SA Power Networks

Supporting document 5.10

Myponga to Square Waterhole Business Case

2020-25 Revised Regulatory Proposal

10 December 2019

SA Power Networks

Myponga – Square Waterhole 66kV Line

Reset Review and Business Case

6/12/2019 – Version 1.0

Document Control

Version	Date	Notes
1.0	12/11/2019	Initial publication

Contents

List of Tables

List of Figures

Abbreviations

Term	Description
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BFRA	Bushfire Risk Area
CPI	Consumer Price Index
EMCa	Energy Market Consulting associates
KI	Kangaroo Island
LF	Load Factor
LLF	Load Loss Factor
MBA	Market Benefit Analysis
NER	National Electricity Rules
POE	Probability of Exceedance
PV	Photovoltaic Generating System
RIT-D	Regulatory Investment Test – Distribution
SA	South Australia
SD1568	Willunga to Myponga 66kV line identifier
SD1570	Willunga to Square Waterhole 66kV line identifier
SHWF	Starfish Hill Wind Farm
SQWH	Square Waterhole
VCR	Value of Customer Reliability

1 Executive Summary

SA Power Networks' 2020-25 Original Proposal asked for provision of $10.4 million during the 2020-25 regulatory control period to construct a new 66kV line between Myponga and Square Waterhole (SQWH) substations. This was part of a total project capital cost of $21.6 million[1]. The project aimed to provide an alternate source of supply for a fault on either of the existing radial Fleurieu Peninsula 66kV lines emanating from Willunga Substation.

The proposal was rejected in its entirety in the AER's Draft Reset Decision[2]. Their conclusion was that SA Power Networks had not demonstrated the project was prudent or efficient citing the following concerns:

(1) Modelling contained inconsistent load factor (LF) assumptions.
(2) Model used non-coincident rather than coincident peak load data.
(3) Insufficient consideration of alternative options (eg reliability improvements or Starfish Hill Wind Farm island solution).
(4) Sensitivity analysis was unlikely to show positive market benefits under most reasonable scenarios.

A revised analysis was conducted aimed at addressing these elements as well as any other perceived deficiencies identified in the Energy Market Consulting associates (EMCa) review[3]. It reflects a conscious effort to use the most conservative option for each relevant parameter. Even with this approach, a positive net market benefit has been demonstrated for the new Myponga – SQWH 66kV line under *most* reasonable scenarios. The relative market benefit compared to a 'Do Nothing' base case is positive for *all* sensitivities. A revised sensitivity analysis has shown there is sufficient evidence to reinstate the funding for the new Myponga – Square Waterhole 66kV line as originally proposed.

[1] SA Power Networks Asset Plan 1.1.01 Distribution System Planning Report, January 2019, pp. 66, 10.1.11
[2] AER Draft Decision SA Power Networks 2020-25 Attachment 5, October 2019, pp. 5-31–5-32, A.3.3
[3] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 73-77, 6.3.3

2 Introduction

This review represents a hybrid analysis integrating the AER/EMCa's feedback, the latest SA Power Networks' data and forecasts and industry standard methodologies. The scope was revised from the previous Regulatory Investment Test – Distribution (RIT-D) assessment where different variants of the proposed Myponga – SQWH 66kV line were considered, focussing on a singular project cost and more accurately assessing the market benefit compared with a 'Do Nothing' base case.

2.1 AER and EMCa Feedback

The rejection of the project in the AER Draft Reset Decision[2] was based on several findings in the preceding EMCa review[4]. The review specified the reasonable Market Benefit Analysis (MBA) parameters already used by SA Power Networks[5] and made recommendations for prudent adjustments to other parameters[6]. These are summarised in Table 1. All parameters used in this revised analysis that differ from the EMCa recommendations are individually explained.

2.2 Alternative Options

2.2.1 Starfish Hill Windfarm Enhancement

The AER and EMCa review[7] made a further recommendation to consider a more detailed analysis of the alternative option of enhancing the Starfish Hill Wind Farm (SHWF) to operate in islanded configuration. This is not a viable solution and was not included in the revised analysis for two main reasons. Firstly, SHWF is a *semi-scheduled* generator (ie intermittent) that cannot be dispatched on request or for a specific output amount. Secondly, this solution would only benefit 15% (or 4,326) of the radial customers (Table 3) after including the support provided by the existing Kingscote back-up generating system (refer Section 3.1). There is no benefit provided to the majority of the radialised customers (22,891) on the eastern side of the Fleurieu peninsula should the Willunga – SQWH line become faulted.

