Geoff Brown & Associates Ltd

REVIEW OF WESTERN POWER'S APPLICATION FOR A TECHNICAL RULES EXEMPTION FOR KONDININ-BOUNTY SUB-NETWORK

Prepared for

ECONOMIC REGULATION AUTHORITY

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This report has been prepared for the Economic Regulation Authority to assist it in its review of Western Power's application for an exemption from compliance of the Kondinin-Boundary subnetwork with clause 2.5.2.1(b) of its Technical Rules. Geoff Brown and Associates Ltd accepts no responsibility to any party other than the Authority for the accuracy or completeness of the information or advice provided in this report and does not accept liability to any party if this report is used for other than its stated purpose.

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1. INTRODUCTION

Western Power has applied for three exemptions from clause 2.5.2.1(b) of its Technical Rules (Rules) so that it can connect a new lithium mining load to the Bounty 132/33kV zone substation without upgrading its Kondinin-Bounty (KDN-BNY) subnetwork to fully comply with the N-1 criterion of its Technical Rules. The Authority has contracted Geoff Brown & Associates Ltd to review Western Power's exemption application and provide advice on whether the exemptions should be granted. This report documents our review and the advice provided to the Economic Regulation Authority (Authority).

2. BACKGROUND

2.1 WESTERN POWER'S TECHNICAL RULES

Western Power's Rules have been prepared in accordance with Chapter 12 of the Electricity Networks Access Code 2004 (Code). They specify the criteria that Western Power must apply when planning, constructing and operating its South-West Interconnected Network (SWIN) and the technical requirements that a user installation must meet before being allowed to connect. The Rules have been approved by the Authority. Should Western Power want to plan, construct or operate the SWIN in a manner that does not comply with the Rules, it must apply to the Authority for an exemption. Similarly, should a user want to connect an installation that does not fully comply with the technical requirements of a connected user installation, it must apply to Western Power, rather than the Authority, for an exemption.

The overarching purpose of the Rules is to ensure that the SWIN is developed and operated to a standard that enables the Wholesale Electricity Market (WEM) to provide a safe, secure, and affordable supply of electricity to consumers in the south-west of the State. More specifically, under clause 12.1 of the Code, the objectives of the Rules are that they:

a) Are reasonable.

b) Do not impose inappropriate barriers to entry to a market.

c) Are consistent with good electricity industry practice.

d) Are consistent with written laws and statutory instruments.

2.2 PLANNING CRITERIA

The Rules include the planning criteria, which specify the level of security Western Power must build into different parts of its transmission network. The default level of security for the transmission network supplying consumers in regional parts of its supply area is N-1[1], which means that the network must have sufficient built-in redundancy for supply to be maintained without interruption following an outage of any one transmission element (generally a transformer or transmission line or circuit breaker) of the network for either a planned or fault outage.

Under Clause 2.5.2.1(b) of its Rules, Western Power need not provide an N-1 level of security in subnetworks of its transmission system that, in the case of transmission lines, supply a load with a peak demand of less than 20MVA, and, in the case of substations, supply a load with a peak demand of less than 10MVA. Where peak demands are under this threshold, an N-0 level of security, where supply will be interrupted after any single transmission element fault, will suffice.

The rationale for specifying planning criteria is to mitigate the risk of widespread supply interruptions affecting large numbers of consumers. Hence, subnetworks supplying relatively small loads may be planned and constructed to a lower level of security given the smaller impact of a supply interruption. The different N-0 thresholds for lines and transformers reflect the different repair times for the two asset types – lines can generally be repaired in hours, whereas the replacement of a transformer could take days.[2]

[1] The Technical Rules provide for different levels of security in the Perth CBD and Perth metropolitan areas, but these are not relevant to this review.

[2] Delivery times for new transformers can now be much longer 12 months, given the supply chain constraints impacting the industry as a result of Covid. However, we would expect Western Power to have contingency plans in place to restore supply in days following a fault in an N-0 power transformer. These could involve the installation of a strategic spare, the relocation of a compatible transformer from an N-1 substation or, the use of generators as a temporary measure.

2.3 KONDININ-BOUNTY SUBNETWORK

The Kondinin-Bounty subnetwork is supplied at 220kV from the single circuit Muja-West Kalgoorlie transmission line supplying the Eastern Goldfields. It comprises:

- A single 27/45MVA[3] 220/132/33kV transformer at Kondinin terminal substation. The transformer was installed in 1993 and its 33kV winding is a backup to the 220/33kV transformer installed in 1989 to supply Kondinin town and its surrounding area.

