

Our ref: DM#12947998

15 May 2015

Elizabeth Walters
Assistant Director Electricity
Economic Regulation Authority
Level 4, 469 Wellington Street
PERTH WA 6000

Dear Elizabeth

EXEMPTION REQUEST – MEADOW SPRINGS ZONE SUBSTATION

In accordance with clause 1.9.2 of the Technical Rules, Western Power requests the Economic Regulation Authority grant Western Power an exemption from complying with clause 2.5.4(b) (Normal Cyclic Rating Criterion) of the Technical Rules.

Details of the proposed exemption are contained in the enclosed document.

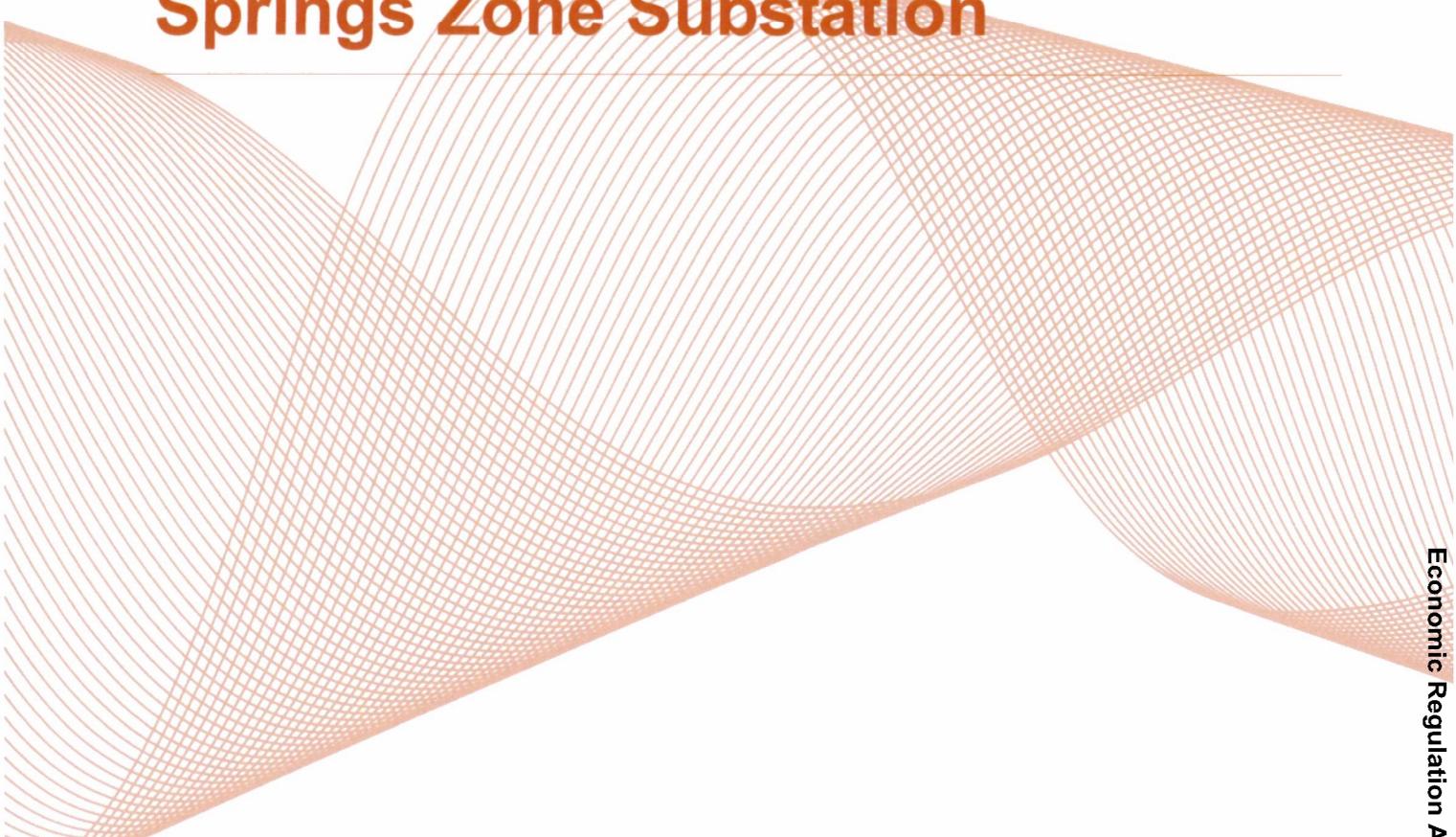
If you have any queries with regards to the exemption request, please do not hesitate to contact Lindsay Offer on (08) 9326 6303.

Yours sincerely,

Margaret Pyrchla
Regulatory Compliance Manager

Enclosed: Submission for exemption from compliance with clause 2.5.4(b) of the Technical Rules

Submission to the Economic Regulatory Authority for Exemption from the Technical Rules Clause 2.5.4 (b) for Meadow Springs Zone Substation



Date: 15 May 2015
Prepared by: Network Planning and Standards

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List of document references

DM reference	Title of document	Relevance of document	Can be made public? (Y/N)
8786206	Works Planning Report – Mandurah Load Area: Reinforcement MSS: STG 1	Provides all project supporting material	N
8494654	Transmission Planning Guidelines – Interpretation of the Technical Rules	Explains WP's interpretation of the NCR Criterion including the application of a wind-back from 90% to 75% transformer utilisation as endorsed by the Executive. Refer to section 16 'Contingency criteria' pp.63-75 and appendix C.2.4 'NCR capacity' pp.98-101	N

Executive summary

This submission requests that the Economic Regulation Authority (ERA) grant Western Power a temporary exemption from complying with clause 2.5.4(b) Normal Cyclic Rating (NCR) Criterion of the Technical Rules with respect to capacity requirements at Meadow Springs (MSS) zone substation. The temporary exemption will cease upon completion of Stage 2 of the Mandurah (MH) load area investment strategy, indicative completion by 2020.