2.2.2 Willunga – Myponga Re-Insulation

The previously used line reliability of 0.015 outages per km of 66kV sub-transmission line, per annum, was acknowledged as a reasonable value.[5] The revised sensitivity analysis therefore retained this as the medium (nominal) value. Re-insulation of the Willunga – Myponga 66kV line, or the Willunga – Square Waterhole 66kV line, will have negligible impact on reducing this outage rate and also will not mitigate against all fault types (eg conductor failure, fauna, third party damage etc.). A ±30% variation of the line reliability was included in the sensitivity analysis to assess the viability of the new line considering a hypothetical improvement in reliability through re-insulation.

[4] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 73-77, 6.3.3
[5] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 75, 6.3.3, 328
[6] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 75-77, 6.3.3, 331-339
[7] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 75, 6.3.3, 329

2.3 Market Benefit Analysis Adjustments

Table 1 – Market Benefit Analysis Parameters

Parameter		Previous MBA	Recommendation	Revised MBA
Line Reliability		0.015 outages/km p.a.	*Reasonable*	*Unchanged*
Load Recovery Time		8 hrs	*Reasonable*	
KI Generator Deployment		30 min	*Reasonable*	
Load Factor (LF)	**SD1570:**	0.48	0.25	0.34*
	SD1568:	0.38	0.25	0.39*
Analysis Period (years)		25	10	10
KI Diesel Generators		Omitted	Include	Included
Discount Rate		6.50%	Not specified	3.51%
VCR		$38,000/MWh	Not specified	$29,099/MWh†
Forecast Load		Non-Coincident	Coincident	Coincident

*Refer to individual derivation summary in Section 4.1.

†Refer to individual derivation summary in Section 4.2.

3 Background

The entire Fleurieu Peninsula region is supplied by two radial 66kV lines from Willunga Substation:

Table 2 – Fleurieu Peninsula 66kV line Overview

ID	Line	Substation(s)	Length (km)	BFRA	Customers (Oct 2019)
SD1570	**Willunga – SQWH**	Square Waterhole Victor Harbor Goolwa	15.3	High	22,891
SD1568	**Willunga – Myponga**	Myponga Yankalilla Cape Jervis Kangaroo Island (4x Substations)	16.6	High	10,434
			Total:		**33,325**

The National Electricity Rules[8], permit reliability improvements within a regulated budget when the project demonstrates a *positive* net market benefit as part of a RIT-D. This does not require a capacity constraint. Additionally, SA Power Networks' Planning Criteria[9] stipulates consideration to installing a second sub-transmission supply when the maximum load supplied by a single radial line exceeds 30MVA. This has occurred regularly on the Willunga – Square Water Hole 66kV line servicing the eastern Fleurieu Peninsula since 2006 and is expected to continue for at least the next ten years based on the *coincident* forecast of the downstream substations (refer Figure 1).

