

Application to revoke Technical Rule temporary exemption granted to Western Power for Meadow Springs Zone Substation

Appendix 5 - Western Power - NCR substation capacities, load
forecast and investment data

Economic Regulation Authority

WESTERN AUSTRALIA

Our reference: 47293183
Contact Person: Sabina Roshan

24 January 2018

Elizabeth Walters
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Dear Elizabeth

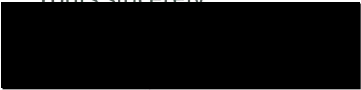
NCR substation capacities, load forecast and investment data

On 17 Oct 2018, the Authority requested data on NCR substations via email, which was presented on 19 Dec 2018 in a meeting at the Authority's office. On the same day the Authority requested further information on investments made at NCR substations since the commencement of the Access Arrangement. Western Power has collated all the requested information as listed below and the information is attached with this letter:

1. Attachment 1: A list of NCR substations with the substation capacities calculated as per the 2011 and 2016 Technical Rules versions.
2. Attachment 2: The most recent peak load at the NCR substations and the 10 year load forecast
3. Attachment 3: A list of transformers installed at NCR substations since 1 April 2006, with the install date.

The assumptions and limitations of the data are included in the attachment. If you have any queries in regards to this matter, please do not hesitate to contact Sabina Roshan on 9326 7141.

Yours sincerely


Rudi James
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Attachment 1

A list of all zone substations subject to the NCR criterion with the NCR capacity for each of them using the literal interpretation of the 2011 Technical Rules and the current definition.

Note:

1. Zone substations within the Perth metropolitan area with one transformer can be subject to the NCR criterion. The capacity of the substation is considered to be 75% of the transformer rating
2. The highlighted substations in the table below have had a new transformer installed since 2006. For a complete list of the transformers and the install date refer to Attachment 3.

NCR Capacity (MVA) based on 2011 and 2016 Methods									
Substation	Substation Abbreviation	TX Count	Type	Transformer 1 Ratings (MVA)	Transformer 2 Ratings (MVA)	Transformer 3 Ratings (MVA)	Transformer 4 Ratings (MVA)	2011 Technical Rules NCR (MVA)	2016 Technical Rules NCR Current (MVA)
Arkana	A	3	NCR	36.24	29.87	30.10		82.38	72.16
Amherst	AMT	3	NCR	38.56	38.91	35.29		100.31	84.56
Australian Paper Mills	APM	2	NCR	30.67	30.67			53.68	46.01
Beechboro	BCH	3	NCR	38.33	38.45	38.83		105.53	86.71
Balcatta	BCT	2	NCR	34.29	35.78			60.02	52.56
Belmont	BEL	3	NCR	36.89	29.72	29.80		81.81	72.30
Bibra Lake	BIB	2	NCR	39.13	35.21			61.62	55.76
Bentley	BTY	2	NCR	37.34	37.34			65.35	56.01
Byford	BYF	3	NCR	33.34	33.34	35.93		91.69	76.96
Cockburn	CC	3	NCR	31.28	31.40	40.05		86.15	77.05
Clarkson	CKN	2	NCR	36.31	37.95			63.55	55.70

NCR Capacity (MVA) based on 2011 and 2016 Methods									
Substation	Substation Abbreviation	TX Count	Type	Transformer 1 Ratings (MVA)	Transformer 2 Ratings (MVA)	Transformer 3 Ratings (MVA)	Transformer 4 Ratings (MVA)	2011 Technical Rules NCR (MVA)	2016 Technical Rules NCR Current (MVA)
Clarence	CL	2	NCR	28.58	29.11			50.01	43.27
Collier	COL	3	NCR	27.78	36.20	27.78		76.39	68.82
Cottesloe	CTE	2	NCR	34.92	37.32			61.12	54.19
Canning vale	CVE	4	NCR	29.11	29.26	28.50	36.54	108.26	92.57
Darlington	D	3	NCR	12.54	12.04	39.06		33.61	47.73
Edmund St	E	2	NCR	28.81	28.81			50.41	43.21
Forrestfield	FFD	3	NCR	32.12	37.91	36.12		92.34	79.62
Gosnells	G	3	NCR	35.74	33.11	36.73		93.69	79.19
Hadfield	H	3	NCR	26.60	40.62	35.78		82.33	77.25
Henley Brook	HBK	2	NCR	34.60	35.55			60.55	52.61
Hazelmere	HZM	1	NCR	36.20				27.15	27.15
Joondalup	JDP	2	NCR	34.29	35.93			60.02	52.67
Kalamunda	K	3	NCR	30.98	38.11	39.06		92.32	81.11
Kewdale	KDL	2	NCR	36.24	38.18			63.42	55.81
Lansdale	LDE	3	NCR	39.06	40.70	37.99		105.54	88.31
Manning St	MA	2	NCR	32.22	32.35			56.38	48.43
Maddington	MDN	1	NCR	34.64				25.98	25.98
Munday	MDY	2	NCR	35.29	36.39			61.75	53.76
Medina	MED	3	NCR	36.16	36.16	35.32		97.98	80.74
Mandurah	MH	3	NCR	32.12	32.12	37.11		88.34	76.02
Midland Junction	MJ	4	NCR	25.80	25.80	38.11	35.67	106.61	94.02
Malaga	MLG	3	NCR	34.18	38.41	35.40		95.22	80.99
Morley	MO	3	NCR	30.16	33.00	35.06		85.78	73.66
Meadow Springs	MSS	2	NCR	38.64	35.51			62.15	55.61

