Regions and Marginal Loss Factors: FY 2019-20

May 2019

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 2019-20 inter-regional loss equations under clause 3.6.1 of the Rules and 2019-20 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.

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Introduction

This document sets out the 2019-20 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 (NER).

As well as the MLFs, this document includes the 2019-20 NEM inter-regional loss factor equations and loss equations (NER clause 3.6.1) and restates the following information published on 1 April 2019 related to NEM regions:

- Virtual transmission nodes (VTNs).
- Connection point transmission node identifiers (TNIs).
- Regions, regional reference nodes (RRNs), and region boundaries.

Loss factors apply for 2019-20 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 and longer-term solutions to manage the impact of potentially volatile MLFs in the rapidly changing NEM, in the interests of electricity consumers.

Marginal loss factors in a transforming NEM

The NEM continues to transform, driven by new technology, a changing generation mix, and rapidly developing areas of high renewable energy penetration. This transformation is leading to large year-on-year changes in MLFs calculated under the current regulatory framework and methodology.

In many locations, MLFs have fallen by large margins, and this in turn has material financial implications for existing and intending market participants.

AEMO is actively engaged with industry and the AEMC on options to minimise these impacts of current rules, both in the relatively short term and in the longer term through appropriate amendments to the National Electricity Rules (NER):

- AEMO continues to support the work program currently being progressed by the AEMC that will consider why and how losses in the NEM are changing and what measures may be introduced to make these changes more manageable for generators. This will include consideration of two rule change requests from Adani Renewables which deal with issues related to the existing MLF framework in the NER and how this might be improved.
- In the longer term, the AEMC is progressing a work program to examine how generation and transmission investment may be more effectively coordinated, including how generators gain access to the transmission network. This longer-term work program is taking a more holistic view of issues related to losses.

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 2018 Integrated System Plan (ISP), are critical in the provision of information to participants regarding the needs and changes to the power system.

MLFs reflect the quality of input assumptions

After publishing the initial draft 2019-20 MLFs on 8 March 2019, AEMO received substantial and credible new information on the status of several committed projects which did not align with the information that AEMO had considered when calculating the draft loss factors. This meant the draft MLFs were unlikely to reflect actual marginal losses between the regional reference node and each transmission connection point in many parts of the network.

Given the potential materiality of this new information for MLF calculations, and after informing the Australian Energy Regulator (AER), AEMO considered it necessary to defer finalisation of the 2019-20 MLFs beyond the normal 1 April publication date. This allowed AEMO to seek confirmation of the most up to date generation profiles for relevant projects from proponents.

In April 2019, AEMO wrote to proponents requesting updates on the status and commissioning timelines for 46 generation projects, and received advice that the generation profile of 29 projects needed to be revised. AEMO has now completed the assessment of MLFs for 2019-20 using this updated information.

Observations and trends

MLFs represent electrical transmission losses within each of the five regions in the NEM – Queensland, New South Wales, Victoria, South Australia, and Tasmania.

In general, MLFs have declined between 2018-19 and 2019-20. The main changes in regional loss factors are, in summary:

- Reduction in MLFs at connection points in central and northern Queensland.
- A very large reduction in MLFs at connection points in south-west New South Wales, with a moderate reduction in the Australian Capital Territory and Snowy subregions, and a moderate increase in northern New South Wales.
- A very large reduction in MLFs at connection points in north-west Victoria, a moderate reduction in central Victoria, and a small increase in MLFs at connection points in northern Victoria.
- Increase 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.

Changes between the 2018-19 MLFs and the 2019-20 MLFs are mainly driven by the large volume of new generation projects connecting to the NEM. Of the 46 new generator connections considered, 13 are registered and the remaining 33 are included in the 2019-20 MLF study due to their committed[1] status, representing approximately 4,500 megawatts (MW) of new capacity that is being considered for the first time.

New generation is increasingly connecting at the periphery of the transmission network, including north-west Victoria, south-west New South Wales, and north and central Queensland. In these areas, access to renewable resources is good, yet the network is electrically weak and remote from the regional reference node. This additional generation has resulted in a large reduction in MLFs in these areas.

The reduction in MLFs is exacerbated by the high correlation in generation profiles, where new generation tends to be running at the same time as other nearby generators, as well as during periods of light load in the area.

AEMO applied a number of quality assurance steps when calculating the 2019-20 MLFs. This included engaging an independent consultant to perform a two-step parallel MLF calculation to identify and resolve issues and ensure outcomes are consistent with the Forward Looking Loss Factor (FLLF) methodology. The consultant is satisfied that AEMO is appropriately applying the published Forward Looking Loss Factor Methodology based on the data provided by market participants, historical market data and AEMO's electricity consumption forecasts.

AEMO also engaged a consultant to carry out due diligence on the profiles of new generation projects.

[1] Committed refers to the new development status as published in the latest Generation information page - https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information

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1. Marginal Loss Factors by region

This section shows the intra-regional loss factors, commonly known as marginal loss factors (MLFs), for financial year 2019-20, 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 FLLF 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 "2019-20 MLF Applicable from 1 July 2019" spreadsheet which is also published on AEMO's website[2].

1.1 Queensland Marginal Loss Factors

Table 1 Queensland loads

Location	Voltage in kilovolts (kV)	TNI	2019-20 MLF	2018-19 MLF
Abermain	33	QABM	1.0027	1.0015
Abermain	110	QABR	1.0044	0.9968
Alan Sherriff	132	QASF	0.9601	0.9656
Algester	33	QALG	1.0164	1.0161
Alligator Creek	132	QALH	0.9551	0.9640
Alligator Creek	33	QALC	0.9630	0.9654
Ashgrove West	33	QAGW	1.0152	1.0139
Ashgrove West	110	QCBW	1.0128	1.0122
Belmont	110	QBMH	1.0122	1.0123
Belmont Wecker Road	33	QBBS	1.0112	1.0104
Belmont Wecker Road	11	QMOB	1.0357	1.0353
Biloela	66/11	QBIL	0.9092	0.9141
Blackstone	110	QBKS	1.0007	1.0001
Blackwater	66/11	QBWL	0.9527	0.9624
Blackwater	132	QBWH	0.9516	0.9621

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

Location	Voltage in kilovolts (kV)	TNI	2019-20 MLF	2018-19 MLF
Bluff	132	QBLF	0.9508	0.9608
Bolingbroke	132	QBNB	0.9447	0.9486
Bowen North	66	QBNN	0.9401	0.9469
Boyne Island	275	QBOH	0.9363	0.9411
Boyne Island	132	QBOL	0.9346	0.9383
Braemar – Kumbarilla Park	275	QBRE	0.9788	0.9764
Bulli Creek (Essential Energy)	132	QBK2	0.9803	0.9840
Bulli Creek (Waggamba)	132	QBLK	0.9803	0.9840
Bundamba	110	QBDA	1.0021	1.0013
Burton Downs	132	QBUR	0.9492	0.9596
Cairns	22	QCRN	0.9571	0.9713
Cairns City	132	QCNS	0.9516	0.9682
Callemondah (Rail)	132	QCMD	0.9254	0.9314
Calliope River	132	QCAR	0.9248	0.9258
Cardwell	22	QCDW	0.9632	0.9777
Chinchilla	132	QCHA	0.9846	0.9830
Clare	66	QCLR	0.9742	0.9615
Collinsville Load	33	QCOL	0.9395	0.9494
Columboola	132	QCBL	0.9891	0.9891
Columboola 132 (Bellevue LNG load)	132	QCBB	0.9922	0.9899
Coppabella (Rail)	132	QCOP	0.9614	0.9690
Dan Gleeson	66	QDGL	0.9618	0.9713
Dingo (Rail)	132	QDNG	0.9409	0.9538
Duaringa	132	QDRG	0.9467	0.9684
Dysart	66/22	QDYS	0.9585	0.9629
Eagle Downs Mine	132	QEGD	0.9545	0.9630
Edmonton	22	QEMT	0.9743	0.9847
Egans Hill	66	QEGN	0.9131	0.9159
El Arish	22	QELA	0.9761	0.9846
Garbutt	66	QGAR	0.9633	0.9664
Gin Gin	132	QGNG	0.9550	0.9541
Gladstone South	66/11	QGST	0.9292	0.9384

Location	Voltage in kilovolts (kV)	TNI	2019-20 MLF	2018-19 MLF
Goodna	33	QGDA	1.0059	1.0052
Goonyella Riverside Mine	132	QGYR	0.9687	0.9836
Grantleigh (Rail)	132	QGRN	0.9204	0.9150
Gregory (Rail)	132	QGRE	0.9277	0.9423
Ingham	66	QING	1.0356	0.9597
Innisfail	22	QINF	0.9685	0.9747
Invicta Load	132	QINV	0.9039	0.9660
Kamerunga	22	QKAM	0.9841	0.9844
Kemmis	66	QEMS	0.9621	0.9643
King Creek	132	QKCK	0.9459	0.9563
Lilyvale	66	QLIL	0.9327	0.9451
Lilyvale (Barcaldine)	132	QLCM	0.9647	0.9378
Loganlea	33	QLGL	1.0143	1.0151
Loganlea	110	QLGH	1.0117	1.0116
Mackay	33	QMKA	0.9456	0.9556
Middle Ridge (Energex)	110	QMRX	0.9859	0.9878
Middle Ridge (Ergon)	110	QMRG	0.9859	0.9878
Mindi (Rail)	132	QMND	0.9364	0.9425
Molendinar	110	QMAR	1.0138	1.0143
Molendinar	33	QMAL	1.0133	1.0136
Moranbah (Mine)	66	QMRN	0.9693	0.9819
Moranbah (Town)	11	QMRL	0.9626	0.9538
Moranbah South (Rail)	132	QMBS	0.9560	0.9745
Moranbah Substation	132	QMRH	0.9583	0.9709
Moura	66/11	QMRA	0.9411	0.9480
Mt McLaren (Rail)	132	QMTM	0.9616	0.9786
Mudgeeraba	33	QMGL	1.0124	1.0169
Mudgeeraba	110	QMGB	1.0122	1.0174
Murarrie (Belmont)	110	QMRE	1.0134	1.0130
Nebo	11	QNEB	0.9337	0.9394
Newlands	66	QNLD	0.9712	0.9831
North Goonyella	132	QNGY	0.9712	0.9789

Location	Voltage in kilovolts (kV)	TNI	2019-20 MLF	2018-19 MLF
Norwich Park (Rail)	132	QNOR	0.9455	0.9528
Oakey	110	QOKT	0.9835	0.9818
Oonooie (Rail)	132	QOON	0.9605	0.9651
Orana LNG	275	QORH	0.9810	0.9805
Palmwoods	132	QPWD	1.0020	1.0025
Pandoin	132	QPAN	0.9151	0.9198
Pandoin	66	QPAL	0.9158	0.9199
Peak Downs (Rail)	132	QPKD	0.9662	0.9710
Pioneer Valley	66	QPIV	0.9710	0.9623
Proserpine	66	QPRO	0.9670	0.9723
Queensland Alumina Ltd (Gladstone South)	132	QQAH	0.9328	0.9381
Queensland Nickel (Yabulu)	132	QQNH	0.9506	0.9616
Raglan	275	QRGL	0.9182	0.9217
Redbank Plains	11	QRPN	1.0062	1.0031
Richlands	33	QRLD	1.0155	1.0149
Rockhampton	66	QROC	0.9165	0.9134
Rocklands (Rail)	132	QRCK	0.9094	0.9164
Rocklea (Archerfield)	110	QRLE	1.0059	1.0061
Ross	132	QROS	0.9511	0.9625
Runcorn	33	QRBS	1.0175	1.0174
South Pine	110	QSPN	1.0041	1.0042
Stony Creek	132	QSYC	0.9612	0.9723
Sumner	110	QSUM	1.0073	1.0071
Tangkam (Dalby)	110	QTKM	0.9849	0.9867
Tarong	66	QTRL	0.9756	0.9756
Teebar Creek	132	QTBC	0.9723	0.9764
Tennyson	33	QTNS	1.0096	1.0098
Tennyson (Rail)	110	QTNN	1.0082	1.0087
Townsville East	66	QTVE	0.9539	0.9669
Townsville South	66	QTVS	0.9589	0.9698
Townsville South (KZ)	132	QTZS	1.0026	1.0147
Tully	22	QTLL	1.0037	0.9516

Location	Voltage in kilovolts (kV)	TNI	2019-20 MLF	2018-19 MLF
Turkinje	66	QTUL	0.9836	0.9966
Turkinje (Craiglie)	132	QTUH	0.9857	0.9915
Wandoan South	132	QWSH	0.9986	1.0036
Wandoan South (NW Surat)	275	QWST	0.9975	1.0030
Wandoo (Rail)	132	QWAN	0.9433	0.9471
Wivenhoe Pump	275	QWIP	0.9977	0.9974
Woolooga (Energex)	132	QWLG	0.9764	0.9756
Woolooga (Ergon)	132	QWLN	0.9764	0.9756
Woree	132	QWRE	0.9614	0.9754
Wotonga (Rail)	132	QWOT	0.9581	0.9685
Wycarbah	132	QWCB	0.9128	0.9061
Yarwun – Boat Creek (Ergon)	132	QYAE	0.9260	0.9282
Yarwun – Rio Tinto	132	QYAR	0.9221	0.9266

Table 2 Queensland generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Barcaldine Solar at Lilyvale (132)	132	BARCSF1	QLLV1B	QLLV	0.8729	0.8934
Barron Gorge Power Station (PS) Unit 1	132	BARRON-1	QBGH1	QBGH	0.9134	0.9346
Barron Gorge PS Unit 2	132	BARRON-2	QBGH2	QBGH	0.9134	0.9346
Braemar PS Unit 1	275	BRAEMAR1	QBRA1	QBRA	0.9706	0.9709
Braemar PS Unit 2	275	BRAEMAR2	QBRA2	QBRA	0.9706	0.9709
Braemar PS Unit 3	275	BRAEMAR3	QBRA3	QBRA	0.9706	0.9709
Braemar Stage 2 PS Unit 5	275	BRAEMAR5	QBRA5B	QBRA	0.9706	0.9709
Braemar Stage 2 PS Unit 6	275	BRAEMAR6	QBRA6B	QBRA	0.9706	0.9709
Braemar Stage 2 PS Unit 7	275	BRAEMAR7	QBRA7B	QBRA	0.9706	0.9709
Callide PS Load	132	CALLNL1	QCAX	QCAX	0.9016	0.9048
Callide A PS Unit 4	132	CALL_A_4	QCAA4	QCAA	0.9015	0.9074
Callide A PS Unit 4 Load	132	CALLNL4	QCAA2	QCAA	0.9015	0.9074
Callide B PS Unit 1	275	CALL_B_1	QCAB1	QCAB	0.9042	0.9069
Callide B PS Unit 2	275	CALL_B_2	QCAB2	QCAB	0.9042	0.9069
Callide C PS Unit 3	275	CPP_3	QCAC3	QCAC	0.9017	0.9080

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Callide C PS Unit 4	275	CPP_4	QCAC4	QCAC	0.9017	0.9080
Clare Solar Farm	132	CLARESF1	QCLA1C	QCLA	0.8589	0.8727
Collinsville Solar Farm	33	CSPVPS1	QCOS1C	QCOS	0.8579	0.8719
Darling Downs PS	275	DDPS1	QBRA8D	QBRA	0.9706	0.9709
Darling Downs Solar Farm	275	DDSF1	QBRS1D	QBRS	0.9825	0.9812
Daydream Solar Farm	33	DAYDSF1	QCCK1D	QCCK	0.8488	0.8836
Gladstone PS (132 kV) Unit 3	132	GSTONE3	QGLD3	QGLL	0.9194	0.9206
Gladstone PS (132 kV) Unit 4	132	GSTONE4	QGLD4	QGLL	0.9194	0.9206
Gladstone PS (132kV) Load	132	GLADNL1	QGLL	QGLL	0.9194	0.9206
Gladstone PS (275 kV) Unit 1	275	GSTONE1	QGLD1	QGLH	0.9214	0.9240
Gladstone PS (275 kV) Unit 2	275	GSTONE2	QGLD2	QGLH	0.9214	0.9240
Gladstone PS (275 kV) Unit 5	275	GSTONE5	QGLD5	QGLH	0.9214	0.9240
Gladstone PS (275 kV) Unit 6	275	GSTONE6	QGLD6	QGLH	0.9214	0.9240
Hamilton Solar Farm	33	HAMISF1	QSLD1H	QSLD	0.8567	0.8741
Hayman Solar Farm	33	HAYMSF1	QCCK2H	QCCK	0.8488	0.8836
Hughenden Solar Farm	132	HUGSF1	QROG2H	QROG	0.8671	0.8842
Kareeya PS Unit 1	132	KAREEYA1	QKAH1	QKYH	0.9286	0.9523
Kareeya PS Unit 2	132	KAREEYA2	QKAH2	QKYH	0.9286	0.9523
Kareeya PS Unit 3	132	KAREEYA3	QKAH3	QKYH	0.9286	0.9523
Kareeya PS Unit 4	132	KAREEYA4	QKAH4	QKYH	0.9286	0.9523
Kidston Solar Farm	132	KSP1	QROG1K	QROG	0.8671	0.8842
Kogan Creek PS	275	KPP_1	QBRA4K	QWDN	0.9715	0.9743
Koombooloomba	132	KAREEYA5	QKYH5	QKYH	0.9286	0.9523
Lilyvale Solar Farm	132	LILYSF1	QBDR1L	QBDR	0.8685	0.8855
Millmerran PS Unit 1	330	MPP_1	QBCK1	QMLN	0.9799	0.9812
Millmerran PS Unit 2	330	MPP_2	QBCK2	QMLN	0.9799	0.9812
Mount Emerald Wind farm	275	MEWF1	QWKM1M	QWKM	0.9430	0.9515
Mt Stuart PS Unit 1	132	MSTUART1	QMSP1	QMSP	0.9024	0.8842
Mt Stuart PS Unit 2	132	MSTUART2	QMSP2	QMSP	0.9024	0.8842
Mt Stuart PS Unit 3	132	MSTUART3	QMSP3M	QMSP	0.9024	0.8842
Oakey PS Unit 1	110	OAKEY1	QOKY1	QOKY	0.9589	0.9562

