes	66	NPK6	1.0095	1.0385
Parkes	132	NPKS	1.0040	1.0322
Peakhurst	33	NPHT	1.0035	1.0030
Pt Macquarie	33	NPMQ	1.0382	1.0104
Pyrmont	33	NPT3	1.0063	1.0070
Pyrmont	132	NPT1	1.0035	1.0040
Queanbeyan 132	132	NQBY	0.9976	0.9913
Raleigh	132	NRAL	0.9982	0.9722
Regentville	132	NRGV	0.9983	0.9981
Rockdale (Ausgrid)	11	NRKD	1.0056	1.0047

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Rookwood Road	132	NRWR	1.0013	1.0020
Rozelle	132	NRZH	1.0151	1.0174
Rozelle	33	NRZL	1.0154	1.0172
Snowy Adit	132	NSAD	0.9721	0.9767
Somersby	11	NSMB	1.0031	1.0049
South of Broken Bay VTN		NEV3	1.0052	1.0057
St Peters	11	NSPT	1.0063	1.0067
Stroud	132	NSRD	1.0084	1.0042
Sydney East	132	NSE2	1.0058	1.0070
Sydney North (Ausgrid)	132	NSN1	1.0035	1.0045
Sydney North (Endeavour Energy)	132	NSN2	1.0035	1.0045
Sydney South	132	NSYS	1.0009	1.0001
Sydney West (Ausgrid)	132	NSW1	1.0010	1.0010
Sydney West (Endeavour Energy)	132	NSW2	1.0010	1.0010
Tamworth	66	NTA2	0.9760	0.9596
Taree (Essential Energy)	132	NTR2	1.0438	1.0238
Tenterfield	132	NTTF	0.9763	0.9399
Terranora	110	NTNR	1.0056	0.9835
Tomago	330	NTMG	0.9908	0.9910
Tomago (Ausgrid)	132	NTME	0.9926	0.9927
Tomago (Essential Energy)	132	NTMC	0.9926	0.9927
Top Ryde	11	NTPR	1.0163	1.0181
Tuggerah	132	NTG3	0.9940	0.9952
Tumut	66	NTU2	0.9913	0.9840
Tumut 66 (AusNet DNSP)	66	NTUX	0.9913	0.9840
Vales Pt.	132	NVP1	0.9884	0.9902
Vineyard	132	NVYD	0.9997	0.9997
Wagga	66	NWG2	0.9686	0.9740
Wagga North	132	NWGN	0.9754	0.9751
Wagga North	66	NWG6	0.9729	0.9757
Wallerawang (Endeavour Energy)	132	NWW6	0.9776	0.9733
Wallerawang (Essential Energy)	132	NWW5	0.9776	0.9733
Wallerawang 66 (Essential Energy)	66	NWW4	0.9779	0.9740
Wallerawang 66	66	NWW7	0.9779	0.9740
Wallerawang 330 PS Load	330	NWWP	0.9770	0.9737
Wellington	132	NWL8	0.9887	0.9835
West Gosford	11	NGWF	1.0035	1.0055
Williamsdale (Essential Energy) (Bogong)	132	NWD1	0.9795	0.9840
Wyong	11	NWYG	0.9961	0.9977
Yanco	33	NYA3	0.9683	0.9692
Yass	66	NYS6	0.9799	0.9799
Yass	132	NYS1	0.9392	0.9713

Table 4 New South Wales generation

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
AGL Sita Landfill 1	132	AGLSITA1	NLP13K	NLP1	1.0012	1.0009
Appin Power Station	66	APPIN	NAPP1A	NAPP	0.9978	0.9953
Bayswater PS Unit 1	330	BW01	NBAY1	NBAY	0.9625	0.9592
Bayswater PS Unit 2	330	BW02	NBAY2	NBAY	0.9625	0.9592
Bayswater PS Unit 3	500	BW03	NBAY3	NBYW	0.9633	0.9598
Bayswater PS Unit 4	500	BW04	NBAY4	NBYW	0.9633	0.9598
Beryl Solar Farm	66	BERYLSF1	NBES1B	NBES	0.9348	0.9243
Blowering	132	BLOWERNG	NBLW8	NBLW	0.9580	0.9391
Boco Rock Wind Farm	132	BOCORWF1	NCMA3B	NBCO	0.9536	0.9555
Bodangora Wind Farm	132	BODWF1	NBOD1B	NBOD	0.9659	0.9495
Bomen Solar Farm	132	BOMENSF1	NWGS1B	NWGS	0.9417	0.9181
Broadwater PS	132	BWTR1	NLS21B	NLS2	1.0432	1.0107
Broken Hill GT 1	22	GB01	NBKG1	NBKG	0.8734	0.8538
Broken Hill Solar Farm	22	BROKENH1	NBK11B	NBK1	0.7844	0.7566
Brown Mountain	66	BROWNMT	NCMA1	NCMA	0.9809	0.9797
Burrendong Hydro PS	132	BDONGHYD	NWL81B	NWL8	0.9887	0.9835
Burrinjuck PS	132	BURRIN	NBUK	NBUK	0.9848	0.9670
Campbelltown WSLC	66	WESTCBT1	NING1C	NING	0.9983	0.9973
Capital Wind Farm	330	CAPTL_WF	NCWF1R	NCWF	0.9674	0.9701
Coleambally Solar Farm	132	COLEASF1	NCLS1C	NCLS	0.9002	0.8689
Colongra PS Unit 1	330	CG1	NCLG1D	NCLG	0.9819	0.9852
Colongra PS Unit 2	330	CG2	NCLG2D	NCLG	0.9819	0.9852
Colongra PS Unit 3	330	CG3	NCLG3D	NCLG	0.9819	0.9852
Colongra PS Unit 4	330	CG4	NCLG4D	NCLG	0.9819	0.9852
Condong PS	110	CONDONG1	NTNR1C	NTNR	1.0056	0.9835
Copeton Hydro PS	66	COPTNHYD	NNVL1C	NNVL	0.9603	0.9303
Crookwell 2 Wind Farm	330	CROOKWF2	NCKW1C	NCKW	0.9716	0.9742
Cullerin Range Wind Farm	132	CULLRGWF	NYS11C	NYS1	0.9392	0.9713
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	0.9835	0.9836
Eraring 330 PS Unit 1	330	ER01	NEPS1	NEP3	0.9835	0.9836
Eraring 330 PS Unit 2	330	ER02	NEPS2	NEP3	0.9835	0.9836
Eraring 500 PS Unit 3	500	ER03	NEPS3	NEPS	0.9845	0.9845
Eraring 500 PS Unit 4	500	ER04	NEPS4	NEPS	0.9845	0.9845
Eraring PS Load	500	ERNL1	NEPSL	NEPS	0.9845	0.9845
Finley Solar Farm	132	FINLYSF1	NFNS1F	NFNS	0.8800	0.8461
Glenbawn Hydro PS	132	GLBWNHYD	NMRK2G	NMRK	0.9784	0.9728
Glenn Innes (Pindari PS)	66	PINDARI	NGLN1	NGLN	0.9579	0.9205
Glennies Creek PS	132	GLENNCRK	NMRK3T	NMRK	0.9784	0.9728
Grange Avenue	132	GRANGEAV	NVYD1	NVYD	0.9997	0.9997
Griffith Solar Farm	33	GRIFSF1	NGG11G	NGG1	0.9001	0.9063

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Gullen Range Solar Farm	330	GULLRSF1	NGUR2G	NGUR	0.9693	0.9694
Gullen Range Wind Farm	330	GULLRWF1	NGUR1G	NGUR	0.9693	0.9694
Gunning Wind Farm	132	GUNNING1	NYS12A	NYS1	0.9392	0.9713
Guthega	132	GUTHEGA	NGUT8	NGUT	0.9125	0.9016
Guthega Auxiliary Supply	11	GUTHNL1	NMY11	NMY1	0.9865	0.9922
Hume (New South Wales Share)	132	HUMENSW	NHUM	NHUM	0.9471	0.9574
Jindabyne Generator	66	JNDABNE1	NCMA2	NCMA	0.9809	0.9797
Jounama PS	66	JOUNAMA1	NTU21J	NTU2	0.9913	0.9840
Kangaroo Valley – Bendeela (Shoalhaven) Generation – Dual MLF	330	SHGEN	NSHL	NSHN	0.9809	0.9769
Kangaroo Valley (Shoalhaven) Pumps – Dual MLF	330	SHPUMP	NSHP1	NSHN	1.0007	0.9962
Keepit	66	KEEPIT	NKPT	NKPT	1.0064	0.9866
Kincumber Landfill	66	KINCUM1	NGF31K	NGF3	1.0019	1.0036
Liddell 33 – Hunter Valley GTs	33	HVGTS	NLD31	NLD3	0.9673	0.9654
Liddell 330 PS Load	330	LIDDNL1	NLDPL	NLDP	0.9631	0.9593
Liddell 330 PS Unit 1	330	LD01	NLDP1	NLDP	0.9631	0.9593
Liddell 330 PS Unit 2	330	LD02	NLDP2	NLDP	0.9631	0.9593
Liddell 330 PS Unit 3	330	LD03	NLDP3	NLDP	0.9631	0.9593
Liddell 330 PS Unit 4	330	LD04	NLDP4	NLDP	0.9631	0.9593
Limondale Solar Plant 2	22	LIMOSF21	NBL21L	NBL2	0.7926	0.7872
Liverpool 132 (Jacks Gully)	132	JACKSGUL	NLP11	NSW2	1.0010	1.0010
Lower Tumut Generation – dual MLF	330	TUMUT3	NLTS8	NLTS	0.9246	0.9276
Lower Tumut Pipeline Auxiliary	66	TUMT3NL3	NTU2L3	NTU2	0.9913	0.9840
Lower Tumut Pumps – dual MLF	330	SNOWYP	NLTS3	NLTS	0.9942	0.9986
Lower Tumut T2 Auxiliary	66	TUMT3NL1	NTU2L1	NTU2	0.9913	0.9840
Lower Tumut T4 Auxiliary	66	TUMT3NL2	NTU2L2	NTU2	0.9913	0.9840
Lucas Heights II Power Plant	132	LUCASHGT	NSYS2G	NSYS	1.0009	1.0001
Lucas Heights Stage 2 Power Station	132	LUCAS2S2	NSYS1	NSYS	1.0009	1.0001
Manildra Solar Farm	132	MANSLR1	NMLS1M	NMLS	0.9542	0.9818
Moree Solar Farm	66	MOREESF1	NMR41M	NMR4	0.8950	0.8602
Mt Piper PS Load	330	MPNL1	NMPPL	NMTP	0.9745	0.9714
Mt Piper PS Unit 1	330	MP1	NMTP1	NMTP	0.9745	0.9714
Mt Piper PS Unit 2	330	MP2	NMTP2	NMTP	0.9745	0.9714
Narromine Solar Farm	132	NASF1	NWLS1N	NWLS	0.9569	0.9582
Nevertire Solar Farm	132	NEVERSF1	NWLS3N	NWLS	0.9569	0.9582
Nine Willoughby	132	NINEWIL1	NSE21R	NSE2	1.0058	1.0070
Nyngan Solar Farm	132	NYNGAN1	NWL82N	NWL8	0.9887	0.9835
Parkes Solar Farm	66	PARSF1	NPG11P	NPG1	0.9259	0.9812
Sapphire Wind Farm	330	SAPHWF1	NSAP1S	NSAP	0.9553	0.9301
Silverton Wind Farm	220	STWF1	NBKW1S	NBKW	0.8496	0.8298
Sithe (Holroyd Generation)	132	SITHE01	NSYW1	NHD2	1.0025	1.0029
South Keswick Solar Farm	132	SKSF1	NWLS2S	NWLS	0.9569	0.9582
St George Leagues Club	33	STGEORG1	NPHT1E	NPHT	1.0035	1.0030

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Tahmoor PS	132	TAHMOOR1	NLP12T	NLP1	1.0012	1.0009
Tallawarra PS	132	TALWA1	NDT13T	NTWA	0.9913	0.9893
Taralga Wind Farm	132	TARALGA1	NMR22T	NMR2	1.0103	1.0086
Teralba Power Station	132	TERALBA	NNEW1	NNEW	0.9907	0.9907
The Drop Power Station	66	THEDROP1	NFNY1D	NFNY	0.9537	0.9895
Tower Power Plant	132	TOWER	NLP11T	NLP1	1.0012	1.0009
Upper Tumut	330	UPPTUMUT	NUTS8	NUTS	0.9468	0.9514
Uranquinty PS Unit 11	132	URANQ11	NURQ1U	NURQ	0.8570	0.8671
Uranquinty PS Unit 12	132	URANQ12	NURQ2U	NURQ	0.8570	0.8671
Uranquinty PS Unit 13	132	URANQ13	NURQ3U	NURQ	0.8570	0.8671
Uranquinty PS Unit 14	132	URANQ14	NURQ4U	NURQ	0.8570	0.8671
Vales Point 330 PS Load	330	VPNL1	NVPPL	NVPP	0.9857	0.9865
Vales Point 330 PS Unit 5	330	VP5	NVPP5	NVPP	0.9857	0.9865
Vales Point 330 PS Unit 6	330	VP6	NVPP6	NVPP	0.9857	0.9865
West Nowra	132	AGLNOW1	NDT12	NDT1	0.9967	0.9929
Wests Illawara Leagues Club	132	WESTILL1	NDT14E	NDT1	0.9967	0.9929
White Rock Solar Farm	132	WRSF1	NWRK2W	NWRK	0.8801	0.8394
White Rock Wind Farm	132	WRWF1	NWRK1W	NWRK	0.8801	0.8394
Wilga Park A	66	WILGAPK	NNB21W	NNB2	1.0212	1.0030
Wilga Park B	66	WILGB01	NNB22W	NNB2	1.0212	1.0030
Woodlawn Bioreactor	132	WDLNGN01	NMR21W	NMR2	1.0103	1.0086
Woodlawn Wind Farm	330	WOODLWN1	NCWF2W	NCWF	0.9674	0.9701
Woy Woy Landfill	66	WOYWOY1	NGF32W	NGF3	1.0019	1.0036
Wyangala A PS	66	WYANGALA	NCW81A	NCW8	1.0009	1.0314
Wyangala B PS	66	WYANGALB	NCW82B	NCW8	1.0009	1.0314