- A 154km 132kV single circuit transmission line that was constructed in 1993 to supply the Bounty gold mine in Mt Holland. The line has a thermal rating of 69MVA, but the line rating is currently limited to 29MVA due to the low rating of a circuit breaker protecting the line.

- The Bounty 132/33kV substation, located adjacent to the old Bounty mine at Mt Holland. The substation comprises a 20/22/27MVA 132/33kV transformer[4] and two 33kV distribution feeders. One of these feeders supply the Flying Fox mine and Cosmic Boy nickel concentrator at Forrestania, about 50km south of the Bounty mine[5]. The second feeder supplied the Bounty mine, but is now unused, as the mine closed in 2002. No other consumers are supplied from the Bounty substation. The current CMD of the Forrestania load is 9.7MVA.

As a failure of any of the above transmission elements will cause a loss of supply to all loads supplied from the Bounty substation, the subnetwork as currently configured provides only N-0 security. This applies to both the transmission line and the transformer capacity at both substations.

Western Power has now received an application from a new customer (Covalent Lithium), which is establishing an open cut lithium mine at Mt Holland on the site of the old Bounty mine. This new customer has an initial load requirement of 5MVA, ramping up to 13.5MVA six months after commencing production. Western Power is considering connecting this new customer to the now disused Bounty mine feeder to give supply at 33kV.

After the connection of this new lithium mining load, the total contracted maximum demand on the Kondinin-Bounty subnetwork will be about 23.2MVA. While this is within the maximum thermal rating of all the above three subnetwork elements, it is higher than the maximum threshold for supply to be given at N-0 security. Western Power has applied to the Authority for an exemption from the requirement to comply with these planning thresholds, so that the new lithium mine can be connected without having to first upgrade the subnetwork to provide N-1 security.

In respect of the transmission line, it has requested that the exemption be permanent. In respect of the two substations, it has requested that the exemption be for a period of five years, which would give it sufficient time to install the additional transformer capacity to make the substations N-1 compliant.

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[3] The limiting factor that determines the rating of a transformer is the temperature within the transformer tank. The two ratings of a dual rated transformer relate to how the transformer is cooled. The lower rating assumes no active cooling of the transformer whereas the higher rating only applies if the transformer is actively cooled, typically using fans to circulate the air around radiators attached to the transformer tanks.

[4] The 20MVA rating is with no forced cooling (ONAN). The 22MVA rating assumes oil is circulated through the transformer using a pump but fans are not used (ODAN). The 27MVA rating applies when both an oil pump and fans are used to cool the transformer (ODAF).

[5] The mine and concentrator are now both operated by IGO, which also operates the Spotted Quoll nickel mine in the Forrestania region. Hence, while there are two feeders, which are likely separately metered, they supply the same consumer.

2.4 NEW LOADS

- In its response to follow-up questions on its application, Western Power stated that the new lithium mine had expansion plans that would increase its load to 23MVA and had a preference to be metered at 132kV.[6]

- In its exemption application, Western Power indicated that it had an application for the connection of a new wind farm to the KDN-BNY 132kV line but did not state either the capacity of the wind farm or when it was expected to connect. Our internet search established that the wind farm is Synergy's King Rocks wind farm with a capacity of 150MVA. This was subsequently confirmed by Western Power. Synergy's website indicates it is expecting to complete the windfarm in 2025.

[6] Wesfarmers is a 50% joint venture partner in Covalent Lithium. The Australian Financial Review has reported that Wesfarmers and its Chilean partner are investigating doubling the capacity of the mine from the planned 50,000 tonnes per year. https://www.afr.com/companies/mining/lithium-giant-looks-to-double-down-in-wa-20230502-p5d516.

3. COMMENT

3.1 KONDININ TERMINAL STATION

The KDN-BNY subnetwork includes a single 27/45MVA 220/132/33kV transformer at KDN substation, providing 132kV supply to the Bounty substation at N-0 substation security. This currently supplies only the 9.7MVA load of the Forrestania mines and nickel concentrator. With the connection of Stage 1 of the new lithium mine and concentrator the maximum potential load on the transformer will increase to 23.2MVA, which is comfortably within the 27MVA naturally cooled rating of this transformer. However, as it is above the 10MVA planning threshold, an exemption from clause 2.5.2.1(b) of the Rules is required before the additional load can be connected to the existing network arrangement. In this situation, we see no technical reason to increase the transformer capacity, unless the additional security is required by the new mine.