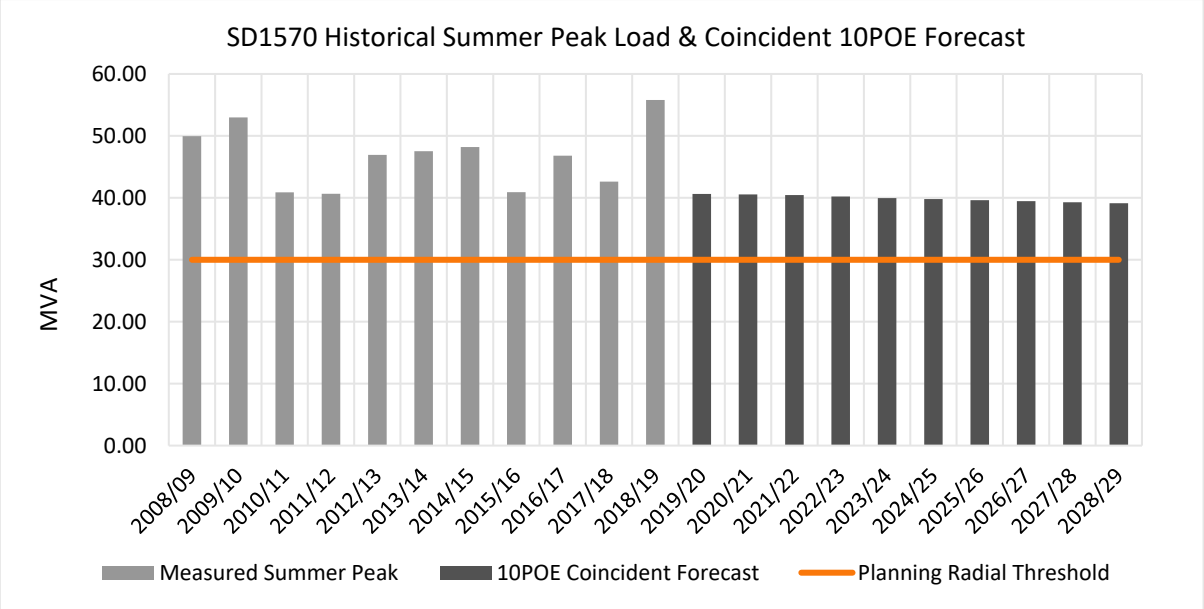

Figure 1 – Willunga – SQWH Historical Summer Peak Load and Coincident 10POE Forecast

[8] AEMC National Electricity Rules V126, November 2019, pp. 564, 5.17.1 (b) and (c) (4) (i) (ii).

[9] SA Power Networks Procedure 630 – Network Planning Criteria and Process, March 2019, pp. 15, 6.2.3.7

3.1 Established Generation

Table 3 – South-West Fleurieu Network Summary

Line	Area	Substation(s)	Generator(s)	Generator Capacity (MW)	Customers (Oct 2019)
Myponga – Yankalilla (excluding Myponga)	Mainland	Yankalilla	-	-	3,977
		Cape Jervis	SHWF	34.5	349
		Mainland Sub Total:		**34.5**	**4,326**
	Kangaroo Island	4x Substations	Kingscote	8	4,134

The western Fleurieu Peninsula is supplied by the Willunga – Myponga 66kV line and has two established generating systems. The Kingscote 8MW diesel generating system owned by SA Power Networks was installed to restore supply to Kangaroo Island in the event of an upstream outage. For the purposes of this analysis, a 30-minute deployment time was used for this generator. EMCa acknowledged this delay was reasonable[10]. The other generating system is the *semi-scheduled* (ie intermittent), 34.5MW Starfish Hill Wind Farm connected at Cape Jervis Substation and was considered to provide *no* network support in an outage scenario (refer 2.2.1). Figure 2 compares the SHWF generating system output against the average and peak western Fleurieu Peninsula mainland load for the 2018/19 financial year. It shows SHWF was unable to supply the *average* load for more than 39% of the year. It could not meet *peak* demand for more 67% of the year.

