

***Geoff Brown & Associates Ltd***

**REVIEW OF PROPOSED AA4 EXPANDITURE ON  
PICTON-BUSSELTON 132KV LINE**

**Prepared for**

**ECONOMIC REGULATION AUTHORITY**

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## DISCLAIMER

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## 1. INTRODUCTION

### 1.1 BACKGROUND

In its AA4 capital expenditure proposal, Western Power (WP) included the construction of a new 132kV line between Picton and Busselton as a key transmission capacity expansion project<sup>1</sup>. The estimated cost was \$19.2 million (2017, real, excluding capitalised overheads) and the project was to extend over the whole AA4 period. The AA4 capital expenditure report described this project in the following two paragraphs

181. *Load growth studies of the region south of Bunbury still show moderate growth, however, there remain significant asset condition issues in the existing 66 kV network. These issues are:*

- *asset condition – the majority of the 66 kV assets in the area are old and some of them have been assessed to be in poor and bad condition. The Picton 132/66 kV transformers are considered very critical as they are the main source for the 66 kV in the area and they are in bad condition;*
- *voltage recovery issues – under loss of the four ended 132 kV Picton / Pinjarra / Kemerton / Busselton line, the remaining 2 x 66 kV lines are unable to supply all the load on the 66 kV network under peak loading conditions due to voltage issues;*
- *thermal overload under N-1 contingency condition at the zone substations – some of the zone substations have transformer capacity related issues under N-1 conditions, especially at capacity where the thermal capacity is currently exceeded under N-1 conditions.*

182. *Optimised asset replacement and load growth studies indicate that the partial upgrade of one of the existing 66 kV circuits to 132 kV with additional new construction of the 132 kV line between Picton and Busselton will address the above issues with the following benefits:*

- *complete replacement of the 66 kV assets that are in bad condition and reducing reliance on the 66 kV network in the Bunbury load area;*
- *addressing voltage recovery issues and N-1 overloading issues driven by continuous load growth in the area following the first stage of resolving the voltage recovery issues.*

No additional information was provided. We consider the above completely inadequate as justification for the second largest transmission capacity expansion project proposed during AA4 (now that WP has withdrawn its proposal to construct a new substation in the Perth CBD).

In its draft decision the Authority did not approve this expenditure. No reason was given, but the expenditure was not recommended by GHD in its review. GHD stated<sup>2</sup>:

*We do not accept that the justification included in the AA4 forecast capital expenditure is sufficient for this project to be included in the current portfolio. We invite Western Power to provide additional information to support this project, particularly as it relates to the asset condition assessment of the existing PIC-PNJ/BSN 66 kV line and other 66 kV assets, and any network security issues relating to the Picton South area due to a bushfire contingency.*

<sup>1</sup> AA4 Forecast Capital Expenditure Report, Table 1.7, p24.

<sup>2</sup> GHD AA4 Review Report, Section 11.4.3, p164

*We therefore do not accept the proposed \$19.2 million CAPEX allowance, and recommend it is excluded from the AA4 CAPEX forecast.*

In its revised Access Arrangement Information (AAI), WP did not accept the Authority's decision. The revised AAI stated that it undertook further analysis of the need for the Picton-Busselton line upgrade in late 2017 after the AA4 proposal was lodged. It provided a copy of a 92-page Works Planning Report (WPR) with an "effective" date of January 2018 that detailed a long-term development plan for the Bunbury load area stretching though to 2030.

The WPR considered two development options:

- retaining the existing 66kV assets; and
- a hybrid option whereby one of the existing 66kV lines would be uprated to 132kV while the second 66kV line and associated substation assets would be refurbished and retained. This option was further subdivided into two sub-options, but the differences were relatively minor.

As the difference in the NPC of the three options was only 4%, its preferred option was selected on technical merits. In principle, we agree with this approach given that the cost differential was small compared to the accuracy of the estimates.