NCR Capacity (MVA) based on 2011 and 2016 Methods									
Substation	Substation Abbreviation	TX Count	Type	Transformer 1 Ratings (MVA)	Transformer 2 Ratings (MVA)	Transformer 3 Ratings (MVA)	Transformer 4 Ratings (MVA)	2011 Technical Rules NCR (MVA)	2016 Technical Rules NCR Current (MVA)
Muchea	MUC	3	NCR	15.74	14.98	37.88		41.94	51.44
Mullaloo	MUL	3	NCR	29.19	29.61	29.19		80.27	65.99
Murdoch	MUR	2	NCR	37.72	34.60			60.55	54.24
Myaree	MYR	3	NCR	24.01	24.01	38.07		66.02	64.56
North Beach	NB	3	NCR	36.24	32.01	32.01		88.02	75.19
North Perth	NP	3	NCR	35.70	35.44	34.35		95.55	79.12
O'Connor	OC	3	NCR	28.35	37.08	28.35		77.96	70.33
Osborne Park	OP	3	NCR	27.13	28.88	28.35		75.83	63.27
Padbury	PBY	3	NCR	36.05	36.62	36.39		99.47	81.79
Rockingham	RO	3	NCR	33.68	33.65	36.20		92.57	77.65
Riverton	RTN	3	NCR	35.59	35.59	36.85		97.87	81.02
Rivervale	RVE	3	NCR	39.82	36.24	34.45		96.52	82.88
Southern River	SNR	3	NCR	37.84	37.19	38.52		102.92	85.16
Sawyers Valley	SVY	2	NCR	36.85	37.65			64.48	55.87
Tate Street	TT	3	NCR	29.72	36.96	29.72		81.74	72.30
Waikiki	WAI	3	NCR	35.29	36.01	36.01		97.76	80.48
Wembley downs	WD	2	NCR	28.79	28.79			50.38	43.18
Welshpool	WE	3	NCR	40.28	40.24	38.91		108.32	89.57
Wangara	WGA	1	NCR	37.00				27.75	27.75
Willetton	WLN	1	NCR	35.06				26.29	26.29
Wanneroo	WNO	3	NCR	38.41	36.85	36.85		101.33	84.08
Yokine	Y	3	NCR	27.91	27.91	37.93		76.76	70.32
Yanchep	YP	2	NCR	40.35	40.58			70.62	60.70

Attachment 2

The current and projected load information for NCR substations.

Note:

1. **The forecast is presented in Mega Watts (MW) and the zone substation capacities are recorded in Mega Volta-Ampere (MVA) taking into consideration the power factor at the substation.
2. The 2018/19 forecast will be available after the recording of new summer peak in 2019.
3. The substation highlighted in yellow represent transformer installation between 2006 and 2018. For a complete list of the transformers and the install date refer to Attachment 3.