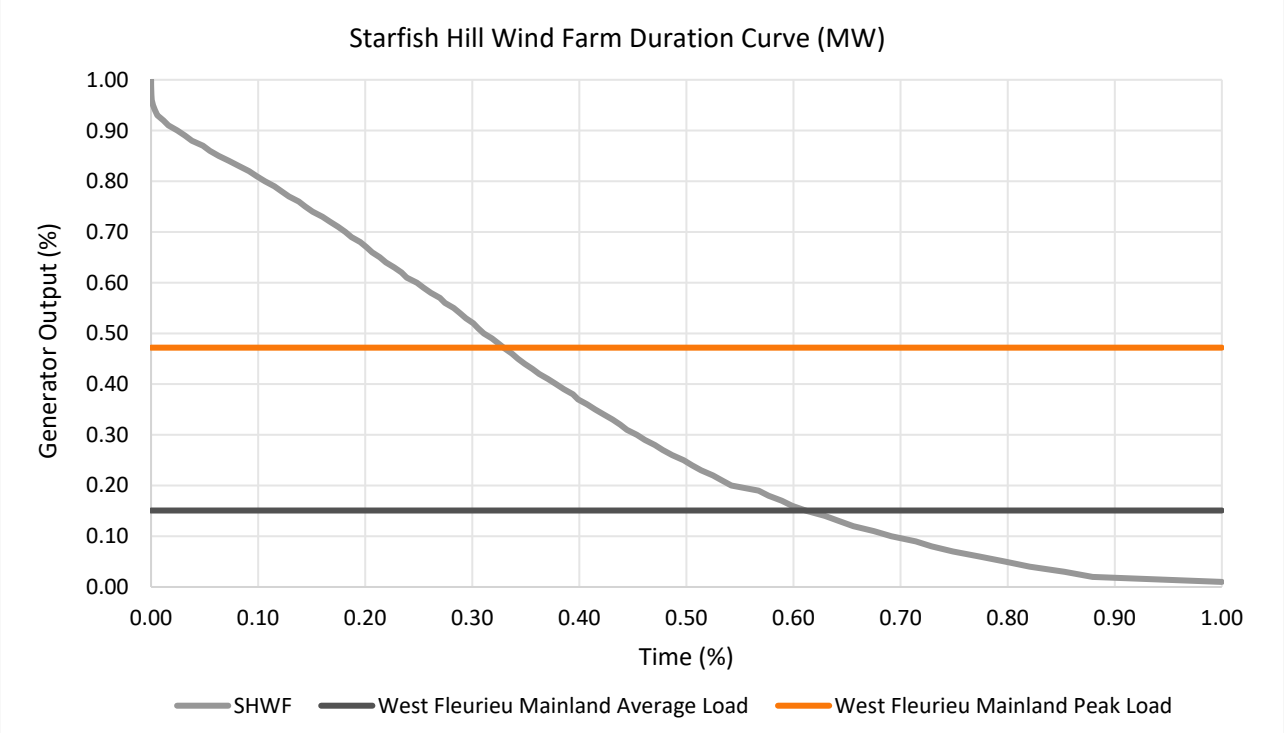

Figure 2 – Starfish Hill Wind Farm Duration Curve

[10] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 75, 6.3.3, 328

4 Market Benefits

There are three primary elements that influence the benefits realised by the proposed Myponga – Square Waterhole 66kV line. These are:

(1) Load Factor (LF);
(2) Value of Customer Reliability (VCR); and
(3) Line Outage Rate

4.1 Load Factor

A comprehensive review of the respective load factors for each 66kV line was undertaken as part of this revised analysis. Acknowledging the importance of this parameter in the overall project benefit, SA Power Networks' aim was to reconcile the significant difference between the previous submission (LF: 0.48 and 0.38) and the EMCa recommendation (LF: 0.25)[11].

An important distinction included in SA Power Networks' load factor derivation was the provision for embedded generation in accordance with the AEMO VCR Application Guide[12]. The guide specifies that the correct method for determining the unserved energy from an outage must account for the demand (or energy) supplied by local generation (eg rooftop photovoltaic systems) and thus represent the underlying rather than 'network measured' load. To correctly ascertain the most accurate market benefit for the revised analysis, individual load factors for each of the two 66kV radial lines were calculated based on a derivation of the underlying demand over the 2018/19 financial year.

Half-hourly measured data spanning the most recent financial year (2018/19) was used as the basis for the underlying load factor derivation. The process followed to prepare the data is summarised in Table 4. Approximately 16% of the measured readings of each line and Starfish Hill Wind Farm were omitted due to network abnormalities. A further 10% of the remaining MW measurements for SHWF (0 ± 0.1MW) were manually adjusted to zero (0 MW) to compensate for limitations in measurement precision (ie significant figure availability).