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Oakey PS Unit 2	110	OAKEY2	QOKY2	QOKY	0.9589	0.9562
Ross River Solar Farm	132	RRSF1	QROG3R	QROG	0.8671	0.8842
Stanwell PS Load	132	STANNL1	QSTX	QSTX	0.9046	0.9104
Stanwell PS Unit 1	275	STAN-1	QSTN1	QSTN	0.9051	0.9075
Stanwell PS Unit 2	275	STAN-2	QSTN2	QSTN	0.9051	0.9075
Stanwell PS Unit 3	275	STAN-3	QSTN3	QSTN	0.9051	0.9075
Stanwell PS Unit 4	275	STAN-4	QSTN4	QSTN	0.9051	0.9075
Stapylton	110	STAPYLTON1	QLGH4S	QLGH	1.0117	1.0116
Sun Metals Solar Farm	132	SMCSF1	QTZS1S	QTZS	1.0026	1.0147
Swanbank E GT	275	SWAN_E	QSWE	QSWE	1.0011	1.0009
Tarong North PS	275	TNPS1	QTNT	QTNT	0.9746	0.9755
Tarong PS Unit 1	275	TARONG#1	QTRN1	QTRN	0.9749	0.9752
Tarong PS Unit 2	275	TARONG#2	QTRN2	QTRN	0.9749	0.9752
Tarong PS Unit 3	275	TARONG#3	QTRN3	QTRN	0.9749	0.9752
Tarong PS Unit 4	275	TARONG#4	QTRN4	QTRN	0.9749	0.9752
Whitsunday Solar Farm	33	WHITSF1	QSLS1W	QSLS	0.8567	0.8741
Wivenhoe Generation Unit 1	275	W/HOE#1	QWIV1	QWIV	0.9936	0.9939
Wivenhoe Generation Unit 2	275	W/HOE#2	QWIV2	QWIV	0.9936	0.9939
Wivenhoe Pump 1	275	PUMP1	QWIP1	QWIP	0.9977	0.9974
Wivenhoe Pump 2	275	PUMP2	QWIP2	QWIP	0.9977	0.9974
Yabulu PS	132	YABULU	QTYP	QTYP	0.9142	0.9346
Yarwun PS	132	YARWUN_1	QYAG1R	QYAG	0.9216	0.9245

Table 3 Queensland embedded[3] generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Baking Board Solar Farm (Chinchilla Solar Farm)	132	BAKING1	QCHS1C	QCHS	0.9863	0.9834
Barcaldine PS – Lilyvale	132	BARCALDN	QBCG	QBCG	0.8864	0.9029
Browns Plains Landfill Gas PS	110	BPLANDF1	QLGH3B	QLGH	1.0117	1.0116

[3] Please note that the breakdown between transmission connected and embedded generation is provided for information purposes only. Please refer to the Distribution Loss Factor publication to determine if a DLF applies, at http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2019/Distribution-Loss-Factors-for-the-2019-20-Financial-Year.pdf.

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Childers Solar Farm	132	CHILDSF1	QTBS1C	QTBS	0.9528	0.9511
Columboola – Condamine PS	132	CPSA	QCND1C	QCND	0.9909	0.9882
Daandine PS	110	DAANDINE	QTKM1	QTKM	0.9849	0.9867
Emerald Solar Farm	66	EMERASF1	QLIS1E	QLIS	0.8705	0.8778
German Creek Generator	66	GERMCRK	QLIL2	QLIL	0.9327	0.9451
Grosvenor PS At Moranbah 66 No 2	66	GROSV2	QMRV1G	QMRV	0.9558	0.9683
Grosvenor PS At Moranbah 66 No 1	66	GROSV1	QMRN2G	QMRV	0.9558	0.9683
Invicta Sugar Mill	132	INVICTA	QINV1I	QINV	0.9039	0.9660
Isis CSM	132	ICSM	QGNG1I	QTBC	0.9723	0.9764
Longreach Solar Farm	132	LRSF1	QLLV2L	QLLV	0.8729	0.8934
Mackay GT	33	MACKAYGT	QMKG	QMKG	0.9064	0.8863
Moranbah Generation	11	MORANBAH	QMRL1M	QMRL	0.9626	0.9803
Moranbah North PS	66	MBAHNTH	QMRN1P	QMRN	0.9693	0.9819
Oakey 1 Solar Farm	110	OAKEY1SF	QTKS1O	QTKS	0.9825	0.9826
Oaky Creek Generator	66	OAKYCREK	QLIL1	QLIL	0.9327	0.9451
Oaky Creek 2	66	OAKY2	QLIL3O	QLIL	0.9327	0.9451
Racecourse Mill PS 1 – 3	66	RACOMIL1	QMKA1R	QPIV	0.9710	0.9623
Rochedale Renewable Energy Plant	110	ROCHEDAL	QBMH2	QBMH	1.0122	1.0123
Rocky Point Gen (Loganlea 110kV)	110	RPCG	QLGH2	QLGH	1.0117	1.0116
Roghan Road Generator	110	EDLRGNRD	QSPN2	QSPN	1.0041	1.0042
Roma PS Unit 7 – Columboola	132	ROMA_7	QRMA7	QRMA	0.9779	0.9729
Roma PS Unit 8 – Columboola	132	ROMA_8	QRMA8	QRMA	0.9779	0.9729
Southbank Institute Of Technology	110	STHBKTEC	QCBD1S	QCBW	1.0128	1.0122
Sunshine Coast Solar Farm	132	VALDORA1	QPWD1S	QPWD	1.0020	1.0025
Susan River Solar Farm	132	SRSF1	QTBS2S	QTBS	0.9528	0.9511
Ti Tree BioReactor	33	TITREE	QABM1T	QABM	1.0027	1.0015
Whitwood Rd Renewable Energy Plant	110	WHIT1	QSBK1	QBKS	1.0007	1.0001
Windy Hill Wind Farm	66	WHILL1	QTUL	QTUL	0.9836	0.9966
Wivenhoe Small Hydro	110	WIVENSH	QABR1	QABR	1.0044	0.9968
Yabulu Steam Turbine (Garbutt 66kV)	66	YABULU2	QGAR1	QYST	0.9185	0.9495

1.2 New South Wales Marginal Loss Factors [4]

Table 4 New South Wales loads

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Alexandria	33	NALX	1.0040	1.0093
Albury	132	NALB	0.9808	1.0792
Alcan	132	NALC	0.9931	0.9932
Armidale	66	NAR1	0.9390	0.8957
Australian Newsprint Mill	132	NANM	0.9852	1.0810
Balranald	22	NBAL	0.9174	1.1047
Beaconsfield North	132	NBFN	1.0034	1.0084
Beaconsfield South	132	NBFS	1.0035	1.0084
Belmore Park	132	NBM1	1.0037	1.0085
Beresfield	33	NBRF	0.9935	0.9957
Beryl	66	NBER	0.9710	1.0062
BHP (Waratah)	132	NWR1	0.9906	0.9893
Boambee South	132	NWST	0.9624	0.9125
Boggabri East	132	NBGE	0.9892	0.9692
Boggabri North	132	NBGN	0.9902	0.9692
Brandy Hill	11	NBHL	0.9939	0.9935
Broken Hill	22	NBKG	0.8654	1.0603
Broken Hill	220	NBKH	0.8452	1.0486
Bunnerong	132	NBG1	1.0033	1.0081
Bunnerong	33	NBG3	1.0056	1.0103
Burrinjuck	132	NBU2	0.9742	1.0155
Canterbury	33	NCTB	1.0120	1.0136
Carlingford	132	NCAR	1.0010	1.0033
Casino	132	NCSN	0.9592	0.8960
Charmhaven	11	NCHM	0.9948	0.9930
Chullora	132	NCHU	1.0021	1.0076
Coffs Harbour	66	NCH1	0.9586	0.9072

[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	2019-20 MLF	2018-19 MLF
Coleambally	132	NCLY	0.9526	1.0783
Cooma	66	NCMA	0.9810	1.0307
Cooma (AusNet Services)	66	NCM2	0.9810	1.0307
Croydon	11	NCRD	1.0178	1.0089
Cowra	66	NCW8	1.0320	1.0411
Dapto (Endeavour Energy)	132	NDT1	0.9931	1.0037
Dapto (Essential Energy)	132	NDT2	0.9931	1.0037
Darlington Point	132	NDNT	0.9634	1.0764
Deniliquin	66	NDN7	0.9826	1.1081
Dorrigo	132	NDOR	0.9566	0.9070
Drummoyne	11	NDRM	1.0204	1.0087
Dunoon	132	NDUN	0.9667	0.8822
Far North VTN		NEV1	0.9721	0.9654
Finley	66	NFNY	0.9928	1.1441
Forbes	66	NFB2	1.0438	1.0429
Gadara	132	NGAD	0.9846	1.0504
Glen Innes	66	NGLN	0.9199	0.8920
Gosford	66	NGF3	1.0035	1.0011
Gosford	33	NGSF	1.0043	1.0021
Green Square	11	NGSQ	1.0060	1.0098
Griffith	33	NGRF	0.9796	1.0929
Gunnedah	66	NGN2	0.9863	0.9579
Haymarket	132	NHYM	1.0036	1.0084
Heron's Creek	132	NHNC	1.0115	0.9885
Holroyd	132	NHLD	1.0025	1.0000
Hurstville North	11	NHVN	1.0040	1.0068
Homebush Bay	11	NHBB	1.0184	1.0110
Ilford	132	NLFD	0.9665	0.9901
Ingleburn	66	NING	0.9973	1.0006
Inverell	66	NNVL	0.9301	0.9063
Kemps Creek	330	NKCK	0.9944	0.9972
Kempsey	66	NKS2	0.9834	0.9510

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Kempsey	33	NKS3	0.9929	0.9542
Koolkhan	66	NKL6	0.9731	0.9174
Kurnell	132	NKN1	1.0014	1.0054
Kogarah	11	NKOG	1.0062	1.0090
Kurri	33	NKU3	0.9958	0.9961
Kurri	11	NKU1	0.9940	0.9940
Kurri – Dual MLF[5] (Generation)	132	NKUR	0.9948	0.9913
Kurri – Dual MLF (Load)	132	NKUR	0.9948	0.9934
Lake Munmorah	132	NMUN	0.9880	0.9835
Lane Cove	132	NLCV	1.0151	1.0083
Leichhardt	11	NLDT	1.0173	1.0103
Liddell	33	NLD3	0.9653	0.9596
Lismore	132	NLS2	1.0096	0.8965
Liverpool	132	NLP1	1.0009	1.0024
Macarthur	132	NMC1	0.9942	0.9987
Macarthur	66	NMC2	0.9958	1.0008
Macksville	132	NMCV	0.9788	0.9305
Macquarie Park	11	NMQP	1.0300	1.0122
Manildra	132	NMLD	1.0253	1.0223
Marrickville	11	NMKV	1.0089	1.0138
Marulan (Endeavour Energy)	132	NMR1	1.0092	0.9977
Marulan (Essential Energy)	132	NMR2	1.0092	0.9977
Mason Park	132	NMPK	1.0154	1.0084
Meadowbank	11	NMBK	1.0192	1.0116
Molong	132	NMOL	1.0275	1.0236
Moree	66	NMRE	0.9707	0.9612
Morven	132	NMVN	0.9772	1.0752
Mt Piper	66	NMP6	0.9730	0.9734
Mudgee	132	NMDG	0.9722	1.0039
Mullumbimby	11	NML1	0.9587	0.8642

[5] Kurri 132 kV (NKUR) has a single MLF for 2019-20, dual MLF for 2018-19 is published for comparison only.

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Mullumbimby	132	NMLB	0.9548	0.8591
Munmorah STS 33	33	NMU3	0.9905	1.0058
Munyang	11	NMY1	0.9928	1.0256
Munyang	33	NMYG	0.9928	1.0256
Murrumbateman	132	NMBM	0.9802	1.0129
Murrumburrah	66	NMRU	0.9919	1.0448
Muswellbrook	132	NMRK	0.9726	0.9659
Nambucca Heads	132	NNAM	0.9758	0.9243
Narrabri	66	NNB2	1.0026	0.9789
Newcastle	132	NNEW	0.9904	0.9901
North of Broken Bay VTN		NEV2	0.9945	0.9933
Orange	66	NRGE	1.0303	1.0343
Orange North	132	NONO	1.0296	1.0322
Ourimbah	33	NORB	1.0003	0.9986
Ourimbah	132	NOR1	0.9990	0.9972
Ourimbah	66	NOR6	0.9997	0.9972
Panorama	66	NPMA	1.0167	1.0225
Parkes	66	NPK6	1.0386	1.0372
Parkes	132	NPKS	1.0323	1.0336
Peakhurst	33	NPHT	1.0030	1.0063
Pt Macquarie	33	NPMQ	1.0099	0.9783
Pyrmont	33	NPT3	1.0071	1.0092
Pyrmont	132	NPT1	1.0040	1.0086
Queanbeyan 132	132	NQBY	0.9927	1.0457
Raleigh	132	NRAL	0.9715	0.9166
Regentville	132	NRGV	0.9981	0.9993
Rockdale (Ausgrid)	11	NRKD	1.0047	1.0081
Rookwood Road	132	NRWR	1.0021	1.0027
Rozelle	132	NRZH	1.0174	1.0092
Rozelle	33	NRZL	1.0172	1.0098
Snowy Adit	132	NSAD	0.9777	1.0132
Somersby	11	NSMB	1.0048	1.0020

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
South of Broken Bay VTN		NEV3	1.0057	1.0062
St Peters	11	NSPT	1.0068	1.0115
Stroud	132	NSRD	1.0041	1.0022
Sydney East	132	NSE2	1.0070	1.0049
Sydney North (Ausgrid)	132	NSN1	1.0045	1.0015
Sydney North (Endeavour Energy)	132	NSN2	1.0045	1.0015
Sydney South	132	NSYS	1.0001	1.0036
Sydney West (Ausgrid)	132	NSW1	1.0010	1.0033
Sydney West (Endeavour Energy)	132	NSW2	1.0010	1.0033
Tamworth	66	NTA2	0.9592	0.9348
Taree (Essential Energy)	132	NTR2	1.0235	1.0105
Tenterfield	132	NTTF	0.9392	0.8945
Terranora	110	NTNR	0.9822	0.9223
Tomago	330	NTMG	0.9909	0.9898
Tomago (Ausgrid)	132	NTME	0.9929	0.9925
Tomago (Essential Energy)	132	NTMC	0.9929	0.9925
Top Ryde	11	NTPR	1.0180	1.0091
Tuggerah	132	NTG3	0.9952	0.9935
Tumut	66	NTU2	0.9858	1.0438
Vales Pt.	132	NVP1	0.9902	0.9883
Vineyard	132	NVYD	0.9997	0.9991
Wagga	66	NWG2	0.9767	1.0616
Wagga North	132	NWGN	0.9777	1.0642
Wagga North	66	NWG6	0.9783	1.0673
Wallerawang (Endeavour Energy)	132	NWW6	0.9733	0.9737
Wallerawang (Essential Energy)	132	NWW5	0.9733	0.9737
Wallerawang 66 (Essential Energy)	66	NWW4	0.9740	0.9747
Wallerawang 66	66	NWW7	0.9740	0.9747
Wallerawang 330 PS Load	330	NWWP	0.9737	0.9766
Wellington	132	NWL8	0.9834	0.9824
West Gosford	11	NGWF	1.0054	1.0026
Williamsdale (Essential Energy) (Bogong)	132	NWD1	0.9853	1.0272

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Wyong	11	NWYG	0.9976	0.9958
Yanco	33	NYA3	0.9728	1.0833
Yass	66	NYS6	0.9807	1.0136
Yass	132	NYS1	0.9716	1.0054

Table 5 New South Wales generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Bayswater PS Unit 1	330	BW01	NBAY1	NBAY	0.9591	0.9538
Bayswater PS Unit 2	330	BW02	NBAY2	NBAY	0.9591	0.9538
Bayswater PS Unit 3	500	BW03	NBAY3	NBYW	0.9597	0.9555
Bayswater PS Unit 4	500	BW04	NBAY4	NBYW	0.9597	0.9555
Beryl Solar Farm	66	BERYLSF1	NBES1B	NBES	0.9243	0.9654
Blowering	132	BLOWERNG	NBLW8	NBLW	0.9410	0.9900
Bodangora Wind Farm	132	BODWF1	NBOD1B	NBOD	0.9494	0.9819
Broken Hill GT 1	22	GB01	NBKG1	NBKG	0.8654	1.0603
Broken Hill Solar Farm	22	BROKENH1	NBK11B	NBK1	0.7579	0.9789
Burrinjuck PS	132	BURRIN	NBUK	NBUK	0.9684	1.0124
Capital Wind Farm	330	CAPTL_WF	NCWF1R	NCWF	0.9702	1.0100
Coleambally Solar Farm	132	COLEASF1	NCLS1C	NCLS	0.8705	1.0019
Colongra PS Unit 1	330	CG1	NCLG1D	NCLG	0.9849	0.9827
Colongra PS Unit 2	330	CG2	NCLG2D	NCLG	0.9849	0.9827
Colongra PS Unit 3	330	CG3	NCLG3D	NCLG	0.9849	0.9827
Colongra PS Unit 4	330	CG4	NCLG4D	NCLG	0.9849	0.9827
Crookwell 2 Wind Farm	330	CROOKWF2	NCKW1C	NCKW	0.9746	0.9963
Eraring 330 PS Unit 1	330	ER01	NEPS1	NEP3	0.9835	0.9828
Eraring 330 PS Unit 2	330	ER02	NEPS2	NEP3	0.9835	0.9828
Eraring 500 PS Unit 3	500	ER03	NEPS3	NEPS	0.9844	0.9853
Eraring 500 PS Unit 4	500	ER04	NEPS4	NEPS	0.9844	0.9853
Eraring PS Load	500	ERNL1	NEPSL	NEPS	0.9844	0.9853
Griffith Solar Farm	33	GRIFSF1	NGG11G	NGG1	0.9081	1.0603
Gullen Range Solar Farm	330	GULLRSF1	NGUR2G	NGUR	0.9695	0.9959