The AA4 project as described in the revised AAI is the first stage of the preferred option and includes:

- *swapping the WSD site connection from the existing PIC-CAP/WSD 71 66 kV overhead line to the PIC-CAP 72 66 kV overhead line*
- *upgrading the PIC-CAP 71 66 kV overhead line to 132 kV specification i.e. to PIC-CAP 81*
- *earth wire replacements on various PIC-CAP-BSN 66 kV and 132 kV circuits*
- *replacing existing T1 66 / 22 kV 19 MVA transformer at Capel with a new voltage configurable 132 (66) / 22 kV 33 MVA transformer. Replace existing T1 66 kV circuit breaker with new 132 kV transformer circuit breaker (initially energised at 66 kV)*
- *adding a new 132 / 69 kV 100 MVA transformer at Busselton with new 132 kV and 66 kV transformer circuit breaker bays*
- *replacing T5 66 / 22 kV 27 MVA transformer at Picton with 132 / 22 kV 33 MVA transformer. Add new T5 132 kV transformer circuit breaker bay at Picton.*

## 2. COMMENT

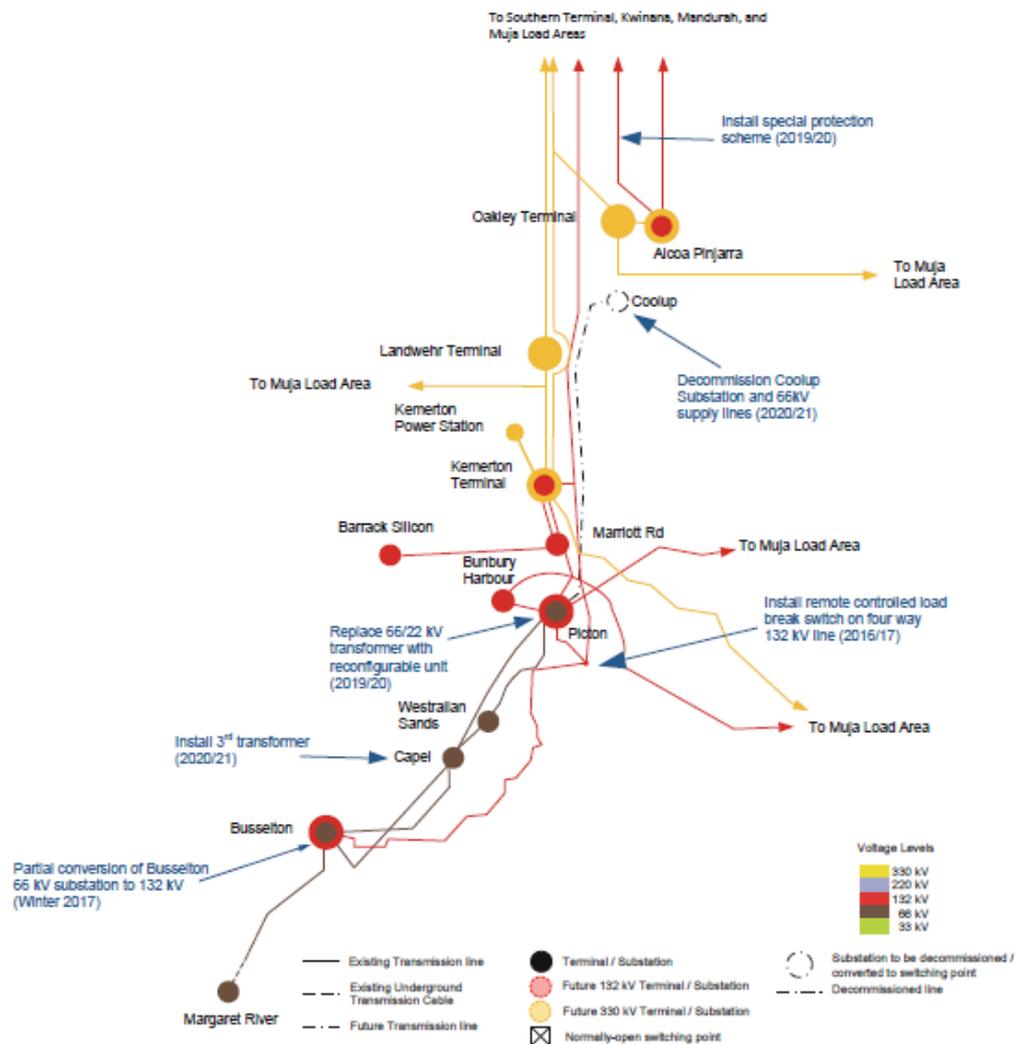
### 2.1 PROJECT DESCRIPTION

The project as described in the revised AAI is very different from the description in the original AAI. In particular, it has a much larger asset replacement component. It was also not clear from the initial project description that most of the existing 66kV line (apart from a 12 km section close to Busselton) is already built to 132kV specifications. So, rather than building a new line, WP is, for the most part, proposing to increase the operating voltage of an existing line to its design level.

While it seems that the AA4 project was only fully scoped after the AA4 revenue proposal was submitted, there is no change to the estimated cost of the works.

### 2.2 EXISTING NETWORK ARRANGEMENT

The configuration of the existing network is shown below<sup>3</sup>.



**Figure 1: Existing Network Configuration**

There are three incoming circuits feeding Busselton. The two older circuits operate at 66kV and supply Busselton from Picton, via Capel. One of the circuits between Picton and Capel supplies Westralian Sands which is a customer owned substation with a contracted

<sup>3</sup> Source: Western Power's 2017 Annual Planning Report, p50

maximum demand of 13 MW. This demand is not forecast to change. The 132kV incoming circuit is a four-way circuit that terminates at Pinjarra, Kemerton, Picton and Busselton.

Key parameters of this arrangement that are relevant to this analysis are:

- The two 66kV circuits between Picton and Capel have a summer rating of 73 MVA and are both already constructed to be capable of 132 kV operation. This would double their power transfer capacity of each circuit to 146 MVA.
