Submission to the Economic Regulation Authority

Australian Energy Market Operator Fourth Allowable Revenue proposal

5 December 2016

Introduction

Western Power welcomes the opportunity to make a submission in response to the Economic Regulation Authority's (**Authority**) issues paper on the Fourth Allowable Revenue (**AR4**) proposal submitted by the Australian Energy Market Operator (**AEMO**).

Western Power supports the evolution of the energy market in Western Australia, and is committed to providing services to network customers that are safe, reliable and affordable. At present, constraints exist on the network that limit the provision of these services in a manner that meets the needs of new customers.

Western Power supports AEMO's allowable revenue submission, specifically the 'Market Reforms' expenditure, that includes planning and establishment costs associated with AEMO's development and implementation of new systems and procedures to comply with the amended Wholesale Electricity Market (**WEM**) requirements being developed by the Electricity Market Review (**EMR**) team.

Whilst Western Power acknowledges appropriate rigour will be applied in evaluating the expenditure building blocks, in Western Power's view the development of these new systems and procedures for the purposes of managing generator dispatch should be progressed to facilitate the connection of new generators thus providing broad market and customer benefits.

Background

Phase 2 of the EMR included reforms to introduce constrained access to the South West Interconnected System (**SWIS**) from 1 July 2018. The benefits of this reform to WA were significant in terms of reducing the barriers to entry and promoting competition within the electricity wholesale and retail markets. They would have provided the necessary foundation for WA to secure its large scale renewable energy certificates locally and deferred network expansion requirements (and environmental footprint) to meet increasing supply requirements of new customers.

Central to the EMR reforms was the transition from the current unconstrained access regime to a fully constrained access regime that, amongst other market benefits, would have facilitated the ability to efficiently, safely and securely connect any large scale new generators to the Western Power network.

To facilitate the constrained access reform it was essential that the AEMO develop a new central dispatch engine capable of scheduling the dispatch of WEM generation in an economic manner, subject to network constraints. The central dispatch engine would have also facilitated other local EMR reforms, such as co-optimised energy and ancillary service markets. AEMO has included the costs to develop the new central dispatch engine in its Fourth Allowable Revenue submission for the AR4 period, which is currently being assessed by the Authority.

The Public Utilities Office recently announced that the Government's proposed legislation did not pass in time for the constrained access reform to be implemented as planned. As a result, the need for AEMO to receive funding to develop a new central dispatch engine in the AR4 period[1] could be questioned by the Authority.

Despite the constrained access reform being delayed, Western Power supports the development of a jurisdictional constrained access regime to facilitate the connection of new generation. Central to this is

[1] AR4 period is three years from 1 July 2016 through to 30 June 2019

AEMO's continued development of a new central dispatch engine in the AR4 period and the introduction of facility bidding and other WEM reforms to support a partially constrained network. This would allow new generators to connect on a constrained basis whilst preserving the firm access arrangements for existing generators. The dispatch engine would provide a much needed mechanism to connect new generators to the Western Power network on a constrained basis under the existing Electricity Networks Access Code 2004 (**Access Code**) framework.

Without the availability of the new central dispatch engine, Western Power's ability to safely and securely connect additional generation is severely limited. Western Power has undertaken an analysis of alternative solutions but was unable to identify any viable alternatives to cater for the volume of connection applications it has received. Western Power considers the new dispatch engine fundamentally supports the Code Objective to:

> *"promote the economically efficient investment in, and operation of and use of, networks and services of networks in Western Australia in order to promote competition in markets upstream and downstream of the networks."*

The development of the new central dispatch engine would realise significant net market benefits attributed to the connection of lower cost renewable facilities and would enable the Federal Large Scale Renewable Energy Targets to be met from WA based sources. Connecting these facilities would also put downward pressure on capacity prices offering a further benefit to consumers and provide a significant local economic stimulus from the construction of new power stations. Without the new central dispatch engine the ability to realise these benefits is limited.