MSS is forecast to be non-compliant with the NCR Criterion from 2015/16.

Western Power considers the following grounds as reasonable and prudent to granting the Technical Rules exemption request:

- Bringing forward the MSS Expansion Project minimises the financial risk of premature investment in the Mandurah load area. The subsequent risk exposure period is considered less than 2% of the year.
- Deferral of costly augmentation at MH zone substation is justified based on high investment risk due to recent urban development trends and historic load volatility resulting in uncertainty in future load projections.
- The proposed investment strategy is economically efficient, satisfies the New Facilities Investment Test (NFIT) and represents a pathway towards compliance.
- The unserved energy expected to occur during the exposure (non-compliance) period defines the cut-off limits and subsequent acceptable level of risk at MSS.
- The forecast exposure period at MSS is dependent on the realisation of the load forecast (i.e. NCR Criterion may not be breached if demand stabilises or reduces in the future).
- The impact of unserved energy during the forecast exposure period will be managed by existing operational procedures inherent to the NCR Criterion in the event of a major transformer failure during summer peak demand.
- The impact on compliance, reputation and financial risk exposure will be reduced by obtaining an exemption.
- No foreseeable adverse impact on the existing level of safety and reliability to other network users.

The analysis of MSS includes references to MH which is expected to become non-compliant from 2016/17. If this arises, a separate Technical Rules exemption will be sought.

In summary, in this case, Western Power considers the advantages of operating with the exemption outweigh the disadvantages of requiring full compliance.

1 Exemption details

MH and MSS 132/22 kV zone substations are designed in accordance with the planning criteria in the Technical Rules under clause 2.5.4(b) – NCR Criterion.

The bulk of load in the Mandurah area is located along the southern metropolitan coastal strip served by the MH and MSS zone substations, both of which are experiencing rapid growth. In 2014/15, the network growth rates have been high with the majority of future urban¹ development expected to appear in the coastal corridor north of MSS, illustrated in Figure 1. This urban growth is the primary driver behind the emerging capacity constraints at MH and MSS.

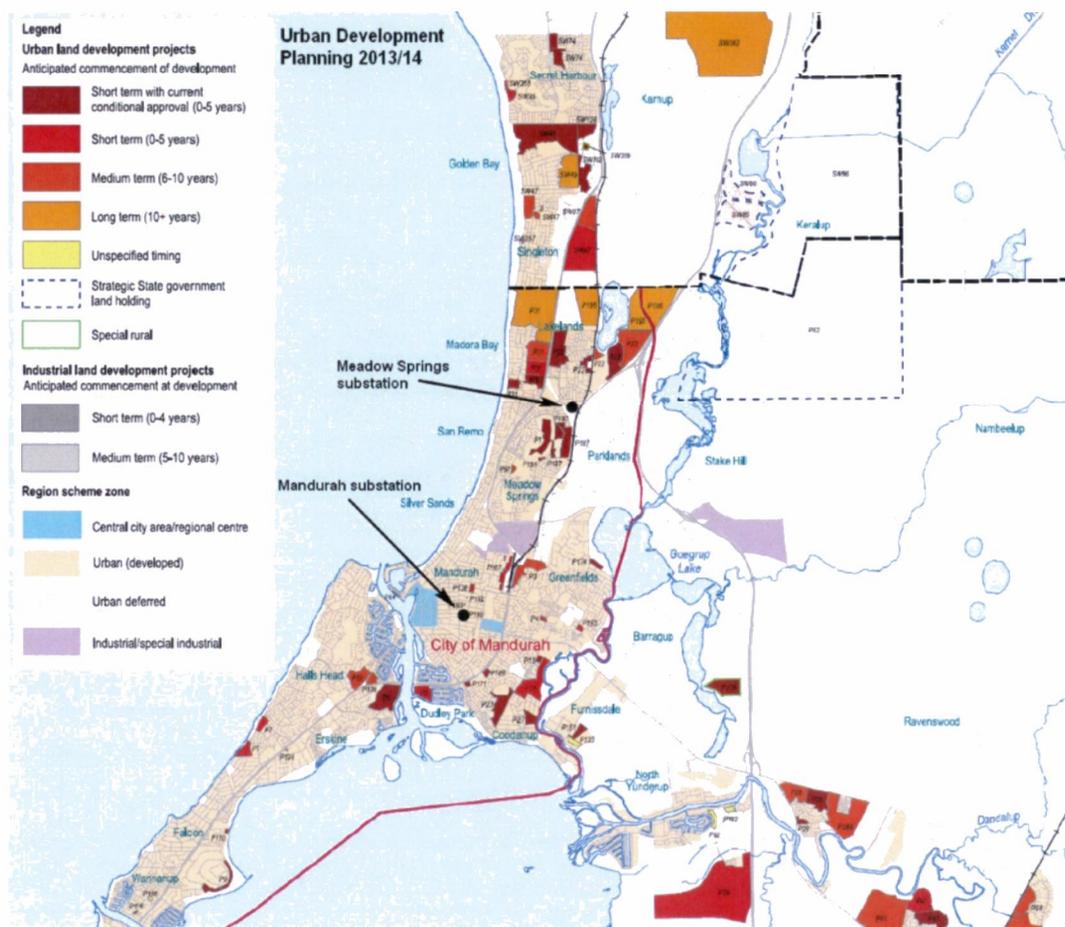


Figure 1: Peel urban development outlook
[\[http://www.planning.wa.gov.au/dop_pub_pdf/ULDO_2013_14_South_metro_spatial_plan.pdf\]](http://www.planning.wa.gov.au/dop_pub_pdf/ULDO_2013_14_South_metro_spatial_plan.pdf)