Table 5 ACT loads

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Angle Crossing	132	AAXG	0.9722	0.9875
Belconnen	132	ABCN	0.9804	0.9797
City East	132	ACTE	0.9839	0.9825
Civic	132	ACVC	0.9823	0.9800
East lake	132	AELK	0.9836	0.9813
Gilmore	132	AGLM	0.9839	0.9800
Gold Creek	132	AGCK	0.9804	0.9793
Latham	132	ALTM	0.9795	0.9788
Telopea Park	132	ATLP	0.9839	0.9821
Theodore	132	ATDR	0.9803	0.9793
Wanniassa	132	AWSA	0.9810	0.9802
Woden	132	AWDN	0.9815	0.9792
ACT VTN	132	AAVT	0.9819	0.9803

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Queanbeyan (ACTEW)	66	AQB1	0.9982	0.9890
Queanbeyan (Essential Energy)	66	AQB2	0.9982	0.9890

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	2020/21 MLF	2019/20 MLF
Capital East Solar Farm	66	CESF1	AQB21C	AQB2	0.9982	0.9890
Mugga Lane Solar Farm	132	MLSP1	ACA12M	AMS1	0.9731	0.9645
Royalla Solar Farm	132	ROYALLA1	ACA11R	ARS1	0.9725	0.9639

The Regional Reference Node (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	2020/21 MLF	2019/20 MLF
Altona	66	VATS	1.0065	1.0033
Altona	220	VAT2	0.9910	0.9944
Ballarat	66	VBAT	0.9711	0.9716
Bendigo	66	VBE6	1.0022	1.0012
Bendigo	22	VBE2	1.0090	1.0025
BHP Western Port	220	VJLA	0.9907	0.9898
Brooklyn (Jemena)	22	VBL2	0.9989	1.0007
Brooklyn (Jemena)	66	VBL6	1.0037	1.0027
Brooklyn (POWERCOR)	22	VBL3	0.9989	1.0007
Brooklyn (POWERCOR)	66	VBL7	1.0037	1.0027
Brunswick (CitiPower)	22	VBT2	0.9976	0.9974
Brunswick (Jemena)	22	VBTS	0.9976	0.9974
Brunswick 66 (CitiPower)	66	VBT6	0.9969	0.9958
Cranbourne	220	VCB2	0.9899	0.9882
Cranbourne (AusNet Services)	66	VCBT	0.9918	0.9911
Cranbourne (United Energy)	66	VCB5	0.9918	0.9911
Deer Park	66	VDPT	0.9982	0.9981
East Rowville (AusNet Services)	66	VER2	0.9948	0.9944
East Rowville (United Energy)	66	VERT	0.9948	0.9944
Fishermens Bend (CITIPOWER)	66	VFBT	0.9993	0.9992
Fishermens Bend (POWERCOR)	66	VFB2	0.9993	0.9992
Fosterville	220	VFVT	1.0041	1.0009
Geelong	66	VGT6	0.9914	0.9908
Glenrowan	66	VGNT	1.0274	1.0188
Heatherton	66	VHTS	0.9967	0.9970
Heywood	22	VHY2	0.9865	0.9889
Horsham	66	VHOT	0.9269	0.9193

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Keilor (Jemena)	66	VKT2	0.9969	0.9987
Keilor (POWERCOR)	66	VKTS	0.9969	0.9987
Kerang	22	VKG2	1.0104	0.9900
Kerang	66	VKG6	1.0096	0.9810
Khancoban	330	NKHN	1.0318	1.0087
Loy Yang Substation	66	VLY6	0.9763	0.9757
Malvern	22	VMT2	0.9946	0.9943
Malvern	66	VMT6	0.9935	0.9932
Morwell Power Station Units 1 to 3	66	VMWG	0.9726	0.9724
Morwell PS (G4&5)	11	VMWP	0.9777	0.9770
Morwell TS	66	VMWT	0.9955	0.9938
Mt Beauty	66	VMBT	1.0235	1.0192
Portland	500	VAPD	0.9913	0.9922
Red Cliffs	22	VRC2	0.9516	0.9237
Red Cliffs	66	VRC6	0.9406	0.9082
Red Cliffs (Essential Energy)	66	VRCA	0.9406	0.9082
Richmond	22	VRT2	0.9969	0.9959
Richmond (CITIPOWER)	66	VRT7	0.9980	0.9972
Richmond (United Energy)	66	VRT6	0.9980	0.9972
Ringwood (AusNet Services)	22	VRW3	0.9978	0.9973
Ringwood (AusNet Services)	66	VRW7	1.0011	1.0003
Ringwood (United Energy)	22	VRW2	0.9978	0.9973
Ringwood (United Energy)	66	VRW6	1.0011	1.0003
Shepparton	66	VSHT	1.0289	1.0203
South Morang (Jemena)	66	VSM6	0.9954	0.9941
South Morang (AusNet Services)	66	VSMT	0.9954	0.9941
Springvale (CITIPOWER)	66	VSVT	0.9984	0.9987
Springvale (United Energy)	66	VSV2	0.9984	0.9987
Templestowe (CITIPOWER)	66	VTS2	0.9991	0.9985
Templestowe (Jemena)	66	VTST	0.9991	0.9985
Templestowe (AusNet Services)	66	VTS3	0.9991	0.9985
Templestowe (United Energy)	66	VTS4	0.9991	0.9985
Terang	66	VTGT	1.0063	1.0019
Thomastown (Jemena)	66	VTTS	1.0000	1.0000
Thomastown (AusNet Services)	66	VTT2	1.0000	1.0000
Tyabb	66	VTBT	0.9921	0.9910
Wemen 66 (Essential Energy)	66	VWEA	0.9345	0.9161
Wemen TS	66	VWET	0.9345	0.9161
West Melbourne	22	VWM2	0.9995	0.9987
West Melbourne (CITIPOWER)	66	VWM7	0.9978	0.9994
West Melbourne (Jemena)	66	VWM6	0.9978	0.9994
Wodonga	22	VWO2	1.0303	1.0164
Wodonga	66	VWO6	1.0263	1.0116

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Yallourn	11	VYP1	0.9581	0.9563

Table 8 Victoria generation

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Ararat Wind Farm	220	ARWF1	VART1A	VART	0.8983	0.9038
Bairnsdale Power Station	66	BDL01	VMWT2	VBDL	0.9899	0.9871
Bairnsdale Power Station Generator Unit 2	66	BDL02	VMWT3	VBDL	0.9899	0.9871
Bald Hills Wind Farm	66	BALDHWF1	VMWT9B	VMWT	0.9955	0.9938
Ballarat BESS - Generation	22	BALBG1	VBA21B	VBA2	0.9643	0.9634
Ballarat BESS - Load	22	BALBL1	VBA22B	VBA2	0.9630	0.9830
Ballarat Health Services	66	BBASEHOS	VBAT1H	VBAT	0.9711	0.9716
Banimboola	220	BAPS	VDPS2	VDPS	0.9854	0.9490
Bannerton Solar Farm	66	BANN1	VWES1B	VWES	0.8096	0.8246
Basslink (Loy Yang Power Station Switchyard) Tasmania to Victoria	500	BLNKVIC	VLYP13	VTBL	0.9620	0.9728
Basslink (Loy Yang Power Station Switchyard) Victoria to Tasmania	500	BLNKVIC	VLYP13	VTBL	0.9620	0.9789
Broadmeadows Power Plant	66	BROADMDW	VTTS2B	VTTS	1.0000	1.0000
Brooklyn Landfill & Recycling Facility	66	BROOKLYN	VBL61	VBL6	1.0037	1.0027
Challicum Hills Wind Farm	66	CHALLHWF	VHOT1	VHOT	0.9269	0.9193
Chepstowe Wind Farm	66	CHPSTWF1	VBAT3C	VBAT	0.9711	0.9716
Clayton Landfill Gas Power Station	66	CLAYTON	VSV21B	VSV2	0.9984	0.9987
Clover PS	66	CLOVER	VMBT1	VMBT	1.0235	1.0192
Codrington Wind Farm	66	CODRNGTON	VTGT2C	VTGT	1.0063	1.0019
Coonooer Bridge Wind Farm	66	CBWF1	VBE61C	VBE6	1.0022	1.0012
Corio LFG PS	66	CORIO1	VGT61C	VGT6	0.9914	0.9908
Crowlands Wind Farm	220	CROWLWF1	VCWL1C	VCWL	0.9026	0.9139
Dartmouth PS	220	DARTM1	VDPS	VDPS	0.9854	0.9490
Dundonnell Wind Farm 1	500	DUNDWF1	VM051D	VM05	0.9790	0.9812
Dundonnell Wind Farm 2	500	DUNDWF2	VM052D	VM05	0.9790	0.9812
Dundonnell Wind Farm 3	500	DUNDWF3	VM053D	VM05	0.9790	0.9812
Eildon Hydro PS	66	EILDON3	VTT22E	VSMT	0.9954	0.9941
Eildon PS Unit 1	220	EILDON1	VEPS1	VEPS	0.9903	0.9859
Eildon PS Unit 2	220	EILDON2	VEPS2	VEPS	0.9903	0.9859
Gannawarra BESS (Generation)	66	GANNBG1	VKGB1G	VKGB	0.9793	0.9643
Gannawarra BESS (Load)	66	GANNBL1	VKGB2G	VKGL	0.9823	1.0191
Gannawarra Solar Farm	66	GANNSF1	VKGS1G	VKGS	0.8863	0.8994
Glenmaggie Hydro PS	66	GLENMAG1	VMWT8G	VMWT	0.9955	0.9938
Hallam Mini Hydro	66	HLMSEW01	VER21H	VER2	0.9948	0.9944
Hallam Road Renewable Energy Facility	66	HALAMRD1	VER22L	VER2	0.9948	0.9944
Hepburn Community Wind Farm	66	HEPWIND1	VBAT2L	VBAT	0.9711	0.9716
Hume (Victorian Share)	66	HUMEV	VHUM	VHUM	0.9833	0.9439

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Jeeralang A PS Unit 1	220	JLA01	VJLGA1	VJLG	0.9734	0.9731
Jeeralang A PS Unit 2	220	JLA02	VJLGA2	VJLG	0.9734	0.9731
Jeeralang A PS Unit 3	220	JLA03	VJLGA3	VJLG	0.9734	0.9731
Jeeralang A PS Unit 4	220	JLA04	VJLGA4	VJLG	0.9734	0.9731
Jeeralang B PS Unit 1	220	JLB01	VJLGB1	VJLG	0.9734	0.9731
Jeeralang B PS Unit 2	220	JLB02	VJLGB2	VJLG	0.9734	0.9731
Jeeralang B PS Unit 3	220	JLB03	VJLGB3	VJLG	0.9734	0.9731
Jindabyne pump at Guthega	132	SNOWYGJP	NGJP	NGJP	1.1231	1.0211
Karadoc Solar Farm	66	KARSF1	VRCS1K	VRCS	0.8045	0.8097
Kiata Wind Farm	66	KIATAWF1	VHOG1K	VHOG	0.8974	0.9066
Laverton PS (LNGS1)	220	LNGS1	VAT21L	VAT2	0.9910	0.9944
Laverton PS (LNGS2)	220	LNGS2	VAT22L	VAT2	0.9910	0.9944
Longford	66	LONGFORD	VMWT6	VMWT	0.9955	0.9938
Loy Yang A PS Load	500	LYNL1	VLYPL	VLYP	0.9760	0.9754
Loy Yang A PS Unit 1	500	LYA1	VLYP1	VLYP	0.9760	0.9754
Loy Yang A PS Unit 2	500	LYA2	VLYP2	VLYP	0.9760	0.9754
Loy Yang A PS Unit 3	500	LYA3	VLYP3	VLYP	0.9760	0.9754
Loy Yang A PS Unit 4	500	LYA4	VLYP4	VLYP	0.9760	0.9754
Loy Yang B PS Unit 1	500	LOYYB1	VLYP5	VLYP	0.9760	0.9754
Loy Yang B PS Unit 2	500	LOYYB2	VLYP6	VLYP	0.9760	0.9754
MacArthur Wind Farm	500	MACARTH1	VTRT1M	VTRT	0.9757	0.9818
Maroona Wind Farm	66	MAROOWF1	VBAT5M	VBAT	0.9711	0.9716
McKay Creek / Bogong PS	220	MCKAY1	VMKP1	VT14	0.9650	0.9618
Mortlake Unit 1	500	MORTLK11	VM0P1O	VM0P	0.9845	0.9852
Mortlake Unit 2	500	MORTLK12	VM0P2O	VM0P	0.9845	0.9852
Mortons Lane Wind Farm	66	MLWF1	VTGT4M	VTGT	1.0063	1.0019
Mt Gellibrand Windfarm	66	MTGELWF1	VGTW1M	VGTW	0.9850	0.9871
Mt Mercer Windfarm	220	MERCER01	VELT1M	VELT	0.9501	0.9650
Murra Warra Wind Farm	220	MUWAWF1	VMRT1M	VMRT	0.8885	0.8885
Murray	330	MURRAY	NMUR8	NMUR	0.9674	0.9539
Murray (Geehi Tee off Auxiliary)	330	MURAYNL3	NMURL3	NMUR	0.9674	0.9539
Murray Power Station M1 Auxiliary	330	MURAYNL1	NMURL1	NMUR	0.9674	0.9539
Murray Power Station M2 Auxiliary	330	MURAYNL2	NMURL2	NMUR	0.9674	0.9539
Newport PS	220	NPS	VNPS	VNPS	0.9914	0.9922
Numurkah Solar Farm	66	NUMURSF1	VSHS1N	VSHS	0.9945	0.9896
Oaklands Hill Wind Farm	66	OAKLAND1	VTGT3A	VTGT	1.0063	1.0019
Rubicon Mountain Streams Station	66	RUBICON	VTT21R	VSMT	0.9954	0.9941
Salt Creek Wind Farm	66	SALTCRK1	VTG61S	VTG6	0.9588	0.9742
Shepparton Waste Gas	66	SHEP1	VSHT2S	VSHT	1.0289	1.0203
Somerton Power Station	66	AGLSOM	VTTS1	VSOM	0.9924	0.9915
Springvale Power Plant	66	SVALE1	VSV22S	VSV2	0.9984	0.9987
Tatura	66	TATURA01	VSHT1	VSHT	1.0289	1.0203
Timboon West Wind Farm	66	TIMWEST	VTGT5T	VTGT	1.0063	1.0019

