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TRANSMISSION SERVICE STANDARD BENCHMARKS REGULATORY FRAMEWORK

Prepared for

ECONOMIC REGULATION AUTHORITY

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DISCLAIMER

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1. INTRODUCTION

In its revised Access Arrangement Information (AAI) for AA4 Western Power (WP) noted that, while service performance measures were universally set based on historical data, this was not always appropriate as it is often necessary to adjust for known changes or emerging issues. The revised AAI identified the following two emerging issues that should be taken into account in setting service standard benchmarks to apply during AA4.

- high impact, low probability (HILP) events;
- the impact of a protection change to prevent overload and stability problems in the supply to the Eastern Goldfields following an unplanned outage of a 220kV circuit between the Muja power station and the Merredin terminal station.

The service stand benchmarks (SSBs) set in the Authority's Draft Decision were based on the actual performance of the network during AA3. WP submitted that, as there were no HILP events during AA3 and as the protection change was not implemented until February 2016, the analysis on which the SSBs specified in the Draft Decision were based did not consider the potential impact of such events and therefore needed to be adjusted.

Failure to achieve an SSB is a non-compliance with Clause 11.1 of the Access Code and could result in a civil penalty being applied in accordance with clause 18(2) of the Electricity Industry Act (2004). Failure also means forfeiture of any reward for that year that WP would otherwise receive under the Gain Sharing Mechanism (GSM) in the Access Arrangement. Given these potential consequences, it is important to WP that the analyses on which SSBs are determined take due account of all relevant inputs.

The Authority has asked us to review this information, which was not presented in the original AAI, and advise it on the appropriateness of the revised SSBs proposed by WP. This report documents the advice we provided.

2. BACKGROUND

2.1 SERVICE STANDARD BENCHMARKS

SSBs are required by the Access Code to be

- *5.6 (a) reasonable;*
- *5.6(b) sufficiently detailed and complete to allow a user or applicant to determine the value represented by the reference service at the reference tariff.*

Clause 11.1 of the Code states:

> *A service provider **must** [our emphasis] provide reference services at a service standard at least equivalent to the service standard benchmarks set out in the access arrangement …*

and clause 11.6 states that the Authority, after due consideration, may impose a financial penalty under section 118(2) of the Electricity Industry Act (2004).

However, clause 7.4.4 of Western Power's AA3 Access Arrangement provides that:

> *If in any year in which an above-benchmark surplus is calculated to be a positive value and Western Power fails to provide a reference service at a service standard at least equivalent to the service standard benchmark, Western Power will demonstrate to the Authority how and to what extent there is, or is not, a relationship between that failure and Western Power's achieved efficiency gains or innovation in excess of the efficiency and innovation benchmarks, through consideration of:*
>
> *a) which service standard benchmark has not been met in that year;*
>
> *b) an analysis of the causes for not meeting the service standard benchmark in that year;*
>
> *c) the categories of non-capital costs that impact on the achievement of that service standard benchmark (which may be sub-categories of the cost categories in section 7.4.8);*
>
> *d) after normalising the forecast non-capital costs for those categories in section 7.4.4c) used to establish the non-capital costs component of approved total costs for inflation (using the CPI) and scale escalation factors in a manner that is consistent with 7.4.8, whether there has, or has not, been an underspend in those non-capital costs categories; and*
>
> *e) any other issues that are relevant.*
>
> *This information will be used to determine the extent, if any, that Western Power achieved efficiency gains or innovation in excess of the efficiency and innovation benchmarks during this access arrangement period by failing to provide reference services at a service standard at least equivalent to the service standard benchmarks.*

2.1.1 Comment

Clause 7.4 .4 of the AA3 Access Arrangement appears to say that failure to achieve an SSB in a particular year does not mean that WP automatically forfeits its share of any opex efficiency gains recorded for that year that it would otherwise be entitled to under the GSM. Rather, it provides an avenue whereby WP can provide the Authority with an analysis to show that the failure was not a consequence of a reduction in operational expenditure

below the GSM benchmark expenditure. The implication is that in this case WP would not forfeit any gain under the GSM to which it would otherwise be entitled. However, the Authority has advised GBA that this is not the case. Clause 7.4.4 does not override clause 11.1 of the Access Code and if WP does not achieve any one of its 17 SSBs in a given regulatory year, any GSM reward for that year is automatically forfeited.