Mandurah Load Area (MH + MSS)

The combined rate of growth at MH and MSS is 7.56 MVA per annum. The actual combined summer 2015 peak² reached 123 MVA, 8.5 MVA less than the NCR capacity limit. Based on both the combined growth rate and combined forecast for MH and MSS, the Mandurah load area is expected to exceed NCR capacity (131.5 MVA) and become non-compliant with the NCR Criterion during 2015. Refer to Figure 2 below.

¹ The Mandurah load area is heavily weighted by the locational share of residential customers (~97%)
² Interim value (represents data up to 10 February 2015)

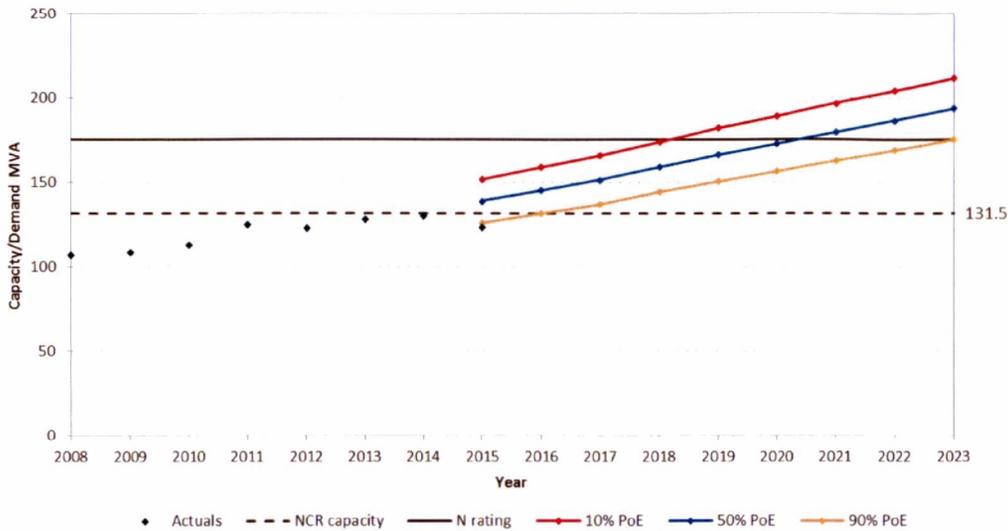


Figure 2: Combined MH + MSS capacity, actual performance and demand forecasts

Mandurah Zone Substation

The rate of growth at MH is 3.81 MVA per annum. MH exceeded NCR capacity (75.9 MVA) between 2010 and 2013; however, in 2011, 2013 and 2014, a series of staged load transfers from MH to MSS were made to reduce the impact of the capacity shortfall.

The actual summer 2015 peak³ reached 70.9 MVA, 5.0 MVA less than the NCR capacity limit. Based on the growth rate and forecast, MH is expected to exceed NCR capacity and become non-compliant with the NCR Criterion from 2016. Refer to Figure 3 below.

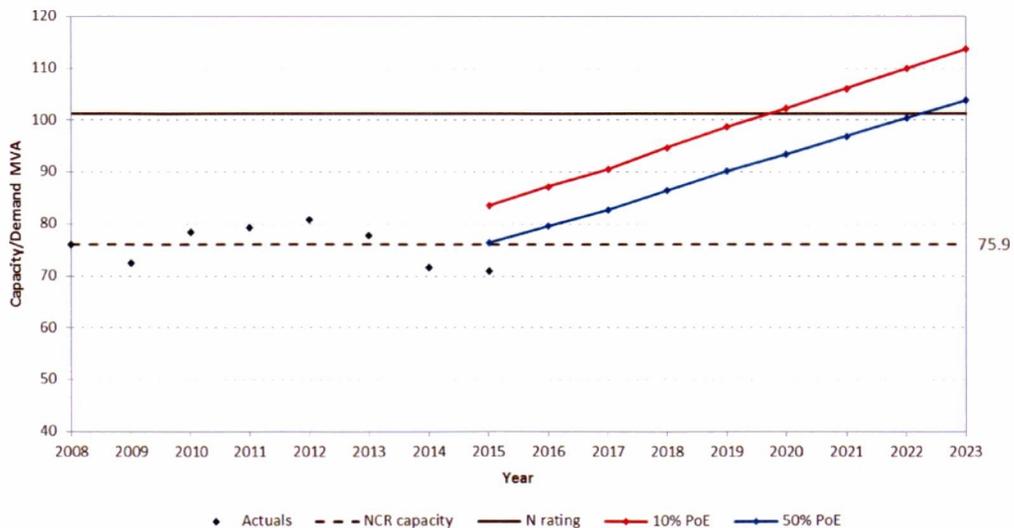


Figure 3: MH capacity, actual performance and demand forecasts⁴

³ Interim value (represents data up to 10 February 2015)

⁴ The decline in actuals at MH from 2012 onwards is due to a number of staged load transfers from MH to MSS where the transfer either equalled or exceeded the growth rate

Meadow Springs Zone Substation

The rate of growth at MSS is 3.75 MVA per annum. MSS exceeded NCR capacity (55.6 MVA) in 2014 and was non-compliant with the NCR Criterion as identified in Figure 4. The actual summer 2015 peak⁵ (52.1 MVA) is less than the NCR capacity limit thereby recovering compliance with the NCR Criterion. Based on the growth rate and forecast, MSS is expected to exceed NCR capacity and become non-compliant with the NCR Criterion from 2015.