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Toora Wind Farm	66	TOORAWF	VMWT5	VMWT	0.9955	0.9938
Traralgon NSS	66	TGNSS1	VMWT1T	VMWT	0.9955	0.9938
Valley Power Unit 1	500	VPGS1	VLYP07	VLYP	0.9760	0.9754
Valley Power Unit 2	500	VPGS2	VLYP08	VLYP	0.9760	0.9754
Valley Power Unit 3	500	VPGS3	VLYP09	VLYP	0.9760	0.9754
Valley Power Unit 4	500	VPGS4	VLYP010	VLYP	0.9760	0.9754
Valley Power Unit 5	500	VPGS5	VLYP011	VLYP	0.9760	0.9754
Valley Power Unit 6	500	VPGS6	VLYP012	VLYP	0.9760	0.9754
Waubra Wind Farm	220	WAUBRAWF	VWBT1A	VWBT	0.9228	0.9324
Wemen Solar Farm	66	WEMENSF1	VWES2W	VWES	0.8096	0.8246
West Kiewa PS Unit 1	220	WKIEWA1	VWKP1	VWKP	1.0024	0.9989
West Kiewa PS Unit 2	220	WKIEWA2	VWKP2	VWKP	1.0024	0.9989
William Hovell Hydro PS	66	WILLHOV1	VW061W	VGNT	1.0274	1.0188
Wollert Renewable Energy Facility	66	WOLLERT1	VSMT1W	VSMT	0.9954	0.9941
Wonthaggi Wind Farm	66	WONWP	VMWT7	VMWT	0.9955	0.9938
Yallourn W PS 220 Load	220	YWNL1	VYP2L	VYP2	0.9549	0.9546
Yallourn W PS 220 Unit 1	220	YWPS1	VYP21	VYP3	0.9660	0.9650
Yallourn W PS 220 Unit 2	220	YWPS2	VYP22	VYP2	0.9549	0.9546
Yallourn W PS 220 Unit 3	220	YWPS3	VYP23	VYP2	0.9549	0.9546
Yallourn W PS 220 Unit 4	220	YWPS4	VYP24	VYP2	0.9549	0.9546
Yaloak South Wind Farm	66	YSWF1	VBAT4Y	VBAT	0.9711	0.9716
Yambuk Wind Farm	66	YAMBUKWF	VTGT1	VTGT	1.0063	1.0019
Yarrawonga Hydro PS	66	YWNGAHYD	VSHT3Y	VSHT	1.0289	1.0203
Yawong Wind Farm	66	YAWWF1	VBE62Y	VBE6	1.0022	1.0012
Yendon Wind Farm	66	YENDWF1	VBAW1Y	VBAW	0.9474	0.9612

1.4 South Australia marginal loss factors

Table 9 South Australia loads

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Angas Creek	33	SANC	1.0119	1.0102
Ardrossan West	33	SARW	0.9493	0.9419
Back Callington	11	SBAC	1.0139	1.0137
Baroota	33	SBAR	1.0018	0.9958
Berri	66	SBER	1.0932	1.1277
Berri (POWERCOR)	66	SBE1	1.0932	1.1277
Blanche	33	SBLA	1.0107	1.0285
Blanche (POWERCOR)	33	SBL1	1.0107	1.0285
Brinkworth	33	SBRK	0.9951	0.9941
Bungama Industrial	33	SBUN	0.9908	0.9890
Bungama Rural	33	SBUR	1.0013	0.9976

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
City West	66	SACR	1.0075	1.0076
Clare North	33	SCLN	0.9922	0.9923
Dalrymple	33	SDAL	0.9141	0.9069
Davenport	275	SDAV	0.9940	0.9937
Davenport	33	SDAW	0.9960	0.9957
Dorrien	33	SDRN	1.0068	1.0053
East Terrace	66	SETC	1.0022	1.0024
Happy Valley	66	SHVA	1.0046	1.0053
Hummocks	33	SHUM	0.9663	0.9597
Kadina East	33	SKAD	0.9738	0.9654
Kanmantoo	11	SKAN	1.0141	1.0140
Keith	33	SKET	1.0165	1.0256
Kilburn	66	SKLB	1.0008	0.9998
Kincraig	33	SKNC	1.0093	1.0243
Lefevre	66	SLFE	1.0003	0.9998
Leigh Creek South	33	SLCS	1.0200	1.0604
Magill	66	SMAG	1.0041	1.0046
Mannum	33	SMAN	1.0162	1.0150
Mannum – Adelaide Pipeline 1	3.3	SMA1	1.0209	1.0177
Mannum – Adelaide Pipeline 2	3.3	SMA2	1.0185	1.0156
Mannum – Adelaide Pipeline 3	3.3	SMA3	1.0183	1.0152
Middleback	33	SMDL	1.0116	0.9977
Middleback	132	SMBK	1.0106	0.9957
Millbrook	132	SMLB	1.0041	1.0038
Mobilong	33	SMBL	1.0137	1.0143
Morgan – Whyalla Pipeline 1	3.3	SMW1	1.0360	1.0512
Morgan – Whyalla Pipeline 2	3.3	SMW2	1.0191	1.0284
Morgan – Whyalla Pipeline 3	3.3	SMW3	1.0026	1.0072
Morgan – Whyalla Pipeline 4	3.3	SMW4	0.9944	0.9963
Morphett Vale East	66	SMVE	1.0050	1.0053
Mount Barker South	66	SMBS	1.0061	1.0071
Mt Barker	66	SMBA	1.0053	1.0064
Mt Gambier	33	SMGA	1.0134	1.0316
Mt Gunson South	132	SMGS	1.0124	1.1310
Mt Gunson	33	SMGU	1.0121	1.1148
Munno Para	66	SMUP	1.0000	1.0009
Murray Bridge – Hahndorf Pipeline 1	11	SMH1	1.0158	1.0170
Murray Bridge – Hahndorf Pipeline 2	11	SMH2	1.0172	1.0181
Murray Bridge – Hahndorf Pipeline 3	11	SMH3	1.0150	1.0155
Neuroodla	33	SNEU	1.0102	1.0256
New Osborne	66	SNBN	1.0005	0.9999
North West Bend	66	SNWB	1.0402	1.0531
Northfield	66	SNFD	1.0027	1.0024

Location	Voltage [kV]	TNI code	2020/21 MLF	2019/20 MLF
Para	66	SPAR	1.0016	1.0009
Parafield Gardens West	66	SPGW	1.0012	1.0016
Penola West 33	33	SPEN	1.0016	1.0199
Pimba	132	SPMB	1.0176	1.2248
Playford	132	SPAA	0.9923	0.9929
Port Lincoln	33	SPLN	0.9851	0.9789
Port Pirie	33	SPPR	0.9983	0.9949
Roseworthy	11	SRSW	1.0109	1.0086
Snuggery Industrial - (Generation)	33	SSNN	0.9723	0.9996
Snuggery Industrial – (Load)	33	SSNN	0.9723	1.0150
Snuggery Rural	33	SSNR	0.9859	1.0045
South Australian VTN		SJP1	1.0045	1.0060
Stony Point	11	SSPN	0.9997	0.9985
Tailem Bend	33	STAL	1.0127	1.0161
Templers	33	STEM	1.0048	1.0035
Torrens Island	66	STSY	1.0000	1.0000
Waterloo	33	SWAT	0.9864	0.9854
Whyalla Central Substation	33	SWYC	0.9994	1.0006
Whyalla Terminal BHP	33	SBHP	1.0004	1.0006
Woomera	132	SWMA	1.0169	1.1268
Wudina	66	SWUD	1.0055	0.9936
Yadnarie	66	SYAD	0.9913	0.9806

Table 10 South Australia generation

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Angaston Power Station	33	ANGAST1	SDRN1	SANG	1.0079	0.9517
Barker Inlet PS	275	BARKIPS1	SBPS1B	SBPS	0.9998	0.9998
Bolivar WWT Plant	66	BOLIVAR1	SPGW1B	SPGW	1.0012	1.0016
Bungala One Solar Farm	132	BNGSF1	SBEM1B	SBEM	0.9744	0.9717
Bungala Two Solar Farm	132	BNGSF2	SBEM2B	SBEM	0.9744	0.9717
Canunda Wind Farm	33	CNUNDAWF	SSNN1	SCND	0.9702	0.9881
Cathedral Rocks Wind Farm	132	CATHROCK	SCRK	SCRK	0.9324	0.8858
Clements Gap Wind Farm	132	CLEMGPWF	SCGW1P	SCGW	0.9597	0.9583
Cummins Lonsdale PS	66	LONSDALE	SMVE1	SMVE	1.0050	1.0053
Dalrymple North BESS (Generation)	33	DALNTH01	SDAN1D	SDAM	0.9193	0.9045
Dalrymple North BESS (Load)	33	DALNTHL1	SDAN2D	SDAN	0.9249	0.9990
Dry Creek PS Unit 1	66	DRYCGT1	SDCA1	SDPS	1.0011	0.9971
Dry Creek PS Unit 2	66	DRYCGT2	SDCA2	SDPS	1.0011	0.9971
Dry Creek PS Unit 3	66	DRYCGT3	SDCA3	SDPS	1.0011	0.9971
Hallet 2 Wind Farm	275	HALLWF2	SMOK1H	SMOK	0.9710	0.9770
Hallett 1 Wind Farm	275	HALLWF1	SHPS2W	SHPS	0.9666	0.9748

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Hallett PS	275	AGLHAL	SHPS1	SHPS	0.9666	0.9748
Hornsdale Battery (Generation)	275	HPRG1	SMTL1H	SMTL	0.9817	0.9851
Hornsdale Battery (Load)	275	HPRL1	SMTL2H	SMTL	0.9753	0.9831
Hornsdale Wind Farm Stage 1	275	HDWF1	SHDW1H	SHDW	0.9595	0.9698
Hornsdale Wind Farm Stage 2	275	HDWF2	SHDW2H	SHDW	0.9595	0.9698
Hornsdale Wind Farm Stage 3	275	HDWF3	SHDW3H	SHDW	0.9595	0.9698
Ladbroke Grove PS Unit 1	132	LADBROK1	SPEW1	SPEW	0.9685	0.9831
Ladbroke Grove PS Unit 2	132	LADBROK2	SPEW2	SPEW	0.9685	0.9831
Lake Bonney BESS - Generation	33	LBBG1	SLBB1L	SLBB	0.9741	0.9922
Lake Bonney BESS - Load	33	LBBL1	SLBB2L	SLBB	0.9925	1.0059
Lake Bonney Wind Farm	33	LKBONNY1	SMAY1	SMAY	0.9587	0.9777
Lake Bonney Wind Farm Stage 2	33	LKBONNY2	SMAY2	SMAY	0.9587	0.9777
Lake Bonney Wind Farm Stage 3	33	LKBONNY3	SMAY3W	SMAY	0.9587	0.9777
Lincoln Gap Wind Farm	275	LGAPWF1	SLGW1L	SLGW	0.9779	0.9821
Mintaro PS	132	MINTARO	SMPS	SMPS	0.9907	0.9795
Morphett Vale East 66	66	SATGS1	SMVG1L	SMVG	0.9972	1.0045
Mt Millar Wind Farm	33	MTMILLAR	SMTM1	SMTM	0.9355	0.8935
North Brown Hill Wind Farm	275	NBHWF1	SBEL1A	SBEL	0.9661	0.9728
O.C.P.L. Unit 1	66	OSB-AG	SNBN1	SOCP	0.9998	0.9997
Para 66	66	SATGN1	SPAG1E	SPAG	0.9963	1.0006
Pelican Point PS	275	PPCCGT	SPPT	SPPT	0.9987	0.9989
Port Lincoln 3	33	POR03	SPL31P	SPL3	0.9916	0.9707
Port Lincoln PS	132	POR01	SPLN1	SPTL	0.9886	0.9676
Pt Stanvac PS	66	PTSTAN1	SMVE3P	SMVE	1.0050	1.0053
Quarantine PS Unit 1	66	QPS1	SQPS1	SQPS	0.9854	0.9852
Quarantine PS Unit 2	66	QPS2	SQPS2	SQPS	0.9854	0.9852
Quarantine PS Unit 3	66	QPS3	SQPS3	SQPS	0.9854	0.9852
Quarantine PS Unit 4	66	QPS4	SQPS4	SQPS	0.9854	0.9852
Quarantine PS Unit 5	66	QPS5	SQPS5Q	SQPS	0.9854	0.9852
Snowtown Wind Farm	33	SNOWTWN1	SNWF1T	SNWF	0.9165	0.9095
Snowtown Wind Farm Stage 2 – North	275	SNOWNTH1	SBLWS1	SBLW	0.9717	0.9722
Snowtown Wind Farm Stage 2 – South	275	SNOWSTH1	SBLWS2	SBLW	0.9717	0.9722
Snuggery PS Units 1 to 3	132	SNUG1	SSGA1	SSPS	0.9518	0.9474
Starfish Hill Wind Farm	66	STARHLWF	SMVE2	SMVE	1.0050	1.0053
Tailem Bend Solar Farm	132	TBSF1	STBS1T	STBS	1.0013	1.0054
Tatiara Meat Co	33	TATIARA1	SKET1E	SKET	1.0165	1.0256
The Bluff wind Farm	275	BLUFF1	SBEL2P	SBEL	0.9661	0.9728
Torrens Island PS A Unit 1	275	TORRA1	STSA1	STPS	0.9998	0.9997
Torrens Island PS A Unit 2	275	TORRA2	STSA2	STPS	0.9998	0.9997
Torrens Island PS A Unit 3	275	TORRA3	STSA3	STPS	0.9998	0.9997
Torrens Island PS A Unit 4	275	TORRA4	STSA4	STPS	0.9998	0.9997
Torrens Island PS B Unit 1	275	TORRB1	STSB1	STPS	0.9998	0.9997
Torrens Island PS B Unit 2	275	TORRB2	STSB2	STPS	0.9998	0.9997