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Gullen Range Wind Farm	330	GULLRWF1	NGUR1G	NGUR	0.9695	0.9959
Guthega	132	GUTHEGA	NGUT8	NGUT	0.9026	0.9537
Guthega Auxiliary Supply	11	GUTHNL1	NMY11	NMY1	0.9928	1.0256
Hume (New South Wales Share)	132	HUMENSW	NHUM	NHUM	0.9625	1.0675
Kangaroo Valley – Bendeela (Shoalhaven) Generation – Dual MLF	330	SHGEN	NSHL	NSHN	0.9778	0.9981
Kangaroo Valley (Shoalhaven) Pumps – Dual MLF	330	SHPUMP	NSHP1	NSHN	0.9964	1.0137
Liddell 330 PS Load	330	LIDDNL1	NLDPL	NLDP	0.9591	0.9537
Liddell 330 PS Unit 1	330	LD01	NLDP1	NLDP	0.9591	0.9537
Liddell 330 PS Unit 2	330	LD02	NLDP2	NLDP	0.9591	0.9537
Liddell 330 PS Unit 3	330	LD03	NLDP3	NLDP	0.9591	0.9537
Liddell 330 PS Unit 4	330	LD04	NLDP4	NLDP	0.9591	0.9537
Lower Tumut Generation – dual MLF	330	TUMUT3	NLTS8	NLTS	0.9304	0.9954
Lower Tumut Pipeline Auxiliary	66	TUMT3NL3	NTU2L3	NTU2	0.9858	1.0438
Lower Tumut Pumps – dual MLF	330	SNOWYP	NLTS3	NLTS	1.0012	1.0545
Lower Tumut T2 Auxiliary	66	TUMT3NL1	NTU2L1	NTU2	0.9858	1.0438
Lower Tumut T4 Auxiliary	66	TUMT3NL2	NTU2L2	NTU2	0.9858	1.0438
Mt Piper PS Load	330	MPNL1	NMPPL	NMTP	0.9714	0.9738
Mt Piper PS Unit 1	330	MP1	NMTP1	NMTP	0.9714	0.9738
Mt Piper PS Unit 2	330	MP2	NMTP2	NMTP	0.9714	0.9738
Parkes Solar Farm	66	PARSF1	NPG11P	NPG1	0.9812	0.9964
Sapphire Wind Farm	330	SAPHWF1	NSAP1S	NSAP	0.9294	0.8821
Silverton Wind Farm	220	STWF1	NBKW1S	NBKW	0.8438	1.0062
Upper Tumut	330	UPPTUMUT	NUTS8	NUTS	0.9534	1.0112
Uranquinty PS Unit 11	132	URANQ11	NURQ1U	NURQ	0.8704	0.9609
Uranquinty PS Unit 12	132	URANQ12	NURQ2U	NURQ	0.8704	0.9609
Uranquinty PS Unit 13	132	URANQ13	NURQ3U	NURQ	0.8704	0.9609
Uranquinty PS Unit 14	132	URANQ14	NURQ4U	NURQ	0.8704	0.9609

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Vales Point 330 PS Load	330	VPNL1	NVPPL	NVPP	0.9864	0.9851
Vales Point 330 PS Unit 5	330	VP5	NVPP5	NVPP	0.9864	0.9851
Vales Point 330 PS Unit 6	330	VP6	NVPP6	NVPP	0.9864	0.9851
Woodlawn Wind Farm	330	WOODLWN1	NCWF2W	NCWF	0.9702	1.0100
White Rock Wind Farm	132	WRWF1	NWRK1W	NWRK	0.8390	0.8427
White Rock Solar Farm	132	WRSF1	NWRK2W	NWRK	0.8390	0.8427

Table 6 New South Wales embedded[6] generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
AGL Sita Landfill 1	132	AGLSITA1	NLP13K	NLP1	1.0009	1.0024
Appin Power Station	66	APPIN	NAPP1A	NAPP	0.9954	1.0010
Boco Rock Wind Farm	132	BOCORWF1	NCMA3B	NBCO	0.9556	1.0068
Broadwater PS	132	BWTR1	NLS21B	NLS2	1.0096	0.8965
Brown Mountain	66	BROWNMT	NCMA1	NCMA	0.9810	1.0307
Burrendong Hydro PS	132	BDONGHYD	NWL81B	NWL8	0.9834	0.9824
Campbelltown WSLC	66	WESTCBT1	NING1C	NING	0.9973	1.0006
Condong PS	110	CONDONG1	NTNR1C	NTNR	0.9822	0.9223
Copeton Hydro PS	66	COPTNHYD	NNVL1C	NNVL	0.9301	0.9063
Cullerin Range Wind Farm	132	CULLRGWF	NYS11C	NYS1	0.9716	1.0054
Eastern Creek	132	EASTCRK	NSW21	NSW2	1.0010	1.0033
Eraring 330 BS UN (GT)	330	ERGT01	NEP35B	NEP3	0.9835	0.9828
Glenbawn Hydro PS	132	GLBWNHYD	NMRK2G	NMRK	0.9726	0.9659
Glenn Innes (Pindari PS)	66	PINDARI	NGLN1	NGLN	0.9199	0.8920
Glennies Creek PS	132	GLENNCRK	NMRK3T	NMRK	0.9726	0.9659
Grange Avenue	132	GRANGEAV	NVYD1	NVYD	0.9997	0.9991
Gunning Wind Farm	132	GUNNING1	NYS12A	NYS1	0.9716	1.0054
Jindabyne Generator	66	JNDABNE1	NCMA2	NCMA	0.9810	1.0307
Jounama PS	66	JOUNAMA1	NTU21J	NTU2	0.9858	1.0438

[6] Please note that the breakdown between transmission connected and embedded generation is provided for information purposes only. Please refer to the Distribution Loss Factor publication to determine if a DLF applies, at http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2019/Distribution-Loss-Factors-for-the-2019-20-Financial-Year.pdf.

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Keepit	66	KEEPIT	NKPT	NKPT	0.9863	0.9579
Kincumber Landfill	66	KINCUM1	NGF31K	NGF3	1.0035	1.0011
Liddell 33 – Hunter Valley GTs	33	HVGTS	NLD31	NLD3	0.9653	0.9596
Liverpool 132 (Jacks Gully)	132	JACKSGUL	NLP11	NSW2	1.0010	1.0033
Lucas Heights II Power Plant	132	LUCASHGT	NSYS2G	NSYS	1.0001	1.0036
Lucas Heights Stage 2 Power Station	132	LUCAS2S2	NSYS1	NSYS	1.0001	1.0036
Manildra Solar Farm	132	MANSLR1	NMLS1M	NMLS	0.9818	0.9905
Moree Solar Farm	66	MOREESF1	NMR41M	NMR4	0.8602	0.8988
Narromine Solar Farm	132	NASF1	NWLS1N	NWLS	0.9603	0.9708
Nine Willoughby	132	NINEWIL1	NSE21R	NSE2	1.0070	1.0049
Nyngan Solar Farm	132	NYNGAN1	NWL82N	NWL8	0.9834	0.9824
Sithe (Holroyd Generation)	132	SITHE01	NSYW1	NHD2	1.0029	1.0000
South Keswick Solar Farm	132	SKSF1	NWLS2S	NWLS	0.9603	0.9708
St George Leagues Club	33	STGEORG1	NPHT1E	NPHT	1.0030	1.0063
Tahmoor PS	132	TAHMOOR1	NLP12T	NLP1	1.0009	1.0024
Tallawarra PS	132	TALWA1	NDT13T	NTWA	0.9895	1.0001
Taralga Wind Farm	132	TARALGA1	NMR22T	NMR2	1.0092	0.9977
Teralba Power Station	132	TERALBA	NNEW1	NNEW	0.9904	0.9901
The Drop Power Station	66	THEDROP1	NFNY1D	NFNY	0.9928	1.1441
Tower Power Plant	132	TOWER	NLP11T	NLP1	1.0009	1.0024
West Nowra	132	AGLNOW1	NDT12	NDT1	0.9931	1.0037
Wests Illawara Leagues Club	132	WESTILL1	NDT14E	NDT1	0.9931	1.0037
Wilga Park A	66	WILGAPK	NNB21W	NNB2	1.0026	0.9789
Wilga Park B	66	WILGB01	NNB22W	NNB2	1.0026	0.9789
Woodlawn Bioreactor	132	WDLNGN01	NMR21W	NMR2	1.0092	0.9977
Woy Woy Landfill	66	WOYWOY1	NGF32W	NGF3	1.0035	1.0011
Wyangala A PS	66	WYANGALA	NCW81A	NCW8	1.0320	1.0411
Wyangala B PS	66	WYANGALB	NCW82B	NCW8	1.0320	1.0411

Table 7 ACT loads

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Angle Crossing	132	AAXG	0.9890	1.0327
Belconnen	132	ABCN	0.9809	1.0288
City East	132	ACTE	0.9837	1.0322
Civic	132	ACVC	0.9812	1.0295
East lake	132	AELK	0.9825	1.0309
Gilmore	132	AGLM	0.9812	1.0303
Gold Creek	132	AGCK	0.9805	1.0283
Latham	132	ALTM	0.9800	1.0276
Telopea Park	132	ATLP	0.9833	1.0320
Theodore	132	ATDR	0.9805	1.0293
Wanniassa	132	AWSA	0.9814	1.0304
Woden	132	AWDN	0.9805	1.0296
ACT VTN	132	AAVT	0.9815	1.0300
Queanbeyan (ACTEW)	66	AQB1	0.9903	1.0438
Queanbeyan (Essential Energy)	66	AQB2	0.9903	1.0438

Table 8 ACT generation and embedded[7] generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Capital East Solar Farm	66	CESF1	AQB21C	AQB2	0.9903	1.0438
Mugga Lane Solar Farm	132	MLSP1	ACA12M	AMS1	0.9651	1.0200
Royalla Solar Farm	132	ROYALLA1	ACA11R	ARS1	0.9645	1.0178

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

[7] Please note that the breakdown between transmission connected and embedded generation is provided for information purposes only. Please refer to the Distribution Loss Factor publication to determine if a DLF applies, at http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2019/Distribution-Loss-Factors-for-the-2019-20-Financial-Year.pdf.

1.3 Victoria Marginal Loss Factors

Table 9 Victoria loads

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Altona	66	VATS	1.0032	1.0054
Altona	220	VAT2	0.9945	1.0018
Ballarat	66	VBAT	0.9759	1.0016
Bendigo	66	VBE6	1.0035	1.0136
Bendigo	22	VBE2	1.0045	1.0163
BHP Western Port	220	VJLA	0.9898	0.9944
Brooklyn (Jemena)	22	VBL2	1.0008	1.0051
Brooklyn (Jemena)	66	VBL6	1.0027	1.0042
Brooklyn (POWERCOR)	22	VBL3	1.0008	1.0051
Brooklyn (POWERCOR)	66	VBL7	1.0027	1.0042
Brunswick (CitiPower)	22	VBT2	0.9974	1.0008
Brunswick (Jemena)	22	VBTS	0.9974	1.0008
Brunswick 66 (CitiPower)	66	VBT6	0.9958	0.9992
Cranbourne	220	VCB2	0.9881	0.9935
Cranbourne (AusNet Services)	66	VCBT	0.9911	0.9957
Cranbourne (United Energy)	66	VCB5	0.9911	0.9957
Deer Park	66	VDPT	0.9983	1.0038
East Rowville (AusNet Services)	66	VER2	0.9944	0.9956
East Rowville (United Energy)	66	VERT	0.9944	0.9956
Fishermens Bend (CITIPOWER)	66	VFBT	0.9992	1.0034
Fishermens Bend (POWERCOR)	66	VFB2	0.9992	1.0034
Fosterville	220	VFVT	1.0026	1.0096
Geelong	66	VGT6	0.9911	1.0002
Glenrowan	66	VGNT	1.0188	0.9903
Heatherton	66	VHTS	0.9970	1.0001
Heywood	22	VHY2	0.9890	1.0028
Horsham	66	VHOT	0.9330	0.9957
Keilor (Jemena)	66	VKT2	0.9988	1.0024

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Keilor (POWERCOR)	66	VKTS	0.9988	1.0024
Kerang	22	VKG2	0.9949	1.0292
Kerang	66	VKG6	0.9854	1.0192
Khancoban	330	NKHN	1.0075	0.9459
Loy Yang Substation	66	VLY6	0.9757	0.9822
Malvern	22	VMT2	0.9943	0.9983
Malvern	66	VMT6	0.9932	0.9971
Morwell Power Station Units 1 to 3	66	VMWG	0.9724	0.9816
Morwell PS (G4&5)	11	VMWP	0.9770	0.9817
Morwell TS	66	VMWT	0.9938	0.9879
Mt Beauty	66	VMBT	1.0187	0.9882
Portland	500	VAPD	0.9924	1.0058
Pt Henry	220	VPTH	0.9856	0.9980
Red Cliffs	22	VRC2	0.9331	1.0129
Red Cliffs	66	VRC6	0.9160	1.0062
Red Cliffs (Essential Energy)	66	VRCA	0.9160	1.0062
Richmond	22	VRT2	0.9959	0.9996
Richmond (CITIPOWER)	66	VRT7	0.9972	1.0011
Richmond (United Energy)	66	VRT6	0.9972	1.0011
Ringwood (AusNet Services)	22	VRW3	0.9973	1.0007
Ringwood (AusNet Services)	66	VRW7	1.0003	1.0012
Ringwood (United Energy)	22	VRW2	0.9973	1.0007
Ringwood (United Energy)	66	VRW6	1.0003	1.0012
Shepparton	66	VSHT	1.0206	1.0002
South Morang (Jemena)	66	VSM6	0.9941	0.9979
South Morang (AusNet Services)	66	VSMT	0.9941	0.9979
Springvale (CITIPOWER)	66	VSVT	0.9987	0.9986
Springvale (United Energy)	66	VSV2	0.9987	0.9986
Templestowe (CITIPOWER)	66	VTS2	0.9985	1.0006
Templestowe (Jemena)	66	VTST	0.9985	1.0006
Templestowe (AusNet Services)	66	VTS3	0.9985	1.0006
Templestowe (United Energy)	66	VTS4	0.9985	1.0006

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Terang	66	VTGT	1.0071	1.0149
Thomastown (Jemena)	66	VTTS	1.0000	1.0000
Thomastown (AusNet Services)	66	VTT2	1.0000	1.0000
Tyabb	66	VTBT	0.9910	0.9958
Wemen 66 (Essential Energy)	66	VWEA	0.9234	1.0066
Wemen TS	66	VWET	0.9234	1.0066
West Melbourne	22	VWM2	0.9987	1.0019
West Melbourne (CITIPOWER)	66	VWM7	0.9994	1.0029
West Melbourne (Jemena)	66	VWM6	0.9994	1.0029
Wodonga	22	VWO2	1.0158	0.9735
Wodonga	66	VWO6	1.0111	0.9712
Yallourn	11	VYP1	0.9561	0.9584

Table 10 Victoria generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Ararat Wind Farm	220	ARWF1	VART1A	VART	0.9030	0.9691
Ballarat BESS - Generation	22	BALBG1	VBA21B	VBA2	0.9647	0.9948
Ballarat BESS - Load	22	BALBL1	VBA22B	VBA2	0.9864	1.0085
Banimboola	220	BAPS	VDPS2	VDPS	0.9472	0.9249
Basslink (Loy Yang Power Station Switchyard) Victoria to Tasmania	500	BLNKVIC	VLYP13	VTBL	0.9789	0.9839
Basslink (Loy Yang Power Station Switchyard) Tasmania to Victoria	500	BLNKVIC	VLYP13	VTBL	0.9728	0.9839
Coonooer Bridge Wind Farm	66	CBWF1	VBE61C	VBE6	1.0035	1.0136
Crowlands Wind Farm	220	CROWLWF1	VCWL1C	VCWL	0.9249	0.9803
Dartmouth PS	220	DARTM1	VDPS	VDPS	0.9472	0.9249
Eildon PS Unit 1	220	EILDON1	VEPS1	VEPS	0.9855	0.9782
Eildon PS Unit 2	220	EILDON2	VEPS2	VEPS	0.9855	0.9782
Gannawarra BESS (Generation)	66	GANNBG1	VKGB1G	VKGB	0.9679	1.0070
Gannawarra BESS (Load)	66	GANNBL1	VKGB2G	VKGL	1.0257	1.0311
Hazelwood PS Load	220	HWPNL1	VHWPL	VHWP	0.9767	0.9813
Jeeralang A PS Unit 1	220	JLA01	VJLGA1	VJLG	0.9733	0.9783

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Jeeralang A PS Unit 2	220	JLA02	VJLGA2	VJLG	0.9733	0.9783
Jeeralang A PS Unit 3	220	JLA03	VJLGA3	VJLG	0.9733	0.9783
Jeeralang A PS Unit 4	220	JLA04	VJLGA4	VJLG	0.9733	0.9783
Jeeralang B PS Unit 1	220	JLB01	VJLGB1	VJLG	0.9733	0.9783
Jeeralang B PS Unit 2	220	JLB02	VJLGB2	VJLG	0.9733	0.9783
Jeeralang B PS Unit 3	220	JLB03	VJLGB3	VJLG	0.9733	0.9783
Jindabyne pump at Guthega	132	SNOWYGJP	NGJP	NGJP	1.0254	1.0124
Kiata Wind Farm	66	KIATAWF1	VHOG1K	VHOG	0.9180	0.9911
Laverton PS (LNGS1)	220	LNGS1	VAT21L	VAT2	0.9945	1.0018
Laverton PS (LNGS2)	220	LNGS2	VAT22L	VAT2	0.9945	1.0018
Loy Yang A PS Load	500	LYNL1	VLYPL	VLYP	0.9754	0.9798
Loy Yang A PS Unit 1	500	LYA1	VLYP1	VLYP	0.9754	0.9798
Loy Yang A PS Unit 2	500	LYA2	VLYP2	VLYP	0.9754	0.9798
Loy Yang A PS Unit 3	500	LYA3	VLYP3	VLYP	0.9754	0.9798
Loy Yang A PS Unit 4	500	LYA4	VLYP4	VLYP	0.9754	0.9798
Loy Yang B PS Unit 1	500	LOYYB1	VLYP5	VLYP	0.9754	0.9798
Loy Yang B PS Unit 2	500	LOYYB2	VLYP6	VLYP	0.9754	0.9798
MacArthur Wind Farm	500	MACARTH1	VTRT1M	VTRT	0.9815	0.9971
McKay Creek / Bogong PS	220	MCKAY1	VMKP1	VT14	0.9601	0.9265
Mortlake Unit 1	500	MORTLK11	VM0P1O	VM0P	0.9855	0.9961
Mortlake Unit 2	500	MORTLK12	VM0P2O	VM0P	0.9855	0.9961
Mt Mercer Windfarm	220	MERCER01	VELT1M	VELT	0.9668	0.9909
Murray	330	MURRAY	NMUR8	NMUR	0.9516	0.9069
Murray (Geehi Tee off Auxiliary)	330	MURAYNL3	NMURL3	NMUR	0.9516	0.9069
Murray Power Station M1 Auxiliary	330	MURAYNL1	NMURL1	NMUR	0.9516	0.9069
Murray Power Station M2 Auxiliary	330	MURAYNL2	NMURL2	NMUR	0.9516	0.9069
Murra Warra Wind Farm	220	MUWAWF1	VMRT1M	VMRT	0.8852	0.9549
Newport PS	220	NPS	VNPS	VNPS	0.9922	0.9962
Numurkah Solar Farm	66	NUMURSF1	VSHS1N	VSHS	0.9897	0.9820
Salt Creek Wind Farm	66	SALTCRK1	VTG61S	VTG6	0.9731	1.0076
Valley Power Unit 1	500	VPGS1	VLYP07	VLYP	0.9754	0.9798