Note: In early January 2015, a contingency event occurred resulting in a temporary load transfer of approx. 6 MVA from MSS to Waikiki Zone Substation. This transfer potentially understates the summer 2015 peak at MSS.

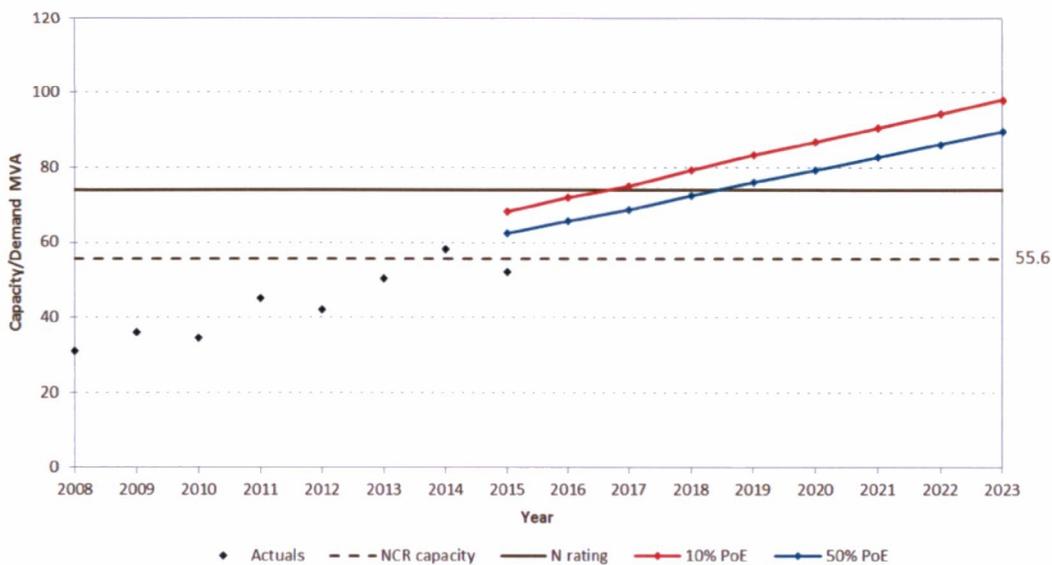


Figure 4: MSS capacity, actual performance and demand forecasts

The Mandurah load area is exposed to the risk of non-compliance from 2015/16 onwards. However, a major transformer failure would need to occur during the summer peak period to achieve the estimated load at risk. The exposure period is less than 2% of the year⁶ and would be further minimised by the Rapid Response Spare Transformer (RRST) contingency strategy characteristic to NCR classified substations.

Internal studies have shown that in order to maintain compliance obligations at both substations, the required network investment option (MH Extension Project) would involve significant substation augmentation at MH. The project cost estimate is \$27 M. Recent cost benefit analysis and risk-based planning techniques have presented an alternative investment strategy for the Mandurah load area. The revised network investment recommends deferring the MH Extension Project to 2019/20 and bringing forward capacity expansion at MSS to 2016/17. The MSS Expansion Project cost estimate is \$9.2 M.

This revised strategy represents a pathway towards compliance as Western Power aims to minimise the risk of over-investment in the face of potential variability in forecast demand. However, Western Power would be exposed to the risk of breaching Technical Rules compliance at MSS during the investment period (2015/16 to 2019/20). Therefore, Western Power seeks a temporary exemption from compliance with the NCR Criterion for the MSS substation.

⁵ Interim value (represents data up to 10 February 2015)

⁶ Refer to load duration curves in Attachment 2

2 Exemption impacts and risks

2.1 Network constraint

Western Power's 2014 load forecasts indicate the NCR capacity of MH and MSS zone substations in the Mandurah load area will be exceeded within the five year outlook.

MH zone substation:

- forecast non-compliance exposure with NCR Criterion from 2016/17.

MSS zone substation:

- forecast non-compliance exposure with NCR Criterion from 2015/16.

Internal studies recommend a two staged approach to address the emerging capacity constraints in the Mandurah load area.

Mandurah load area investment strategy includes:

- Stage 1: MSS Expansion Project – 2016/17 (partial compliance recovery)
 - installation of a 132/22 kV 33 MVA power transformer
 - transferring load from MH to MSS via distribution upgrades and switching arrangements
- Stage 2: MH Extension Project – 2019/20 (full compliance recovery)

The initial proposal (Stage 1) will provide additional transformer capacity at MSS (and subsequently MH by way of distribution load transfer) thereby establishing a pathway towards compliance at both sites.

2.2 Operating under an exemption

Prior to the delivery of the Mandurah load area investment strategy, the network risks associated with the non-compliance exposure at MSS will be managed by existing mitigation measures inherent in the NCR Criterion including:

- availability of a RRST
- maintaining and monitoring distribution network interconnectivity between MH and MSS to ensure appropriate Distribution Transfer Capacity (DTC)
- monitoring of transformer loadings and ensuring transformer unbalance is minimised
- preparation of operational work instructions for specific transformer contingency events at MH and MSS

2.3 Technical Rules requirements

MH and MSS are zone substations in the metropolitan area and are classified under the planning criteria, clause 2.5.4(b) – NCR Criterion, in the Technical Rules.