Substation Name	Substation Abbrv	2018 Actual Sub Peak (MW)	'2017/18 Substation Non - Coincident POE 10 Load forecast (MW**)									
			2019 (MW)	2020 (MW)	2021 (MW)	2022 (MW)	2023 (MW)	2024 (MW)	2025 (MW)	2026 (MW)	2027 (MW)	2028 (MW)
Arkana	A	49.30	55.10	56.74	52.97	55.23	54.45	54.30	54.16	54.04	53.92	53.82
Amherst	AMT	52.41	78.69	78.26	80.77	82.38	81.54	81.90	82.22	82.51	82.78	83.03
Australian Paper Mills	APM	24.54	31.37	32.05	30.91	30.74	30.62	30.43	30.25	30.10	29.95	29.82
Beechboro	BCH	69.46	61.28	60.14	59.77	58.21	57.38	56.61	55.93	55.31	54.74	54.22
Balcatta	BCT	16.38	20.80	20.35	19.92	19.68	19.38	19.14	18.92	18.72	18.54	18.38
Belmont	BEL	35.02	44.04	44.01	43.27	43.31	42.74	42.45	42.19	41.95	41.74	41.54
Bibra Lake	BIB	42.56	50.07	48.68	49.15	49.82	48.74	48.50	48.29	48.09	47.91	47.75
Bentley	BTY	19.88	24.93	24.34	23.79	23.36	23.46	23.31	23.17	23.04	22.92	22.82
Byford	BYF	65.01	83.38	84.53	86.27	87.17	87.42	88.00	88.51	88.97	89.39	89.78
Cockburn	CC	36.41	41.84	40.20	38.23	35.47	35.04	33.92	32.92	32.01	31.18	30.42
Clarkson	CKN	56.58	53.56	52.21	51.19	50.31	49.52	48.84	48.23	47.68	47.17	46.71
Clarence	CL	24.09	29.20	29.76	29.48	29.25	29.42	29.42	29.42	29.42	29.42	29.42
Collier	COL	38.92	49.04	48.65	50.10	50.71	50.65	50.93	51.19	51.42	51.62	51.82

Substation Name			'2017/18 Substation Non - Coincident POE 10 Load forecast (MW**)									
	Substation Abbrv	2018 Actual Sub Peak (MW)	2019 (MW)	2020 (MW)	2021 (MW)	2022 (MW)	2023 (MW)	2024 (MW)	2025 (MW)	2026 (MW)	2027 (MW)	2028 (MW)
Cottesloe	CTE	38.32	49.07	47.62	47.60	47.25	46.53	46.14	45.79	45.48	45.19	44.92
Canning vale	CVE	57.05	60.41	58.17	57.38	56.22	54.93	53.98	53.14	52.37	51.67	51.03
Darlington	D	19.66	23.73	22.31	21.81	21.23	20.45	19.90	19.41	18.96	18.56	18.19
Edmund St	E	25.36	30.40	30.38	29.85	29.40	29.27	29.05	28.85	28.68	28.51	28.36
Forrestfield	FFD	28.02	42.91	41.39	33.71	31.99	31.39	30.53	29.76	29.06	28.42	27.84
Gosnells	G	52.86	68.42	68.54	67.78	67.11	67.20	66.99	66.80	66.63	66.47	66.33
Hadfield	H	45.06	52.11	49.98	48.57	46.75	45.70	44.62	43.66	42.78	41.99	41.25
Henley Brook	HBK	49.68	68.38	74.51	78.56	82.80	85.28	87.96	90.36	92.53	94.51	96.34
Hazelmere	HZM	25.42	25.25	25.29	25.21	25.32	25.38	25.42	25.46	25.49	25.52	25.54
Joondalup	JDP	33.96	41.50	42.03	40.55	38.45	38.78	38.25	37.78	37.35	36.95	36.59
Kalamunda	K	27.82	39.99	38.58	38.18	38.05	37.14	36.67	36.24	35.86	35.51	35.18
Kewdale	KDL	25.67	33.01	33.61	30.94	31.22	31.25	31.33	31.40	31.47	31.53	31.58
Lansdale	LDE	68.51	76.57	76.89	77.41	75.19	75.41	75.05	74.73	74.44	74.17	73.93
Manning St	MA	24.06	37.24	37.90	39.18	39.89	40.24	40.72	41.15	41.54	41.90	42.23
Maddington	MDN	17.56	24.33	24.47	24.02	23.57	23.63	23.50	23.38	23.27	23.17	23.08
Munday	MDY	22.75	27.12	27.68	27.97	28.65	28.68	28.91	29.12	29.31	29.48	29.64
Medina	MED	46.83	48.98	48.90	47.98	46.04	47.01	46.79	46.59	46.41	46.25	46.10
Mandurah	MH	63.32	79.05	78.44	79.13	78.88	78.45	78.30	78.16	78.03	77.91	77.81
Midland Junction	MJ	77.76	63.32	61.00	60.17	58.44	57.56	56.63	55.79	55.04	54.35	53.71
Malaga	MLG	30.37	44.30	46.28	45.39	45.38	44.74	44.48	44.25	44.04	43.85	43.67
Morley	MO	50.66	54.32	53.65	52.09	52.14	50.49	49.67	48.94	48.28	47.67	47.12
Meadow Springs	MSS	58.00	75.89	79.81	82.60	84.23	85.67	87.11	88.39	89.55	90.61	91.59
Muchea	MUC	23.12	25.18	25.00	25.14	24.75	24.49	24.31	24.15	24.01	23.88	23.75
Mullaloo	MUL	52.13	54.17	53.51	54.27	54.47	54.04	53.99	53.95	53.91	53.88	53.84