Unconstrained access arrangements in the SWIS

Under present arrangements in the SWIS the standard form connection agreement for large generators (**ETAC**) provides generators with unconstrained access rights to the Western Power network. This is commonly referred to as a 'reference service'.[2]

In order to facilitate a new reference service Western Power is required to assess whether the new generator is able to operate unconstrained under the conditions specified in the ETAC, whilst also honouring the unconstrained access rights of incumbents. Where insufficient network capacity is available shared network augmentation is required to connect the new plant. The generator must contribute to the shared network augmentation in accordance with Western Powers capital contribution policy.

Over the past five years, the ability for Western Powers network to accommodate additional generation on an unconstrained access basis has been eroded. In most locations, significant and costly network augmentation is required to accommodate any further generation on an unconstrained basis. The appetite among new generators to provide capital contribution towards network augmentation is low, especially where the existing network capacity is sufficient to accommodate the new plant on an unconstrained basis for the vast majority of the year.

Western Power estimates that the network augmentation costs to connect its 'active' generator applications on a reference service would be in the vicinity of $330 million for generators north of Perth and $35 million for generators in the south. These costs render most projects commercially unviable. Appendix A provides a high level summary of the currently active applications, whilst Appendix B details the network augmentation required to connect these generators.

[2] Unconstrained access rights are not provided under all conditions. Typically unconstrained access only applies under conditions where all network elements necessary to provide such access are in service.

New generators are also conscious of the future planned constrained access reform in WA, which would allow them to connect without capital contribution increasing the financial viability of their venture and subsequently reducing the overall cost to consumers. Additionally, there are also valid concerns that any capital contribution afforded for unconstrained access may only provide an access guarantee for a short period i.e. until the constrained access reform is passed by Parliament.

Non-reference services

Western Power is required under the Access Code to endeavour to provide a reference service. However, where a reference service is not suitable, for one or more reasons, a generator may elect to pursue a non-reference service. In those circumstances, Western Power is obliged to make all reasonable efforts to connect the generator. Irrespective of the type of service, Western Power must be able to demonstrate that any new generator connection does not impede its ability to provide covered services to existing users.

A connection agreement that requires a generator to be constrained at times when all network elements are in service would constitute a non-reference service. The connection of a new generator on this basis cannot impede the access rights of existing users. To ensure this, Western Power requires the new generator to be constrained ahead of existing users on a reference service, irrespective of the type of facility, or its cost to operate.

Western Power currently uses two main approaches to manage the connection of non-reference generators in real time.

1. high speed post-continent line overload runbacks; and
2. slower schemes which operate through the Energy Management System.

In response to a network limitation, most existing non-reference service generators use high speed post contingent runbacks that operate to constrain certain generators before others in reverse order of the connection date (“first come first served” basis). Unfortunately, there is limited opportunity to connect new generation on high speed runback systems due to complexity and risk to system security.

There may be some areas of Western Powers network that could accommodate a generation runback but using this approach presents compounding issues for AEMO and Western Power because the runback systems:

- are largely uncoordinated presenting a risk that their simultaneous response, should that occur, would lead to an unmanageable power system security threat;
- are challenging to ensure proper discrimination between generating units in accordance with their respective connection agreements and appropriate runback ordering (“first come first served”);
- invariably over-constrain generators in excess of the optimum levels due to the nature of the individual control schemes; and
- present inflexibility to system operators as the control systems are not easily modified to account for planned and unplanned outages, or other network reinforcements.

Appendix C provides additional detail regarding the issues associated with the additional high speed runback schemes.

Western Power considers that moving to a centralised form of pre-contingent constraint system[3] is essential to manage the majority of its active non-reference connection applicants in a safe and secure manner. This view is based on three years of detailed investigation into numerous options for how to connect non-reference generators.

None of the options investigated by Western Power were found to be viable for reasons of complexity, lack of market transparency, WEM Rule breaches or inability to adequately manage power system security.

Like all other Network Service Providers across Australia, Western Power is seeing an unprecedented level of renewable technologies connection enquiries, driven largely by the Federal Government's large scale renewable energy target incentives. Nearly all generators are seeking to connect on a non-reference basis as the cost and time required to augment the existing network are prohibitive.