Reference to the applicable Technical Rules is provided in Attachment 1.

2.4 Risk assessment

The Electricity Networks Access Code provides guidance in relation to assessing network service provider's (Western Power) proposed Technical Rules exemptions. To aid in explaining how these requirements are met, the risks associated with the exemption 'granted' versus the exemption 'not granted', is now discussed.

The severity of the impact of non-compliance on the existing level of safety and reliability, to current and future network users supplied by MSS, is dependent on three key factors:

1. summer peak demand forecasts (projected growth rates) must transpire;
2. a major transformer failure must occur in periods of summer peak demand (low probability of occurrence); and
3. proposed MSS Expansion Project is completed by 2017/18.

Operating an NCR substation above its NCR capacity effectively increases the utilisation of the transformers within the substation thereby increasing the quantity of load (and customers) at risk following the unplanned loss of a supply transformer. The load at risk above NCR capacity is in addition to the 'permitted' loss of a portion of the power transfer capacity that may be lost under the NCR Criterion. The unserved energy⁷ expected to occur during the exposure (non-compliance) period defines the cut-off limits and acceptable level of risk.

The impact of the work program intended with gaining this exemption will see little impact on service standard benchmarks. The variation in risk above present levels is not expected to be significant. This is because the deterministic compliance levels, which will eventually be breached, can be expected to be exceeded for relatively short periods of time.

There is also some uncertainty in relation to this proposal that relates to the possibility of outcomes from the present Electricity Market Review (EMR 2) being carried out in Western Australia. For the calculation of NCR, and for outcomes from risk based planning assessment, little variation is expected – and these considerations have been factored into the preparation of calculations which underpin this exemption request.

A risk assessment of the issues and potential network outcomes was undertaken using the Western Power risk assessment criteria and framework⁸. The commentary and assessment of change risks related to the proposed exemption is provided in

⁷ Refer to the supporting material in Attachment 3

⁸ Refer to Appendix H in the Works Planning Report

Table 1.

Table 1: Commentary on qualitative risk assessment for the exemption granted

Risk category: Δ risk	Description of expected impacts
<p>Safety risk The safety risk is unaffected and assessed as low</p>	<p>A higher number of customers than permitted under the NCR Criterion may be exposed to the risk of supply interruptions in the event of an unplanned loss of a supply transformer. Supply interruptions present health/safety risks to sensitive customers, including the 46 registered life support equipment (LSE) customers⁹ supplied from MSS. Existing operational procedures will limit the impact of supply interruptions experienced by LSE customers.</p> <p>An assessment for this case shows an exemption to the NCR Criterion will not impact the safety risk.</p>
<p>Environmental risk The environmental risk is unaffected and assessed as low</p>	<p>Post-contingent operation may lead to brief overloading on remaining in-service transformers and other primary assets due to network reconfiguration to enable load transfers. Existing operational procedures will minimise the risk of localised environmental damage associated with asset failure due to overloading.</p> <p>An assessment for this case shows an exemption to the NCR Criterion will not impact the environmental risk.</p>
<p>Customer risk 1. The reliability of supply risk is assessed to remain medium. 2. The network risk is assessed to remain low.</p>	<p>1. Reliability of supply: The number of customers, in addition to that permitted under the NCR Criterion, that may be affected by supply interruptions lasting up to 12 hours is estimated at 3,282 customers (2015) increasing to 5,035 customers (2017). Forecast load growth is expected to lead to over-utilisation on distribution feeders which may further reduce 'ideal' NCR capacity and impede Network Operations ability to transfer load post contingent. Reliability of supply may also be impacted as planned outages for plant maintenance will become increasingly more complex to plan and manage. Refer to network mitigation measures described in section 2.2. Whilst operating under an exemption, existing Western Power procedures will ensure the risk profile of MSS is maintained. An assessment for this case shows an exemption to the NCR Criterion is not expected to alter customer risk.</p> <p>2. Network risk: The probability of a major transformer failure occurring in periods of summer peak demand is considered a rare event. The proposed MSS Expansion Project is likely to be completed by 2017/18, subject to approvals. Major supply interruptions will be minimised by the existing RRST strategy inherent to the NCR Criterion. An assessment for this case shows an exemption to the NCR Criterion is not expected to alter network risk.</p>

⁹ Registered number of life support customers as at February 2015

3 Advantages and benefits of this exemption

The following table outlines specific advantages that are expected to be realised as a result of the work associated with this exemption being granted.

Table 2: Benefits associated with granting the exemption

Benefit	Site	Comment
Mitigate impact from non-compliance exposure	MH	The forecast non-compliance at MH is expected to be deferred from 2016/17 to 2019/20 (due to load transfers from MH to MSS).
	MSS	Operating under an exemption to the NCR Criterion will minimise the risk of regulatory non-compliance due to a major transformer failure prior to the completion of Stage 2 of the Mandurah load area investment strategy.
Financial benefit due to investment deferral	MH	Large upfront capital investment (MH Extension Project ~ \$27 M) at MH will be deferred for approximately 4-5 years (timing is subject to future demand) resulting in positive NPV benefits.
	MSS	Bringing forward the MSS Expansion Project represents a least cost interim solution to address the emerging capacity constraints in the Mandurah load area.
Mitigate financial risk of premature investment and under-utilisation of assets	MH	Historic load volatility in the Mandurah load area has created uncertainty in future load projections. If demand does not meet the 2014/15 forecast, new assets will be under-utilised and subject to NFIT risk.
	MSS	The urban development outlook and recent forecasting analysis indicates the majority of load growth is forecast to occur north of the MSS catchment area. The risk of asset under-utilisation at MSS is therefore deemed low.
Mitigate near-term capacity constraints	MH	Installing additional transformer capacity at MSS will relieve emerging capacity constraints at MSS and MH (via load transfers). This will assist Western Power in meeting all service levels/benchmarks at both substations.
	MSS	
Prevent disruption to local community	MH	The MH Extension Project requires major construction activities. Deferring this investment temporarily prevents disruption (noise, road closures, planned outages etc.) to the local Mandurah community, especially in the vicinity of MH.
	MSS	The MSS Expansion Project is relatively standard/straight-forward in comparison to MH Extension Project. Community disruption is expected to be minimal.