Generator	Voltage [kV]	DUID	Connection Point ID	TNI code	2020/21 MLF	2019/20 MLF
Torrens Island PS B Unit 3	275	TORRB3	STSB3	STPS	0.9998	0.9997
Torrens Island PS B Unit 4	275	TORRB4	STSB4	STPS	0.9998	0.9997
Torrens Island PS Load	66	TORNL1	STSYL	STSY	1.0000	1.0000
Waterloo Wind Farm	132	WATERLWF	SWLE1R	SWLE	0.9665	0.9677
Wattle Point Wind Farm	132	WPWF	SSYP1	SSYP	0.8200	0.8125
Willogoleche Wind Farm	275	WGWF1	SWGL1W	SWGL	0.9693	0.9828
Wingfield 1 LFG PS	66	WINGF1_1	SKLB1W	SKLB	1.0008	0.9998
Wingfield 2 LFG PS	66	WINGF2_1	SNBN2W	SNBN	1.0005	0.9999

1.5 Tasmania marginal loss factors

Table 11 Tasmania loads

Location	Voltage (kV)	TNI code	2020-21 MLF	2019-20 MLF
Arthurs Lake	6.6	TAL2	0.9703	0.9902
Avoca	22	TAV2	0.9982	1.0064
Boyer SWA	6.6	TBYA	1.0081	1.0168
Boyer SWB	6.6	TBYB	1.0174	1.0169
Bridgewater	11	TBW2	1.0219	1.0265
Burnie	22	TBU3	0.9786	0.9850
Chapel St.	11	TCS3	1.0085	1.0187
Comalco	220	TCO1	1.0006	1.0006
Creek Road	33	TCR2	1.0092	1.0186
Derby	22	TDE2	0.9527	0.9577
Derwent Bridge	22	TDB2	0.9155	0.9325
Devonport	22	TDP2	0.9824	0.9885
Electrona	11	TEL2	1.0239	1.0308
Emu Bay	11	TEB2	0.9761	0.9815
Fisher (Rowallan)	220	TFI1	0.9587	0.9688
George Town	22	TGT3	1.0018	1.0020
George Town (Basslink)	220	TGT1	1.0000	1.0000
Gordon	22	TGO2	0.9859	0.9984
Greater Hobart Area VTN		TVN1	1.0106	1.0195
Hadspen	22	THA3	0.9893	0.9939
Hampshire	110	THM2	0.9750	0.9798
Huon River	11	THR2	1.0256	1.0259
Kermandie	11	TKE2	1.0310	1.0343
Kingston	33	TK13	1.0145	1.0233
Kingston	11	TKI2	1.0198	1.0258
Knights Road	11	TKR2	1.0265	1.0364
Lindisfarne	33	TLF2	1.0110	1.0202
Meadowbank	22	TMB2	0.9913	0.9828

Location	Voltage (kV)	TNI code	2020-21 MLF	2019-20 MLF
Mornington	33	TMT2	1.0125	1.0224
Mowbray	22	TMY2	0.9885	0.9924
New Norfolk	22	TNN2	1.0043	1.0112
Newton	22	TNT2	0.9633	0.9731
Newton	11	TNT3	0.9454	0.9611
North Hobart	11	TNH2	1.0077	1.0176
Norwood	22	TNW2	0.9873	0.9923
Palmerston	22	TPM3	0.9714	0.9816
Port Latta	22	TPL2	0.9479	0.9573
Que	22	TQU2	0.9746	0.9729
Queenstown	11	TQT3	0.9484	0.9637
Queenstown	22	TQT2	0.9517	0.9639
Railton	22	TRA2	0.9829	0.9894
Risdon	33	TRI4	1.0120	1.0195
Risdon	11	TRI3	1.0142	1.0219
Rokeby	11	TRK2	1.0163	1.0223
Rosebery	44	TRB2	0.9611	0.9733
Savage River	22	TSR2	0.9942	1.0030
Scottsdale	22	TSD2	0.9649	0.9704
Smithton	22	TST2	0.9326	0.9409
Sorell	22	TSO2	1.0306	1.0284
St Leonard	22	TSL2	0.9878	0.9921
St. Marys	22	TSM2	1.0175	1.0224
Starwood	110	TSW1	1.0007	1.0009
Tamar Region VTN		TVN2	0.9899	0.9938
Temco	110	TTE1	0.9998	1.0037
Trevallyn	22	TTR2	0.9891	0.9931
Triabunna	22	TTB2	1.0387	1.0393
Tungatinah	22	TTU2	0.9191	0.9351
Ulverstone	22	TUL2	0.9779	0.9847
Waddamana	22	TWA2	0.9354	0.9465
Wayatinah	11	TWY2	0.9865	0.9958
Wesley Vale	22	TWV2	0.9794	0.9890

Table 12 Tasmania generation

Generator description	Voltage [kV]	DUID	Connection Point ID	TNI code	2020-21 MLF	2019-20 MLF
Basslink (George Town)	220	BLNKTAS	TGT11	TGT1	1.0000	1.0000
Bastyan	220	BASTYAN	TFA11	TFA1	0.9301	0.9456
Bell Bay No.3	110	BBTHREE1	TBB11	TBB1	0.9975	0.9997
Bell Bay No.3	110	BBTHREE2	TBB12	TBB1	0.9975	0.9997
Bell Bay No.3	110	BBTHREE3	TBB13	TBB1	0.9975	0.9997

Generator description	Voltage [kV]	DUID	Connection Point ID	TNI code	2020-21 MLF	2019-20 MLF
Bluff Point and Studland Bay Wind Farms	110	WOOLNTH1	TST11	TST1	0.8777	0.8900
Butlers Gorge	110	BUTLERSG	TBG11	TBG1	0.9101	0.9305
Catagunya	220	LI_WY_CA	TLI11	TLI1	0.9817	0.9936
Cethana	220	CETHANA	TCE11	TCE1	0.9545	0.9658
Cluny	220	CLUNY	TCL11	TCL1	0.9855	0.9961
Devils gate	110	DEVILS_G	TDG11	TDG1	0.9618	0.9698
Fisher	220	FISHER	TFI11	TFI1	0.9587	0.9688
Gordon	220	GORDON	TGO11	TGO1	0.9491	0.9594
Granville Harbour Wind Farm	220	GRANWF1	TGH11G	TGH1	0.9408	0.9590
John Butters	220	JBUTTERS	TJB11	TJB1	0.9230	0.9370
Lake Echo	110	LK_ECHO	TLE11	TLE1	0.9173	0.9257
Lemonthyme	220	LEM_WIL	TSH11	TSH1	0.9626	0.9716
Liapootah	220	LI_WY_CA	TLI11	TLI1	0.9817	0.9936
Mackintosh	110	MACKNTSH	TMA11	TMA1	0.9178	0.9347
Meadowbank	110	MEADOWBK	TMB11	TMB1	0.9773	0.9716
Midlands PS	22	MIDLDPS1	TAV21M	TAV2	0.9982	1.0064
Musselroe	110	MUSSELR1	TDE11M	TDE1	0.9024	0.9060
Paloona	110	PALOONA	TPA11	TPA1	0.9604	0.9702
Poatina	220	POAT220	TPM11	TPM1	0.9715	0.9846
Poatina	110	POAT110	TPM21	TPM2	0.9561	0.9728
Reece No.1	220	REECE1	TRCA1	TRCA	0.9202	0.9410
Reece No.2	220	REECE2	TRCB1	TRCB	0.9183	0.9351
Remount	22	REMOUNT	TMY21	TVN2	0.9899	0.9938
Repulse	220	REPULSE	TCL12	TCL1	0.9855	0.9961
Rowallan	220	ROWALLAN	TFI12	TFI1	0.9587	0.9688
Tamar Valley CCGT	220	TVCC201	TTV11A	TTV1	1.0000	1.0000
Tamar Valley OCGT	110	TVPP104	TBB14A	TBB1	0.9975	0.9997
Tarraleah	110	TARRALEA	TTA11	TTA1	0.9167	0.9363
Trevallyn	110	TREVALLN	TTR11	TTR1	0.9805	0.9889
Tribute	220	TRIBUTE	TTI11	TTI1	0.9183	0.9401
Tungatinah	110	TUNGATIN	TTU11	TTU1	0.8920	0.9065
Wayatinah	220	LI_WY_CA	TLI11	TLI1	0.9817	0.9936
Wild Cattle Hill Wind Farm	220	CTHLWF1	TWC11C	TWC1	0.9850	0.9860
Wilmot	220	LEM_WIL	TSH11	TSH1	0.9626	0.9716

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 regional reference node (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[5].

2.2 Reasons why marginal loss factors change

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

1. 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.
2. 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.

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.

The correlation of the generator output in an area also has a significant bearing on MLFs. If new generation is running at the same times as other nearby generators, then the MLF will decline. Further, if new and existing generation in the area is mainly running at times when there is light load on the network, the decline in MLFs will be even greater. This subject is discussed in further detail in Appendix A3.

[5] 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.

2.3 Changes between 2019-20 MLFs and 2020-21 MLFs

This section summarises the changes in MLFs for 2020-21 compared to the 2019-20 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 2020-21 calculations, and key changes from 2019-20.

2.3.1 Changes to marginal loss factors in Queensland

Figure 1 shows the changes to MLFs at Queensland connection points in the 2020-21 study compared to the previous year.

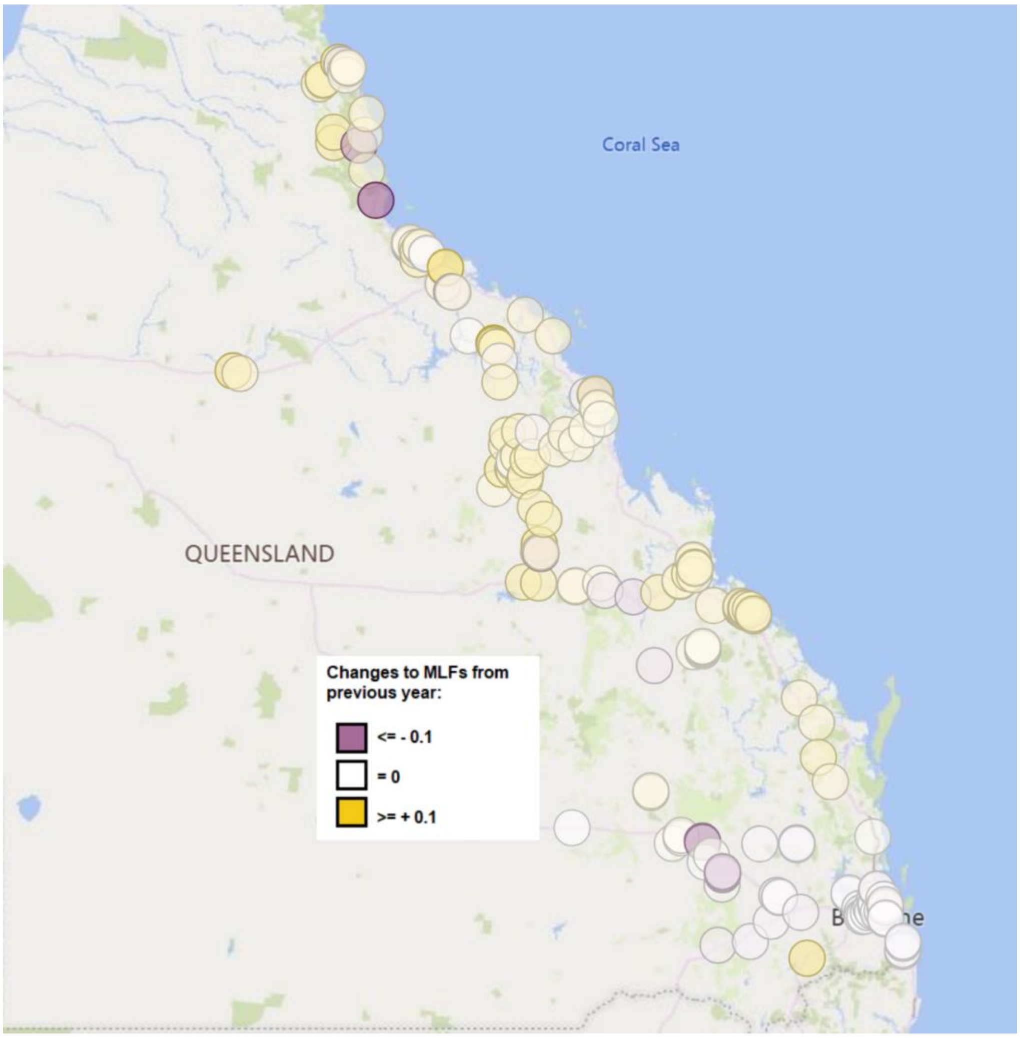
The primary driver of change in Queensland has been a large reduction in exports to New South Wales.

North Queensland MLFs have increased by an average of 0.52% for loads and 0.71% for generation, where generation output in this area is impacted by network (system strength related)limitations.

The MLFs in central Queensland have generally increased since 2019-20, where the average increase is 0.79% for load and 0.89% for generation. This increase is largely driven by a reduction in output of large scheduled generators in Queensland and a large increase in the level of semi-scheduled generation in Victoria and New South Wales. As a result of the reduction in thermal generation output, southerly flows have reduced, and losses incurred between central Queensland and the RRN have decreased, putting upward pressure on MLFs.

The MLFs in south-west and south-east Queensland have decreased, with average reductions of less than 0.3%, mainly due to projected decrease in export to New South Wales.

Figure 1 Queensland changes to 2019-20 MLFs



2.3.2 Changes to marginal loss factors in New South Wales

Figure 2 shows the changes to MLFs at New South Wales connection points in the 2020-21 study compared to the previous year.

The primary drivers of change are variations in imports from both Victoria and Queensland as well as an increase in remote generation.