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Valley Power Unit 2	500	VPGS2	VLYP08	VLYP	0.9754	0.9798
Valley Power Unit 3	500	VPGS3	VLYP09	VLYP	0.9754	0.9798
Valley Power Unit 4	500	VPGS4	VLYP010	VLYP	0.9754	0.9798
Valley Power Unit 5	500	VPGS5	VLYP011	VLYP	0.9754	0.9798
Valley Power Unit 6	500	VPGS6	VLYP012	VLYP	0.9754	0.9798
Waubra Wind Farm	220	WAUBRAWF	VWBT1A	VWBT	0.9326	0.9784
Wemen Solar Farm	66	WEMENSF1	VWES2W	VWES	0.8261	0.9262
West Kiewa PS Unit 1	220	WKIEWA1	VWKP1	VWKP	0.9986	0.9607
West Kiewa PS Unit 2	220	WKIEWA2	VWKP2	VWKP	0.9986	0.9607
Yallourn W PS 220 Load	220	YWNL1	VYP2L	VYP2	0.9544	0.9573
Yallourn W PS 220 Unit 1	220	YWPS1	VYP21	VYP3	0.9650	0.9696
Yallourn W PS 220 Unit 2	220	YWPS2	VYP22	VYP2	0.9544	0.9573
Yallourn W PS 220 Unit 3	220	YWPS3	VYP23	VYP2	0.9544	0.9573
Yallourn W PS 220 Unit 4	220	YWPS4	VYP24	VYP2	0.9544	0.9573

Table 11 Victoria embedded[8] generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Bairnsdale Power Station	66	BDL01	VMWT2	VBDL	0.9871	0.9866
Bairnsdale Power Station Generator Unit 2	66	BDL02	VMWT3	VBDL	0.9871	0.9866
Bald Hills Wind Farm	66	BALDHWF1	VMWT9B	VMWT	0.9938	0.9879
Ballarat Health Services	66	BBASEHOS	VBAT1H	VBAT	0.9759	1.0016
Bannerton Solar Farm	66	BANN1	VWES1B	VWES	0.8261	0.9262
Broadmeadows Power Plant	66	BROADMDW	VTTS2B	VTTS	1.0000	1.0000
Brooklyn Landfill & Recycling Facility	66	BROOKLYN	VBL61	VBL6	1.0027	1.0042
Challicum Hills Wind Farm	66	CHALLHWF	VHOT1	VHOT	0.9330	0.9957
Chepstowe Wind Farm	66	CHPSTWF1	VBAT3C	VBAT	0.9759	1.0016
Clayton Landfill Gas Power Station	66	CLAYTON	VSV21B	VSV2	0.9987	0.9986
Clover PS	66	CLOVER	VMBT1	VMBT	1.0187	0.9882

[8] Please note that the breakdown between transmission connected and embedded generation is provided for information purposes only. Please refer to the Distribution Loss Factor publication to determine if a DLF applies, at http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2019/Distribution-Loss-Factors-for-the-2019-20-Financial-Year.pdf.

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Codrington Wind Farm	66	CODRNGTON	VTGT2C	VTGT	1.0071	1.0149
Corio LFG PS	66	CORIO1	VGT61C	VGT6	0.9911	1.0002
Eildon Hydro PS	66	EILDON3	VTT22E	VSMT	0.9941	0.9979
Gannawarra Solar Farm	66	GANNSF1	VKGS1G	VKGS	0.9014	0.9729
Glenmaggie Hydro PS	66	GLENMAG1	VMWT8G	VMWT	0.9938	0.9879
Hallam Mini Hydro	66	HLMSEW01	VER21H	VER2	0.9944	0.9956
Hallam Road Renewable Energy Facility	66	HALAMRD1	VER22L	VER2	0.9944	0.9956
Hepburn Community Wind Farm	66	HEPWIND1	VBAT2L	VBAT	0.9759	1.0016
Hume (Victorian Share)	66	HUMEV	VHUM	VHUM	0.9513	0.9498
Karadoc Solar Farm	66	KARSF1	VRCS1K	VRCS	0.8167	0.9472
Longford	66	LONGFORD	VMWT6	VMWT	0.9938	0.9879
Maroona Wind Farm	66	MAROOWF1	VBAT5M	VBAT	0.9759	1.0016
Mortons Lane Wind Farm	66	MLWF1	VTGT4M	VTGT	1.0071	1.0149
Mt Gellibrand Windfarm	66	MTGELWF1	VGTW1M	VGTW	0.9864	0.9989
Oaklands Hill Wind Farm	66	OAKLAND1	VTGT3A	VTGT	1.0071	1.0149
Rubicon Mountain Streams Station	66	RUBICON	VTT21R	VSMT	0.9941	0.9979
Shepparton Waste Gas	66	SHEP1	VSHT2S	VSHT	1.0206	1.0002
Somerton Power Station	66	AGLSOM	VTTS1	VSOM	0.9915	0.9963
Springvale Power Plant	66	SVALE1	VSV22S	VSV2	0.9987	0.9986
Tatura	66	TATURA01	VSHT1	VSHT	1.0206	1.0002
Timboon West Wind Farm	66	TIMWEST	VTGT5T	VTGT	0.9923	1.0149
Toora Wind Farm	66	TOORAWF	VMWT5	VMWT	0.9938	0.9879
Traralgon NSS	66	TGNSS1	VMWT1T	VMWT	0.9938	0.9879
William Hovell Hydro PS	66	WILLHOV1	VW061W	VGNT	1.0188	0.9903
Wollert Renewable Energy Facility	66	WOLLERT1	VSMT1W	VSMT	0.9941	0.9979
Wonthaggi Wind Farm	66	WONWP	VMWT7	VMWT	0.9938	0.9879
Yaloak South Wind Farm	66	YSWF1	VBAT4Y	VBAT	0.9759	1.0016
Yambuk Wind Farm	66	YAMBUKWF	VTGT1	VTGT	1.0071	1.0149
Yarrawonga Hydro PS	66	YWNGAHYD	VSHT3Y	VSHT	1.0206	1.0002
Yawong Wind Farm	66	YAWWF1	VBE62Y	VBE6	1.0035	1.0136

1.4 South Australia Marginal Loss Factors

Table 12 South Australia loads

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Angas Creek	33	SANC	1.0098	1.0080
Ardrossan West	33	SARW	0.9416	0.9582
Back Callington	11	SBAC	1.0136	1.0094
Baroota	33	SBAR	0.9955	0.9997
Berri	66	SBER	1.1301	1.0072
Berri (POWERCOR)	66	SBE1	1.1301	1.0072
Blanche	33	SBLA	1.0294	0.9693
Blanche (POWERCOR)	33	SBL1	1.0294	0.9693
Brinkworth	33	SBRK	0.9937	0.9967
Bungama Industrial	33	SBUN	0.9887	0.9939
Bungama Rural	33	SBUR	0.9972	1.0026
City West	66	SACR	1.0072	1.0044
Clare North	33	SCLN	0.9920	0.9924
Dalrymple	33	SDAL	0.9065	0.9258
Davenport	275	SDAV	0.9934	0.9928
Davenport	33	SDAW	0.9954	0.9941
Dorrien	33	SDRN	1.0049	1.0064
East Terrace	66	SETC	1.0020	1.0036
Happy Valley	66	SHVA	1.0049	1.0054
Hummocks	33	SHUM	0.9594	0.9724
Kadina East	33	SKAD	0.9650	0.9791
Kanmantoo	11	SKAN	1.0136	1.0087
Keith	33	SKET	1.0259	0.9952
Kilburn	66	SKLB	0.9998	1.0019
Kincraig	33	SKNC	1.0248	0.9799
Lefevre	66	SLFE	0.9997	0.9999
Leigh Creek	33	SLCC	1.0540	1.0506
Leigh Creek South	33	SLCS	1.0601	1.0549

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Magill	66	SMAG	1.0041	1.0039
Mannum	33	SMAN	1.0148	1.0090
Mannum – Adelaide Pipeline 1	3.3	SMA1	1.0177	1.0135
Mannum – Adelaide Pipeline 2	3.3	SMA2	1.0156	1.0122
Mannum – Adelaide Pipeline 3	3.3	SMA3	1.0152	1.0121
Middleback	33	SMDL	0.9972	0.9996
Middleback	132	SMBK	0.9955	1.0014
Millbrook	132	SMLB	1.0037	1.0040
Mobilong	33	SMBL	1.0141	1.0079
Morgan – Whyalla Pipeline 1	3.3	SMW1	1.0529	1.0023
Morgan – Whyalla Pipeline 2	3.3	SMW2	1.0296	0.9991
Morgan – Whyalla Pipeline 3	3.3	SMW3	1.0077	0.9947
Morgan – Whyalla Pipeline 4	3.3	SMW4	0.9966	0.9919
Morphett Vale East	66	SMVE	1.0049	1.0068
Mount Barker South	66	SMBS	1.0068	1.0050
Mt Barker	66	SMBA	1.0058	1.0043
Mt Gambier	33	SMGA	1.0325	0.9708
Mt Gunson South	132	SMGS	1.1306	1.0257
Mt Gunson	33	SMGU	1.1146	1.0257
Munno Para	66	SMUP	1.0005	1.0002
Murray Bridge – Hahndorf Pipeline 1	11	SMH1	1.0171	1.0129
Murray Bridge – Hahndorf Pipeline 2	11	SMH2	1.0182	1.0157
Murray Bridge – Hahndorf Pipeline 3	11	SMH3	1.0156	1.0140
Neuroodla	33	SNEU	1.0253	1.0226
New Osborne	66	SNBN	0.9996	0.9997
North West Bend	66	SNWB	1.0541	1.0013
Northfield	66	SNFD	1.0019	1.0031
Para	66	SPAR	1.0005	1.0026
Parafield Gardens West	66	SPGW	1.0012	1.0030
Penola West 33	33	SPEN	1.0206	0.9664
Pimba	132	SPMB	1.2248	1.0731
Playford	132	SPAA	0.9927	0.9918

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Port Lincoln	33	SPLN	0.9786	0.9850
Port Pirie	33	SPPR	0.9946	0.9990
Roseworthy	11	SRSW	1.0083	1.0090
Snuggery Industrial – Dual MLF (Generation)	33	SSNN	1.0002	0.9430
Snuggery Industrial – Dual MLF (Load)	33	SSNN	1.0169	0.9482
Snuggery Rural	33	SSNR	1.0054	0.9457
South Australian VTN		SJP1	1.0058	0.9998
Stony Point	11	SSPN	0.9983	0.9990
Tailem Bend	33	STAL	1.0160	1.0017
Templers	33	STEM	1.0031	1.0046
Torrens Island	66	STSY	1.0000	1.0000
Waterloo	33	SWAT	0.9851	0.9886
Whyalla Central Substation	33	SWYC	1.0003	0.9996
Whyalla Terminal BHP	33	SBHP	1.0004	0.9988
Woomera	132	SWMA	1.1265	1.0320
Wudina	66	SWUD	0.9932	1.0049
Yadnarie	66	SYAD	0.9803	0.9927

Table 13 South Australia generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Bungala One Solar Farm	132	BNGSF1	SBEM1B	SBEM	0.9716	0.9700
Bungala Two Solar Farm	132	BNGSF2	SBEM2B	SBEM	0.9716	0.9700
Cathedral Rocks Wind Farm	132	CATHROCK	SCRK	SCRK	0.8857	0.8860
Clements Gap Wind Farm	132	CLEMGPWF	SCGW1P	SCGW	0.9582	0.9683
Dry Creek PS Unit 1	66	DRYCGT1	SDCA1	SDPS	0.9958	1.0030
Dry Creek PS Unit 2	66	DRYCGT2	SDCA2	SDPS	0.9958	1.0030
Dry Creek PS Unit 3	66	DRYCGT3	SDCA3	SDPS	0.9958	1.0030
Dalrymple North BESS (Generation)	33	DALNTH01	SDAN1D	SDAN	0.9027	0.8880
Dalrymple North BESS (Load)	33	DALNTHL1	SDAN2D	SDAN	0.9992	0.9326
Hallett PS	275	AGLHAL	SHPS1	SHPS	0.9747	0.9715
Hallett 1 Wind Farm	275	HALLWF1	SHPS2W	SHPS	0.9747	0.9715

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Hallet 2 Wind Farm	275	HALLWF2	SMOK1H	SMOK	0.9770	0.9715
Hornsdale Wind Farm Stage 1	275	HDWF1	SHDW1H	SHDW	0.9698	0.9744
Hornsdale Wind Farm Stage 2	275	HDWF2	SHDW2H	SHDW	0.9698	0.9744
Hornsdale Wind Farm Stage 3	275	HDWF3	SHDW3H	SHDW	0.9698	0.9744
Hornsdale Battery (Generation)	275	HPRG1	SMTL1H	SMTL	0.9830	0.9771
Hornsdale Battery (Load)	275	HPRL1	SMTL2H	SMTL	0.9842	0.9853
Ladbroke Grove PS Unit 1	132	LADBROK1	SPEW1	SPEW	0.9810	0.9474
Ladbroke Grove PS Unit 2	132	LADBROK2	SPEW2	SPEW	0.9810	0.9474
Lake Bonney Wind Farm	33	LKBONNY1	SMAY1	SMAY	0.9788	0.9144
Lake Bonney Wind Farm Stage 2	33	LKBONNY2	SMAY2	SMAY	0.9788	0.9144
Lake Bonney Wind Farm Stage 3	33	LKBONNY3	SMAY3W	SMAY	0.9788	0.9144
Lincoln Gap Wind Farm	275	LGAPWF1	SLGW1L	SLGW	0.9820	0.9947
Mintaro PS	132	MINTARO	SMPS	SMPS	0.9779	0.9942
Mt Millar Wind Farm	33	MTMILLAR	SMTM1	SMTM	0.8935	0.9055
North Brown Hill Wind Farm	275	NBHWF1	SBEL1A	SBEL	0.9729	0.9674
O.C.P.L. Unit 1	66	OSB-AG	SNBN1	SOCP	0.9995	0.9992
Pelican Point PS	275	PPCCGT	SPPT	SPPT	0.9986	1.0005
Port Lincoln 3	33	POR03	SPL31P	SPL3	0.9702	1.0383
Port Lincoln PS	132	POR01	SPLN1	SPTL	0.9669	0.9691
Quarantine PS Unit 1	66	QPS1	SQPS1	SQPS	0.9961	0.9854
Quarantine PS Unit 2	66	QPS2	SQPS2	SQPS	0.9961	0.9854
Quarantine PS Unit 3	66	QPS3	SQPS3	SQPS	0.9961	0.9854
Quarantine PS Unit 4	66	QPS4	SQPS4	SQPS	0.9961	0.9854
Quarantine PS Unit 5	66	QPS5	SQPS5Q	SQPS	0.9961	0.9854
Snowtown Wind Farm Stage 2 – North	275	SNOWNTH1	SBLWS1	SBLW	0.9721	0.9813
Snowtown Wind Farm Stage 2 – South	275	SNOWSTH1	SBLWS2	SBLW	0.9721	0.9813
Snowtown Wind Farm	33	SNOWTWN1	SNWF1T	SNWF	0.9094	0.9203
Snuggery PS Units 1 to 3	132	SNUG1	SSGA1	SSPS	0.9498	0.9325

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Tailem Bend Solar Farm	132	TBSF1	STBS1T	STBS	1.0054	0.9973
The Bluff wind Farm	275	BLUFF1	SBEL2P	SBEL	0.9729	0.9674
Torrens Island PS A Unit 1	275	TORRA1	STSA1	STPS	0.9992	1.0009
Torrens Island PS A Unit 2	275	TORRA2	STSA2	STPS	0.9992	1.0009
Torrens Island PS A Unit 3	275	TORRA3	STSA3	STPS	0.9992	1.0009
Torrens Island PS A Unit 4	275	TORRA4	STSA4	STPS	0.9992	1.0009
Torrens Island PS B Unit 1	275	TORRB1	STSB1	STPS	0.9992	1.0009
Torrens Island PS B Unit 2	275	TORRB2	STSB2	STPS	0.9992	1.0009
Torrens Island PS B Unit 3	275	TORRB3	STSB3	STPS	0.9992	1.0009
Torrens Island PS B Unit 4	275	TORRB4	STSB4	STPS	0.9992	1.0009
Torrens Island PS Load	66	TORNL1	STSYL	STSY	1.0000	1.0000
Waterloo Wind Farm	132	WATERLWF	SWLE1R	SWLE	0.9677	0.9712
Wattle Point Wind Farm	132	WPWF	SSYP1	SSYP	0.8124	0.8279
Willogoleche Wind Farm	275	WGWF1	SWGL1W	SWGL	0.9827	0.9689

Table 14 South Australia embedded[9] generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Angaston Power Station	33	ANGAST1	SDRN1	SANG	0.9493	1.0087
Bolivar WWT Plant	66	BOLIVAR1	SPGW1B	SPGW	1.0012	1.0030
Canunda Wind Farm	33	CNUNDAWF	SSNN1	SCND	0.9892	0.9237
Cummins Lonsdale PS	66	LONSDALE	SMVE1	SMVE	1.0049	1.0068
Morphett Vale East 66 (Generation)	66	SATGS1	SMVG1L	SMVG	1.0043	1.0061
Para 66 (Generation)	66	SATGN1	SPAG1E	SPAG	1.0003	0.9971
Pt Stanvac PS	66	PTSTAN1	SMVE3P	SMVE	1.0049	1.0068
Starfish Hill Wind Farm	66	STARHLWF	SMVE2	SMVE	1.0049	1.0068
Tatiara Meat Co	33	TATIARA1	SKET1E	SKET	1.0259	0.9952
Wingfield 1 LFG PS	66	WINGF1_1	SKLB1W	SKLB	0.9998	1.0019
Wingfield 2 LFG PS	66	WINGF2_1	SNBN2W	SNBN	0.9996	0.9997

[9] Please note that the breakdown between transmission connected and embedded generation is provided for information purposes only. Please refer to the Distribution Loss Factor publication to determine if a DLF applies, at http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2019/Distribution-Loss-Factors-for-the-2019-20-Financial-Year.pdf.