This regulatory framework, as interpreted by the Authority, appears to be predicated on the assumption that WP's management has a high degree of control over service standard outcomes and that there is a strong correlation between the service standards delivered and WP's total opex in a single year. In our view both these assumptions are flawed:

- Environmental conditions over which WP management has no control can have a strong influence on the service levels that the network is able to provide. While it is possible to design a network to mitigate environmental factors, this can be uneconomic. A balance must therefore be struck between service level and cost. Occasionally a high impact low probability (HILP) event will occur where the impact is so severe that service levels falls well below the level the network is designed to deliver. In such circumstances the measured service levels are statistical outliers. This is a problem for all network operators and is not an issue unique to WP.

- The correlation between network service levels and operational expenditure is the same year is relatively weak as evidenced by Western Power's performance during AA3. In two of the five years of AA3, WP achieved all its 17 SSBs. In each of the other years it met 16 of the 17 SSBs and failed to meet one. Significantly, the two years where its opex was higher than the GSM benchmark and it therefore didn't qualify for a GSM reward were the years in which it failed to meet an SSB.

This is not to suggest there is no correlation between service levels and opex – obviously it would be possible for WP to reduce expenditure on network management to the point where service levels deteriorate over time. However, in this situation there is generally a lag between cause and effect. A reduction in expenditure will manifest itself in reduced service levels in later years – the impact is usually not immediate. We consider that the structure of the current regulatory framework does not adequately account for this lag.

2.2 SYSTEM MINUTES INTERRUPTED

SMI is a measure of the amount of energy not supplied to loads connected to the transmission system over the course of a year, normalised by the total energy the system would deliver if it had operated at peak demand over the whole year. It is measured in system minutes with each system minute representing the amount of energy the transmission system would deliver in a minute if operated at peak demand. While SMI is a measure of transmission system performance in an area highly relevant to users, it suffers from two major shortcomings.

- Energy not supplied cannot be measured. While the demand at the time a load is interrupted and the demand at the time the load is restored are both known, the variations in demand over the period of the interruption are not known. All transmission loads are metered half-hourly and WP *estimates* the amount of energy not served based on an analysis of historic demand curves for the loads in question. At best this is an informed estimate, the accuracy of which is likely to reduce with increasing interruption duration.

- Unlike service levels based on frequency, it is an unbounded measure. When an interruption occurs, it will count as a single interruption irrespective of duration. However, SMI will continue to accumulate until supply is restored. This means that estimated SMI following an HILP event could be substantially higher than the typically expected level. This is discussed further below.

As SMI is a parameter that is very relevant to network users, we consider that the Authority should require WP to continue to measure it. However, given that the measure is only an

estimate and therefore to some degree subjective, we have strong reservations about its inclusion in either the GSM or the SSAM, since WP is then in a position where its own estimate would have potentially significant financial implications. From a regulatory perspective this creates a conflict of interest. Our view is also influenced by the potential distortion caused by HILP events that can be a result of circumstances outside the reasonable control of WP. We are also concerned at the relatively high number of measures included in the GSM, noting that failure to achieve only one of 17 measures can have significant financial consequences. We also note that the AER no longer uses SMI as a measure of transmission network performance in its service standard incentive scheme.

2.2.1 Recommendation

It is therefore recommended that SMI not be used as an SSB nor included in either the GSM or SSAM. However, the Authority should require WP to report its best estimate of the actual SMI in its annual Service Standard Reports and to provide a detailed explanation for significant deviations from levels typically recorded for the network. This would include a discussion of the causes of any HILP events encountered during the reporting year and the SMI impact of each such event.

3. IMPACT OF HILP EVENTS ON SMI RADIAL

3.1 WESTERN POWER PROPOSAL

Assuming that SMI is to remain an SSB, in its revised AAI WP proposes to increase the benchmark SMI radial from its present 5.0 minutes to a proposed 9.4, an increase of 88%. It notes that during AA3 there were no HILP events but also states that:

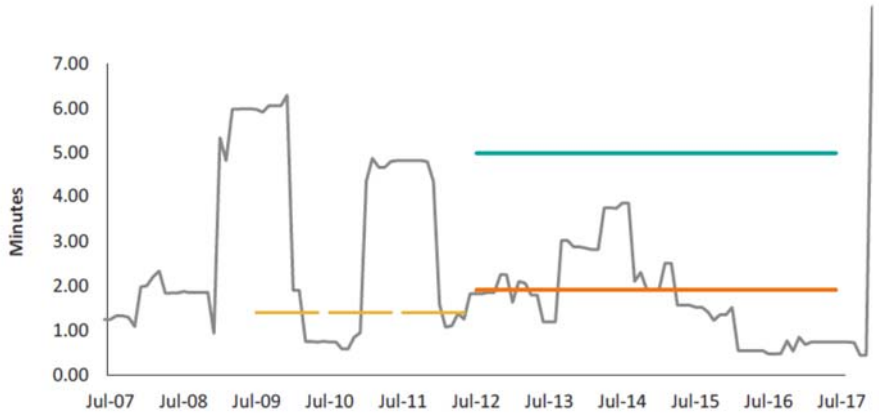
> *In 2017/18 we have already seen individual events that have significantly affected our service performance on the transmission network. For example, in December 2017 severe weather conditions caused the 132kV line between West Kalgoorlie Terminal and Black Flag to trip. This line is compliant with the Technical Rules for N-0 design as a radial part of the network, therefore there is no redundancy available to continue to supply customers fed from this line during a line outage. The time taken to restore the fault and therefore the load at Black Flag caused an interruption of approximately 8 system minutes. Our SMI radial performance measure increased from 0.4 system minutes in November 2017 to 8.3 system minutes in December 2017 due to this event alone. This is significantly greater than our current SMI radial compliance SSB target of 5.0 system minutes.*