[11] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 75, 6.3.3, 331
[12] AEMO Value of Customer Reliability – Application Guide, December 2014, pp. 14, 3.2.3

Table 4 – Underlying Load Factor Derivation Process

Step	Description	Outcome		
1	Separate the Starfish Hill Wind Farm and SVC output from SD1568 readings.	Isolate customer demand masked by generator output.		
2	Cleanse data for known network abnormalities and telemetry errors or limitations.	**Network Element**	**Network Abnormalities**	**Resultant Dataset**
			Half-Hourly Readings	
		SHWF	**Omitted:** 2873 **Other Adjustment (Retained):** 1481 0 ± 0.1MW manually overridden to 0.0 MW	14647 **(Max Total: 17520)**
		SD1568	**Omitted:** 2873	14647 **(Max Total: 17520)**
		SD1570	**Omitted:** 2872	14648 **(Max Total: 17520)**
3	Calculate PV output for each 'network measured' reading.	Measured to underlying load adjustment		
4	Add PV output to measurements to determine underlying demand	Underlying load data – LF derivation source		

Calculation of the PV output (Step 3) used the installed PV capacity for each month (Figure 3) combined with empirically based monthly insolation curves. Historical weather conditions were not considered due to the uncertainty in measuring solar irradiance. The underlying demand (Step 4) is therefore based on the assumption PV was generating for *all days* in the data sample.

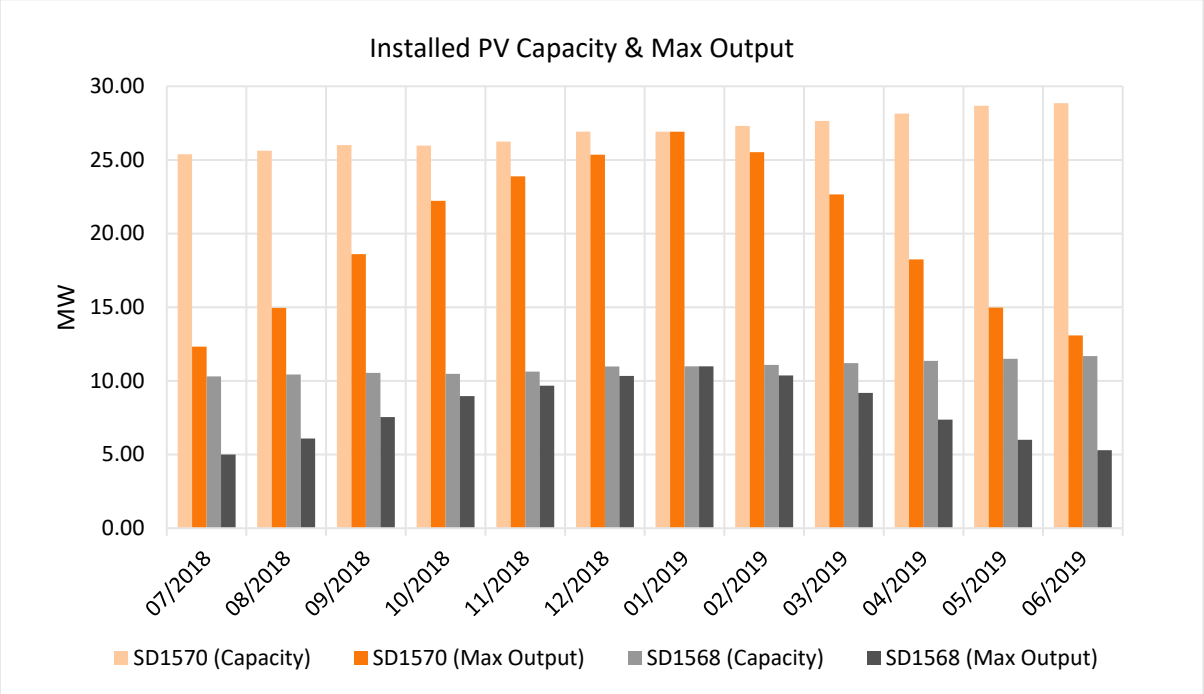

Figure 3 – Installed PV Capacity and Output

The resultant underlying load factor, accounting for the demand met by local embedded generation, was calculated to be approximately 29% less for the Willunga – Square Waterhole 66kV line compared with the draft submission (LF=0.34 from 0.48). There was a negligible increase for the Willunga – Myponga 66kV line (LF=0.39 from 0.38). These respective underlying load factors were used as the medium value for the revised analysis over the generic residential recommendation of 0.25. Consideration was given to lower (and higher) underlying load factors in the sensitivity analysis with a variation of ±30% from the medium value.

