



Final Project Assessment Report (FPAR)

Kangaroo Island Submarine Cable

23 December 2016

SA Power Networks

www.sapowernetworks.com.au

Disclaimer

This Final Project Assessment Report (FPAR) has been prepared following the conclusion of the consultation on the Draft Project Assessment Report (DPAR) in accordance with and is limited to the requirements of Clause 5.17.4 of the National Electricity Rules for the purpose of publicly announcing the final outcome of SA Power Networks evaluation of options in response to a specific set of identified needs. The FPAR is a summary or general description only of the matters considered by SA Power Networks when evaluating the various options. It is not intended to be used for other purposes, such as making decisions to invest in generation, transmission or distribution capacity.

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Version Control

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1. Report Summary

Kangaroo Island (KI) is the third largest island off the coast of Australia, situated in the Southern Ocean approximately 15 kilometres off the tip of the Fleurieu Peninsula, across the waters of Backstairs Passage. Kangaroo Island is supplied via a radial (single path) sub-transmission network consisting of approximately 50km of 66kV line between Willunga and Cape Jervis and 90km of 33kV line between Cape Jervis and Kingscote, with a 15km section of 33kV submarine cable installed between Fishery Beach on the mainland and Cuttlefish Bay on Kangaroo Island.

In compliance with SA Power Networks distribution license, we are obligated to use best endeavours to achieve reliability targets¹ for each year ending 30 June. In part, these targets are achieved by operating the existing network standby generators near Kingscote on KI, when there are failures of the radial supply to Kangaroo Island. SA Power Networks has identified that when the 33kV submarine cable fails, the standby generators would be required to operate for up to 12 months in order to maintain supply to customers on Kangaroo Island, at a cost of up to \$25.4 million, whilst the cable is repaired². In addition, the backup generators are less reliable than grid supply and consequently if the generators are required to be operated for a sustained period then this may impact on tourism, business, community and the economic development of Kangaroo Island.

As the submarine cable is nearing the end of its expected 30-year average life, the risk of a failure increases every year. As such, SA Power Networks considered it prudent to determine if the cost to replace the cable in the near future was lower than to run it to failure.

SA Power Networks has identified a potential credible network option to address the identified network security constraint by installing a new submarine cable from Fishery Beach to Cuttlefish Bay in 2018. SA Power Networks has sought firm offers for the supply and installation of a new cable in parallel with performance of the Regulatory Investment Test – Distribution (RIT-D) process.

As required by the National Electricity Rules (NER), SA Power Networks has undertaken the Regulatory Investment Test – Distribution (RIT-D) process prior to committing to investment in this network solution to address the identified security constraint. In April 2016, SA Power Networks commenced the formal RIT-D consultation process by publishing the Non-Network Options Report (NNOR), seeking submissions from non-network providers for potential credible options to address the identified security constraint. A question and answer session was then held at SA Power Networks office on 16th May 2016 to assist any interested parties in preparing their non-network submissions.

In response to this consultation, SA Power Networks received eight external proposals by the NNOR closing date of 15th July 2016 to address the network security constraint. Of the initial eight submissions, SA Power Networks short listed three submissions deemed to be credible and compliant in that they potentially resolved the identified network constraints either individually or when combined with other augmentations, within the timeframes specified within the NNOR.

¹ The targets are detailed in the South Australia Electricity Distribution Code (EDC) clause 2.2.1.

² A repair may not be possible depending on where the fault occurs and what condition the cable is in when recovered from the sea bed.

The network and non-network options considered as part of the RIT-D evaluation were as follows:

- Option 1 Install new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018.
- Option 2 Base option: Run the existing cable to failure, repair and install a new submarine cable post failure of the existing cable.
This is the base option against which all options are compared in RIT-D.
- Option 3 Run the existing cable to failure but provide the capital and operating expenditure including additional spare cable to reduce the time to repair the cable.
- Option 4 Run the existing cable to failure with pre-purchase of submarine cable to reduce the cable replacement time.
- Option 5 A non-network solution consisting of biomass, solar and diesel generation as proposed by Applicant 1.
- Option 6 A non-network hybrid solution consisting of wind, solar and diesel generation combined with short-term battery storage as proposed by Applicant 2.
- Option 7 A non-network generation solution consisting of solar and diesel as proposed by Applicant 3 with a turn-key solution for the design, supply, delivery, installation and commissioning of a 10MVA submarine cable when the existing submarine cable fails.
- Option 8 Install new 66kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 (added since publication of the DPAR).