1.5 Tasmania Marginal Loss Factors

Table 15 Tasmania loads

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Arthurs Lake	6.6	TAL2	0.9902	0.9943
Avoca	22	TAV2	1.0064	1.0140
Boyer SWA	6.6	TBYA	1.0168	1.0227
Boyer SWB	6.6	TBYB	1.0169	1.0239
Bridgewater	11	TBW2	1.0265	1.0233
Burnie	22	TBU3	0.9850	0.9857
Chapel St.	11	TCS3	1.0187	1.0231
Comalco	220	TCO1	1.0006	1.0006
Creek Road	33	TCR2	1.0186	1.0232
Derby	22	TDE2	0.9577	0.9647
Derwent Bridge	22	TDB2	0.9325	0.9386
Devonport	22	TDP2	0.9885	0.9885
Electrona	11	TEL2	1.0308	1.0360
Emu Bay	11	TEB2	0.9815	0.9832
Fisher (Rowallan)	220	TFI1	0.9688	0.9660
George Town	22	TGT3	1.0020	1.0025
George Town (Basslink)	220	TGT1	1.0000	1.0000
Gordon	22	TGO2	0.9984	1.0024
Greater Hobart Area VTN		TVN1	1.0195	1.0236
Hadspen	22	THA3	0.9939	0.9967
Hampshire	110	THM2	0.9798	0.9819
Huon River	11	THR2	1.0259	1.0380
Kermandie	11	TKE2	1.0343	1.0399
Kingston	33	TK13	1.0233	1.0290
Kingston	11	TKI2	1.0258	1.0306
Knights Road	11	TKR2	1.0364	1.0433
Lindisfarne	33	TLF2	1.0202	1.0237
Meadowbank	22	TMB2	0.9828	0.9938

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Mornington	33	TMT2	1.0224	1.0239
Mowbray	22	TMY2	0.9924	0.9955
New Norfolk	22	TNN2	1.0112	1.0179
Newton	22	TNT2	0.9731	0.9773
Newton	11	TNT3	0.9611	0.9552
North Hobart	11	TNH2	1.0176	1.0224
Norwood	22	TNW2	0.9923	0.9951
Palmerston	22	TPM3	0.9816	0.9847
Port Latta	22	TPL2	0.9573	0.9604
Que	22	TQU2	0.9729	0.9743
Queenstown	11	TQT3	0.9637	0.9635
Queenstown	22	TQT2	0.9639	0.9629
Railton	22	TRA2	0.9894	0.9900
Risdon	33	TRI4	1.0195	1.0245
Risdon	11	TRI3	1.0219	1.0257
Rokeby	11	TRK2	1.0223	1.0259
Rosebery	44	TRB2	0.9733	0.9750
Savage River	22	TSR2	1.0030	0.9938
Scottsdale	22	TSD2	0.9704	0.9731
Smithton	22	TST2	0.9409	0.9482
Sorell	22	TSO2	1.0284	1.0317
St Leonard	22	TSL2	0.9921	0.9947
St. Marys	22	TSM2	1.0224	1.0284
Starwood	110	TSW1	1.0009	1.0011
Tamar Region VTN		TVN2	0.9938	0.9965
Temco	110	TTE1	1.0037	1.0043
Trevallyn	22	TTR2	0.9931	0.9961
Triabunna	22	TTB2	1.0393	1.0454
Tungatinah	22	TTU2	0.9351	0.9396
Ulverstone	22	TUL2	0.9847	0.9879
Waddamana	22	TWA2	0.9465	0.9617
Wayatinah	11	TWY2	0.9958	1.0006

Location	Voltage (kV)	TNI	2019-20 MLF	2018-19 MLF
Wesley Vale	22	TWV2	0.9890	0.9867

Table 16 Tasmania generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Basslink (George Town)	220	BLNKTAS	TGT11	TGT1	1.0000	1.0000
Bastyan	220	BASTYAN	TFA11	TFA1	0.9456	0.9410
Bell Bay No.3	110	BBTHREE1	TBB11	TBB1	0.9997	1.0003
Bell Bay No.3	110	BBTHREE2	TBB12	TBB1	0.9997	1.0003
Bell Bay No.3	110	BBTHREE3	TBB13	TBB1	0.9997	1.0003
Bluff Point and Studland Bay Wind Farms	110	WOOLNTH1	TST11	TST1	0.8900	0.8952
Butlers Gorge	110	BUTLERSG	TBG11	TBG1	0.9305	0.9350
Catagunya	220	LI_WY_CA	TLI11	TLI1	0.9936	0.9977
Cethana	220	CETHANA	TCE11	TCE1	0.9658	0.9628
Cluny	220	CLUNY	TCL11	TCL1	0.9961	1.0019
Devils gate	110	DEVILS_G	TDG11	TDG1	0.9698	0.9692
Fisher	220	FISHER	TFI11	TFI1	0.9688	0.9660
Gordon	220	GORDON	TGO11	TGO1	0.9594	0.9868
John Butters	220	JBUTTERS	TJB11	TJB1	0.9370	0.9365
Lake Echo	110	LK_ECHO	TLE11	TLE1	0.9257	0.9385
Lemonthyme	220	LEM_WIL	TSH11	TSH1	0.9716	0.9701
Liapootah	220	LI_WY_CA	TLI11	TLI1	0.9936	0.9977
Mackintosh	110	MACKNTSH	TMA11	TMA1	0.9347	0.9282
Meadowbank	110	MEADOWBK	TMB11	TMB1	0.9716	0.9773
Musselroe	110	MUSSELR1	TDE11M	TDE1	0.9060	0.9105
Paloona	110	PALOONA	TPA11	TPA1	0.9702	0.9771
Poatina	220	POAT220	TPM11	TPM1	0.9846	0.9912
Poatina	110	POAT110	TPM21	TPM2	0.9728	0.9799
Reece No.1	220	REECE1	TRCA1	TRCA	0.9410	0.9350
Reece No.2	220	REECE2	TRCB1	TRCB	0.9351	0.9264
Repulse	220	REPULSE	TCL12	TCL1	0.9961	1.0019
Rowallan	220	ROWALLAN	TFI12	TFI1	0.9688	0.9660

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Tamar Valley CCGT	220	TVCC201	TTV11A	TTV1	1.0000	0.9999
Tamar Valley OCGT	110	TVPP104	TBB14A	TBB1	0.9997	1.0003
Tarraleah	110	TARRALEA	TTA11	TTA1	0.9363	0.9405
Trevallyn	110	TREVALLN	TTR11	TTR1	0.9889	0.9909
Tribute	220	TRIBUTE	TTI11	TTI1	0.9401	0.9377
Tungatinah	110	TUNGATIN	TTU11	TTU1	0.9065	0.9184
Wayatinah	220	LI_WY_CA	TLI11	TLI1	0.9936	0.9977
Wilmot	220	LEM_WIL	TSH11	TSH1	0.9716	0.9701

Table 17 Tasmania embedded[10] generation

Location	Voltage (kV)	DUID	Connection Point ID	TNI	2019-20 MLF	2018-19 MLF
Midlands PS	22	MIDLDPS1	TAV21M	TAV2	1.0064	1.0140
Remount	22	REMOUNT	TMY21	TVN2	0.9938	0.9965

[10] Please note that the breakdown between transmission connected and embedded generation is provided for information purposes only. Please refer to the Distribution Loss Factor publication to determine if a DLF applies, at http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2019/Distribution-Loss-Factors-for-the-2019-20-Financial-Year.pdf.

2. Changes in Marginal Loss Factors

2.1 MLFs 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[11].

2.2 Reasons why MLFs 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 regional reference node (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 regional reference node, 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.

[11] AEMO, Treatment of Loss Factors in the National Electricity Market,1 July 2012, available 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 2018-19 MLF and 2019-20 MLF

This section summarises the changes in MLFs for 2019-20 from the 2018-19 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 2019-20 calculations, and key changes from 2018-19.

2.3.1 Changes to Marginal Loss Factors in Queensland

In the 2019-20 MLF study, Queensland thermal generation, is projected to decrease by more than the projected increase from new wind and solar projects. Consequently, the net total energy transferred from Queensland to New South Wales through the interconnectors is projected to reduce for the 2019-20 MLF calculation study compared to the 2018-19 study.

Electricity generated by new solar and wind generators connecting and ramping up in north and central Queensland will increase power flow from the north of the region toward the RRN located in Brisbane.

Central Queensland coal generation projections are lower in the 2019-20 MLF calculation study than the 2018-19 study, however the impact of increased renewable generation is greater than the decrease in coal generation. This means the power flow from central Queensland to south Queensland is higher in the 2019-20 MLF study than the 2018-19 study.

The increase in projected power flow from north and central Queensland toward the RRN has led to decreases in MLFs for connection points in northern Queensland of 0.8% on average and decreases for connection points in central Queensland of 0.47% on average.

The MLFs for connection points in north Queensland have decreased more than those in central Queensland due to a combination of two issues:

- First, the network impedance between northern Queensland and the RRN is higher than it is for central Queensland.
- Second, much of the new renewable generation is located northern Queensland.

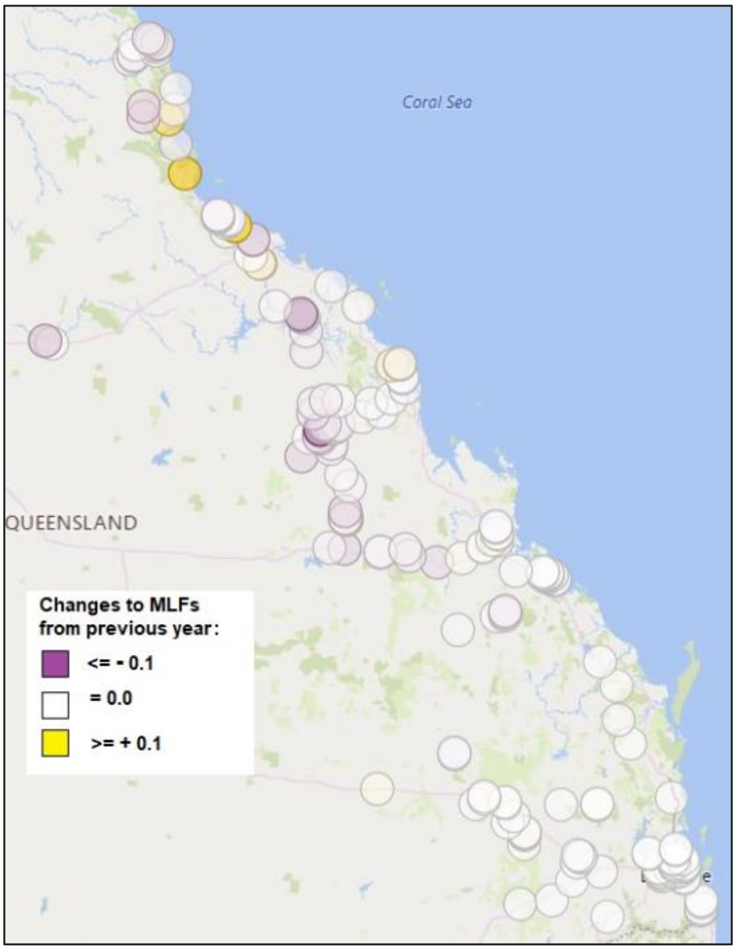
Combined, these issues mean the increase in projected losses between north Queensland and the RRN is higher than that between central Queensland and the RRN.

South-west Queensland MLFs reduced on average by 0.04% due to expected new generation in the area as well as the reduction in projected flow south across the QNI interconnector.

MLFs for connection points in south east Queensland have not changed substantially from 2019-20, because most connection points in the area are electrically close to the RRN.

Figure 1 shows the changes to MLFs at Queensland connection points in the 2019-20 study compared to the previous year.

Figure 1 Queensland changes to 2019-20 MLFs



2.3.2 Changes to Marginal Loss Factors in New South Wales

MLFs for connection points in the south of New South Wales and the ACT, including Canberra and Snowy, have decreased on average by 3.8% and 3.6% respectively. New renewable generation connections in the area, combined with a reduction in projected interconnector flow from Queensland as well as from New South Wales to Victoria, have resulted in an effective projected power flow increase toward the RRN in western Sydney from the south of the region.

MLFs for connection points in south-west New South Wales have decreased by 11% on average. The amount of wind and solar generation that has connected near Broken Hill has increased, thus increasing the projected power flow toward the RRN substantially.

MLFs for most connection points in west New South Wales have reduced by 1.5% on average from 2018-19 to 2019-20. The new solar and wind farms in this area contributed to an increase in flow towards the RRN hence MLFs in the area have decreased.

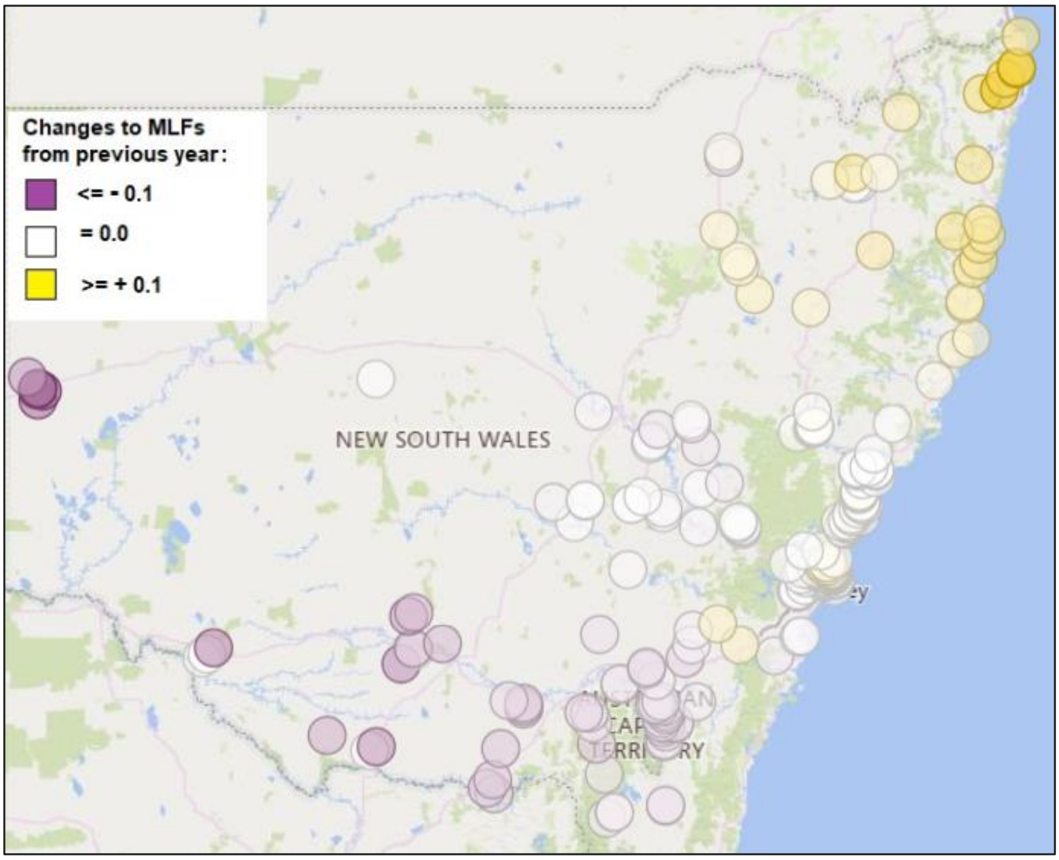
MLFs for connection points in the Sydney zone have not changed substantially from 2018-19 since most connection points in the area are electrically close to the RRN.

Connection points in north New South Wales have increased by 2.8% on average due to reduced projected interconnector import from Queensland. However, there are localised reductions in MLF connected to the 132 kV transmission network caused by projected increases in generation connected to this network.

Changes in MLFs for the Hunter region from 2018-19 to 2019-20 are very small due to the lack of changes to the supply and demand balance in this area compared to previous year.

Figure 2 shows the changes to MLFs at New South Wales connection points in the 2019-20 study compared to the previous year.

Figure 2 New South Wales changes to 2019-20 MLFs



2.3.3 Changes to Marginal Loss Factors in Victoria

MLFs for connection points in central and north-west Victoria have decreased on average by 3.3% and 7.5% respectively. This is due to the increase in projected generation in the region from new wind and solar farms, causing an increase in projected power flow from these areas to the RRN located in Melbourne, as well as additional power from South Australia through the Murraylink interconnector.

Connection points in north Victoria lie on the transmission flow path connecting the main components of the Victoria – New South Wales interconnection with the RRN. MLFs in north Victoria have increased by 1.8% on average due to increased generation in Victoria and increased imports from South Australia resulting in increased flows to New South Wales.