- The two lines between Capel and Busselton are rated at 53 MVA and 44 MVA. Approximately 70% of the 44 MVA circuit is constructed to 132 kV specification.
- The incoming 132 kV line is rated at 146 MVA. This line has a total length of 187 km and four terminations but is normally operated with the circuit breaker at Picton open. We have not examined the system load flows, but it appears that the main function of this line is to supply power from Kemerton, where there is a 330kV injection point and a 340 MW open cycle gas turbine power station, to Busselton and Pinjarra. WP has indicated that this line needs to be in service at times of peak demand to avoid overloads in the Pinjarra area.
- While there is currently demand growth around Busselton, no material load growth is anticipated at Margaret River or Capel substations, or at Westralian Sands. For the purposes of this high-level analysis, the following planning demands shown in Table 1 are assumed.

Substation	Maximum Demand (MW)
Westralian Sands	13
Capel	25
Busselton	60
Margaret River	17
<b>Total</b>	<b>115</b>

**Table 1: Substation Maximum Demands**

### 2.3 PROJECT NEED

We are satisfied there is a need that must be addressed and that to do nothing until the end of AA4 is not a prudent strategy. The main drivers for the project are:

- Many of the existing 66kV substation assets are at the end of their economic life and in poor condition;
- There is a voltage stability issue following a fault on the incoming 132 kV circuit at times of peak demand. WP currently manages this by opening the two 66kV Capel-Busselton line circuit breakers at Capel when the demand reaches the point where voltage instability could be a problem. This fully mitigates the stability risk but means that supply to Busselton and Margaret River is reliant on the single 132 kV incoming circuit and is in an N-0 situation.
- Given the above, we think the length and configuration of the incoming 132 kV circuit is a concern. The probability of a fault depends on line length and in our view 187 km is excessive for such a critical 132 kV line. This issue is exacerbated as, south of Pinjarra, the line passes through a high-risk bushfire area. We understand that during the Waroona bushfires in January 2016 the line was taken out of service for an extended period, during which time Busselton and Margaret River were completely dependent on the two incoming 66 kV lines from Picton. Over this period,

WP had to ration power in Picton and Busselton during peak demand periods to avoid a low voltage situation in the event of a fault on one of the 66 kV circuits.