It proposed increase to 9.3 minutes is based on a statistical analysis that it describes thus:

> *We retain the use of a five-year sample from July 2012 to June 2017 for setting service performance benchmarks. This sample does not contain any low probability, high impact events. We sample data directly from the monthly SMI radial series for the period from August 2011 to June 2017 to generate 10,000 simulations of 71 months. Each sample contains 71 months of data, starting in August 2011, as performance metrics are based on a 12-month rolling average.*

The revised AAI also includes the graph of the variation of the 12-month rolling average SMI radial for the July 2007 to the end of December 2017.

Figure 13.1: Historical transmission service performance, SMI radial



3.2 COMMENT

We are not experts in statistical analysis so cannot comment fully on the validity of the analysis undertaken by WP. We understand that, while the analysis is generally based on actual AA3 data, it also incorporates a one-in-ten-year HILP event based on the worst-case event that was experienced during the five years immediately prior to AA3. This was an interruption that lasted for 4.95 days. In assessing the SMI effect of this interruption, WP adjusted the peak interrupted demand to reflect the current peak demand[1] and has also assumed that this peak demand would have been sustained for the 4.95-day interruption period. While we understand (but do not necessarily accept) WP's rationale for the load adjustment, we believe the calculated SMI impact has been overstated by ignoring the load

[1] At the point where the interruption occurred, the peak demand increased from 2.1MW in 2009 to 8.9MW in 2017, apparently due to the connection of new mining load.

profile over the 4.5 interruption. We further note that in this respect the analysis is inconsistent with the load integration methodology for calculating MWh not supplied, as specified in the definition of loss of supply event frequency (LoSEF) in the Access Arrangement.

Inclusion of this HIPL event in the analysis means that it has produced an outcome that supports a revised measure that is:

- well over double the 12-month total average recorded at any time over AA3; and
- more than 50% higher than the actual 12-month rolling total SMI recorded at any time over the five years immediately prior to AA3.

We consider that WP's proposed benchmark of 9.4 is so much higher than the service level that the network would normally be expected to deliver that it serves no useful purpose as a benchmark against which to assess WP's management of the transmission network.

If SMI radial is to be retained as an SSB, then WP or the Authority could develop a revised benchmark that excludes HILP events. The threshold above which an event is excluded could be calculated using a similar analysis to that used for the exclusion of major event days in the determination of SAIDI and SAIFI SSBs.

4. STEP CHANGE FOR NEW PROTECTION SCHEME

4.1 WESTERN POWER PROPOSAL

In February 2016 WP modified the protection arrangements on its 220kV circuits between Muja and Merredin to address operational issues that it identified in 2012 with the 220kV supply to the Eastern Goldfields. The modification trips the Merredin-Collgar 220kV circuit following an unplanned outage of any of the following 220kV circuits:

- Muja-Norrigon South;
- Norrigon South-Kondinin;
- Kondinin-Merredin Terminal.

This is necessary to avoid a potential thermal overload on the Northam-Merredin Terminal 132kV line, which would need to supply all the Eastern Goldfields load following a loss of injection of power into Merredin from the Muja power station. A consequence of this change is that such an event will result in a loss of approximately 100MW of load in Kalgoorlie and the surrounding area.

WP submits that the impact of this change is material in that it significantly reduces the probability of it achieving its SMI Meshed and LoSEF SSBs and it proposes that these SSBs be adjusted to account for this. The revised SSBs that WP proposes have been developed through an analysis that:

- assumes an Eastern Goldfields load of approximately 100MW and supply restoration of 55 minutes due to location, resulting in an average contribution of 1.4 SMI for each event;
- backcasts the expected network reliability over AA3 by assuming a 1.4 SMI contribution for each 220kV line trip between Muja and Merredin Terminal that occurred prior to the protection change in February 2016; and
- develops revised SSBs by applying a similar analysis to that used for HILP analysis above to the backcast input data.