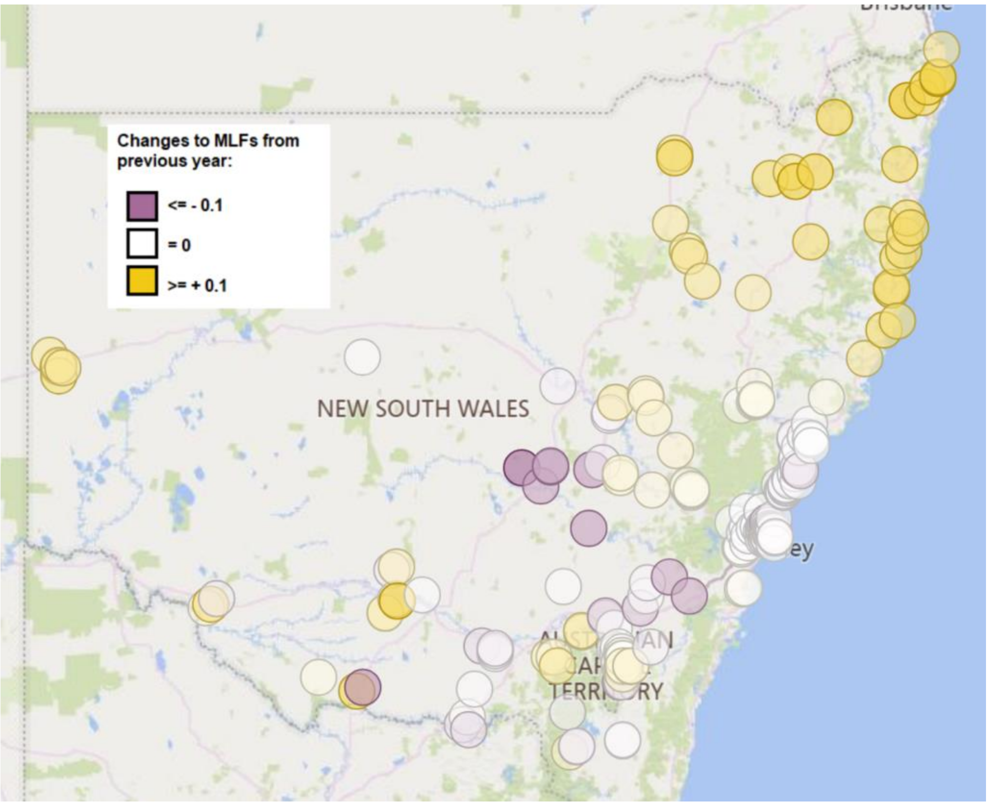
MLFs in north New South Wales generally increased by 2.91% for load and 3.35% for generation.

The increase in MLFs in north New South Wales is a result of the reduced level of imports from Queensland. As a result, there has been a reduction in flows between these areas and the RRN.

The MLFs in south-west New South Wales increased by 0.56% for load and 1.7% for generation as generation output in this area is reduced by network (system strength related) limitations.

Conversely, the remaining areas in New South Wales have seen reductions in MLFs largely driven by increased imports from Victoria.

Figure 2 New South Wales changes to 2019-20 MLFs



2.3.3 Changes to marginal loss factors in Victoria

Figure 3 shows the changes to MLFs at Victorian connection points in the 2020-21 study compared to the previous year.

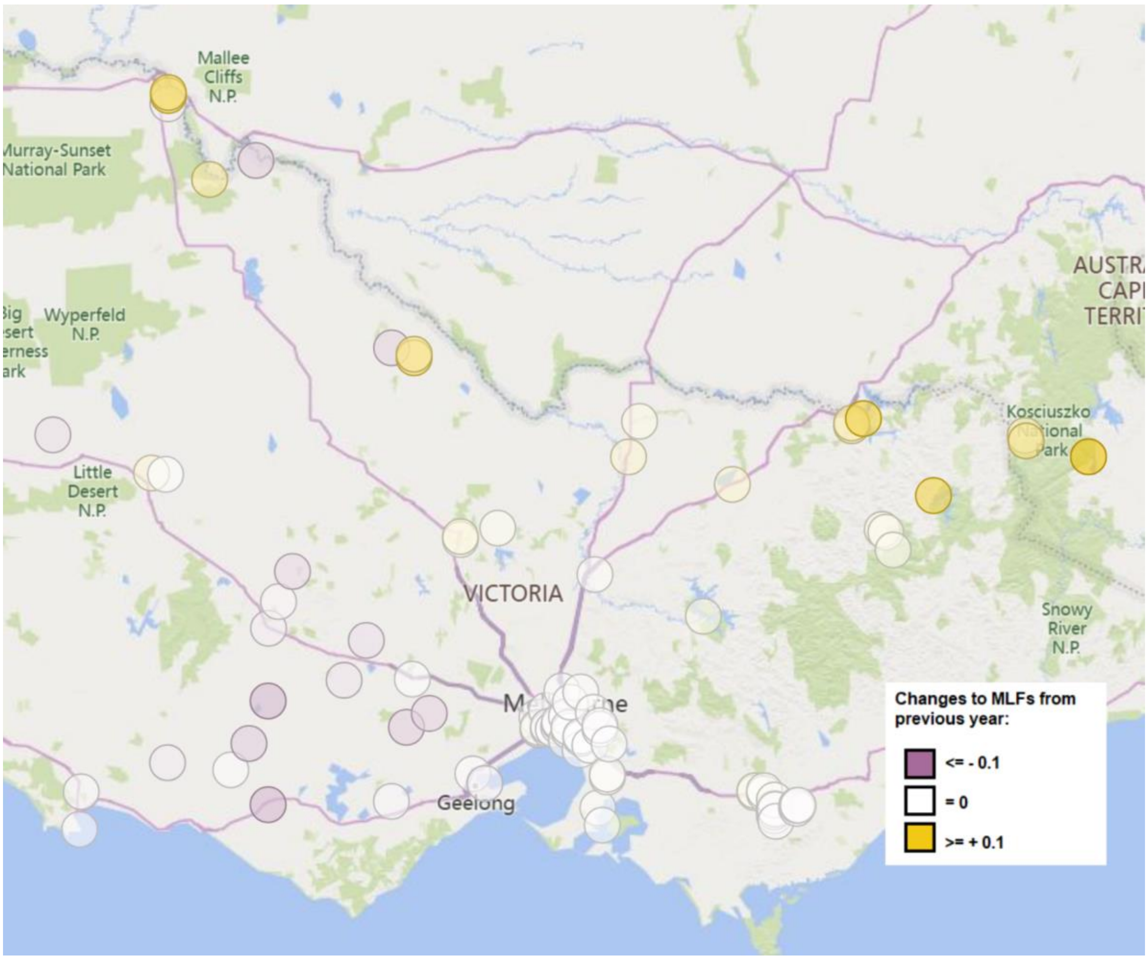
The primary drivers of change in Victoria are variations in exports to New South Wales, imports from South Australia, and an increase in remote generation.

Generation MLFs in north-west Victoria have continued to decline, with an average reduction of 0.32%. Load MLFs within north-west Victoria have increased by 2.3%. The split in direction of change between generation and load MLFs is the result of the generation technology in the area and volume weighting. The loads have seen increases, which have largely been driven by interconnector flows. The generators have seen decreases, which have largely been driven by large levels of localised generation at times of low load.

While generators in north-west Victoria were included for the 2019-20 MLF study, a large portion were only partially operational. For the 2020-21 MLF study, most of these generators are forecast to be commercially operational for the entire financial year, resulting in significantly increased generation levels in the area.

North Victoria has seen marginal increases to MLFs, of 1.29% for load and 2.03% for generation, driven by increased exports to New South Wales.

Figure 3 Victoria changes to 2019-20 MLFs



2.3.4 Changes to marginal loss factors in South Australia

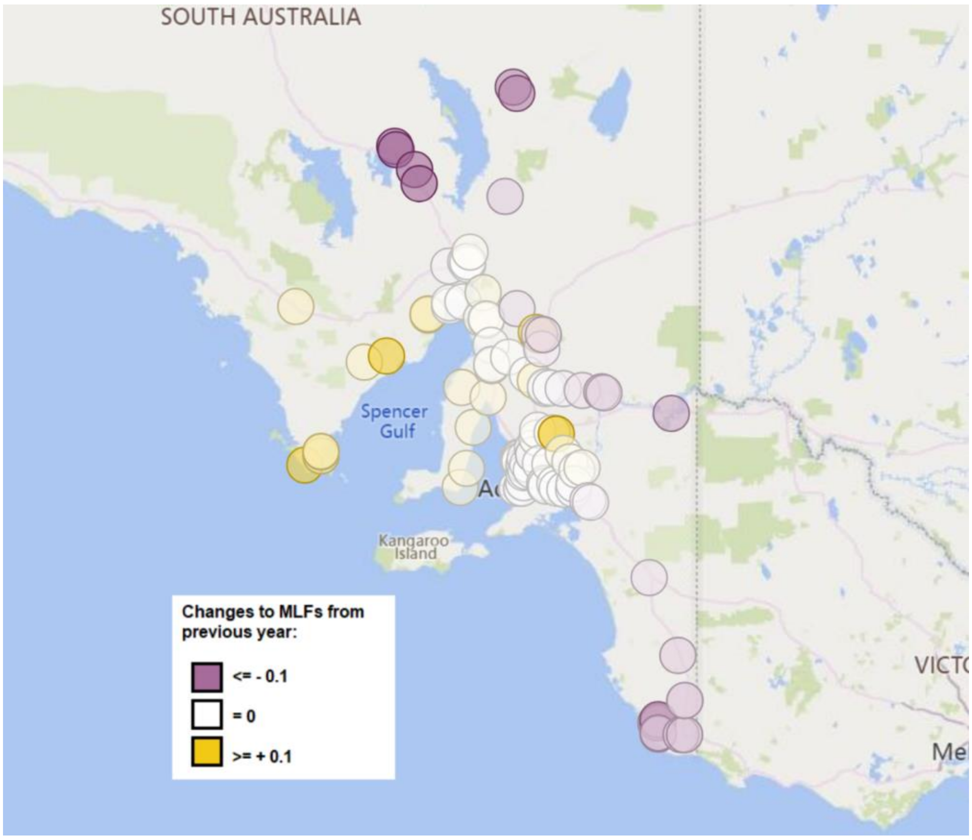
Figure 4 shows the changes to MLFs at South Australian connection points in the 2020-21 study compared to the previous year.

The primary driver of change in South Australia is reduced exports to Victoria.

South-east South Australia has seen a reduction in MLFs of 1.66% for loads and 2.36% for generation, and the Riverland area has seen a reduction in MLFs 1.39% for loads.

The reductions in MLFs along the border with Victoria have been driven by a significant decrease in exports.

Figure 4 South Australia changes to 2019-20 MLFs



2.3.5 Changes to marginal loss factors in Tasmania

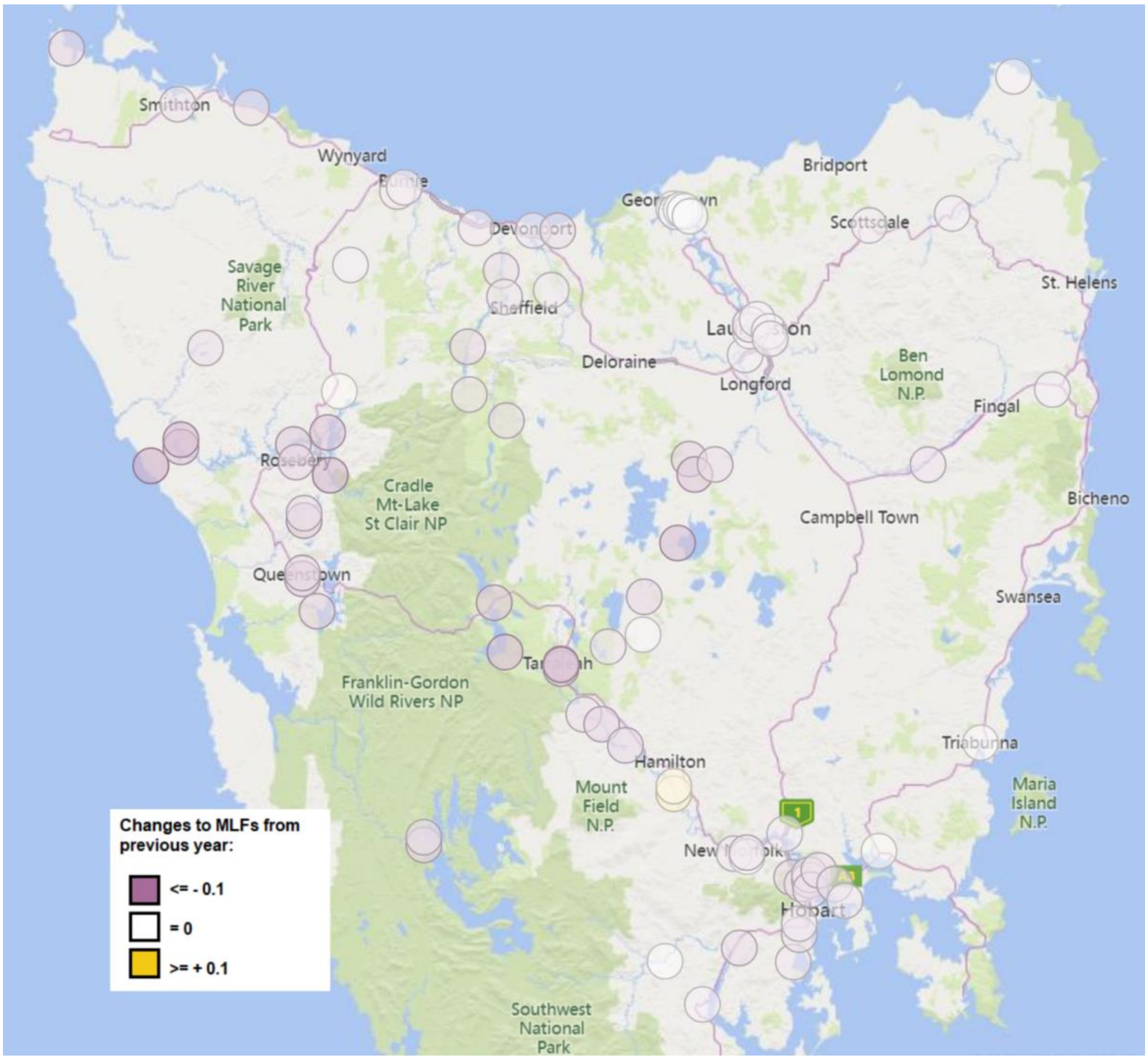
Figure 5 shows the changes to MLFs at Tasmanian connection points in the 2021-20 study compared to the previous year.