Existing AEMO dispatch systems

The existing dispatch systems were transitioned from Western Power to AEMO as part of the reform process. They were due to be replaced by AEMO as part of the EMR. Western Power considers that without extensive and costly modification, the existing dispatch systems are inadequate to control significant new non-reference service generators. The systems:

- cannot automatically identify potential network limitations and modify generation dispatch as required;
- do not provide System Management with the flexibility to consider network constraints and the relative impact of individual facilities on specific network elements when making manual dispatch decisions; and
- are not capable of differentiating between reference and non-reference services.

In Western Power's view the level of automation and sophistication afforded by current dispatch systems falls short of international standards. Without an expansion in capability, the connection of more generation would likely compromise power system security and require an unacceptable level of manual intervention by AEMO System Management.

The benefits of connecting new generation

The benefits of connecting new generation to the Western Power network on a constrained basis is expected to far exceed the costs of developing a new central dispatch engine to adequately control the facilities. Preliminary market simulation studies completed by Western Power indicate market benefits of the order of $100-$200 million per year could be realised by connecting Western Powers most active generator connection applicants.[4]

Western Power expects that the dispatch engine will provide a security-constrained economic dispatch environment on a 5 minute interval basis. It should allow for automated prioritisation between reference and non-reference connections to meet power system security requirements, whilst also considering least-cost objectives. This would avoid the need for the installation of further runback schemes, and is scalable for the long-term.

[3] As per AEMOs new central dispatch engine proposal

[4] These benefits are largely due to operational fuel cost benefits resulting in lower wholesale electricity pricing outcomes.

Without a new dispatch engine, only a limited number of new facilities would be able to safely connect via the high speed runback systems option. The remainder would be required to provide a significant capital contribution to network augmentation for a reference service. Western Power assumes that they would most probably not progress with their projects, as the lead time and costs for the service would be prohibitive. This would adversely impact Western Australia's ability to meet its large scale renewable energy target obligations locally, requiring retailers to potentially look interstate for purchase of energy certificates.

The development of a new central dispatch engine would enable new generation to connect and increase the capability of the existing covered network to provide covered services. It would also increase network utilisation and take advantage of the fact that for the vast majority of time Western Power's transmission network is operating with considerable spare capacity.

Recommendation

Subject to the appropriate scrutiny of the expenditure building blocks, Western Power supports the continued development of AEMO's new central dispatch engine, as part of the scope of its Market Reforms expenditure proposal. This, in combination with other WEM reforms, such as facility bidding, should enable the timely connection of currently active generator applications.

Western Power believes the benefits to customers and the market of the implementation of a constrained network for new generators are significant and a delay in the development and implementation of the central dispatch engine may have undesired outcomes for customers and the State.

Western Power believes that development of the central dispatch engine could potentially provide market benefits of the order of $100-$200 million per annum. It is expected that the annual market benefit attributed to even a small portion of the new generator applicants trying to connect to the Western Power network would significantly outweigh the annualised cost of the new dispatch engine.

Appendix A – Current applications and enquiries to connect to the Western Power network

Western Power is currently progressing one application (a 9.9 MW Solar Farm) that is unconstrained. All other applications of similar size or larger are subject to network constraints.

The following volume of generation is active in the connection process:

- North Country
  - 440 MW Solar Farm
  - 34 MW Solar Farm
  - 30 MW Solar Farm
  - 250 MW Wind Farm
  - 130 MW Wind Farm
  - 105 MW Wind Farm
- South County
  - 30 MW Solar Farm
  - 40MW Biomass generator
  - 40 MW Wind Farm
- East Country
  - 100 MW Solar Farm
  - 100 MW Solar Farm
  - 180 MW Wind/Solar Farm
- Metro
  - 32 MW Waste to Energy plant

Many of these applications and enquiries were progressing on the assumption of constrained access being introduced from July 2018, with in-service dates shortly thereafter. It should be noted that the volume of connection enquiries is most significant in the North Country area, where the ability to utilise additional high-speed runbacks in most limited.

Appendix B – Network augmentation costs associated with unconstrained access

This appendix provides the potential costs and timeframes for network augmentation required to achieve a reference service for Western Power's most active generator connection applicants in the North and South Country areas. The information is provided as an example of the value of capital works that would not be required to connect new generators assuming appropriate central dispatch systems were available to control non-reference facilities.