Substation Name			'2017/18 Substation Non - Coincident POE 10 Load forecast (MW**)									
	Substation Abbrv	2018 Actual Sub Peak (MW)	2019 (MW)	2020 (MW)	2021 (MW)	2022 (MW)	2023 (MW)	2024 (MW)	2025 (MW)	2026 (MW)	2027 (MW)	2028 (MW)
Murdoch	MUR	37.00	38.52	36.74	36.25	35.42	34.46	33.78	33.17	32.61	32.11	31.64
Myaree	MYR	40.91	48.71	47.69	47.55	47.01	46.36	45.93	45.54	45.19	44.88	44.58
North Beach	NB	51.54	62.07	60.61	63.08	63.62	62.21	62.06	61.93	61.81	61.70	61.60
North Perth	NP	47.45	57.08	54.72	55.63	54.12	53.58	53.04	52.55	52.11	51.71	51.34
O'Connor	OC	46.81	45.02	43.14	42.39	41.11	39.96	39.06	38.26	37.53	36.86	36.25
Osborne Park	OP	54.55	53.75	52.06	51.60	50.12	49.13	48.29	47.53	46.85	46.23	45.66
Padbury	PBY	66.77	62.67	59.83	57.46	55.72	53.69	52.11	50.70	49.43	48.26	47.19
Rockingham	RO	50.86	61.71	61.55	61.00	59.94	60.29	60.09	59.92	59.76	59.61	59.48
Riverton	RTN	59.02	66.36	66.59	68.68	70.01	68.82	68.97	69.10	69.22	69.33	69.43
Rivervale	RVE	42.84	50.10	49.65	50.92	50.95	50.60	50.61	50.63	50.64	50.65	50.67
Southern River	SNR	64.28	95.00	94.72	98.45	99.51	101.07	102.35	103.48	104.51	105.46	106.32
Sawyers Valley	SVY	16.64	22.76	22.18	21.83	21.25	21.39	21.24	21.10	20.98	20.86	20.76
Tate Street	TT	37.75	49.10	43.19	40.78	39.67	37.31	35.62	34.11	32.75	31.50	30.35
Waikiki	WAI	64.63	67.68	67.13	65.35	63.30	63.00	62.16	61.41	60.73	60.11	59.54
Wembley downs	WD	38.49	45.11	43.43	43.57	42.67	41.72	41.11	40.56	40.06	39.60	39.19
Welshpool	WE	62.05	61.60	59.79	57.55	55.02	54.15	52.88	51.74	50.71	49.78	48.91
Wangara	WGA	21.45	17.09	16.34	15.68	15.10	14.47	13.99	13.56	13.17	12.81	12.48
Willetton	WLN	24.19	28.21	28.54	27.94	27.60	27.67	27.55	27.45	27.35	27.27	27.19
Wanneroo	WNO	62.89	74.75	74.57	75.74	76.74	75.95	76.04	76.11	76.18	76.24	76.30
Yokine	Y	50.53	54.07	52.21	51.69	50.04	48.72	47.71	46.80	45.97	45.22	44.53
Yanchep	YP	41.84	39.38	37.31	36.19	34.53	33.57	32.60	31.73	30.94	30.22	29.56

Attachment 3

A list of transformers installed in NCR substations since 1 April 2006 in chronological order.