Tasmania has seen small reductions in MLFs across almost all TNIs.

MLFs reduced across the majority of Tasmania. The largest decrease is in west coast Tasmania, where the average reduced by 1.03% for load and 1.87% for generation.

These reductions are the result of an increase in Basslink flows from Tasmania to the mainland and additional wind generation offsetting thermal generation that were in close proximity to the RRN. The increase in exports is resulting in additional flows toward the RRN and additional losses.

Figure 5 Tasmania changes to 2019-20 MLFs



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)

= 0.9481 + 2.1979E-04*NQt + 8.5853E-06*Qd + 2.4685E-06*Nd

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

= 1.0416 + 1.9988E-04*VNt + -1.9319E-05*Vd + 1.5585E-05*Nd + -6.5256E-05*Sd

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

= 1.0191 + 3.6307E-04*VSAt + 2.1163E-07*Vd + -1.5209E-05*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 6 MLF (South Pine 275 referred to Sydney West 330)

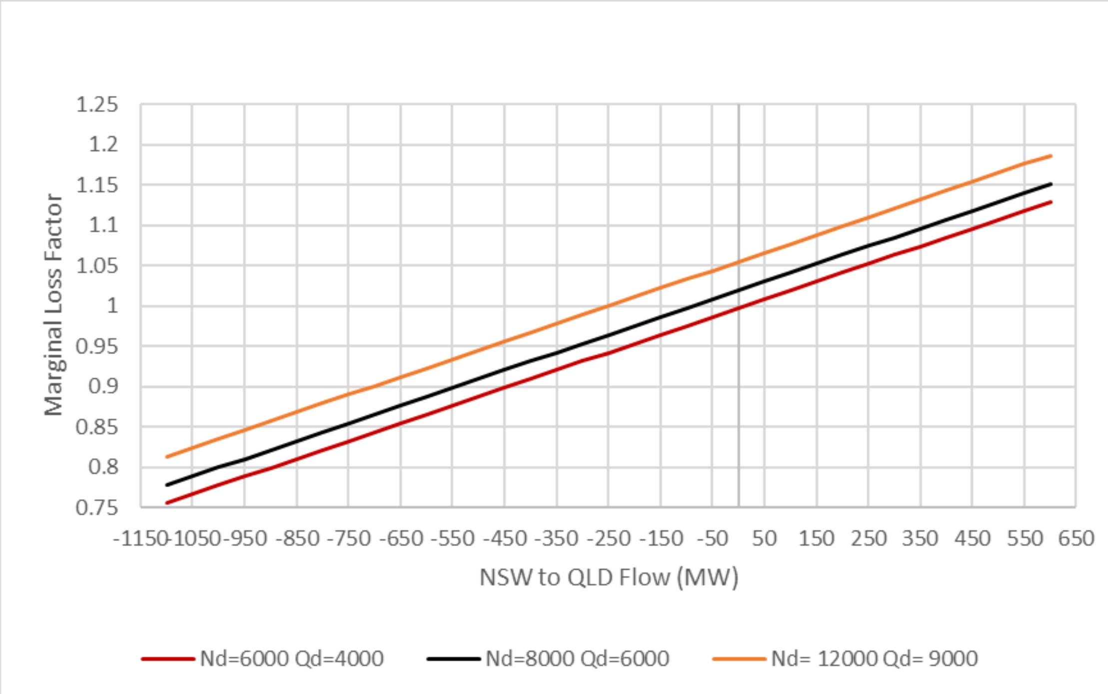


Table 13 South Pine 275 referred to Sydney West 330 MLF versus New South Wales to Queensland flow coefficient statistics

Coefficient	Qd	Nd	NQt	CONSTANT
Coefficient value	8.5853E-06	2.4685E-06	2.1979E-04	0.9481

Figure 7 MLF (Sydney West 330 referred to Thomastown 66)

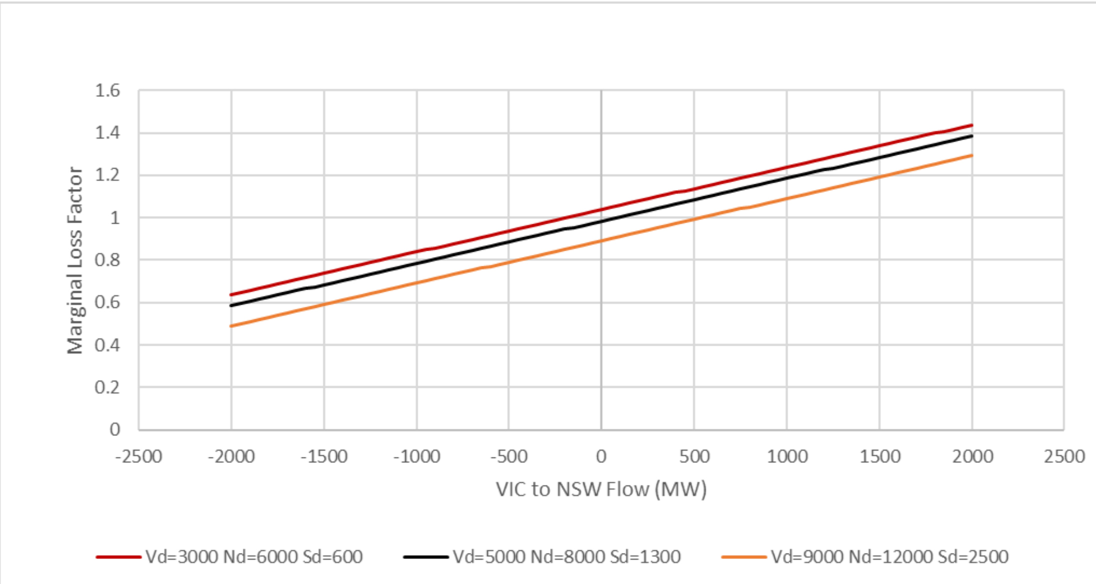


Table 14 Sydney West 330 referred to Thomastown 66 MLF versus Victoria to New South Wales flow coefficient statistics

Coefficient	Sd	Nd	Vd	VNt	CONSTANT
Coefficient value	-6.5256E-05	1.5585E-05	-1.9319E-05	1.9988E-04	1.0416

Figure 8 MLF (Torrens Island 66 referred to Thomastown 66)

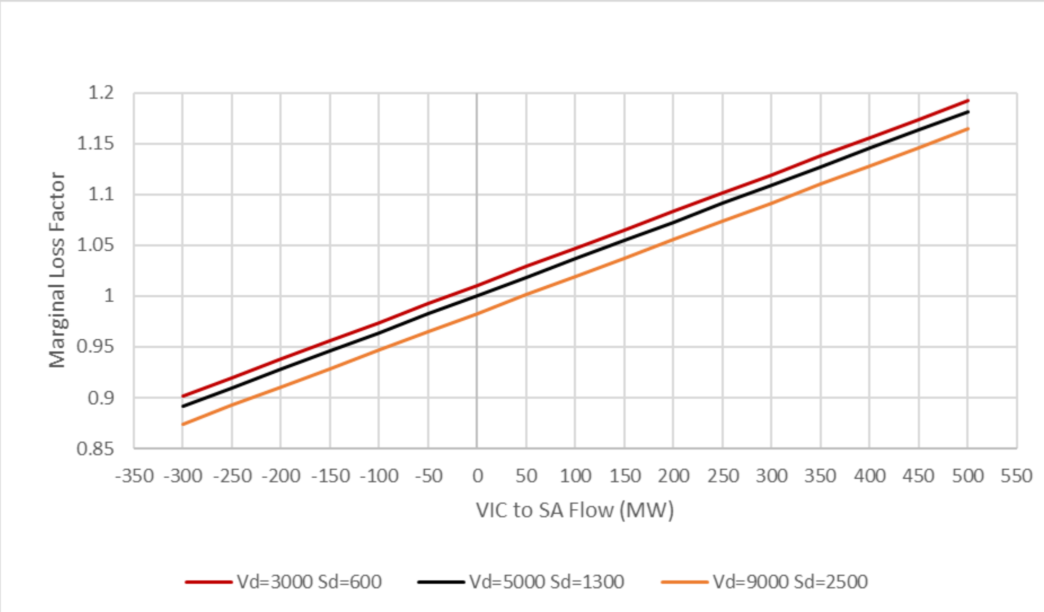


Table 15 Torrens Island 66 referred to Thomastown 66 MLF versus Victoria to South Australia flow coefficient statistics

Coefficient	Sd	Vd	VSAt	CONSTANT
Coefficient value	-1.5209E-05	2.1163E-07	3.6307E-04	1.0191

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

$= (-0.0519 + 8.5853E\text{-}06*Qd + 2.4685E\text{-}06*Nd)*NQt + 1.0989E\text{-}04*(NQt)^2$

Sydney West 330 referred to Thomastown 66 notional link average losses

$= (0.0416 + -1.9319E\text{-}05*Vd + 1.5585E\text{-}05*Nd + -6.5256E\text{-}05*Sd)*VNt + 9.9940E\text{-}05*(VNt)^2$

Torrens Island 66 referred to Thomastown 66 notional link average losses

$= (0.0191 + 2.1163E\text{-}07*Vd + -1.5209E\text{-}05*Sd)*VSAt + 1.8153E\text{-}04*(VSAt)^2$

Where:

Qd = Queensland demand

Vd = Victorian demand

Nd = New South Wales demand

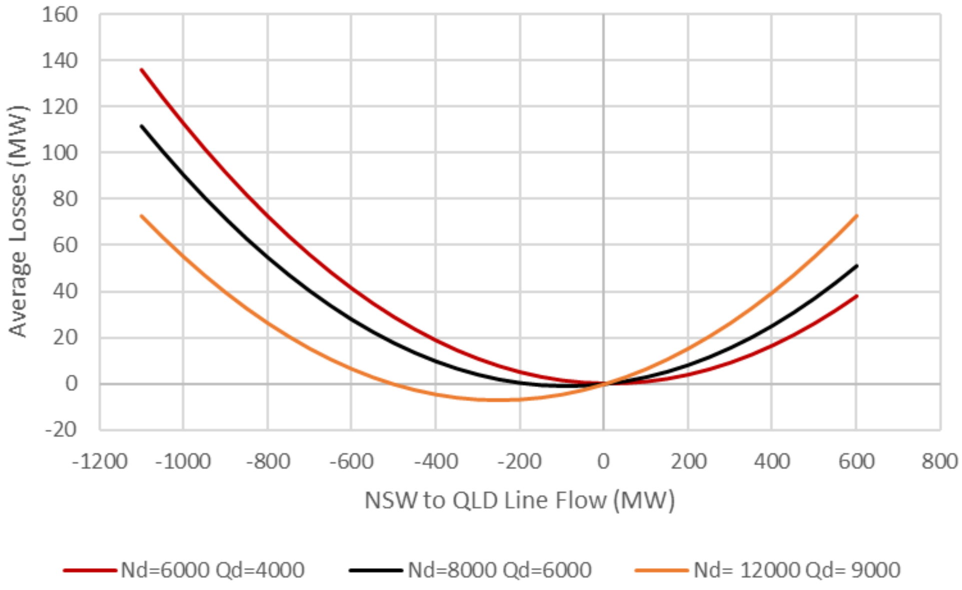
Sd = South Australia demand

NQt = transfer from New South Wales to Queensland

VNt = transfer from Victoria to New South Wales

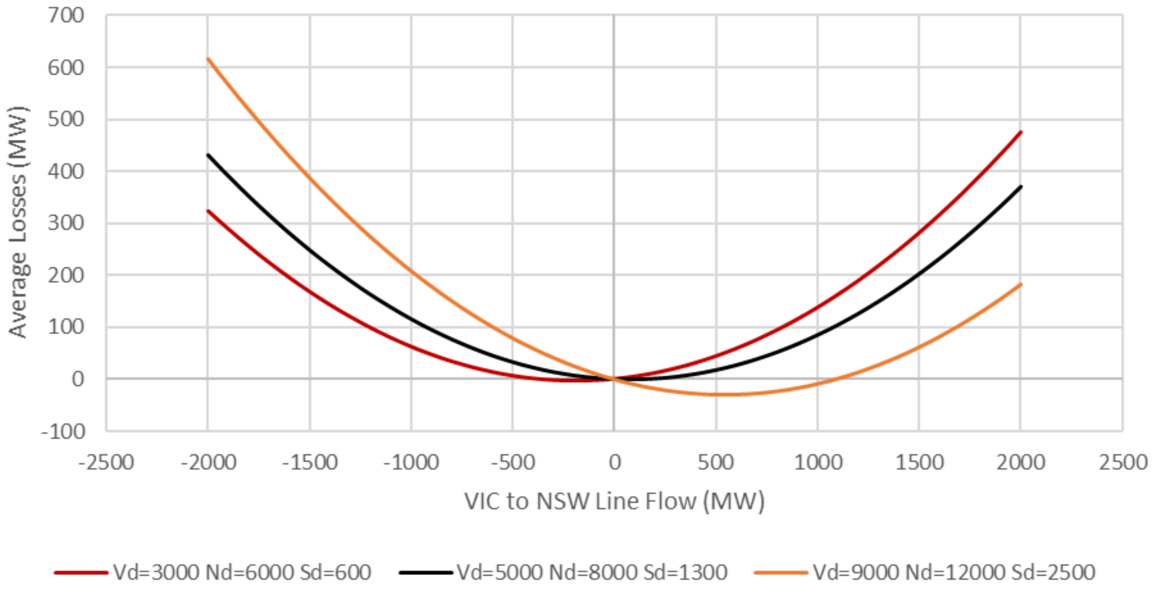
VSAt = transfer from Victoria to South Australia