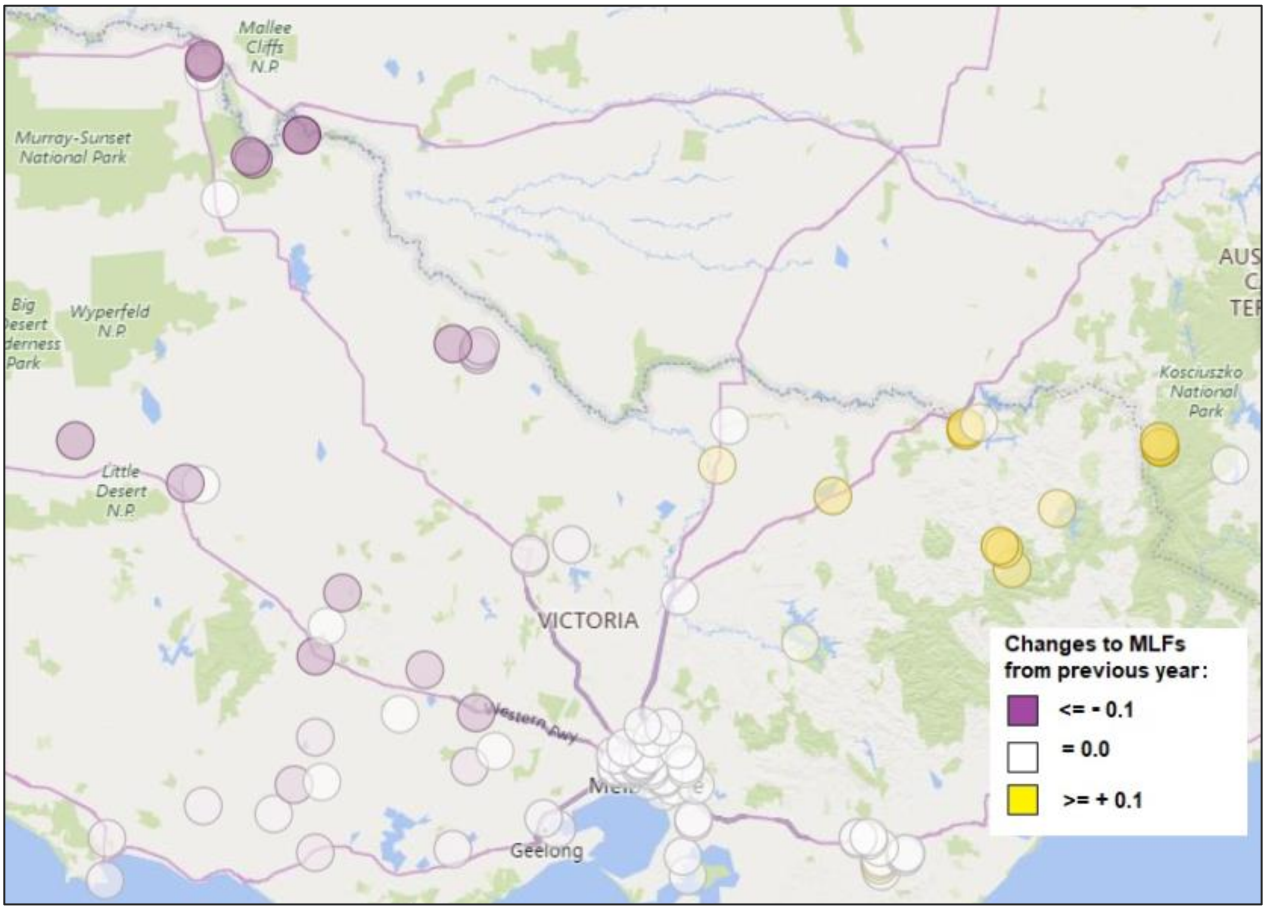
MLFs for connection points in western Victoria have decreased by 1.7% on average, largely due to the projected decrease in interconnector export to South Australia and the new wind farms scheduled to connect in that area. Connection points in this zone lie on the transmission flow path connecting the Victorian RRN with the Heywood interconnector. A decrease in projected interconnector export effectively increases power flow from these connection points to the RRN.

The average changes to the MLFs for connection points in the Latrobe Valley reduced by 0.1%. The total forecast generation in that area has reduced by close to 10% compared to 2018-19 however the flow to Tasmania has also reversed this year, with net import from Tasmania to Victoria in the 2019-20 study.

MLFs for connection points in the Melbourne zone have reduced on average 0.4%. from 2018-19 to 2019-20, as the connection points in this zone are electrically close to the RRN.

Figure 3 shows the changes to MLFs at Victorian connection points in the 2019-20 study compared to the previous year.

Figure 3 Victoria changes to 2019-20 MLFs



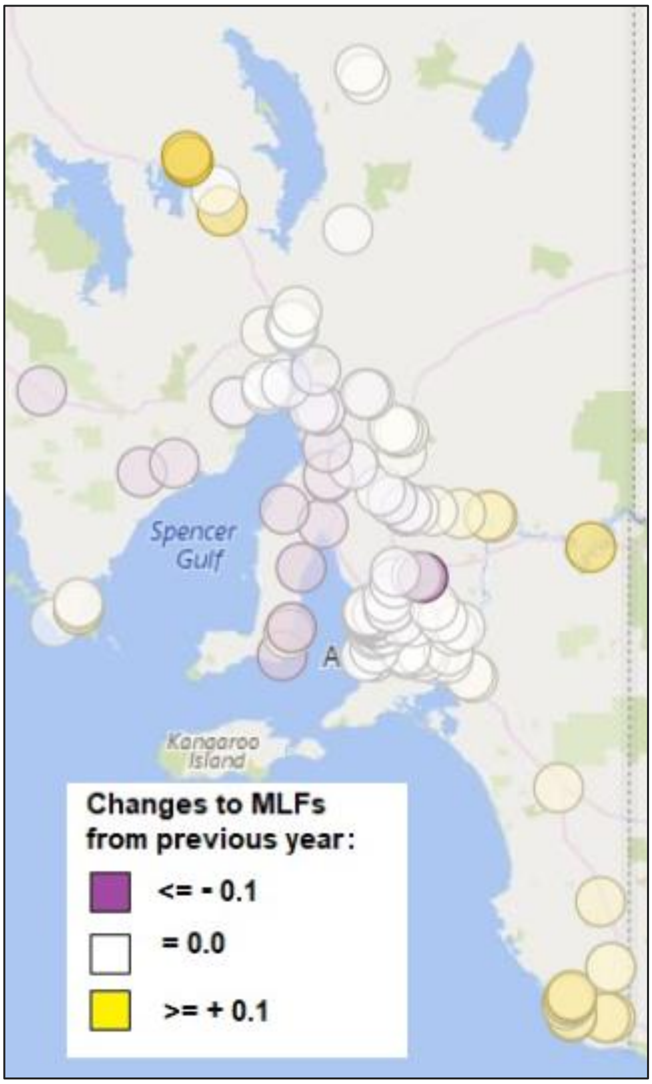
2.3.4 Changes to Marginal Loss Factors in South Australia

Loss factors in the Riverland and south-east South Australia zones have increased on average by 4.2% and 3.8% respectively. Connection points for these zones lie on the transmission corridors between the Heywood and Murraylink interconnectors and the RRN. Projected transfer across these interconnectors reversed this year from Victoria – South Australia to South Australia – Victoria. The resulting projected increased power flow from the South Australia reference node to these regions has led to increased MLFs.

MLFs for connection points in the Adelaide zone have not changed on average from 2018-19 to 2019-20. This is because the connection points in this zone are generally electrically closer to the RRN.

Figure 4 shows the changes to MLFs at South Australian connection points in the 2019-20 study compared to the previous year.

Figure 4 South Australia changes to 2019-20 MLFs



2.3.5 Changes to Marginal Loss Factors in Tasmania

Basslink flow is an input into the MLF calculation (as detailed in A2.4.2). In the 2019-20 studies net power transfers are from Tasmania to the Mainland which differs from the 2018-19 studies where net power transfer were from the mainland to Tasmania,

The impact of these changes is to reduce MLFs by 3.2% on average for connection points in the south Tasmania zone, and 1.7% for connection points in the north Tasmania zone. Generation from these regions increases to meet the additional demand due to lack of imports from Victoria.

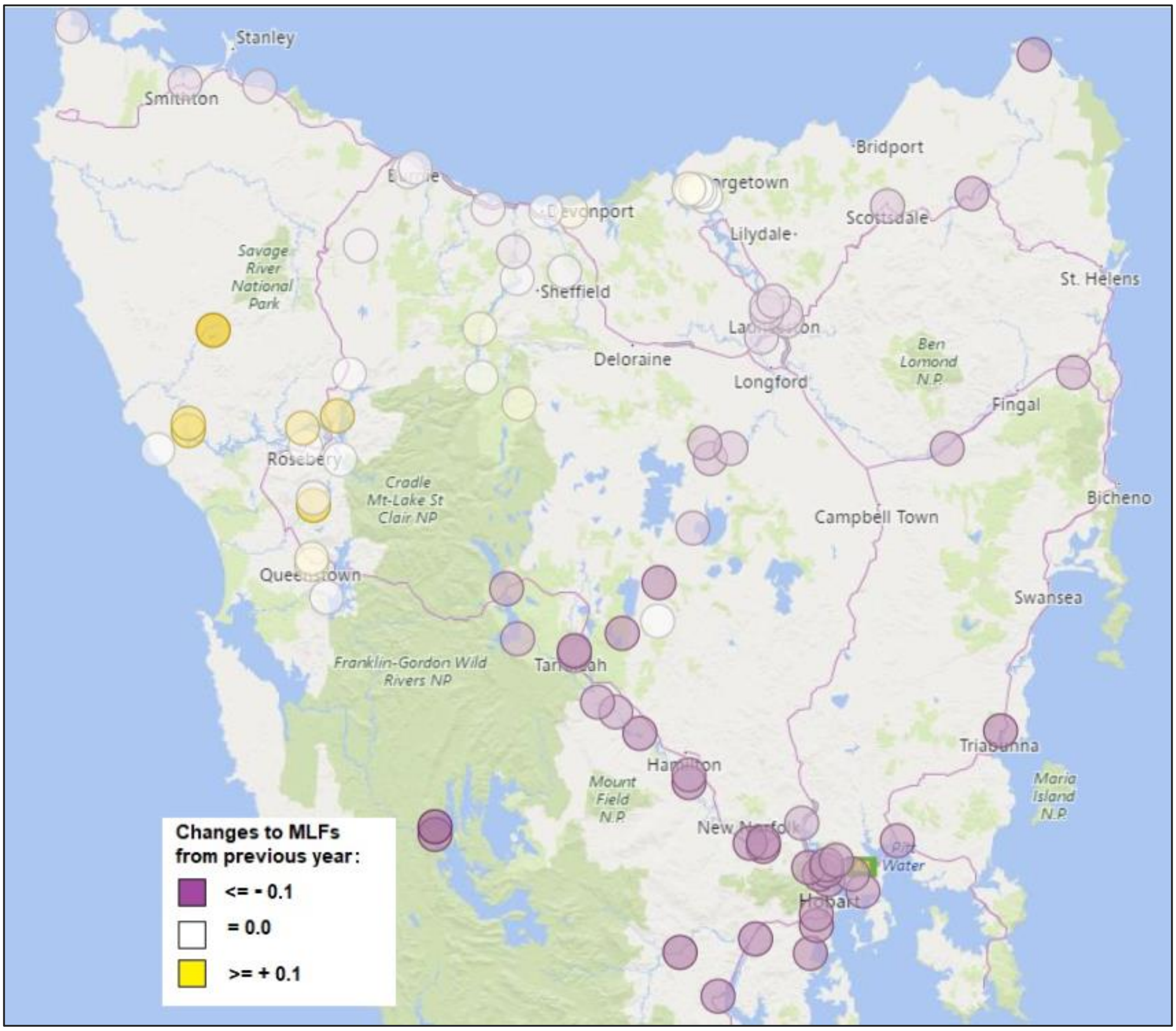
MLFs for connection points in north-west Tasmania decreased by 0.4% on average, due to small changes in demand within this zone.

The MLFs for connection points on the west coast have only reduced by 0.2%, as there has been little change in supply and demand since the 2018-19 study.

MLFs for connection points in the Georgetown zone have not materially changed on average from 2018-19 to 2019-20, because the connection points in this zone are electrically close to the RRN.

Figure 5 shows the changes to MLFs at Tasmanian connection points in the 2019-20 study compared to the previous year.

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 regional reference node (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)

= 0.9531+ 1.9622E-04*NQt -3.9458E-07*Nd + 1.0027E-05*Qd

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

= 1.061+ 1.7268E-04*VNt -3.0201E-05*Vd + 2.147E-05*Nd -6.6377E-05*Sd

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

= 1.0129+ 2.969E-04*VSAt + 1.445E-06*Vd -1.227E-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)**

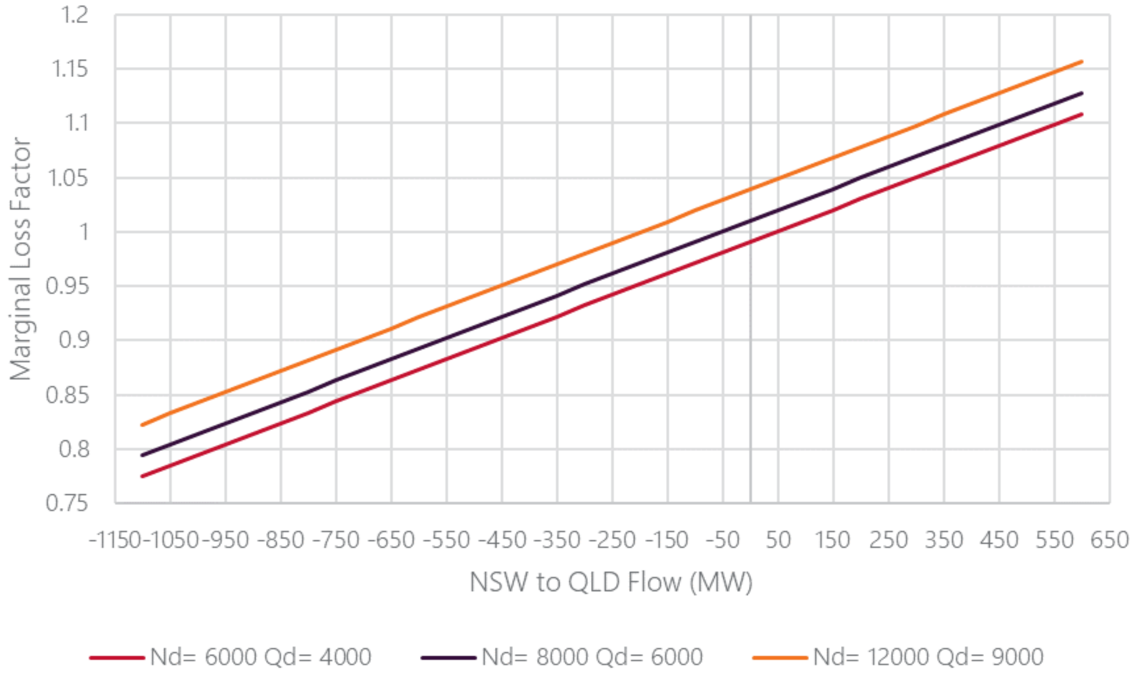


Table 18 South Pine 275 referred to Sydney West 330 MLF versus New South Wales to Queensland flow coefficient statistics

Coefficient	Qd	Nd	NQt	CONSTANT
Coefficient value	1.0027E-05	-3.9458E-07	1.9622E-04	0.9531

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

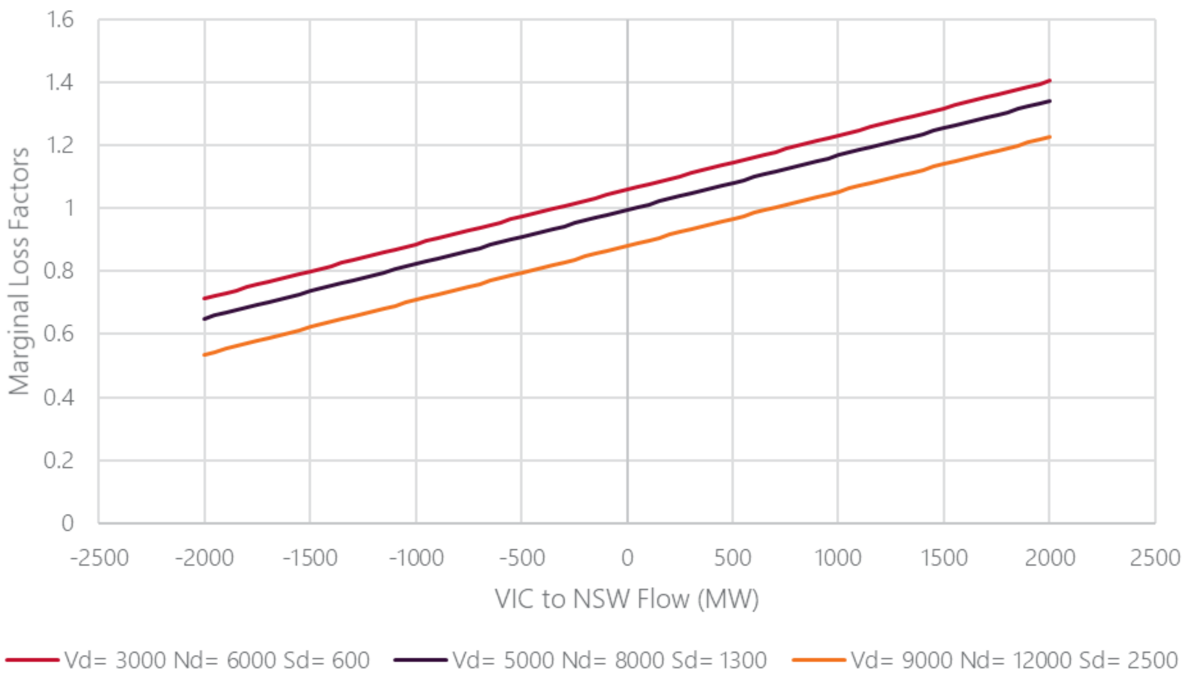


Table 19 Sydney West 330 referred to Thomastown 66 MLF versus Victoria to New South Wales flow coefficient statistics