If the proposed new 150MVA wind farm proceeds, additional transformer capacity would be required. We would expect Western Power to negotiate the extent of the network upgrade required with the wind farm owner, taking into account any potential new lithium mine load, in accordance with the Code and the current Access Arrangement. We would not expect any decision to be made on increasing the KDN transformer capacity until the wind farm requirement is confirmed, as it would make no sense to install additional capacity to service only the lithium mine, and then almost immediately replace it with a larger transformer to accommodate the wind farm.

The third scenario is a situation where the wind farm does not proceed, but Stage 2 of the lithium mine does. In this case the total load on the transformer would be 32.7MVA, above the naturally cooled rating of the existing KDN transformer, but well within its forced cooled rating. The transformer was installed in 1993 so is about two-thirds through its expected life. It is reported by Western Power to be in good condition. Given that it is lightly loaded and that its potential through-fault current is low, we think its probability of failure in the medium term is low. There is a higher probability of a failure of the cooling fans, and in this event Western Power would need to ask the new lithium mine to reduce its demand.

3.2 KDN-BNY TRANSMISSION LINE

With the connection of Stage 1 of the lithium mine, the load on this line will increase to 23.2MVA, which is above the 20MVA planning threshold in clause 2.5.2.1(b) of the Rules. An exemption will therefore be required if the new load is to be connected to the existing network.

The rating of the existing line is currently 29MVA, lower than the 32.7MVA load on the line if Stage 2 of the lithium mine proceeds. Western Power has confirmed that the constraint on this line is due to the rating of a circuit breaker and the line rating could be increased by replacing this circuit breaker, a relatively inexpensive project.[7]

Upgrading the KDN-BNY subnetwork to N-1 security would involve construction of a second line, which would not be economic. There is no suggestion that Western Power should do this.

3.3 BOUNTY SUBSTATION

Bounty substation has a single 20/22/27MVA 132/33kV transformer, as noted in Section 2.3 above. This transformer was manufactured in 1992 and, like the KDN 220/132kV transformer, is about two-thirds through its expected life. Western Power is considering connecting the new lithium mine load to the output of this transformer. However, an

[7] The thermal rating of the line assumes a wind speed of 1 metre/sec. Should the proposed wind farm proceed, Western Power is planning to use the line to transfer up to 150MVA. However, this capacity will only be needed when the wind farm is generating its maximum output. This will require a strong wind, which in turn will allow the conductor to be operated at higher than its 1m/s rating due to the significant cooling effect of strong winds.

exemption from complying with clause 2.5.2.1(b) of the rules will be required before the new mine load can be connected.

There is some risk in connecting the lithium mine load to the existing transformer as the total contracted maximum demand of both the Forrestania and lithium mine loads is higher than the 20MVA ONAN transformer rating that would apply if both the oil pump and cooling fans were not working. Western Power has assessed this risk and concluded that, while the load on the transformer will need to be carefully managed, this risk can be mitigated.[8] We agree with this on the following basis:

- A user's contracted maximum demand (CMD) is generally higher than its actual demand. In this case, the peak demand on the transformer would likely be further reduced by the diversity in the demand of the two users. (Their demands are unlikely to peak at the same time). In reality, the peak load on the transformer can be expected to be lower than the 23.2MVA combined CMD of the two mining customers.

- If the transformer oil pump and air fans are both working, the transformer rating is 27MVA, and this would be the situation most of the time. Should the air fans fail the transformer rating would reduce to 22MVA, and if the oil pump fails the transformer should be able to be safely loaded to somewhere between 22MVA and 27MVA. The transformer rating would only be reduced to 20MVA if both the oil pump and the fans were out of service at the same time. This is unlikely.

- Western Power will be able to monitor the transformer load through its SCADA system and we would expect a cooling system failure to be alarmed. Importantly, should a potential transformer overload become apparent, Western Power is able to ask the lithium mine to reduce its load. Covalent has confirmed that it can do this using its onsite generators.