4 Conclusion

Western Power considers the following grounds as reasonable and prudent to granting the Technical Rules exemption request:

- Bringing forward the MSS Expansion Project minimizes the financial risk of premature investment in the Mandurah load area. The subsequent risk exposure period is considered less than 2% of the year.
- Deferral of costly augmentation at MH zone substation is justified based on high investment risk due to recent urban development trends and historic load volatility resulting in uncertainty in future load projections.
- The proposed investment strategy is economically efficient, satisfies the New Facilities Investment Test (NFIT) and represents a pathway towards compliance.
- The unserved energy expected to occur during the exposure (non-compliance) period defines the cut-off limits and subsequent acceptable level of risk at MSS.
- The forecast exposure period at MSS is dependent on the realisation of the load forecast (i.e. NCR Criterion may not be breached if demand stabilises or reduces in the future).
- The impact of unserved energy during the forecast exposure period will be managed by existing operational procedures inherent to the NCR Criterion in the event of a major transformer failure during summer peak demand.
- The impact on compliance, reputation and financial risk exposure will be reduced by obtaining an exemption.
- No foreseeable adverse impact on the existing level of safety and reliability to other network users.

In summary, Western Power therefore considers the advantages of operating with the exemption sought outweigh the disadvantages of requiring full compliance in this case.

5 Statement of Technical Rules exemption

Under section 12.40 of the *Electricity Networks Access Code*, Western Power as the Service Provider for the Western Power Covered Network hereby applies to the ERA for exemption from a specific requirement of the Technical Rules, as follows:

“Western Power is temporarily exempted from complying with the requirements of clause 2.5.4(b) (NCR Criterion) of the Transmission Planning Criteria in the Technical Rules at Meadow Springs zone substation.

The stated temporary exemption applies until the completion of Stage 2 of the Mandurah load area investment strategy, or unless otherwise revoked under the provisions of the *Electricity Networks Access Code 2004*.”

Attachment 1: Technical Rules requirements

Transmission System Planning Criteria¹⁰:

2.5.4 Zone Substations

(b) Normal Cyclic Rating (NCR) Criterion

- (1) The NCR risk criterion permits the loss of a portion of power transfer capacity at a substation following the unplanned loss of a supply transformer within that substation*
- (2) The portion of the power transfer capacity that may be lost is the lesser of:
 - (A) 75% of the power transfer capacity of the smallest supply transformer within the substation; and*
 - (B) 90% of the power transfer capacity of the rapid response spare supply transformer**

2.5.4.2 Application of the NCR Criterion

- (a) The Network Service Provider may apply the NCR Risk criterion to zone substations in the Perth metropolitan area. Zone substations supplying essential services and zone substations where the application of the NCR Risk criterion is technically or economically unviable may be exempt from classification as NCR classified substations and must fully meet N-1 planning criteria*
- (b) No zone substation may be classified an NCR substation unless a rapid response spare transformer is available to temporarily replace the failed supply transformer within a target period of 12 hours*
- (c) Following the loss of a supply transformer from an NCR classified zone substation, the Network Service Provider must use its best efforts to minimise load shedding by transferring load to other supply transformers or zone substations by utilising available spare capacity*
- (d) Following the deployment of the rapid response spare transformer, the Network Service Provider must install a suitable spare transformer or procure a new transformer to replace the failed transformer permanently and release the rapid response spare transformer to cater for future contingencies*

¹⁰ Calculation of NCR capacity for MH and MSS is provided in Appendix A of the WPR