4.2 Value of Customer Reliability

The value of customer reliability of $29,099/MWh for revised assessment is more than 23% below the value of $38,090/MWh used previously. The new value was derived using the AEMO VCR Application Guide and reflects the most conservatively low nominal value. The weighting for the four different customer types was adjusted from the AEMO South Australian aggregate values by considering all customers as residential, the lowest per unit energy type.

Table 5 – Value of Customer Reliability Summary (SA)

Customer Type	Previous		Revised	
	Weighting (%)	VCR ($2015/MWh)	Weighting (%)	VCR ($2015/MWh)
Residential	36.9	26,880	100.0	26,880
Commercial	44.8	44,720	-	-
Industrial	16.3	44,060	-	-
Agricultural	2.0	47,670	-	-
Aggregate	**100.0**	**38,090**	**100.0**	**26,880**

The VCR was then adjusted to 2019 value in accordance with the AEMO VCR Application Guide[13] by annual indexation using the Australian Bureau of Statistics March-to-March *National* CPIs[14]. The guide explains the national value is preferred over state capital city values. The resultant VCR, $2019 value (Table 6), was used as the medium value in the revised market benefit analysis. The sensitivity analysis range of ±30% is considered prudent by AEMO[15].

Table 6 – Annual and Cumulative VCR increase (to $2019) from Australian CPI

Financial Year Ending	CPI (March)	Annual Increase (%)	Cumulative Increase (%)	Revised VCR ($FY/MWh)
2015	105.4	-	-	26,880
2016	108.2	2.7	2.7	27,594
2017	110.5	2.1	4.8	28,181
2018	112.6	1.9	6.8	28,716
2019	114.1	1.3	8.3	**29,099**

The AEMO VCR Application Guide provides no instruction on how to extrapolate the VCR to quantify the future risk value of an outage. SA Power Networks endeavoured to continue the conservative approach to the revised market benefit analysis by using the 2019 VCR without speculative future indexation or discount rates to derive the future benefits of the project.

4.2.1 Forecast

SA Power Networks agreed with the EMCa recommendation to use a coincident forecast instead of a summation of non-coincident substation forecasts[16]. The latest coincident forecast incorporating 2018/19 summer load data was adopted and Figure 4 shows the respective reductions from the previously used non-coincident forecasts.

[13] AEMO Value of Customer Reliability – Application Guide, December 2014, pp. 23, 5.1-5.2

[14] Australian Bureau of Statistics – Consumer Price Index, Australia, September 2019

[15] AEMO Value of Customer Reliability – Application Guide, December 2014, pp. 15, 3.4