The NER requires that the Final Project Assessment Report (FPAR) include matters as required under NER Clause 5.17.4. (j) together with a summary of, and responses to, any submissions received on the Draft Project Assessment Report (DPAR). Accordingly, this FPAR repeats much of the materials and analysis presented in the DPAR. However, the discussion and analysis has been revised where relevant, to address comments raised in submissions as well as further analysis by SA Power Networks since the publication of the DPAR.

A detailed summary of the issues raised in submissions and SA Power Networks response to those issues are contained in section 8 whilst copies of the original submissions are contained in section 16 of this document.

Key changes within the FPAR since publication of the DPAR include the following:

- Inclusion of Sections 8 and 16 summarising the issues raised in submissions in response to the DPAR and SA Power Networks response to those issues.
- Inclusion of Option 8 in the evaluation – install new 66kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018.
- Review of RIT-D analysis model by comparing all options to Option 2 as a base case (ie run existing cable to failure). Please note that the review has no impact on option relative ranking or cost difference.

SA Power Networks preferred and recommended solution is to install a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 (Option 1). The option analysis undertaken and detailed in this report clearly demonstrates that this option provides the highest net market benefit under all scenarios considered. The total project cost of this recommended option is estimated to be \$25.6 million in present value terms³.

An electronic copy of this report is available at

http://www.sapowernetworks.com.au/centric/industry/our_network/annual_network_plans/financial_project_assessment_reports.jsp

³ The \$25.6 million cost is based on a competitive tender process and it excludes corporate business overheads, contingencies, pre project decision cost and GST.

2. Introduction

2.1 Introduction

SA Power Networks is South Australia's principal Distribution Network Service Provider (DNSP) and is responsible for the distribution of electricity to all distribution grid connected customers within the State. We are a corporate partnership comprising CKI Utilities Development Limited, PAI Utilities Development Limited, Spark Infrastructure (No.1) Pty Ltd, Spark Infrastructure (No.2) Pty Ltd and Spark Infrastructure (No.3) Pty Ltd. More information about us can be obtained from our website at:

<http://www.sapowernetworks.com.au>

Under the National Electricity Rules (NER) a project that is in response to a qualifying Identified Need must be subjected to an evaluation process (the Regulatory Investment Test – Distribution or RIT-D) that is described in Clause 5.17 of the NER. Under the RIT-D, all credible options, both network and non-network, are evaluated equally under the test and the preferred option is the one that maximises the economic gain or minimises the economic loss to the electricity market. A credible option is defined as a solution that must by itself or in combination with other non-network solutions or traditional network solutions,

1. demonstrate that it resolves all of the identified network constraints;
2. is of equal network security performance (availability) than the proposed network solution (ie new cable);
3. Is economically viable (cost effective);
4. be technically feasible in that it is possible that sufficient supply will be provided by the option to meaningfully defer the preferred network option; and
5. is achievable within the required timeframe to resolve the identified need.

More information about this regulatory process may be obtained from the AER through their website.

<http://www.aer.gov.au>

Information on how SA Power Networks applies the RIT-D process can be found within our Demand Side Engagement Document available on our website at:

<http://www.sapowernetworks.com.au/dsed/index.jsp>

This Final Project Assessment Report (FPAR) has been prepared upon conclusion of the consultation period following publication of the Draft Project Assessment Report (DPAR) in accordance with and limited to the requirements of Clause 5.17.4. (j) as described in Section 13 of this document.

2.2 Project History

Table 1: Key dates and milestones

| Milestone | Date |
|---|---|
| Publication of Non-Networks Options Report (NNOR) | Friday, 15 th April 2016 |
| Information Session (Q & A) | Monday, 16 th May 2016 |
| Final date for Final Proposal Submissions to NNOR | Friday 15 th July 2016 |
| Publication of Draft Project Assessment Report (DPAR) | Wednesday, 2 nd November 2016 |
| Final date for submissions in response to DPAR | Wednesday, 14 th December 2016 |
| Publication of Final Project Assessment Report (FPAR) | Friday, 23 rd December 2016 |

2.3 Contact Details

Further enquiries regarding this Final Project Assessment Report (FPAR) should be directed to the following e-mail address:

requestforproposals@sapowernetworks.com.au

Telephone enquiries can be directed to Pat Howard on (08) 8404 5514 or Andrew Lim on (08) 8404 5410.