3.4 SUBNETWORK RATING

The overall power transfer capacity of the subnetwork is limited to the rating of its weakest link, in this case the BNY transformer. As discussed in Section 3.3, this would normally be 27MVA, well above the potential peak transformer demand of 23.2MVA once Stage 1 of the lithium mine is fully operational. Should there be a transformer cooling system failure, this transformer would need to be derated until the fault is repaired but a transformer overload is still unlikely. In a worst-case scenario, when the transformer needs to be derated to below the actual demand of the two mines Western Power would need to ask the lithium mine to reduce its load, as noted in Section 3.3 above.

Furthermore, Western Power has indicated that the new lithium mine may eventually be connected at 132kV, which would bypass the existing BNY transformer, In this event, the mine would need to install its own consumer-owned transformer(s), which would not be subject to the Rules. The maximum demand on the existing BNY transformer would revert to the current Forrestania CMD of 9.7MVA and no ongoing Rules exemption in respect of the BNY substation would be required.

3.5 GENERATION AS NETWORK SUPPORT

Western Power's application and the above analysis looks at Western Power's KDN-BNY subnetwork in isolation and considers only the potential for network solutions to achieve compliance with the Rules. As noted above, the N-0 planning criteria in the Rules appear to have been developed assuming a subnetwork that supplies large numbers of small-use consumers that, individually, have no control over the level of security their subnetwork provides. It is not clear to us that it is consistent with the objective of the Code to rigorously apply these criteria to a subnetwork that supplies only two large industrial mining loads.

Both mines have their own generation with sufficient capacity to supply essential loads. If the frame of reference for this review is extended to include the electrical installation within

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the mines, this generation can be thought of as an *alternative option*, as provided for in Chapter 6A of the Code. The difference is that, rather than being provided by Western Power or an external provider contracted to Western Power, in this case the alternative option is provided by the network users themselves as they have agreed to an N-0 level of security.

We further note that under clause 2.5.2.2(b)(2) of the Rules, subnetworks designed to the N-1 criterion need not maintain supply in an N-1 situation where operational restrictions are agreed between Western Power and a user. This is the case with Covalent.

The objective of the Code, as set out in Clause 2.1, is to promote efficient investment in, and efficient operation and use of, services of networks in Western Australia for long-term interests of consumers in relation to [the] price, quality, safety, reliability and security of supply of electricity .We suggest that the 10MVA and the 20MVA N-0 thresholds set out in the Rules are arbitrary, and rigorously applying these thresholds in all situations come what may will not necessarily promote the efficient investment in, or efficient operation of, networks for the long-term interests of consumers. This is particularly the case if only network solutions are considered or if there is an expectation that the investment be funded by consumers that receive no benefit.

In this case we think it would be more consistent with the Code objective if Western Power negotiated with the users of the subnetwork to provide a subnetwork capable of meeting their security requirements at the lowest overall cost. The potential for the consumers' onsite generation to contribute to this objective should be considered, and the cost of any agreed subnetwork augmentations should not be a burden on consumers that do not take supply from the subnetwork.

4. CONCLUSIONS AND RECOMMENDATION

We recommend that the Authority grant Western Power's request to exempt the KDN-BNY subnetwork, including the 220/132kV KDN substation, the 132kV KDN-BNY transmission line and the BNY 132/33kV substation, from compliance with clause 2.5.2.1(b) of the Rules. This will enable Stage 1 of Covalent's new lithium mine to connect to the subnetwork without any requirement to increase the current subnetwork capacity.

We agree with Western Power's assessment that connecting Covalent's new lithium mine on a curtailable basis and continuing to operate the KDN-BNY subnetwork, including the BNY substation, at N-0 security will not adversely impact the quality of supply currently provided to IGO's nickel mines and concentrator located at Forrestania.

Given the objective of the Code, we see no reason to place a time constraint on this exemption.

It is probable that the capacity of the subnetwork will need to be increased to supply Synergy's planned new wind farm and/or Stage 2 of Covalent's lithium mine, rather than to achieve compliance with the planning criteria in the Rules. In this event, we think Western Power should negotiate with the users of the subnetwork (including IGO) with the objective of agreeing a cost-effective subnetwork development plan that provides the power transfer capacity they need at the level of security they require. Any change to the capacity or configuration of the subnetwork must not adversely impact the quality of supply provided to existing consumers using the network.