[16] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 76, 6.3.3, 334

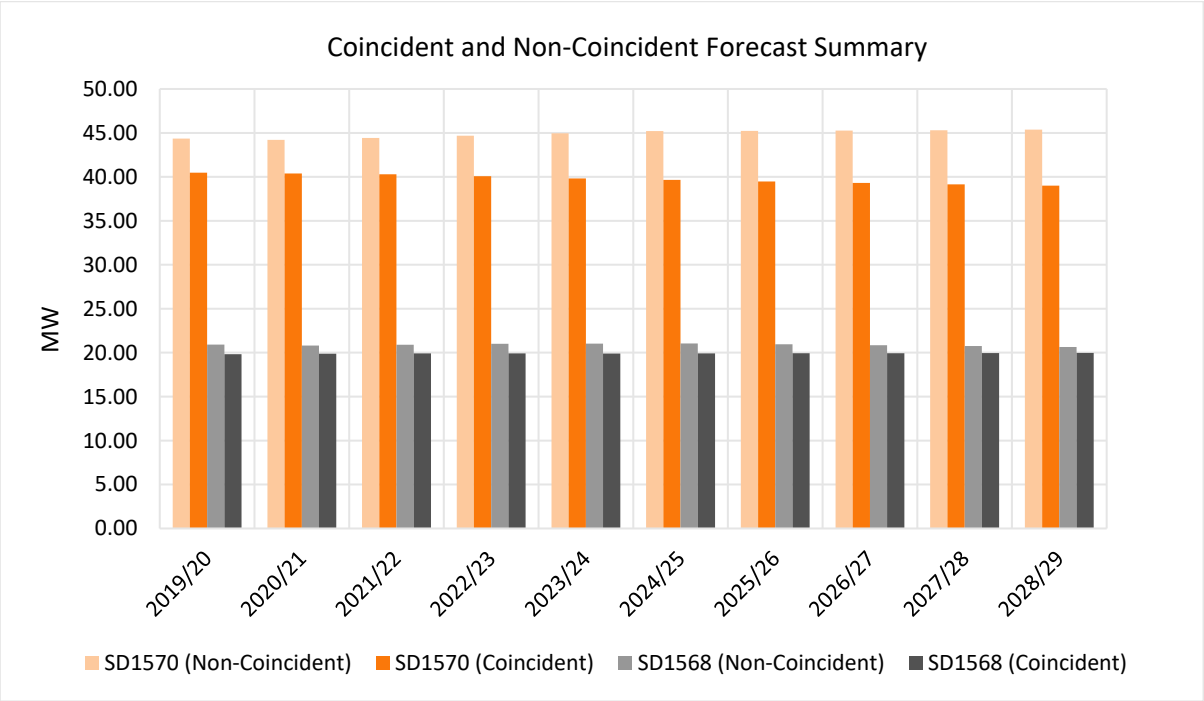

Figure 4 – Coincident Forecast Reduction

4.2.2 Analysis Period

A significantly reduced analysis period from 25 to 10 years (60%), was used in the revised assessment in accordance with another EMCA recommendation[17]. This change proportionally reduces any benefits relative to the 'Do Nothing' base case by the same proportion.

4.2.3 Losses

The respective distribution load loss factors (LLF) for the two 66kV lines were calculated from the same updated dataset as the load factor. These were compared against the average loss factor for South Australia for the Summer, 10 POE forecast, Central Scenario, published in the in the 2019 National Electricity Market, Electricity Statement of Opportunities, in accordance with the AEMO VCR Application Guide[18]. The resultant distribution LLF of 8.5% (10 year analysis period) was less than the individual results, so the more conservative (higher) load loss factors were used for the revised analysis.

Table 7 – Distribution Load Loss Factors

Line	Previous LLF	2019 ESOO Average LLF	Revised LLF
Willunga – SQWH	0%	8.5% (State)	**12.3%**
Willunga – Myponga	0%		**15.9%**

4.2.4 Back-up Generation

The revised analysis has included the contribution of the 8MW Kingscote diesel generator for an outage of the Willunga – Myponga 66kV line. As acknowledged in the EMCa review, this was absent from the previous analysis[17]. A time of 30 min was used for the deployment of the generator[19]. It was modelled as restoring supply to the load of Kangaroo Island in accordance with established operational protocols rather than considered to be using the full nameplate capacity.

[17] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 76, 6.3.3, 334

[18] AEMO Value of Customer Reliability – Application Guide, December 2014, pp. 26-27, Appendix A

[19] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 75, 6.3.3, 328

4.3 Line Outage Rate

As explained in Section 2.2.2 and shown in Table 1, there was no change to the values previously used, and acknowledged as reasonable. A fault/outage rate of 0.015 outages per kilometre of 66kV sub-transmission line per annum was therefore used.

5 Costs

The ECMa review identified an inconsistency in the project capital cost between the previous cost benefit analysis and the SA Power Networks Asset Plan 1.1.01 (Jan 2019)[20]. A summary of the capital expenditure used as the medium value for the revised market benefit analysis is shown in Table 8. This cost breakdown was extracted directly from the SA Power Networks plan that is part of the basis of the 2020-25 Revised Regulatory Proposal, and is $0.60 million less than the Asset Plan cost of $21.6 million. The sensitivity analysis assessed a ±30% variance from the medium project cost.

Table 8 – Myponga – SQWH 66kV line Capital Cost Summary

Year	Expenditure ($M)
1	4.000
2	6.500
3	10.494
Total	**20.994**

The expenditure was further divided between two categories, with a different respective depreciation for each. The category weights could have been updated to more closely align with the elements used to build the above project cost estimate. This would however increase the weighting from substation to line and thus represent a less conservative analysis. The cost share was therefore left *unchanged*.