3. Background to Report

3.1 Kangaroo Island Supply Arrangement

Kangaroo Island is the third largest island off the coast of Australia, situated in the Southern Ocean approximately 15 kilometres off the tip of the Fleurieu Peninsula, across the waters of Backstairs Passage.

Kangaroo Island is supplied via a radial (single path) sub-transmission network consisting of approximately 50km of 66kV line between Willunga and Cape Jervis and 90km of 33kV line between Cape Jervis and Kingscote, with a 15km section of 33kV submarine cable installed between Fishery Beach on the mainland and Cuttlefish Bay on Kangaroo Island. The Cape Jervis to Kingscote 33kV sub-transmission system consists of six line sections. The Cape Jervis to Kingscote sub-transmission system supplies the 33/11kV zone substations at Penneshaw, American River, MacGillivray and Kingscote as well as 33/19kV SWERs supplying Island Beach, Baudin Beach, Brown Beach and Nepean Bay.

The existing 33kV submarine cable provides a single connection to the mainland. A catastrophic cable failure is likely to incur substantial costs to repair and maintain supply via SA Power Networks diesel power station at Kingscote over a sustained period (ie up to one year).

The twenty five (25) year evaluation period for this FPAR is driven by the need to obtain the most cost effective development(s) over a reasonable time frame, allowing for uncertainties associated with future network developments, load and generation patterns. Any proposed non-network solution is to be designed for this period in line with expectations to meet forecast load and any step load changes in customer demand due to major developments on Kangaroo Island.

The area under consideration is shown in Figure 1.

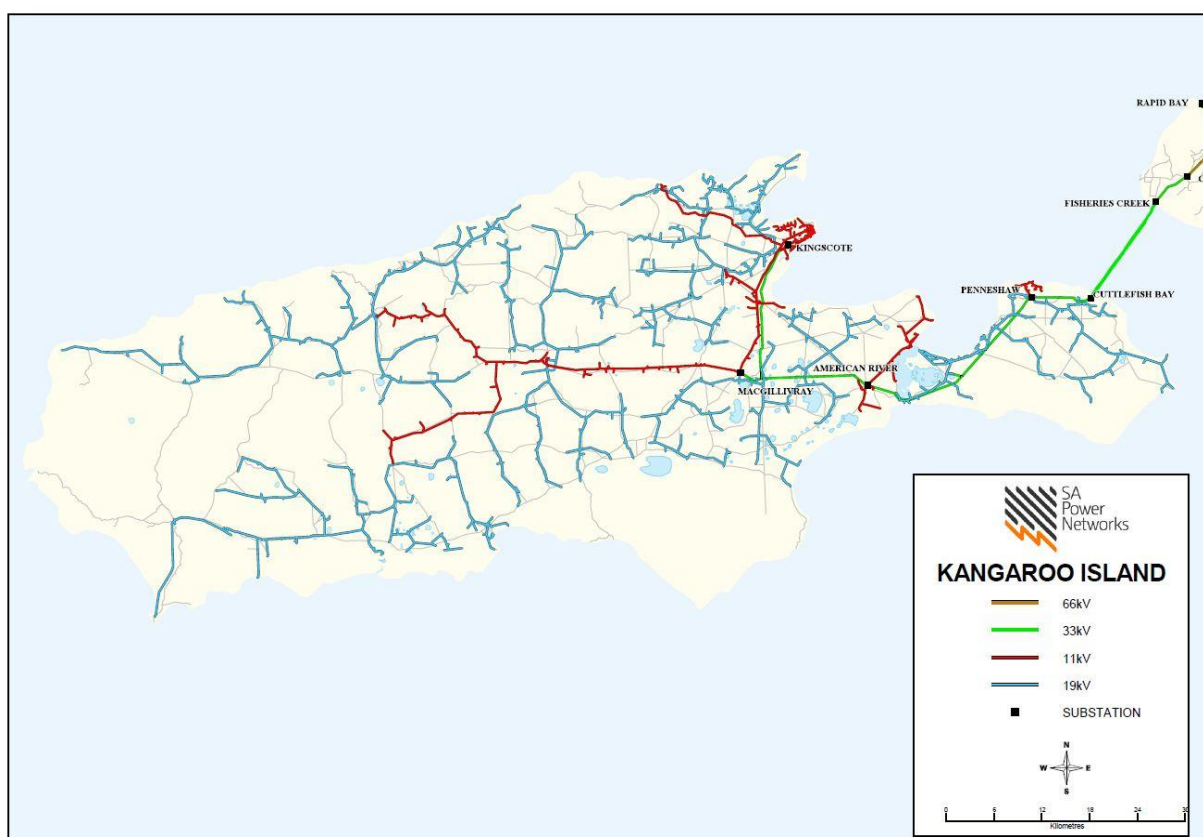


Figure 1: Sub-Transmission Security on Kangaroo Island

3.2 Submarine Cable Background

The existing 33kV submarine cable was installed and first energised in May 1993 with a design life of 30 years. The 50 mm² Copper submarine cable has twenty (20) cable joints (approximately every 750m) and has a normal rating of 10MVA at 33kV.