Table 4.1 below shows the existing and proposed SSBs and the actual performance achieved for each measure since the beginning of AA3 through to 2017/18. During the first three years (2012-15) the protection change was not in place and so a trip of any of the Muja-Merredin circuits did not result in a loss of supply to the Eastern Goldfields. The following year (2015/16) was a transitional year where the change was in place for approximately 4 months and the final two years (2016-18) are years when the change had bene fully implemented.

	SSB		Actual					
	Existing	Proposed	2012/13	2011/14	2014/15	2015/16	2016/17	2017/18
SMI Meshed	12.5	17.3	4.5	4.8	6.6	6.8	8.2	9.4
LoSEF (>1 min)	4	6	1	1	0	1	2	4

Table 4.1: Comparison of Existing and Proposed SSBs with Actual Performance

For the SSAM, WP is not proposing to change the SMI Meshed SST but is proposing to increase the LoSEF (>1 min) from 1 to 2.

4.2 OBSERVATIONS

We have the following observations:

- We have not undertaken a detailed analysis of system load flows, but a high-level examination of the single line diagram indicates that overloading of the Northam-Merredin Terminal following a fault on any of the 220kV lines between Muja and Merredin Terminal is plausible;

- Table 4.1 indicates a deterioration in performance both the SMI meshed and LoSEF (> 1 min) performance indicators in after 2015/16 that is consistent with the introduction of the modified protection scheme in February 2016;

- While we are unable to comment on the validity of WP's statistical analysis, the outcome of this analysis is dependent on the assumed SMI contribution in the revised dataset for each relevant tripping prior to February 2016;

- The approximate 2016/2017 diversified demands (demand at the time of system peak) at the substations impacted by the change are shown in the table below. Collgar is not shown as it is the generation injection point for the Collgar wind farm;

Substation	Peak Demand (MW)
Black Flag	24
Boulder	18
Jan	20
Kalgoorlie	15
Parkeston	35
Piccadilly	22
Western Mining Smelter	14
Western Mining Kambalda	9
Yilgarn	7
Total	**164**

Table 4.2: Goldfields Peak Demands

This exercise was undertaken to confirm the reasonableness of WP's stated 100 MW of peak demand. However, we note the box in Section 2.5.2.1(b) of the Technical Rules, which states:

> *In the event of an unplanned outage of the 220kV interconnection supplying the Eastern Goldfields region the power system is expected to split into two islands. Arrangements are in place to supply the Kalgoorlie-Boulder city and Coolgardie town loads during an interconnection outage but Users outside these areas will need to make their own arrangements for any back-up generation requirement.*

If the 33MW load at the Kalgoorlie and Boulder substations is subtracted, the total load above reduces to 131MW. If the load imposed by non-reference services is removed the 100MW impact could be reasonable. However, we suspect that much of the load outside Kalgoorlie-Boulder is mining load and consider that the mines would have backup generation to service critical loads. We therefore think that the basis for WP's assumption of 1.4 SMI on average should be explored further before any change is to be made to the SMI Meshed SSB.

- The actual SMI for any event will depend on the time of interruption. In the extreme, if an interruption occurred in the middle of the night, when most of the mines were shut down, we suspect that the SMI for that event would be much lower than 1.4 minutes.

- We note that with the new protection arrangements in place, the three 220kV circuits between Muja and Merredin Terminal are hybrid lines in that they have both meshed and radial characteristics. A failure of one of these circuits will not interrupt supply to either Norrigon or Kondinin substations as these have two incoming lines (meshed) but will nevertheless interrupt supply to all Eastern Goldfields substations (radial). However, we do not see any advantage is reclassifying these lines as radial. This is because the SMI Meshed SSB is already much higher the SMI Radial and the LoSEF SSB covers both the meshed and radial networks.

4.3 CONCLUSIONS

The information provided by WP indicates that the decision to modify the special protection scheme on the 220kV lines between Muja and Merredin was justified and that this will result in an increased number of interruptions to the grid supply serving the Eastern Goldfields.

Given there were 4 interruptions in 2017/18 with a SMI greater than 1.0 minutes, WP's proposal to increase the LoSEF (>1 min) SSB from 4 to 6 appears reasonable. The consequential change in the SST from 1 to 2 is also reasonable.

Assuming the SMI Meshed measure is to be retained, there may be some justification for increasing the SMI Meshed SSB. However, we consider that the methodology used by WP to determine the revised SSB, and in particular the validity of the assumption of a 1.4-minute contribution from each event, needs to be examined more closely before a revised benchmark is approved.