Attachment 2: Substation analysis

Mandurah Zone Substation

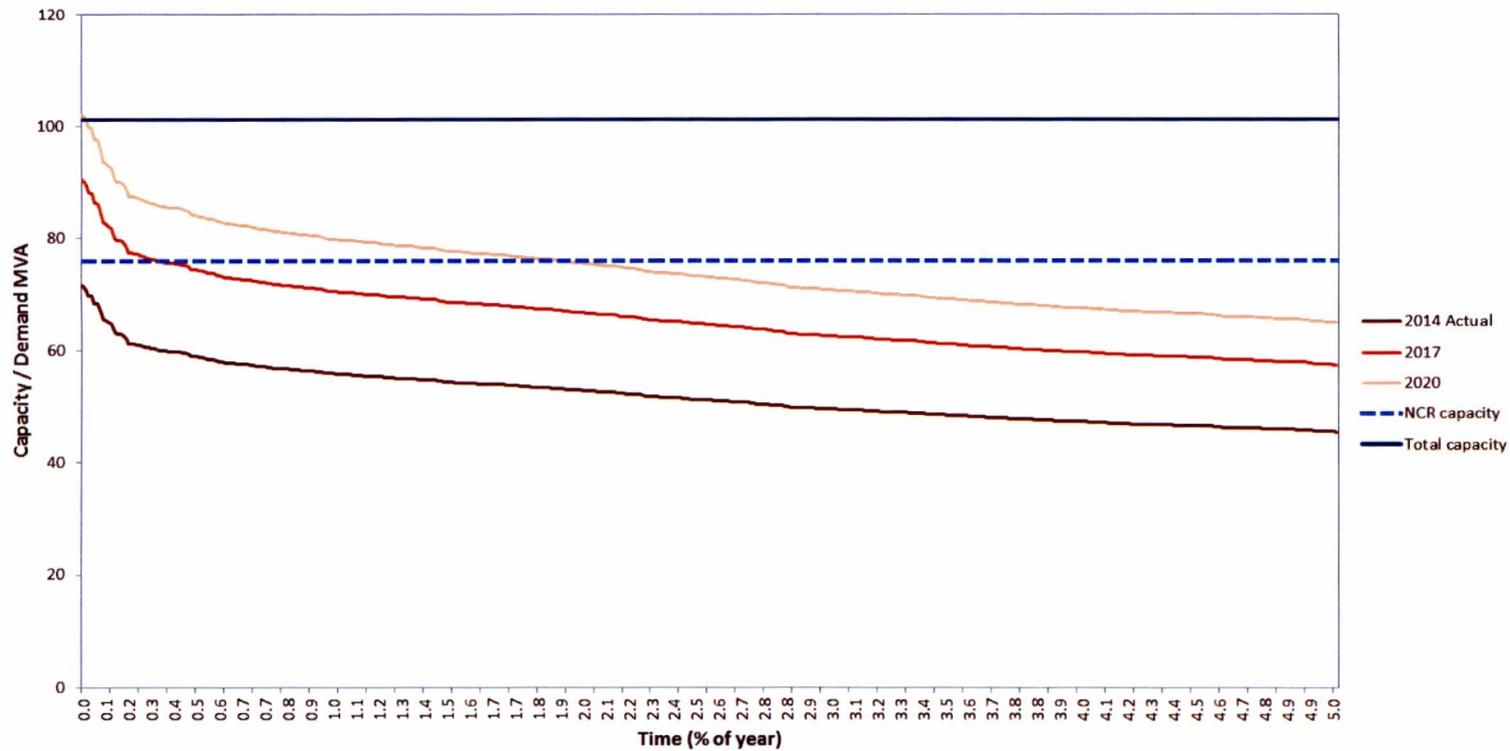


Figure 5: Load duration curve for MH - top 5% demand

Meadow Springs Zone Substation

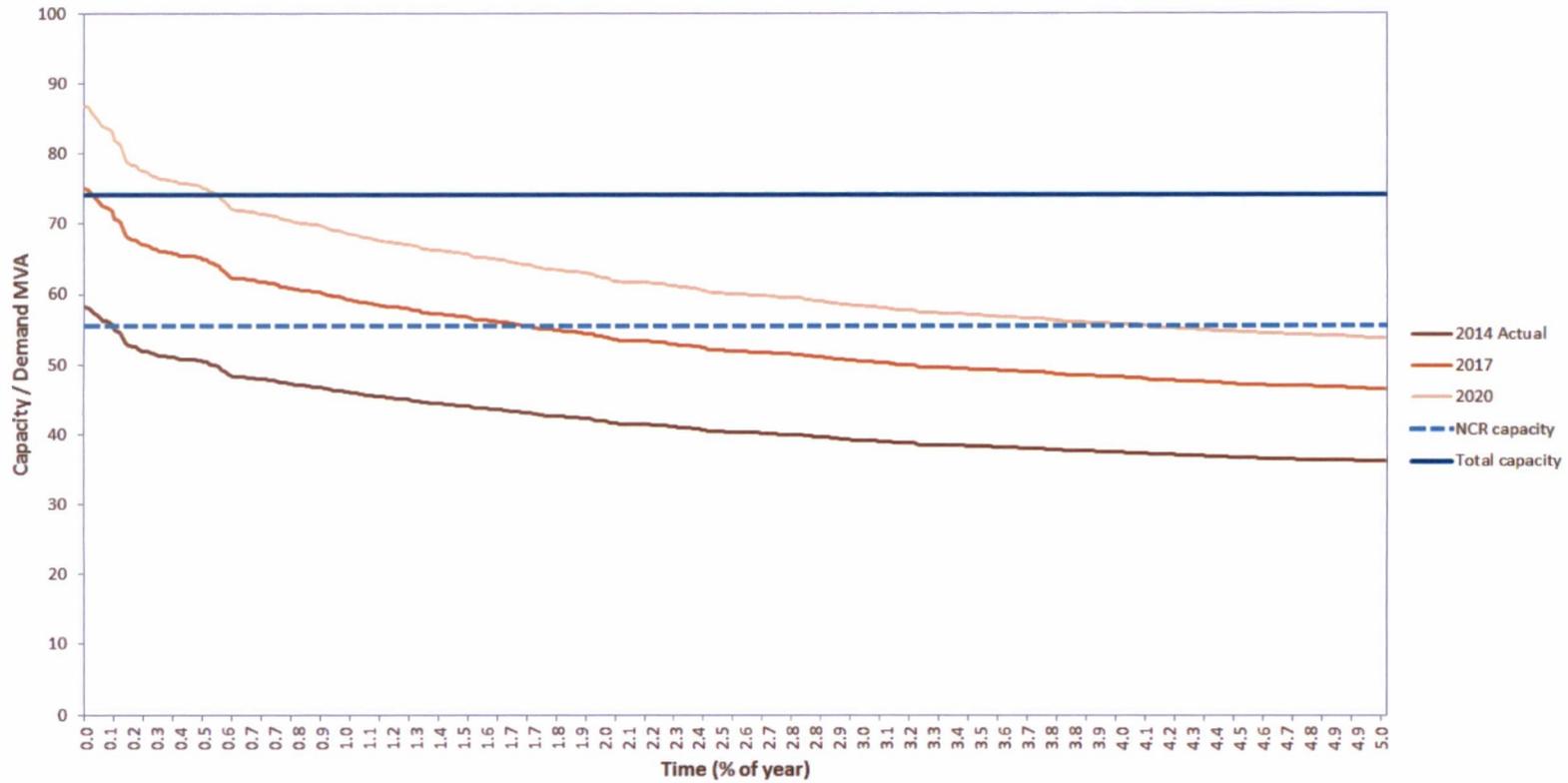


Figure 6: Load duration curve for MSS - top 5% demand

Table 3: Energy at risk and expected unserved energy at MSS

Substation: MSS 132/22 kV (zone)	2014	2015	2016	2017¹¹	2018	2019	2020¹²	2021	2022	2023
Without Augmentation										
10% PoE forecast peak summer demand (MVA)	58.3 ¹³	68.3	71.9	75.1	79.2	83.2	86.8	90.5	94.3	98.0
NCR energy at risk (MVAh)	14	307	581	923	1,514	2,260	3,113	4,198	5,606	7,265
NCR hours at risk (hours)	10	68	111	150	208	274	359	460	591	748
NCR % of year at risk	0.11%	0.78%	1.27%	1.71%	2.37%	3.13%	4.10%	5.25%	6.75%	8.54%
Total weighted expected unserved energy (MWh)	9.5	14.5	19.4	27.0	65.0	132.3	219.2	353.6	525.7	747.6
Value of total weighted expected unserved energy	\$0.27M	\$0.42M	\$0.56M	\$0.78M	\$1.88M	\$3.82M	\$6.33M	\$10.21M	\$15.17M	\$21.58M
With Augmentation (Stage 1 & 2)										
NCR energy at risk (MVAh)	14	307	581	923	54	134	0	0	0	0
Total weighted expected unserved energy (MWh)	9.5	14.5	19.4	27.0	1.42	2.50	0.0	0.0	0.0	0.0
Value of total weighted expected unserved energy	\$0.27M	\$0.42M	\$0.56M	\$0.78M	\$0.04M	\$0.07M	\$0.00M	\$0.00M	\$0.00M	\$0.00M

The maximum unserved energy expected to occur during the exposure period is 27.0 MWh (summer 2017) prior to the completion of Stage 1.

¹¹ Stage 1 required in-service date

¹² Stage 2 required in-service date

¹³ Actual 2014 peak as recorded by System Operations

Attachment 3: Customer impact under an exemption

If an exemption to the NCR Criterion is granted, Western Power will ensure the risk profile of MSS is maintained during the expected exposure period.

For existing customers seeking a Customer Maximum Demand increase, or future customers seeking a reference or non-reference service connection, Western Power will assess whether or not their contribution to unserved energy will exceed the limits set under the exemption.

The unserved energy limits for MSS during the exposure period are shown in Table 4 below.

Table 4: Unserved energy limits at MSS

Exposure years	Annual expected unserved energy limits MWh	Proposed network investment