WP has mitigated this risk by installing a remotely controlled load break switch on the line, to enable the line spur between Kemerton and Pinjarra to be switched out during periods when the fire risk is high. However, we understand that at other times the switch is closed, leaving an elevated fault risk due to the length of the line. We note that the line passes within 5km of the Kemerton terminal station and consider that WP could potentially further mitigate this risk by splitting the line into separate Kemerton-Pinjarra and Kemerton-Picton-Busselton circuits. This would require the construction of a second 132kV circuit over the relatively short distance between Kemerton terminal station and the tee-off point.

Given these drivers, we agree with WP's decision to prepare an optimised network development plan for the Bunbury load area that considers all issues in a holistic and coordinated manner.

## 2.4 OPTION SELECTION

The work proposed for AA4 is the initial phase of the long-term development plan set out in the WPR. Our main concern with the WPR is the selection of the options included in the review and, in particular, WP's failure to consider the possibility of an optimised network comprising two 132 kV and no third 66kV circuit. Relinquishing one of the existing 66kV circuits would result in a significant reduction in operations and maintenance expenditure over a thirty-year life, but this saving was not given any consideration.

Assuming the existing two 66kV circuits between serving Westralian Sands, Capel and Busselton were replaced by a single 132kV circuit rated at 146 MVA<sup>4</sup>, the maximum demand on any one circuit following an N-1 contingency would be the 115 MW shown in Table 1. If this was converted to MVA assuming a worst-case 0.8 power factor, this would equate to 144 MVA, marginally below the single line rating. However, if power factor correction was installed to increase the power factor to 0.95, the maximum MVA would be 121 MVA, 17% below the line rating.

The WPR gives no reason for not considering a "no 66kV" option, but is probable that it considers this margin insufficient, given the forecasting uncertainty, particularly over the longer term. We accept that it would not be a prudent strategy to relinquish the route of the second 66 kV line if a third line could potentially be required at some time in the future. However, if the existing 132kV line supplying Busselton was diverted into Capel, the maximum load on any one line in the event of a worst-case N-1 contingency would reduce to 77 MW, as the Westralian Sands and Capel loads would be removed. This would leave ample spare capacity to cater for possible forecasting errors without a need for the third circuit.

Other, possibilities that could have been considered in the WPR include:

- WP is planning to construct a relatively short 66 kV line to transfer the Westralian Sands load from the Picton-Capel 71 line to the Picton-Capel 72 line so that the newer shorter line with steel structures can be upgraded to 132 kV operation. However, if the Picton-Capel 72 line was to be relinquished, then WP could possibly upgrade the Westralian Sands substation to 132 kV at its cost using a small 132 kV transformer relocated from elsewhere on the network. Alternatively, it could supply the Westralian Sands load from Capel at 22 kV, which is its preferred long-term strategy.
- As noted above the reliability of the existing four terminal 132 kV line supplying Busselton would be improved if this line was split at Kemerton. This would involve the construction of a new 5km circuit between Kemerton and the tee point, and a

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<sup>4</sup> This would require upgrading one of the 66kV circuits between Capel and Busselton to 146 MVA but this is already planned by WP.

new line termination bay in the 132kV Kemerton switchyard, if no spare bay is available.

The information available to us is limited and we cannot be certain that these options are technically feasible, or more economic than WP's preferred option. Nevertheless, we believe that the option to relinquish one of the existing 66kV Picton-Busselton circuits should have been included in the APR and, without having considered this option, we cannot confirm that the development plan proposed by WP is the most cost effective alternative available.

## 2.5 REGULATORY TEST

An issue arising from this review is the application of the regulatory test. The objective of the regulatory test is set out in Section 9.3 of the Access Code:

*The “regulatory test” is an assessment under this Chapter 9 of whether a proposed major augmentation to a covered network maximises the net benefit after considering alternative options.*

where a major augmentation is defined as an augmentation for which the new facilities investment for the shared assets exceeds \$30 million (CPI adjusted).