Coefficient	Sd	Nd	Vd	VNt	CONSTANT
Coefficient value	-6.6377E-05	2.1470E-05	-3.0201E-05	1.7268E-04	1.0601

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

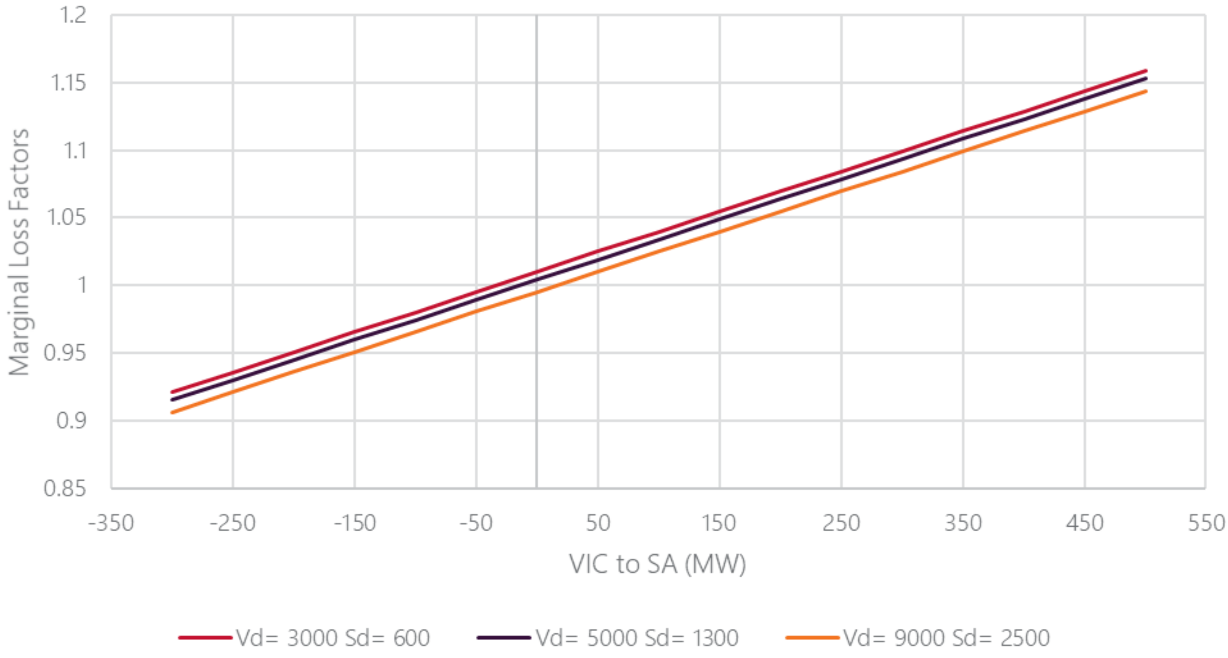


Table 20 Torrens Island 66 referred to Thomastown 66 MLF versus Victoria to South Australia flow coefficient statistics

Coefficient	Sd	Vd	VSAt	CONSTANT
Coefficient value	-1.2277E-05	1.4454E-06	2.9695E-04	1.0129

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

$= (-0.0469 - 3.9458E\text{-}07*Nd + 1.0027E\text{-}05*Qd)*NQt + 9.811E\text{-}05*NQt^2$

Sydney West 330 referred to Thomastown 66 notional link average losses

$= (0.061 - 3.0201E\text{-}05*Vd + 2.147E\text{-}05*Nd - 6.6377E\text{-}05*Sd)*VNt + 8.634E\text{-}05 *VNt^2$

Torrens Island 66 referred to Thomastown 66 notional link average losses

$= (0.0129 + 1.445E\text{-}06*Vd - 1.227E\text{-}05*Sd)*VSAt + 1.4845E\text{-}04 *VSAt^2$

Where:

Qd = Queensland demand

Vd = Victorian demand

Nd = New South Wales demand

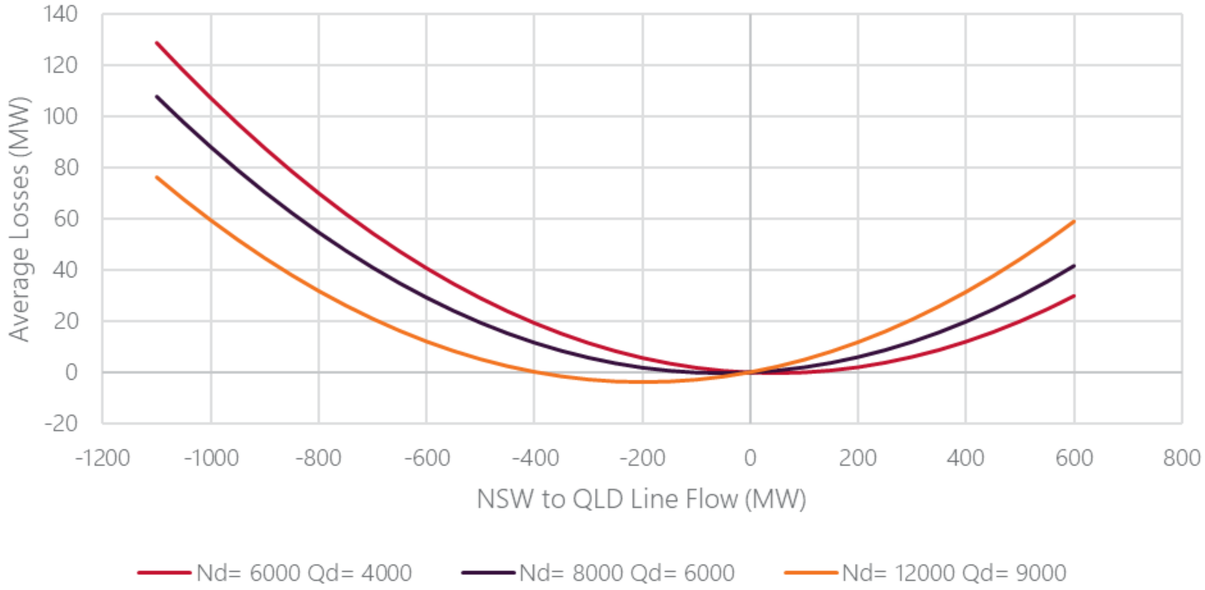
Sd = South Australia demand

NQt = transfer from New South Wales to Queensland

VNt = transfer from Victoria to New South Wales

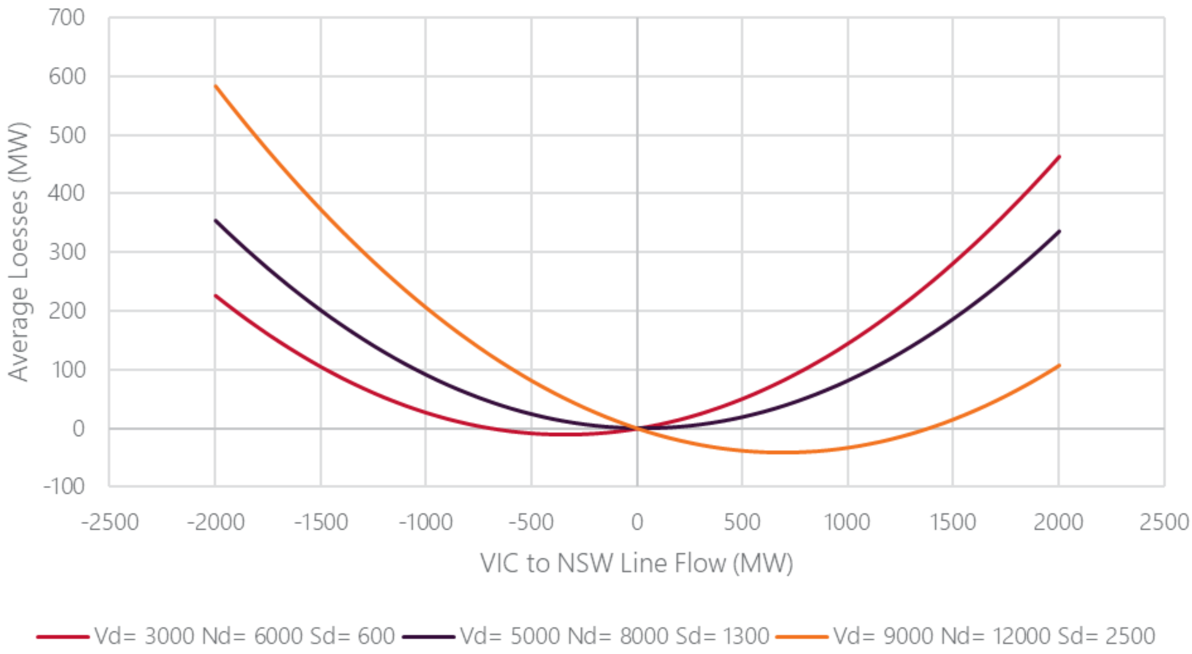
VSAt = transfer from Victoria to South Australia

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



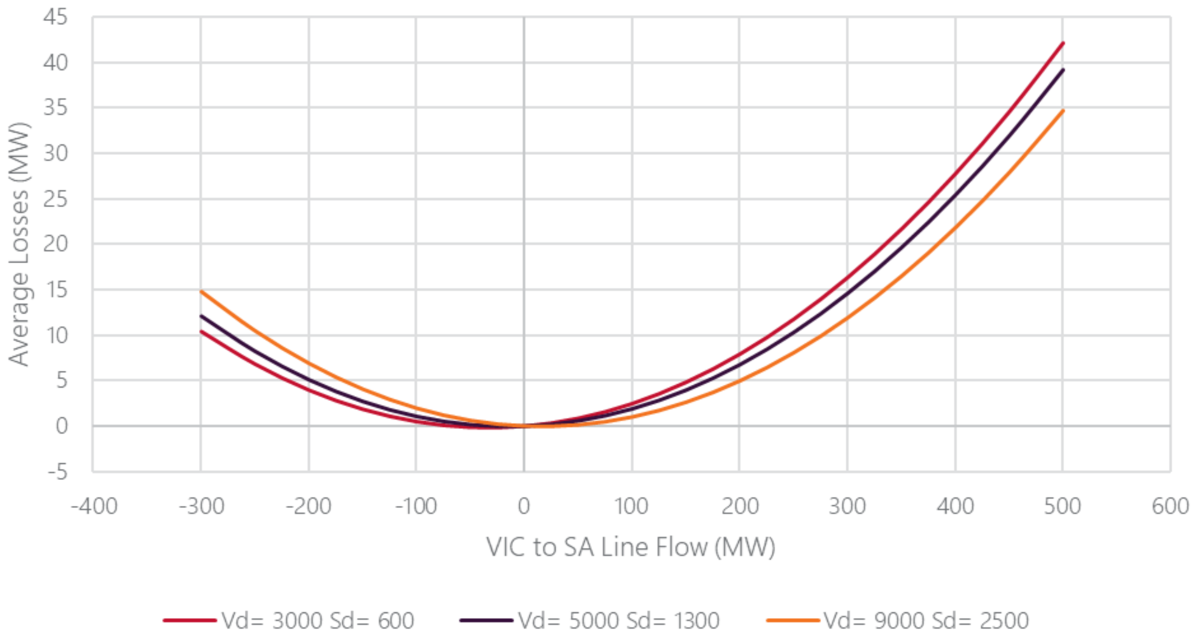
New South Wales to Queensland notional link losses versus New South Wales to Queensland notional link flow

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

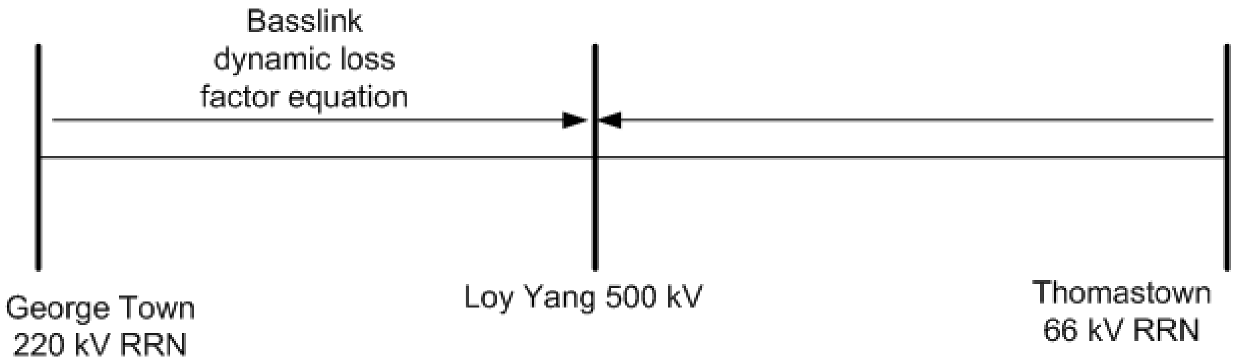
5. Basslink, Terranora, Murraylink loss equations

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 = 0.9857
- 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:

$$P(send) = P(receive) + [\ (-3.92x10^{-3}) * P(receive) + (1.0393x10^{-4}) * P(receive)^2 + 4]$$

Where:

P(send): Power in 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:

$$\text{Murraylink MLF (Torrens Island 66 referred to Thomastown 66)} = 0.905 + 1.89\text{E-}03 * \text{Flow}_t$$

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 21 Regression statistics for Murraylink

COEFFICIENT	Murraylink flow	CONSTANT
Coefficient Value	1.8908E-03	0.90518

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

$$\text{Murraylink loss} = -0.095 * \text{Flow}_t + 9.45\text{E-}04 * \text{Flow}_t^2$$

Figure 12 Murraylink MLF (Torrens Island 66 referred to Thomastown 66)

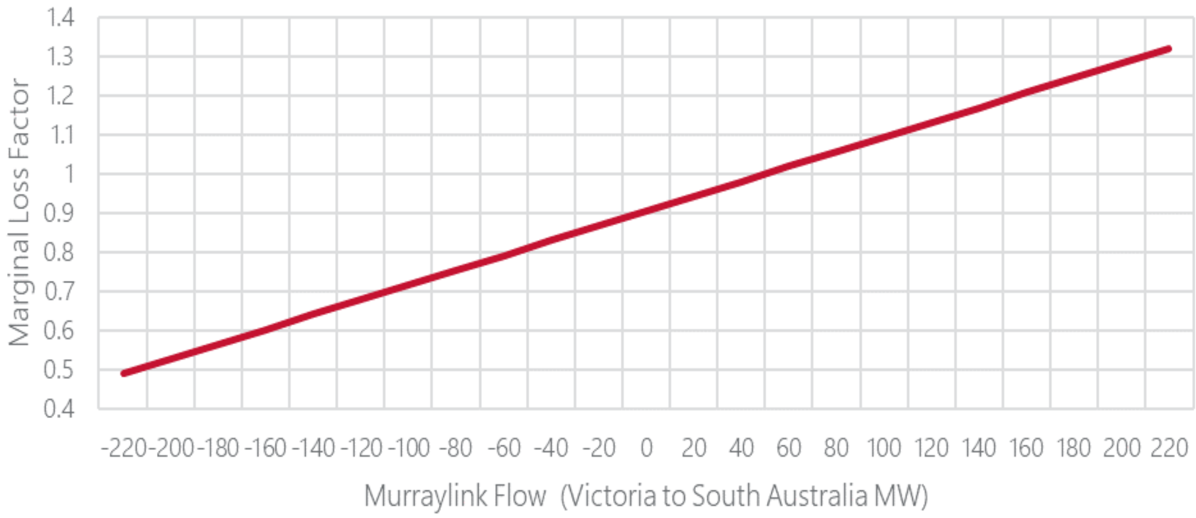
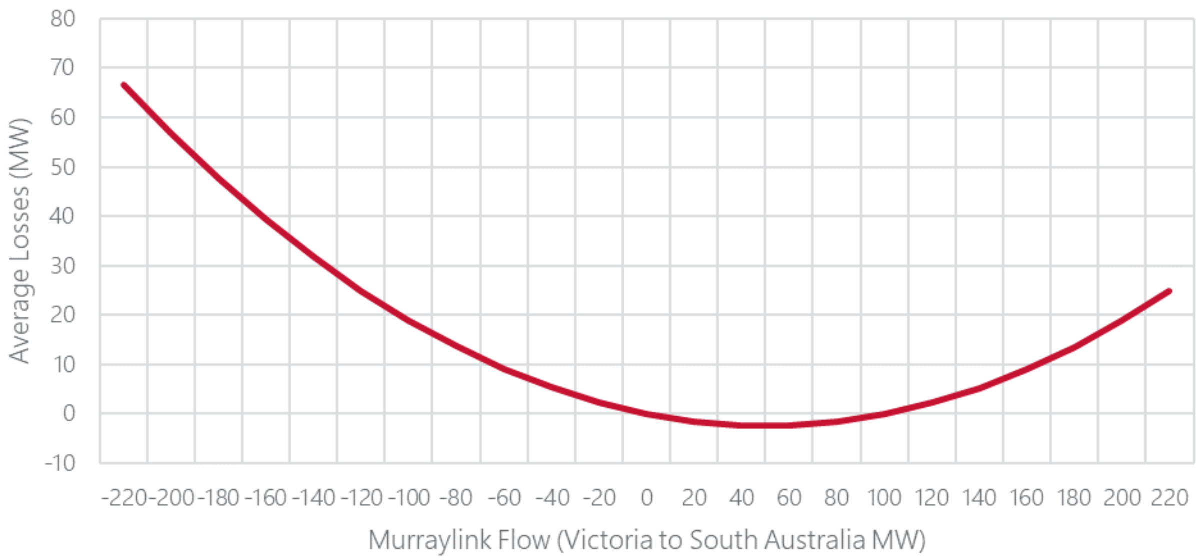


Figure 13 Average losses for Murraylink interconnector (Torrens Island 66 referred to Thomastown 66)



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)

$$= 1.0327 + 2.599\text{E-}03 * \text{Flow}_t$$

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:

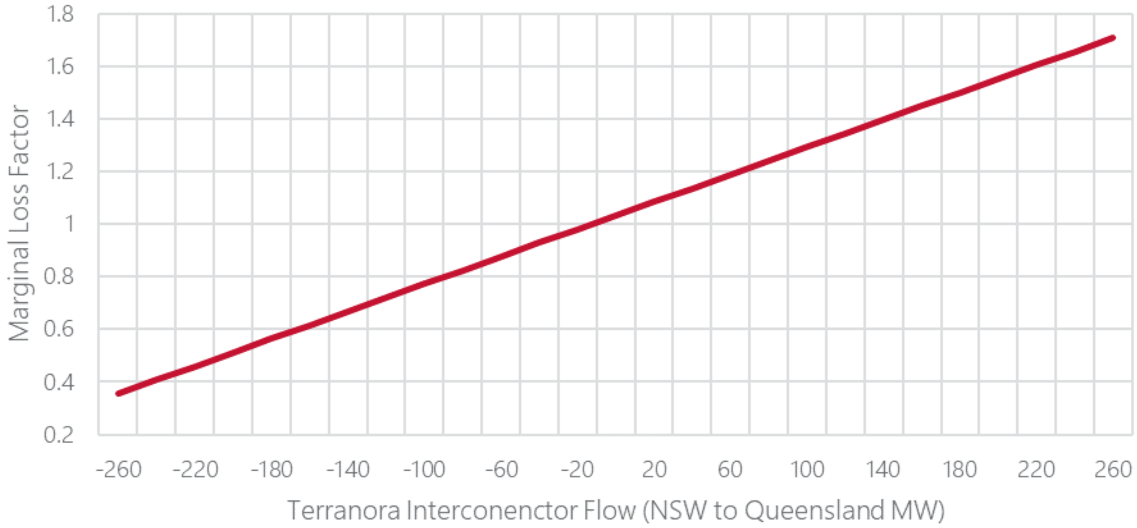
Table 22 Regression statistics for Terranora

Coefficient value	Flow_t	CONSTANT
Coefficient Value	2.5991E-03	1.0327

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

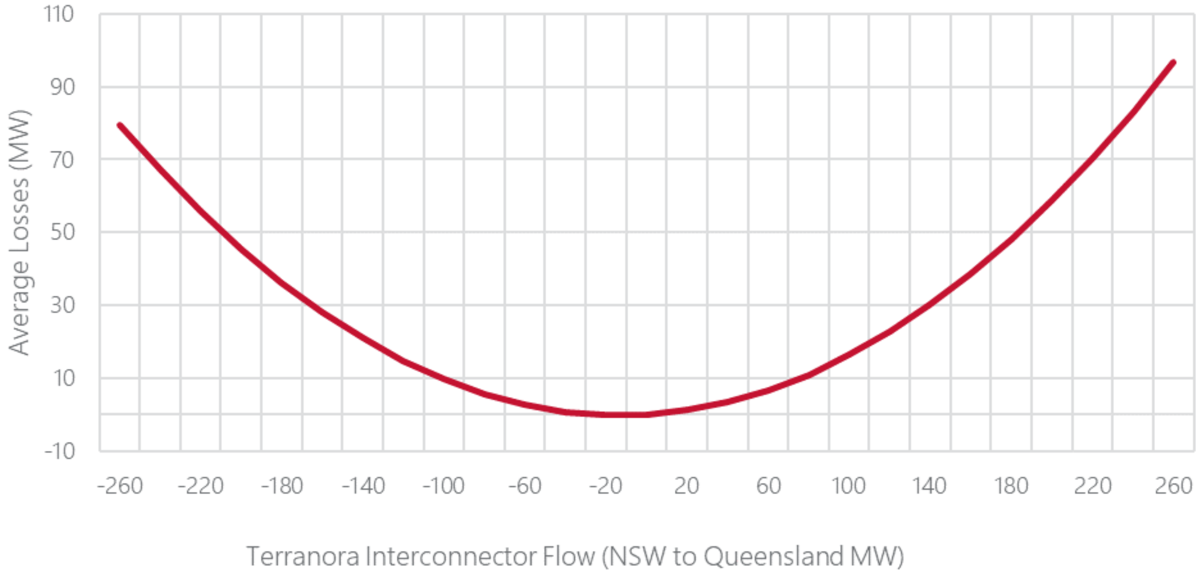
$$\text{Terranora loss} = 0.0327 * \text{Flow}_t + 1.2995\text{E-}03 * \text{Flow}_t^2$$

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 2019-20 financial year:

Table 23 Factors for inter-regional losses

Notional interconnector	Proportioning factor	Applied to
Queensland – New South Wales (QNI)	0.535	New South Wales
Queensland – New South Wales (Terranora Interconnector)	0.518	New South Wales
Victoria – New South Wales	0.479	Victoria
Victoria – South Australia (Heywood)	0.696	Victoria
Victoria – South Australia (Murraylink)	0.696	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 24 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[12].
- 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.

[12] The metering at Dumaresq is internally scaled to produce an equivalent flow at the NEW SOUTH WALES/Queensland State borders.

7.2.3 Between the Victoria and South Australia regions

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

7.2.4 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 25 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 Munmorrah 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, Telopia 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 26 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 3.6.2(A) specify the requirements for calculating the inter-regional loss factor equations and MLFs, and the data used in the calculation.

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

A1.2 Application of Marginal Loss Factors

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

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

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

A1.2.1 Marginal Loss Factors greater than 1.0

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

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

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 $1000 of electricity. The MLF of 1.05 multiplies the purchase value to 1.05 x 1000 = $1050. 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 $1000 of electricity. The MLF of 0.95 multiplies the sales value to 0.95 x 1000 = $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)[13] 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 2019-20 MLF calculation are in the table below.

Table 27 Forecast energy for 2019-20

Region	2019-20 forecast sent-out energy[14] (GWh)	2018-19 forecast sent-out energy[15] (GWh)
New South Wales	66,441	66,727
Victoria	43,184	42,828
Queensland	49,363	50,742
South Australia	11,834	11,949
Tasmania	10,412	10,421

[13] 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.

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

[15] Forecast Operational consumption – as sent out. It was sourced from the 2018 National Energy Forecasting Report (NEFR), 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. 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 that:

- 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 the Marginal Loss Factors calculation

AEMO obtains historical real power (MW) and reactive power (MVAr) data for each trading interval (half-hour) covering every generation connection point in the NEM from 1 July 2017 to 30 June 2018 from its settlements database.

AEMO also obtains the following data:

- Generation capacity data from Generation Information Page published in January 2019.
- 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 MT PASA data, as of 15 January, 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

For new generating units (not previously modelled in MLF calculations), AEMO requests the relevant proponent to provide a generation profile. Where an appropriate profile is not provided, AEMO calculates the initial estimate of the output by reference to similar technology and fuel type in accordance with section 5.4.2 of the Methodology.

For generating units with an incomplete year of generation data from the previous financial year, AEMO uses a combination of existing and estimated 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

- Brigalow Solar Farm
- Clermont Solar Farm
- Coopers Gap Wind Farm
- Haughton Solar Park
- Kennedy Energy Park (Battery + PV + Wind)
- Tableland Mill

- Oakey 2 Solar Farm
- Rugby Run Solar Farm
- Warwick Solar Farm
- Yarranlea Solar
- Dunblane Solar Farm

New South Wales and ACT new generating units

- Crudine Ridge Wind Farm
- Darlington Point Solar Farm
- Finley Solar Farm
- Limondale Solar Plant 1
- Limondale Solar Plant 2
- Nevertire 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
- Dundonnell Wind Farm
- Kiamal Solar Farm Stage 1
- Lal Lal Wind Energy System – Elaine
- Lal Lal Wind Energy System – Yendon
- Moorabool Wind Farm
- Stockyard Hill Wind Farm
- Yatpool Solar Farm

South Australia new generating units

- Barker Inlet PS
- Lake Bonney Battery

Tasmania new generating units

- Granville Harbour Wind Farm
- Wild Cattle Hill Wind Farm

Updates to generation profiles for new projects

In April AEMO requested the proponents of 46 new generation projects to review and if necessary update the generation information previously submitted, to reflect:

- Best estimate of actual electrical power generation over the year commencing 1 July 2019, under a neutral scenario (50% POE).

- Best estimate of timing of first export of actual electrical power generation as well as provision for progressive commissioning hold points.
- Any known electrical power generation limitations that are expected to be applied to the generating unit following commissioning, e.g. local limits.

For any projects where hold point schedules had not yet been determined, AEMO suggested the following generic hold point schedule assumption for wind and solar projects (noting that actual hold points would be individually determined based on plant and network considerations):

- Hold point at 1/3 of individual generating units in service for 2 months.
- Hold point at 2/3 of individual generating units in service for 2 months.
- 100% thereafter.

AEMO received updated generation profiles for 29 projects. One additional project[16] was no longer considered committed and was removed from MLF modelling. A due diligence process was applied and MLFs were subsequently recalculated. Table 28 shows the revised full commercial use dates (where not advised to AEMO as confidential) for the 29 projects which updated their generation profiles since the draft MLFs were published on 1 April 2019.

Table 28 The expected timing of full commercial use as advised to AEMO

Generator name	Region	Full commercial use date modelled
Brigalow Solar Farm	QLD	April 2020
Clare Solar Farm	QLD	October 2019
Coopers Gap Wind Farm	QLD	April 2020
Haughton Solar Farm	QLD	July 2019
Kennedy Energy Park	QLD	July 2019
Lilyvale Solar Farm	QLD	July 2019
Oakey 1 Solar Farm	QLD	August 2019
Oakey 2 Solar Farm	QLD	November 2019
Rugby Run Solar Farm	QLD	December 2019
Tableland Mill Expansion	QLD	September 2019
Warwick Solar Farm	QLD	November 2020
Yarranlea Solar Farm	QLD	January 2020
Crudine Ridge Wind Farm	NSW	May 2020
Darlington Point Solar Farm	NSW	March 2020
Limondale Solar Plant 2	NSW	December 2019
Nevertire Solar Farm	NSW	September 2019
Silverton Wind Farm	NSW	Confidential

[16] Teebar Solar Farm in Queensland.

Generator name	Region	Full commercial use date modelled
Sunraysia Solar Farm	NSW	November 2019
Bulgana Battery	VIC	Confidential
Bulgana Wind Farm	VIC	Confidential
Kiamal Solar Farm	VIC	Confidential
Moorabool Wind Farm	VIC	March 2020
Murra Warra Wind Farm	VIC	October 2019
Stockyard Hill Wind Farm	VIC	Confidential
Barker Inlet PS	SA	October 2019
Lake Bonney Battey	SA	July 2019
Lincoln Gap Wind Farm	SA	February 2020
Granville Harbour Wind Farm	TAS	March 2020
Wild Cattle Hill Wind Farm	TAS	Confidential

A2.3.2 Abnormal generation patterns

AEMO has adjusted a number of generation profiles for the 2019-20 MLF calculation in accordance with section 5.5.6 of the Methodology. This is due to changes in physical circumstances such as:

- Reduction in fuel availability.
- Outages greater than 30 continuous days.
- Reduction in rainfall and water storage levels.

Hydro Tasmania requested an update to forecast generation profiles in accordance with section 5.9 of the Methodology based on new developments.

AEMO has used the adjusted generation profiles to replace historical profiles as an input to the 2019-20 MLF calculation process. AEMO has endeavoured to ensure that the 2019-20 MLF calculation represents the expected system conditions and has made corresponding adjustments to historical Basslink flows in accordance with section 5.3.1 of the Methodology.

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

Table 29 Adjusted generation values for Tasmania

	Historical generation (GWh)	Adjusted generation (GWh)
Jul – Sep	783.49	652.15
Oct – Dec	429.51	398.49
Jan – Mar	337.26	267.95
Apr – Jun	771.55	626.43
Total	2,321.81	1,945.02

A2.4 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 kV and 500 kV networks to ensure they reflect normal operating conditions.

AEMO adds relevant network augmentations that will occur in the 2019-20 financial year. The snapshot is thus representative of the 2019-20 normally-operating power system.

A2.4.1 Network augmentation for 2019-20

Relevant Transmission Network Service Providers (TNSPs) advised of the following network augmentations to be completed in 2019-20:

Queensland network augmentations

Powerlink provided the following list of planned network augmentations to be completed in 2019-20 in Queensland:

- Rebuild of Mackay Substation.
- Rebuild of Gin Gin Substation.
- Dysart Transformer Replacement (132/66 kV)
- Ingham South Transformer Replacement (132/66 kV)
- Kemmis Transformer 2 Replacement (132/66 kV)

New South Wales network augmentations

New South Wales NSPs provided the following list of planned network augmentations in 2019-20 in NSW:

- Decommissioning of Upper Tumut – Canberra 330 kV line.
- Installation of new Upper Tumut – Stockdill 330 kV.
- Installation of new Stockdill – Canberra 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.
- Replacement of Mason Park – Homebush 132 kV feeder (90L).

Victoria network augmentations

AEMO's Victorian Planning Group provided the following list of planned network augmentations to be completed in 2019-20 in Victoria:

- Ballarat – Waubra – Ararat – Crowlands – Bulgana - Horsham 220kV line upgrades
- Richmond 66kV permanent load transfer to new Brunswick 66kV by

- Minor upgrade of Red Cliffs – Buronga 220 kV line

South Australia network augmentations

ElectraNet provided the following list of planned network augmentations to be completed in 2019-20 in South Australia:

- Tailem Bend - Cherry Gardens 275 kV tie-in at Tungkillo
- Mount Gunson 132 kV South Supply

Please note: The following augmentations have not been modelled as they have no impact on MLF calculation for 2019-20.

- Upgrading of Davenport – Robertstown 275 kV lines.
- Upgrading of TIPS – Cherry Gardens 275 kV line.
- Upgrading of TIPS – Magill 275 kV line.
- Upgrading of Kincraig – Penola West 132 kV line.
- Smart Wires PowerGuardian Technology trial - Waterloo - Templers 132 kV line

Tasmania network augmentations

TasNetworks provided the following list of planned network augmentations to be completed in 2019-20 in Tasmania:

- Decommissioning of Waddamana – Bridgewater Junction 110 kV line.
- Replacement of Lindisfarne Substation Transformer (110/33 kV).
- Upgrading of Rosebery Substation Transformer Rating (110/44 kV).
- George Town–Comalco 220 kV transmission line replacement

A2.4.2 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.

A2.4.3 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.

A2.4.4 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.

A2.4.5 Treatment of Yallourn unit 1

The Yallourn Unit 1 can be connected to either the 220 kV or 500 kV network in Victoria.

EnergyAustralia informed AEMO that the switching pattern for 2019-20 will differ from the historical switching pattern for Yallourn Unit 1.

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.

A2.5 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 30 Interconnector capacity

From region	To region	Summer peak (MW)	Summer off-peak (MW)	Winter peak (MW)	Winter off-peak (MW)
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	650	650	650	650
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.

A2.6 Calculation of Marginal Loss Factors

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

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

A2.6.1 Marginal Loss Factor calculation quality control

As with previous years, AEMO has engaged consultants to ensure the quality and accuracy of the MLF calculation. The consultants performed the following work:

- A benchmark study using independent data sources to calculate the MLFs. AEMO will utilise the benchmark study to identify potential issues with AEMO data inputs to the MLF calculation.
- A subsequent verification study using AEMO's input data to independently reproduce AEMO's calculation results. AEMO will utilise the verification study to ensure that AEMO MLF calculation methods and results are accurate.
- A due diligence review of the MW profiles for new generation projects.

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

A3. Impact of highly correlated generation profiles on MLF

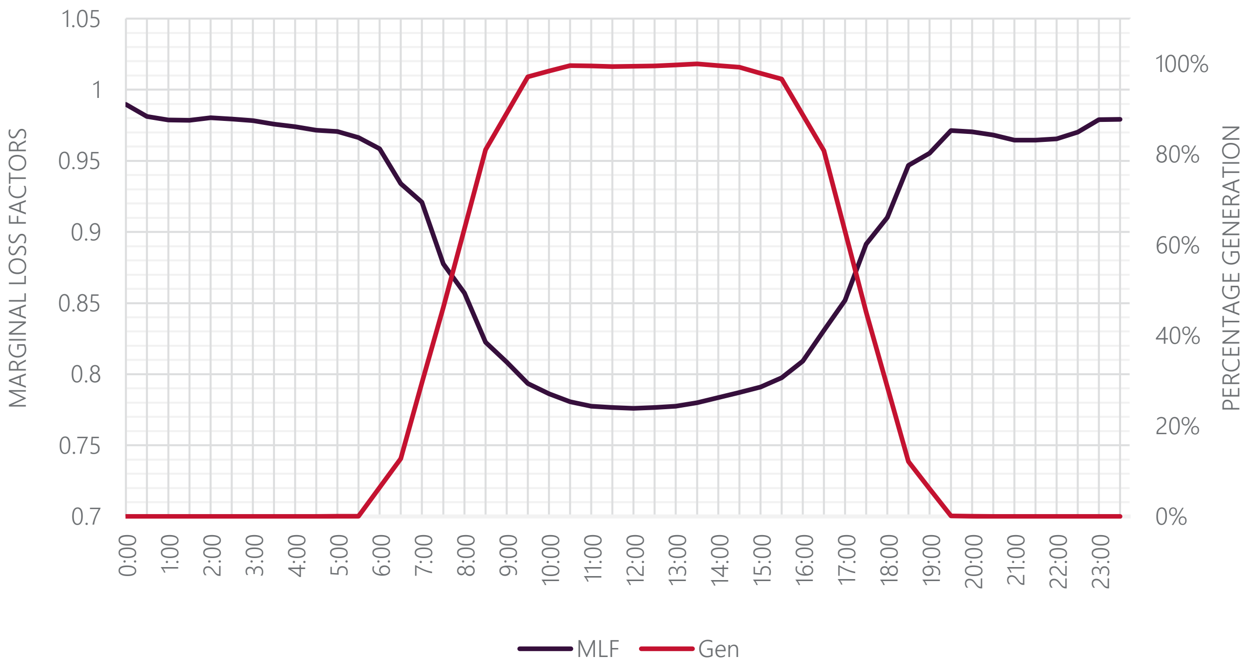
As discussed in Appendix A2.6, MLFs are calculated by simulating power flows on the network for every half-hour, in the next financial year, using forecast supply and demand values. The calculated raw loss factors for each half-hour are then weighted by the volume of energy at the TNI to calculate the 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
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