North Country area

New entrant connections in the North Country area can result in thermal overloads on numerous transmission lines in the North Country transmission system. Table 1 provides a summary of the overloaded lines that would result from the connection Western Power's most active generator connection applicants in that area.

Table 1: Summary of all overloads in the North Country area

Overloaded Transmission Lines	
North of Three Springs	
MGA-TS 81	MBA-MGA 81
MBA-TS 81	
South of Three Springs	
CKN-WNO 81	NBT-WNO 81
CKN-YP 81	NT-EP/BEL 81
CTB-RGN 81	NT-HBK 81
ENB-TS 81	NT-PJR 81
EP-BEL/NT 81	PJR-RGN 81
HBK-MUC 81	PJR-YP 81
JDP-WNO 81	NT-HBK 81
MOR-MUC 81	NT-PJR 81
MOR-TS 81	PJR-RGN 81
MUL-JDP 81	PJR-YP 81
NBT-PJR 81	

The network augmentation required to address all of the above overloaded transmission lines would include work north and south of Three Springs Terminal[5] as detailed below. The total capital cost for this work is estimated to be at around $330 million with a construction lead time of up to 8 years.

Work north of Three Springs Terminal

1. Establishment of a new 132 kV yard at Three Springs Terminal and construction of 125 km of double circuit transmission line between the new 132 kV yard and Mungarra Substation.

[5] This scope of work is indicative only and cost estimates are +/-50%

Total estimated capital cost for works north of Three Springs Terminal is $130m and estimated construction lead time 4-5 years.

Work south of Three Springs Terminal

2. Mid West Energy Project Southern Section Stage 2, involving the re-energising an existing 132 kV circuit at 330 kV to form a 330 kV circuit from Northern Terminal to Three Springs Terminal, cutting into Neerabup Terminal, a new terminal near Eneabba substation and resupply of Regans Substation
3. Construct 25 km of 132 kV double circuit from Neerabup Terminal to Wangara Zone Substation and Neerabup Terminal to Landsdale Zone Substation
4. Convert 12 kms of the existing Neerabup Terminal to Wanneroo split phase circuit to double circuit
5. String the second vacant circuit from Neerabup Terminal to Pinjar
6. Upgrade the current transformer on the MUC809.0 circuit breaker
7. Radialise/isolate the Northern Terminal and Neerabup Terminal 132 kV networks by constructing 6kms of 132 kV single circuit between Padbury and Wangara zone substations and establish normally open point between North Beach and Padbury 132 kV circuit
8. Upgrade 9 kms of the Northern Terminal to Landsdale 132 kV circuit to single circuit
9. Construct 50kms of 132 kV double circuit between Cataby and Regans 132 kV Zone Substation and construct 65kms of 132 kV double circuit between Regans 132 kV Zone Substation and Pinjar
10. Construct32 kms of 132 kV single circuit between Henley brook Zone Substation and Muchea 132 kV Zone Substation, and construct 13 kms of 132 kV single circuit from Henley Brook to Northern Terminal
11. Upgrade 20 kms of the Northern Terminal to East Perth/Belmont 132 kV

Total estimated capital cost for works south of Three Springs Terminal is $198.1million and estimated construction lead time 6-8 years.

South Country area

New generator connections in the South Country area can result in thermal overloads on numerous transmission lines in the South Country transmission system. Table 2 provides a summary of the overloaded lines that would result from the connection Western Power's most active generator connection applicants in the South Country area.

Table 2: Summary of all overloads in the South Country area

Overloaded Transmission Lines
SNR-WGP/APJ 81
PNJ-APJ 81
MH-PNJ 81
PNJ-CT/MSS 81

The network augmentation required to address all of these overloaded transmission lines would include works in the south metropolitan area as detailed below. The total capital cost for this work is estimated at around $35 million[6] with a construction lead time of up to 3-5 years.