This definition does not make it clear what is meant by an *augmentation* in determining whether a regulatory test is required. As WP says in Section 1.5 of the APR, (and this section is quoted in full).

*The overall scope of work for the Gate 2 Recommendation has been detailed in the previous sub-section and has an estimated capital cost of \$80.86 m, based on Western Power's building block costs. For the 2017/18 financial year the Regulatory Test threshold for the capital cost of new facilities is \$34 m (in real \$) which includes both the transmission and distribution works associated with addressing the identified or emerging limitations. The full project scope of work therefore exceeds this threshold by a significant value, and hence would normally require approval from the Economic Regulation Authority before proceeding with the project.*

*However, as per the Gate 2 Recommendation detailed above, at this time Western Power is only seeking to progress and deliver the initial works associated with the project (Stage 1) which has a lower calculated capital cost of \$26.30 m and hence falls below the current Regulatory Test threshold.*

*The subsequent stages of the project work may also, dependent on final timings, fall out with the current Regulatory Test investment threshold during the AA5 period, or potentially AA6 if some works are deferred, and hence no regulatory approval for these latter work stages may be required. However, the summated value of the total project works will exceed the current threshold and hence it is possible that ERA approval will be required for the full project, particularly once the second stage of project works are progressed during AA5.*

*If ERA approval is required then it is recommended that this should be completed at Gate 2 in parallel with planning / design for Gate 3 Business Case approval. It is expected that this could add an additional period (6 months) in order to undertake the necessary submissions and activities associated with this approval process and this should be considered when refining individual work element RIS dates.*

In essence, a regulatory test will be required if the development plan set out in the APR is treated as a single augmentation. However, if the plan is disaggregated to the point where the work planned for each regulatory period is treated as a separate augmentation no regulatory test will be needed for AA4 and regulatory tests may or may not be needed for subsequent regulatory period. It would also be possible to disaggregate the project even further than suggested by WP. We showed above that the work planned for AA4 could be disaggregated into smaller projects. Each of these, while consistent with a coordinated development plan, are physically independent and so could be considered a separate

augmentation in its own right. If the project is disaggregated to this extent and each component treated as a separate augmentation, no regulatory test would be required.

Hence the issue of whether a regulatory test is required hinges on how an augmentation is defined. Leaving this aside (and we note that the regulatory test threshold is much lower in the NER), we think the objective of the regulatory test would be more fully achieved if it were undertaken at this point, when the range of options available to WP going forward is greatest. WP needs to settle on a preferred development option now, as this will determine the specification of some of the assets to be installed during AA4. If the regulatory test is delayed until some later time, many of the options now open will have been closed off and the risk of a sub-optimal outcome will increase.

### 3. RECOMMENDATIONS

We recommend that:

- The \$19.2 million capital expenditure (excluding overheads) for a new 132 kV Picton-Busselton line be reinstated on the basis that it be used for the first stage of a longer-term development plan to address network capacity and condition issues in the Bunbury load area;
- The Authority advise WP that this is an acknowledgement that capital expenditure on the augmentation of the transmission network in the Bunbury load area during AA4 is justified. However, this does not imply approval of the project works as currently planned. This is because it is not satisfied that the range of options considered in the WPR included all potential options available to Western Power. In particular, the long-term need for a third circuit between Picton and Busselton and the possibility of splitting the existing four-way 132 kV line into separate Pinjarra-Kemerton and Kemerton-Picton-Busselton circuits should have been considered;
- The Authority note that it is possible that the most cost-effective development plan could involve more expenditure in AA4 than currently allocated, and less in subsequent periods. This can be accommodated by the investment adjustment mechanism; and
- The Authority consider whether it is appropriate to require the development plan to be subjected to a regulatory test at this point, and whether it is empowered to do this under the provisions of the Access Code.