Figure 9 Average Losses for New South Wales – Queensland Notional Link



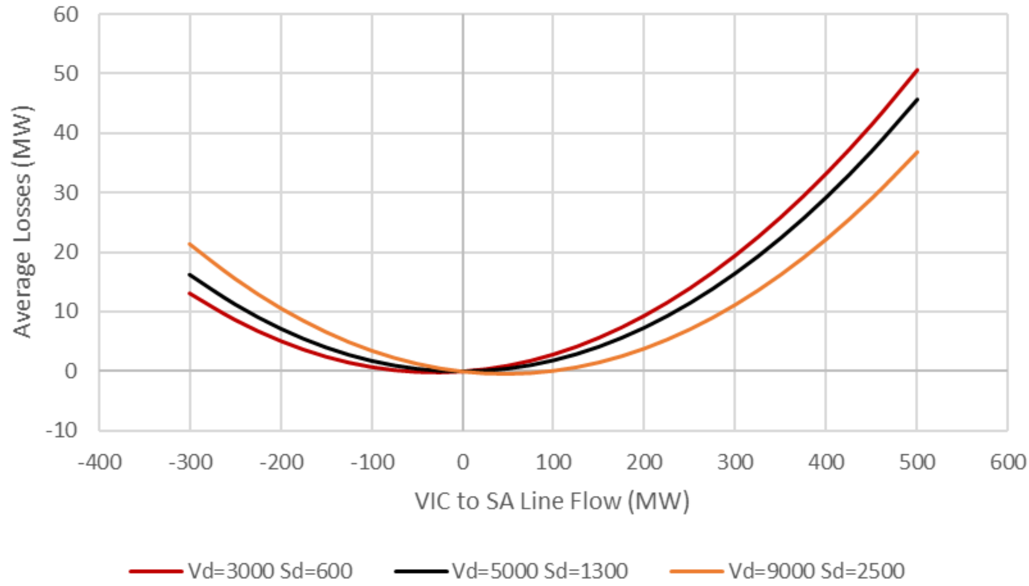
New South Wales to Queensland notional link losses versus New South Wales to Queensland notional link flow

Figure 10 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 11 Average Losses for Victoria – South Australia Notional Link



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

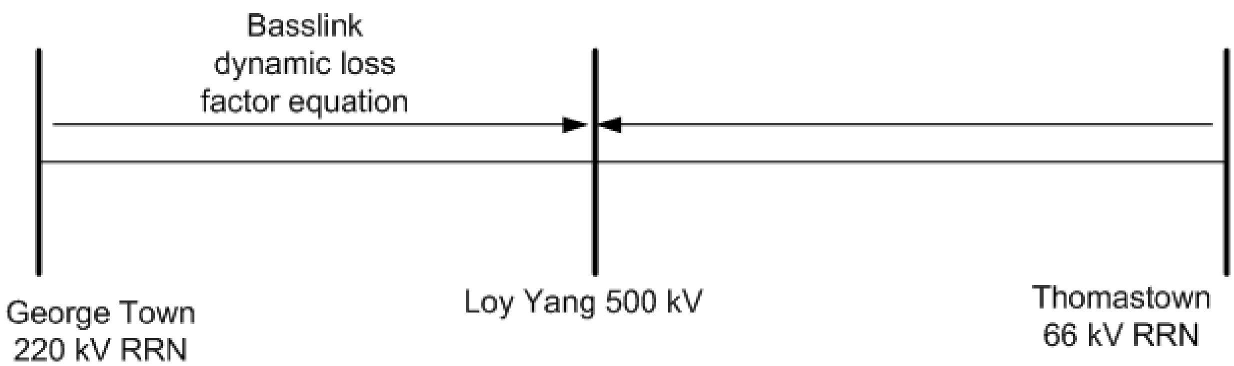
5. Basslink, Murraylink, Terranora loss equations

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 = 0.9620
- 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.



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:

$$\text{Losses} = (0.0039 * \text{Flow}_t + 2.8177 * 10^{-4} * \text{Flow}_t^2)$$

AEMO determined the following Murraylink MLF model using regression analysis:

Murraylink MLF (Torrens Island 66 referred to Thomastown 66) 0.9293 + 2.2959E-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:

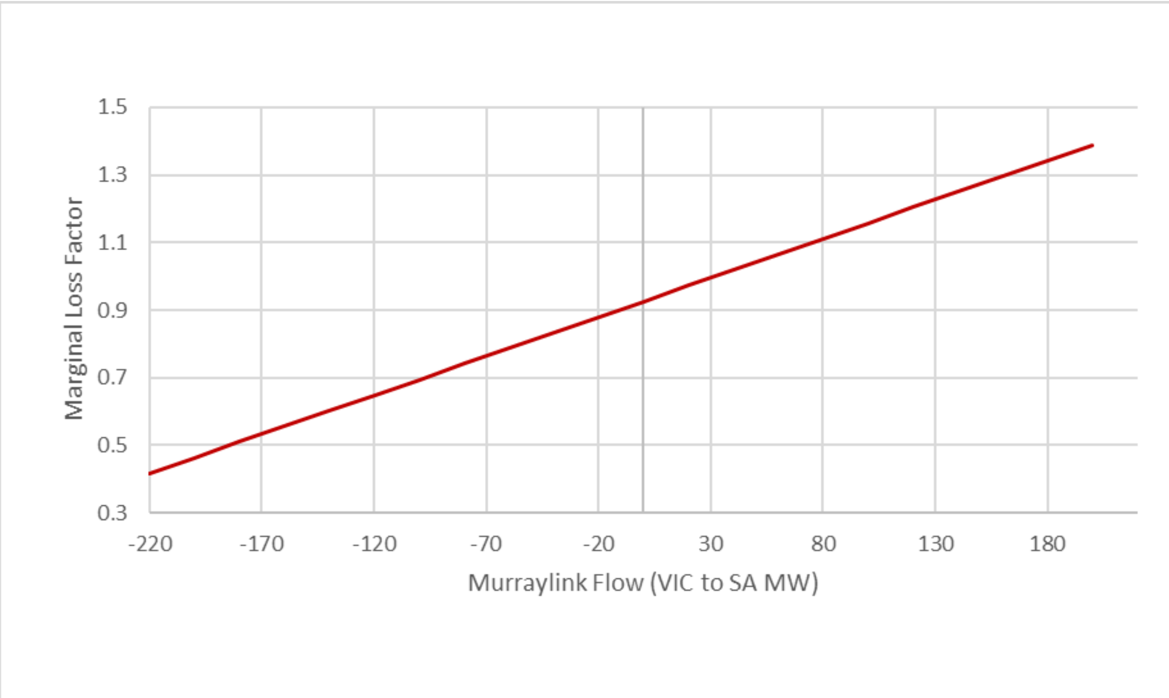
Table 16 Regression statistics for Murraylink

COEFFICIENT	Murraylink flow	CONSTANT
Coefficient Value	2.2959E-03	0.9293

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

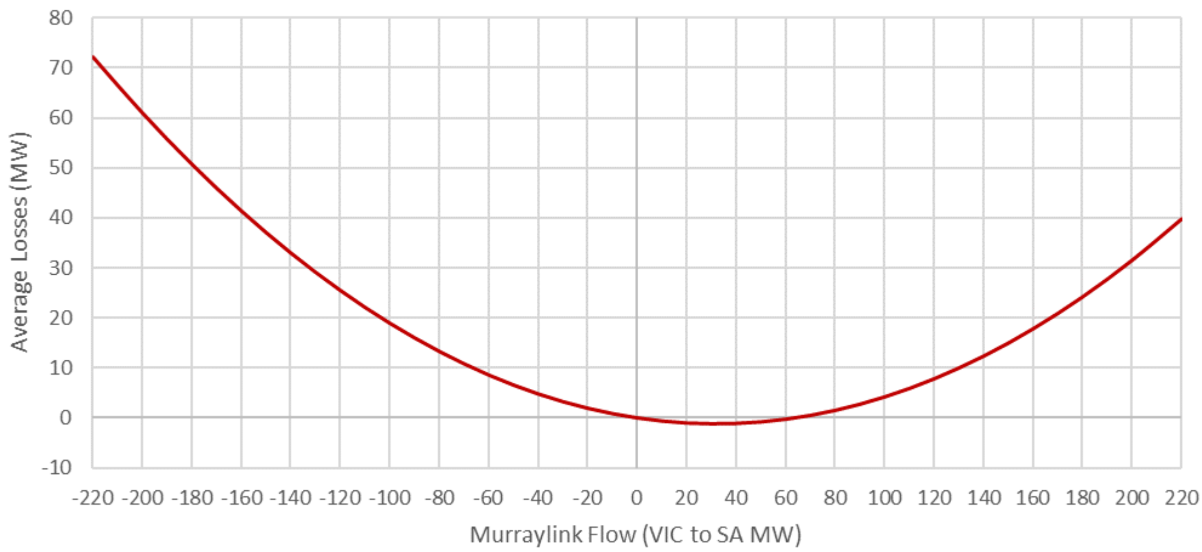
Murraylink loss = -0.0707*Flow_t + 1.1479E-03*$(\text{Flow}_t)^2$

Figure 12 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 13 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:

$$\text{Losses} = (-0.0013 * \text{Flow}_t + 2.7372 * 10^{-4} * \text{Flow}_t^2)$$

AEMO determined the following Terranora MLF model using regression analysis:

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

$$= 1.0555 + 2.2770\text{E-}03*\text{Flow}_t$$

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:

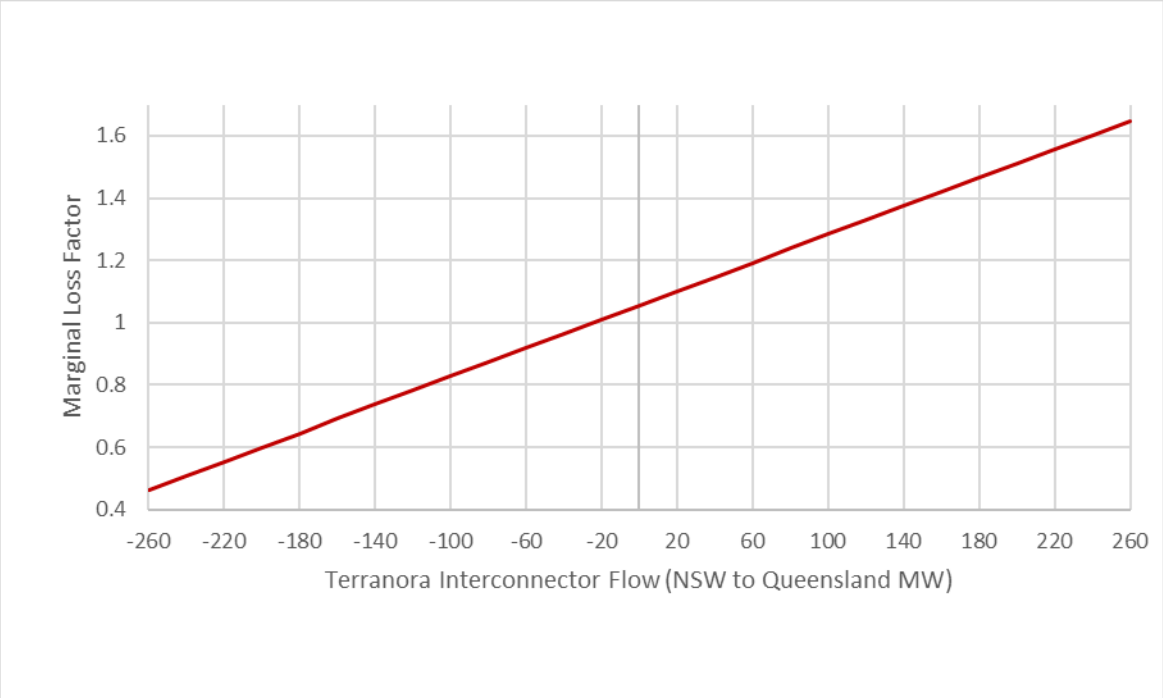
Table 17 Regression statistics for Terranora

Coefficient value	Flow	CONSTANT
Coefficient Value	2.2770E-03	1.0555

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

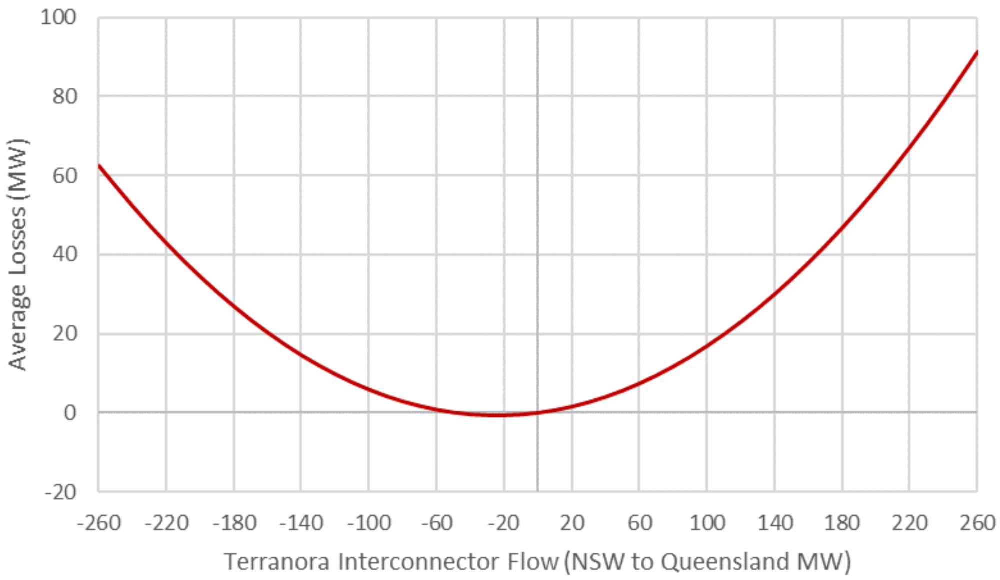
$$\text{Terranora loss} = 0.0555*\text{Flow}_t + 1.1385\text{E-}03*(\text{Flow}_t)^2$$

Figure 14 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 15 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 2020-21 financial year:

Table 18 Factors for inter-regional losses

Notional interconnector	Proportioning factor	Applied to
Queensland – New South Wales (QNI)	0.4286	New South Wales
Queensland – New South Wales (Terranora Interconnector)	0.4816	New South Wales
Victoria – New South Wales	0.4145	Victoria
Victoria – South Australia (Heywood)	0.7441	Victoria
Victoria – South Australia (Murraylink)	0.7296	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 19 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 lines[6].
- 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.