[6] This scope of work is indicative only and cost estimates are +/-50%

Scope of work in South Metropolitan area

1. Operate the four-ended line between PIC-PNJ-BSN-KEM open at the PNJ end.
2. Reroute the PNJ to the tee-point of the four-ended tee-line to form a 132 kV line between PNJ and WGP.
3. Build a second 132 kV line between Picton and Bunbury Harbour Substations.
4. Open the 132 kV lines between Worsley and Wagerup (WOR-WGP 81), and Muja and Bunbury Harbour (MU-BUH 81) Substations.

Appendix C – Runback schemes

Existing generator runback schemes

Western Power has a number of generators connected to its network that are reliant on high speed runback schemes. The majority of the generators are sited in the North Country, East Country and South Metropolitan areas.

The existing generation runback schemes are largely managed by bespoke fast acting control systems that operate after a fault occurs (known as post contingent operation). These bespoke systems include lower cost SCADA based systems to high speed protection grade and more costly installations. The type of solution required is assessed on a case by case basis and depends on the severity of the network issue being managed and how quickly the control system needs to operate after a fault.

Can more schemes be installed?

The existing runback schemes are independent. There is currently no centralised coordination or supervisory system available to ensure that the unforeseen simultaneous operation of two or more customer control systems will not lead to widespread system security threats.

In the past, the risk of this occurring was fairly limited. Each of the existing control systems (particularly generator control systems) is only protecting a part of the network that no other generator control system is also attempting to protect. Therefore, it is very unlikely that more than one generator runback will operate for a certain transmission line overload, placing less emphasis on the need for coordination among the various schemes. Discrimination between generators regarding "who should runback first" has not been problematic as only one generator is available to do so.

More recently the impact of new generators connecting to the network has tended to exacerbate existing network security issues. This has led to the installation of multiple generator runback control systems that potentially operate for a single line overload.[7] Coordination of these systems becomes important as the simultaneous operation of the control systems becomes more probable. Without proper coordination the impact of simultaneous operation could be worse than no operation at all. In some cases, there can be up to 10 transmission lines that would need to be monitored by a single runback system. Planning for multiple generators to runback in a coordinated fashion and consistent with a "last on first off" approach is unwieldy, and the operational impact of unexpected outages or multiple contingencies causing large scale generation runback is considered unacceptable.

In most cases, the existing generator control systems offer coarse generator control only. If a line overload is detected, a signal is sent to one or more generators to wind generation back to zero (0 MW). This coarse response can lead to more generation being runback than necessary, which can subsequently lead to further complications such as line overloads appearing elsewhere in the network, or possibly unacceptable voltage or frequency deviations.

The current runback control schemes are also considered inflexible to changing logic. The response of generation to overloads that may appear during planned outage conditions is not easily configurable and therefore presents operational challenges. Furthermore, it becomes important to properly discriminate between generator runback control systems so that generators runback in an order consistent with their network access contract with Western Power.

[7] For example, two north country generators with non-reference services both monitor flow on the same 7 lines.

The connection of new generation, coupled with increasing load in the network, means more transmission lines can be overloaded more often. Depending on the size and location of the new entrant(s) they may exacerbate a number of existing system security issues, which are already monitored by other generator runback systems (or create new issues).

The installation of additional bespoke independent control systems is becoming prohibitive in some areas of the network. Each new generator is typically required to monitor more transmission lines (depending on its location) which results in higher costs and increased complexity. Western Power must ensure that the simultaneous response of various generator control systems does not lead to subsequent adverse conditions, and that the generators are runback in an order consistent with their respective connection agreements. This is more challenging with each new runback and load curtailment system installation.

Additional independent bespoke high speed runback systems may be possible in some locations of the SWIS but are becoming increasingly more challenging. Confirmation of whether a runback system can be installed requires Western Power to clearly demonstrate that the system:

- does not compromise the management of power system security or reliability;
- can be coordinated to ensure appropriate selection of customers consistent with their connection agreements;
- does not degrade the operability of the network to an unacceptable state; and
- does not to violate good industry practice.

Irrespective of whether the network can accommodate an additional runback scheme in a certain area the general approach of using runback systems is not a viable connection option for all generators, even in the short term. By contrast, the development of a new central dispatch engine capable of managing generators on non-reference services would be expandable, providing an ongoing solution for generators to connect on a non-reference service basis, or contribute to network augmentation necessary to achieve a reference service if viable to do so.