Table 9 – Capital Expenditure Categorisation Summary

Expenditure Category	Life (Years)	Depreciation (p.a.)	Cost Share
Substation	45	2.22%	**25%**
Line	55	1.82%	**75%**

One significant amendment made in the calculation of costs for the revised analysis was regarding the final value of the constructed assets. The preferred approach was to isolate and use the depreciation explicitly rather than using the total project expenditure and an adjustment at the end of the analysis period. Consequently, this cost element is now more transparent within the SA Power Networks' analysis.

5.1 Discount Rate

A revised medium discount rate of 3.51% was deemed to better reflect current and expected market conditions than the previously used 6.50%. The sensitivity analysis considered a range of ±25%, spanning a discount rate from 2.63% (SA Power Networks' present discount rate) to 4.38%. As explained previously, the discount rate (or an inflation index) was *not* used in determining the future benefits of the proposed Myponga – Square Waterhole 66kV line.

[20] EMCa Review of SA Power Networks' Capital Expenditure, September 2019, pp. 76, 6.3.3, 334

6 Sensitivity Analysis

Table 10 summarises the revised sensitivity analysis. Nominal conditions are represented by the *medium* scenario. The relative benefits reflect the improvement with the new Myponga – SQWH 66kV line from the 'Do nothing' base case. All results are calculated using the same 10 year analysis period.

Critically, despite the conservative input parameters, the revised sensitivity analysis clearly demonstrates the new Myponga – Square Waterhole 66kV line achieves a positive *net market benefit* for the majority of scenarios (12/15) and a positive *relative market benefit* for all scenarios. The three *marginally* negative net market benefit results of -$15K (Scenarios [1], [4] and [7]) correspond to questionably realistic conditions. They would require a respective reduction of 30% or greater in the expected value of customer reliability (already the minimum possible value), line reliability (an arguably unachievable rate without further network reinforcement) or the *underlying* load factor (independent of PV growth and thus a significant efficiency improvement or reduction in customers).

Table 10 – Sensitivity Analysis Results (2019/20 $M NPV)

Category	Scenario		Variance (%)	Value	Net Benefit		Relative Benefit
					Base Case (Do Nothing)	Myponga – SQWH Line	
VCR ($2019/MWh)	1	Low	-30	$20,369	-$6.96	$0.63	$7.59
	2	**Medium**	**0**	**$29,099**	**-$9.95**	**$2.80**	**$12.74**
	3	High	30	$37,828	-$12.93	$4.96	$17.89
Load Factor	4	Low	-30	70%	-$6.96	$0.63	$7.59
	5	**Medium**	**0**	**100%**	**-$9.95**	**$2.80**	**$12.74**
	6	High	30	130%	-$12.93	$4.96	$17.89
Line Reliability (Outages/km/yr)	7	Low	-30	0.011	-$6.96	$0.63	$7.59
	8	**Medium**	**0**	**0.015**	**-$9.95**	**$2.80**	**$12.74**
	9	High	30	0.020	-$12.93	$4.96	$17.89
Discount Rate	10	Low	-30	2.63%	-$9.95	$2.41	$12.35
	11	**Medium**	**0**	**3.51%**	**-$9.95**	**$2.80**	**$12.74**
	12	High	30	4.38%	-$9.95	$3.15	$13.10
Capital Costs	13	Low	-30	70%	-$9.95	$4.12	$14.07
	14	**Medium**	**0**	**100%**	**-$9.95**	**$2.80**	**$12.74**
	15	High	30	130%	-$9.95	$1.67	$11.61

7 Recommendation

The revised market benefit analysis and associated sensitivity analysis has demonstrated there is sufficient evidence to justify reinstating the funding for the new Myponga – Square Waterhole 66kV line. The AER and EMCa feedback has been meticulously considered as has the conservative methodology used in this revised assessment. The study leveraged industry standard practices to ensure a transparent approach able to withstand any further scrutiny. As all concerns put forward by the AER and its consultants in rejecting the proposal have been addressed, it is recommended that the AER revise its draft decision and approve funding for reinforcement of the Fleurieu Peninsula's sub-transmission network.