[6] 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 20 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, Kurri 11, Kurri 33, Kurri 132, Newcastle 132, Munmorah 330, Lake Munmorah 132, Vales Pt. 132, Beresfield 33, Charmhaven 11, Gosford 33, Gosford 66, West Gosford 11, Ourimbah 33, Ourimbah 66, Ourimbah 132, Tomago 132, Tuggerah 132, Somersby 11, BHP Waratah 132 and Wyong 11, Hydro Aluminium 132
NEV3	South of Broken Bay	Sydney North 132 (Ausgrid), Lane Cove 132, Meadowbank 11, Mason Park 132, Homebush Bay 11, Chullora 132 kV, Peakhurst 33, Drummoyne 11, Rozelle 33, Pyrmont 132, Pyrmont 33, Marrickville 11, St Peters 11, Beaconsfield West 132, Canterbury 33, Bunnerong 33, Bunnerong 132, Sydney East 132, Sydney West 132 (Ausgrid) and Sydney South 132, Macquarie Park 11, Rozelle 132, Top Ryde 11, Rookwood Road 132, Kurnell 132, Belmore Park 132, Green Square 11, Carlingford 132, Hurstville North 11, Kogarah 11, and Haymarket 132, Croydon 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 21 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.

On 27 February 2020 the AEMC made a final rule determination on Transmission Loss Factors[7], which incorporates a number of minor amendments to the clauses 3.6.1, 3.6.2, and Chapter 10 of the Rules. These changes have not directly impacted the determination for 2020-21, and will be incorporated into subsequent determinations following a review of the Methodology.

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

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.

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.

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 Marginal 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". An overview of the steps in this Methodology is:

- 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 dispatch 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.

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

The annual energy targets used in load forecasting for the 2020-21 MLF calculation are in the table below.

Table 22 Forecast energy for 2020-21[A]

Region	2020-21 forecast sent-out energy (GWh)	2019-20 forecast sent-out energy (GWh)
New South Wales	65,579	66,441
Victoria	41,492	43,184
Queensland	50,940	49,363
South Australia	12,261	11,834
Tasmania	10,234	10,412

A. Forecast operational consumption – as sent out – sourced from the most recent published (2019) Electricity Statement of Opportunities (ESOO), at http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities.

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

AEMO regularly verifies the accuracy of historical connection point data.

[8] Forward Looking Transmission Loss Factors (Version 7), at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2017/Forward-Looking-Loss-Factor-Methodology-v70.pdf.

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 2018 to 30 June 2019 from its settlements database. AEMO also obtains the following data:

- Generation capacity data from Generation Information Page published in January 2020[9].
- Historical generation availability, as well as on-line and off-line status data from AEMO's Market Management System (MMS).
- Future generation availability based on most recent Medium Term Projected Assessment of System Adequacy (MT PASA) data, as of 15 January 2020[10], 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 31 January 2020. Projects listed as committed (Committed/Committed*) and with a target commercial operation date prior to or 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 FY2018-19 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.

Historical data from the previous financial year was incorporated into the profile if available. Relevant proponents for each project were consulted during the process and where applicable, adjustments based on the feedback received were made.

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

[10] 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.

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.
- Warwick Solar Farm.

New South Wales and ACT new generating units

- Crudine Ridge Wind Farm.
- Darlington Point Solar Farm.
- Goonumbla Solar Farm.
- Limondale Solar Plant 1.
- Molong Solar Farm.
- Sunraysia Solar Farm.

Victoria new generating units

- Bulgana Green Power Hub Battery.
- Bulgana Green Power Hub Wind Farm.
- Cherry Tree Wind Farm.
- Cohuna Solar Farm.
- Kiamal Solar Farm Stage 1.
- Lal Wind Energy System – Elaine.
- Moorabool Wind Farm.
- Stockyard Hill Wind Farm.
- Winton Solar Farm.
- Yatpool Solar Farm.

South Australia new generating units

- Lincoln Gap Battery.

Tasmania new generating units

- None.

A2.3.2 Abnormal generation patterns

AEMO has adjusted several generation profiles for the 2020-21 MLF calculation in accordance with section 5.5.6 of the Methodology. Historical generation patterns were adjusted to backfill historical outages and incorporate future outages identified through MT PASA data submitted as of 15 January. This was performed where outages longer than 30 days were 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.

Hydro Tasmania requested an update to forecast generation profiles in accordance with section 5.5.6 of the Methodology based on new developments, equipment upgrades and expected rainfall variability. AEMO used the adjusted generation profiles to replace historical profiles as an input to the 2020-21 MLF calculation process, endeavouring to ensure that the 2020-21 MLF calculation represents expected system conditions.

The table below shows the historical and adjusted generation values aggregated quarterly and on a regional or sub-regional level.

Table 23 Adjusted generation values for Tasmania

	Historical generation (GWh)		Adjusted generation (GWh)	
	Northern Tasmania	Southern Tasmania	Northern Tasmania	Southern Tasmania
Jul – Sep	2,687	1,497	2,649	1,389
Oct – Dec	1,697	1,168	1,665	1,070
Jan – Mar	1,251	930	1,253	882
Apr – Jun	1,988	1,041	2,043	976
Total	7,623	4,637	7,611	4,315

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 2020-21 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.
- North Queensland system strength limit.
- South Australia system strength limit.

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 thermal limit.
- Waubra to Ballarat thermal limit.

- Murray to Dederang transfer limit.
- Western New South Wales voltage collapse limit.
- Darlington Point to Coleambally thermal limit.

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

- Queensland Central to South transfer limit.

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 2020-21 financial year. The snapshot is thus representative of the 2020-21 normally operating power system.

A2.5.1 Network augmentation for 2020-21

Relevant Transmission Network Service Providers (TNSPs) advised of the following network augmentations to be completed in 2020-21.

Queensland network augmentations

Powerlink provided the following list of planned network augmentations in 2020-21 in Queensland:

- Decommissioning of Loganlea 110/33 kV transformer (T2).
- Retirement of Cairns 132/22 transformer (T4) including its 132 kV series reactor and line.
- CP02371 H010 Bouldercombe – 275/132/19.1 Transformer 1 and 2 replacement.

New South Wales network augmentations

New South Wales NSPs provided the following list of planned network augmentations in 2020-21 in New South Wales:

- Decommissioning of Upper Tumut – Canberra 330 kV line.
- Installation of Upper Tumut – Stockdill 330 kV.
- Installation of new Stockdill – Canberra 330 kV line.
- Decommissioning of Canberra – Williamsdale 330 kV line.
- Installation of new Stockdill – Williamsdale 330 kV line.
- Decommissioning of Canberra – Woden 132 kV line.
- Installation of new Canberra – Stockdill 132 kV line.
- Installation of new Stockdill – West Belconnen 132 kV line.
- Installation of new West Belconnen – Woden 132 kV line.
- Installation of new Stockdill 330/132 kV transformer.
- New Greenacre 132/11 kV zone substation and decommission 132 kV feeders 291/1 and 292.
- New Strathfield South 132/11 kV zone substation (Looping into feeder 911).
- Replace 132 kV feeders 282/1 and 283/1 between Sydney South and Revesby.
- 132 kV Feeder 957/3 Uprate (Vales Point to Tee).

- New Morisset Annex 132/33 kV STS.

Victoria network augmentations

AEMO's Victorian Planning Group provided the following list of planned network augmentations in 2020-21 in Victoria:

- FBTS Redevelopment B4 – Replacing the B4 transformer.
- ERTS Redevelopment B3 – Replacing B3 220/66kV transformer.

South Australia network augmentations

ElectraNet provided the following list of planned network augmentations in 2020-21 in South Australia:

- Para – Robertstown 275 kV Line – Re-insulation.
- Para – Munno Para 275 kV Line – Re-insulation.
- TIPS – New Osborne No. 3 and No. 4, 66 kV Line – Re-insulation.
- Waterloo – Mintaro 132 kV line – Re-insulation.
- Davenport – Leigh Creek 132 kV Line – Re-insulation.
- Eyre Peninsula Transmission Supply – Replace placement of existing 132 kV line from Cultuna to Port Lincoln with a new double circuit 132 kV line.
- Davenport Main Grid System Strength Support – two new synchronous condensers.
- Construction of a new 275 kV line from Davenport to Mount Gunson South and a 132 kV line from Mount Gunson South to Prominent Hill (configuration to be confirmed).
- Robertstown Main Grid System Strength Support – two new synchronous condensers.
- Decommissioning of Cherry Garden – Tailem Bend 275kV.
- Installation of Cherry Garden – Tungkillo 275 kV.
- Installation of Tungkillo – Tailem Bend 275 kV.

Tasmania network augmentations

TasNetworks provided the following list of planned network augmentations in 2020-21 in Tasmania:

- Upgrading of Port Latta Substation.
- Upgrading of Sheffield Substation.

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.

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.

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 24 Interconnector capacity (MW)

From region	To region	Summer peak	Summer off-peak	Winter peak	Winter off-peak
Queensland	New South Wales	1,078	1,078	1,078	1,078
New South Wales	Queensland	400	550	400	550
New South Wales	Victoria	1,700 minus Murray generation	1,700 minus Murray generation	1,700 minus Murray generation	1,700 minus Murray generation
Victoria	New South Wales	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)	New South Wales (Terranora)	224	224	224	224
New South Wales (Terranora)	Queensland (Terranora)	107	107	107	107
Tasmania (Basslink)	Victoria (Basslink)*	594	594	594	594
Victoria (Basslink)	Tasmania (Basslink)*	478	478	478	478

* Limit referring to the receiving end.

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 the peak periods, which corresponds to 7.00 am to 10.00 pm on weekdays.

A2.7 Calculation of marginal loss factors

AEMO uses the TPRICE[11] 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.

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.
- A process review of AEMO's data handling, modelling, and results preparation processes to ensure they are consistent with the published Methodology.

The process review conducted by the consultants concluded that the process for calculating 2020-21 MLF values complied with the Methodology, with the exception of one minor procedural non-compliance that was not considered material to the calculation of MLF values. It was noted that, while strictly compliant with the Methodology, AEMO deviated from some requirements to better accommodate power system operations and the changing generation mix. This deviation for unexpected operating or system conditions is provided for in accordance with section 5.9 of the Methodology. Recommendations to update the Methodology were made to AEMO on the basis of these findings.

---

[11] 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.

A3. Impact of highly correlated generation profiles on MLF

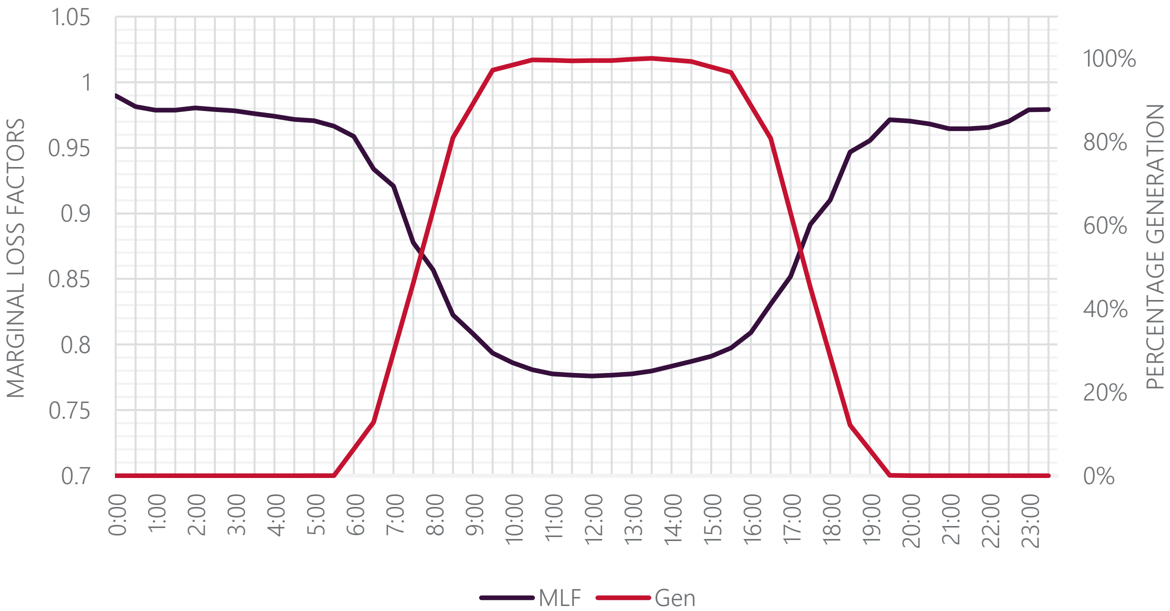
As discussed in Appendix A2.7, MLFs are calculated by simulating power flows on the network for every half-hour, in the next financial year, using forecast supply and demand values. The calculated raw loss factors for each half-hour are then weighted by the volume of energy at the TNI to calculate the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

Calculated raw loss factors reflect the supply and demand at each half-hour, hence can have a large range. With increased generation connections of the same technology in an area, a daily pattern is observed due to increased supply and low demand during daylight hours. As a result, MLFs in these areas are declining sharply.

As an example, Figure 16 shows the time of day average MLF and percentage generation for a selected solar farm, located in an area with a high solar penetration. The MLF at night time is just below 1, however, the MLF during the day is below 0.8. The generation output is nearly 100% during the day, but zero at night. When volume weighted averages are applied, the MLF for the solar farm is close to 0.8, even though the simple average of the MLFs is close to 0.9.

If, however, a generator with a completely independent generation pattern connects in this area, it would have a significantly higher MLF than the solar farm.

Figure 16 Time of day average MLF and percentage generation



Glossary

Term	Definition
ACT	Australian Capital Territory
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BESS	Battery Energy Storage System
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-reactive
MW	Megawatt
NEFR	National Energy Forecasting Report
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
TNI	Transmission Node Identity
TNSP	Transmission Network Service Provider
VTN	Virtual Transmission Node