2014	9.5	
2015	14.5	
2016	19.4	
2017	27.0	Stage 1 – MSS Expansion Project (Winter 2017/18)
2018	1.42	
2019	2.50	
2020	0.0	Stage 2 – MH Expansion Project (Summer 2019/20)

If future customer service connection applications are assessed as exceeding the unserved energy limit in the relevant year of connection, Western Power will consider bringing forward the proposed timing of the MH Expansion Project, or other strategies, in order to ensure the maintenance of the risk position defined under the exemption.

Subsequently, in some cases, a customer may be required to fund the bought forward costs of any substation network project. Investment decisions of this nature will be driven by project/development outcomes which exceed what has been anticipated and accounted for in the underlying load growth, driven primarily by urban development within the load area.

Glossary

Acronym / term	Meaning
ACA	Annualised Cost of Augmentation
AEMO	Australian Energy Market Operator
CMD	Customer Maximum Demand
DTC	Distribution Transfer Capacity
ERA	Economic Regulation Authority
LSE	Life Support Equipment
MH	Mandurah Zone Substation
MSS	Meadow Springs Zone Substation
MVA	Mega-volt-ampere (apparent power)
MVAh	Mega-volt-ampere-hour (apparent energy)
MW	Megawatts (real power)
MWh	Megawatt-hour (real energy)
NCR	Normal Cyclic Rating – refer to Technical Rules clause 2.5.4(b). The NCR Criterion was initially developed to allow each transformer in a substation to be loaded to 90% of its NCR rating
NCR 75% Windback	The NCR Criterion was modified to limit transformer loading to an average of 75% of NCR rating. The policy modification was driven by an external review of the NCR Criterion and is endorsed by Western Power's Executive
NFIT	New Facilities Investment Test
N-1 Rating	Firm capacity of a substation following the loss of the largest transformer in the substation
N-Rating	Total capacity of a substation
NPV	Net Present Value
NSP	Network Service Provider
PoE	Probability of Exceedance
RRST	Rapid Response Spare Transformer
SWIS	Southwest Interconnected System
Tx	Power Transformer
VCR	Value of Customer Reliability
VOUE	Value of Unserved Energy
WAI	Waikiki Zone Substation
WPR	Works Planning Report