According to the hydrographical survey that was carried out across Backstairs Passage at the time of the existing cable's installation, approximately 2.6km of the cable is laid on the sea bed at a depth of less than 25m (ie shallow water). The remaining 12km of cable was laid on the sea bed at a depth of more than 25m (ie deep sea) with a maximum depth of 61.5m. Eighteen (18) of the 20 cable joints in the existing cable (a known common point of cable failure) are located in deep sea, resulting in a higher probability of a deep sea cable failure and consequently long repair time. Approximately 13.9km (95%) of the cable originally installed on the sea bed is now completely buried under sand through tidal and sea current movements.

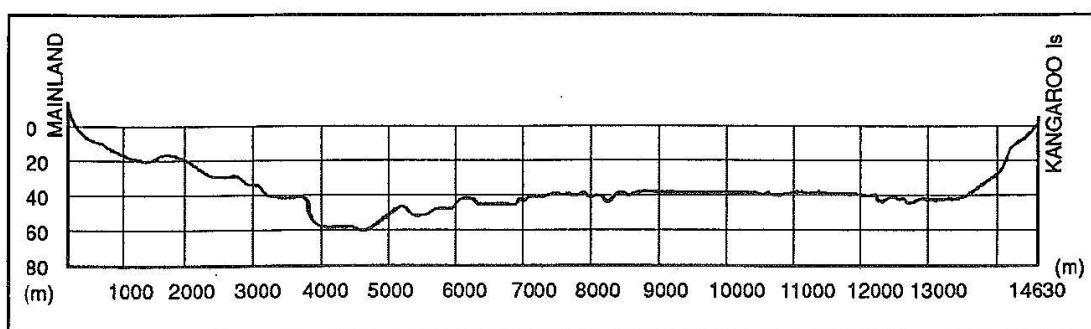


Figure 2: 1991 Hydrographical Survey across Backstairs Passage

3.3 Load Forecasts

The system supplied by this cable was assessed for system normal (N) using a 10% Probability of Exceedance (POE) load forecast for Kangaroo Island assuming all equipment is in service on the island.

Table 2 represents the 25-year load forecast for moderate growth on the island (as measured at the mainland) and incorporates diversity between substation loads, sub-transmission losses and an adjustment due to the presence of any embedded generation (including Photovoltaics – PV). Please note that the load forecast contains certain predictions and assumptions that may change from time to time without notice. SA Power Networks accepts no responsibility or liability whatsoever for any reliance that may be placed upon the predictions and assumptions in the values presented in Table 2 below. The information provided below is done so in good faith based on the latest data available to SA Power Networks. Any use of or reliance placed upon such information is at the sole risk of the user.

| Year | 10% PoE Forecast (MVA) | 10% PoE Forecast (MW) | Year | 10% PoE Forecast (MVA) | 10% PoE Forecast (MW) |
|---------|------------------------|-----------------------|---------|------------------------|-----------------------|
| 2016/17 | 8.0 | 7.8 | 2029/30 | 10.3 | 10.0 |
| 2017/18 | 8.1 | 7.9 | 2030/31 | 10.5 | 10.2 |
| 2018/19 | 8.2 | 8.0 | 2031/32 | 10.7 | 10.4 |
| 2019/20 | 8.4 | 8.1 | 2032/33 | 10.9 | 10.6 |
| 2020/21 | 8.5 | 8.3 | 2033/34 | 11.1 | 10.8 |
| 2021/22 | 8.7 | 8.5 | 2034/35 | 11.4 | 11.1 |
| 2022/23 | 8.9 | 8.7 | 2035/36 | 11.6 | 11.3 |
| 2023/24 | 9.1 | 8.8 | 2036/37 | 11.9 | 11.5 |
| 2024/25 | 9.3 | 9.0 | 2037/38 | 12.1 | 11.8 |
| 2025/26 | 9.5 | 9.2 | 2038/39 | 12.4 | 12.1 |
| 2026/27 | 9.7 | 9.4 | 2039/40 | 12.7 | 12.3 |
| 2027/28 | 9.9 | 9.6 | 2040/41 | 13.0 | 12.6 |
| 2028/29 | 10.1 | 9.8 | | | |

Table 2: Kangaroo Island Load Forecast

Sensitivity analysis conducted as part of the RIT-D process has considered standard and flat (ie nil) growth and potential step load changes in customer demand on Kangaroo Island.