Assumptions and details

1. The dates provided are the actual installation dates of the transformers. The approval date for each investment would be a few years prior to it. Therefore some investments may have been approved prior to the first Access Arrangement and the introduction of the Technical Rules.
2. The table listed below has been filtered out for 'substation capacity expansion' driver at a very high level (without checking the reasons in the respective project Business cases). Therefore it is to be noted that the reason for the investment may not be limited to the NCR criterion requirement in Technical Rules clause 2.5.4.2, but may include other drivers such as asset replacement and customer connections.
3. Some entries may relate to relocated and refurbished assets instead of a new transformer installation
4. Transformer ID is the transformer location name/Identification within the substation. Generally the first transformer is placed in location T1, the second transformer in location T3 and the third transformer in location T2. The exception to this convention within this list are highlighted below:
 - Edmund Street zone substation has two transformers which are located in locations T1 and T2.
 - Murdoch and Sawyers Valley Zone substations have the first transformer installed in location T3 and the second transformer in T1
 - Yanchep has two transformers and the installation of T1 on 19/04/2006 is a replacement of the existing T1 transformer (13MVA) with a higher capacity 33MVA transformer.

Substation	Substation Abbreviation	Transformer ID	Install Date	Year
Hadfields	H	T3	18/02/2006	2006
Yanchep	YP	T1	19/04/2006	2006
Meadow Springs	MSS	T1	28/04/2006	2006
Southern River	SNR	T1	20/09/2006	2006
Padbury	PBY	T1	22/12/2006	2006
Murdoch	MUR	T3	27/01/2007	2007
Southern River	SNR	T3	15/02/2007	2007
Clarkson	CKN	T1	2/03/2007	2007
Forrestfield	FFD	T3	3/06/2007	2007
Amherst	AMT	T2	23/09/2007	2007
Padbury	PBY	T3	29/11/2007	2007
Rivervale	RVE	T3	3/12/2007	2007
Bibra Lake	BIB	T1	17/12/2007	2007
Byford	BYF	T2	20/12/2007	2007

Substation	Substation Abbreviation	Transformer ID	Install Date	Year
Henley brook	HBK	T1	21/12/2007	2007
Waikiki	WAI	T3	22/01/2008	2008
Bentley	BTY	T1	4/03/2008	2008
Bentley	BTY	T3	4/03/2008	2008
Yokine	Y	T2	6/03/2008	2008
Morley	MO	T2	1/05/2008	2008
Padbury	PBY	T2	27/09/2008	2008
North Beach	NB	T2	28/11/2008	2008
Bibra Lake	BIB	T3	9/12/2008	2008
Cottesloe	CTE	T1	10/12/2008	2008
Forrestfield	FFD	T2	11/12/2008	2008
Myaree	MYR	T2	11/12/2008	2008
Forrestfield	FFD	T2	11/12/2008	2008
Clarkson	CKN	T3	12/02/2009	2009
Kewdale	KDL	T1	26/03/2009	2009
Darlington	D	T2	3/10/2009	2009
Hazelmere	HZM	T1	6/11/2009	2009
Waikiki	WAI	T1	24/11/2009	2009
Meadow Springs	MSS	T3	29/11/2009	2009
Murdoch	MUR	T1	13/01/2010	2010
Darlington	D	T1	19/03/2010	2010
Kewdale	KDL	T3	29/04/2010	2010
Kalamunda	K	T2	6/07/2010	2010
Willetton	WLN	T1	8/10/2010	2010
O'Connor	OC	T2	8/10/2010	2010
Wangara	WGA	T1	30/10/2010	2010
Joondalup	JDP	T1	4/11/2010	2010
Cottesloe	CTE	T3	16/11/2010	2010
Tate St	TT	T2	16/11/2010	2010
North Perth	NP	T1	30/11/2010	2010
Malaga	MLG	T1	27/01/2011	2011
Rivervale	RVE	T2	28/02/2011	2011
Sawyers valley	SVY	T3	22/05/2011	2011
Maddington	MDN	T1	24/06/2011	2011
Edmund St	E	T2	1/07/2011	2011
Collier	COL	T2	21/07/2011	2011
Medina	MED	T2	25/08/2011	2011
Henley brook	HBK	T3	3/05/2012	2012
Joondalup	JDP	T3	6/09/2012	2012
Southern River	SNR	T2	4/10/2012	2012
Waikiki	WAI	T2	23/11/2012	2012
Sawyers valley	SVY	T1	16/08/2013	2013

Substation	Substation Abbreviation	Transformer ID	Install Date	Year
Munday	MDY	T1	23/08/2013	2013
Munday	MDY	T3	23/08/2013	2013
Balcatta	BCT	T1	18/11/2013	2013
Balcatta	BCT	T3	18/11/2013	2013
Midland Junction	MJ	T4	20/05/2014	2014
Muchea	MUC	T3	30/06/2015	2015
Meadow Springs	MSS	T3	TBC 2019	2019