3.4 Demand Characteristics

The information and analysis provided in this section is subject to the disclaimer provided in this Final Project Assessment Report.

An example of the Kangaroo Island annual load profile (measured from Cape Jervis Substation) in MW is shown in Figure 3. This shows that peak electricity demand on Kangaroo Island occurs during the summer and winter months, predominantly as a result of air-conditioning or hot water load. Non-network solutions must be able to support the annual demand loads under any credible single contingency operating condition (ie supply the peak load with any piece of equipment (eg generator) out of service).

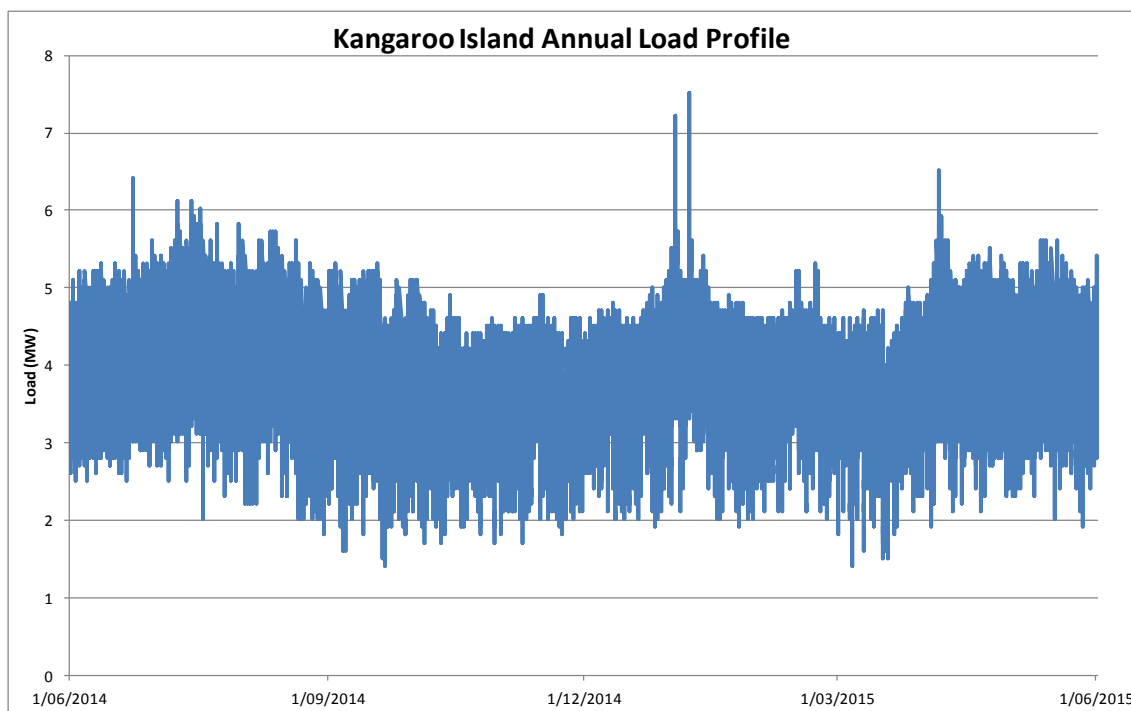


Figure 3: Kangaroo Island Annual Load Profile

The corresponding annual load duration curve (measured from Cape Jervis Substation and including PV impact) is shown in Figure 4. In terms of the annual spread, loads on Kangaroo Island are fairly typical of predominantly residential loads with sharp peaks occurring on a few hot/cold days a year and an average demand occurring for the rest of the time.

The 2014/15 annual electricity consumption on Kangaroo Island was approximately 31GWh with an average daily and hourly consumption of 85MWh and 3.5MWh respectively. Noting that consumption varies, with for example for a week in July, the average daily consumption was approximately 100MWh with an hourly consumption of 4.2MWh. On average, the load is in excess of 95% of the peak for approximately 5 hours per annum and in excess of 85% of peak for approximately 12 hours a year based on the period between June 2014 to June 2015. The average load of 3.5MW is approximately 50% of peak demand.

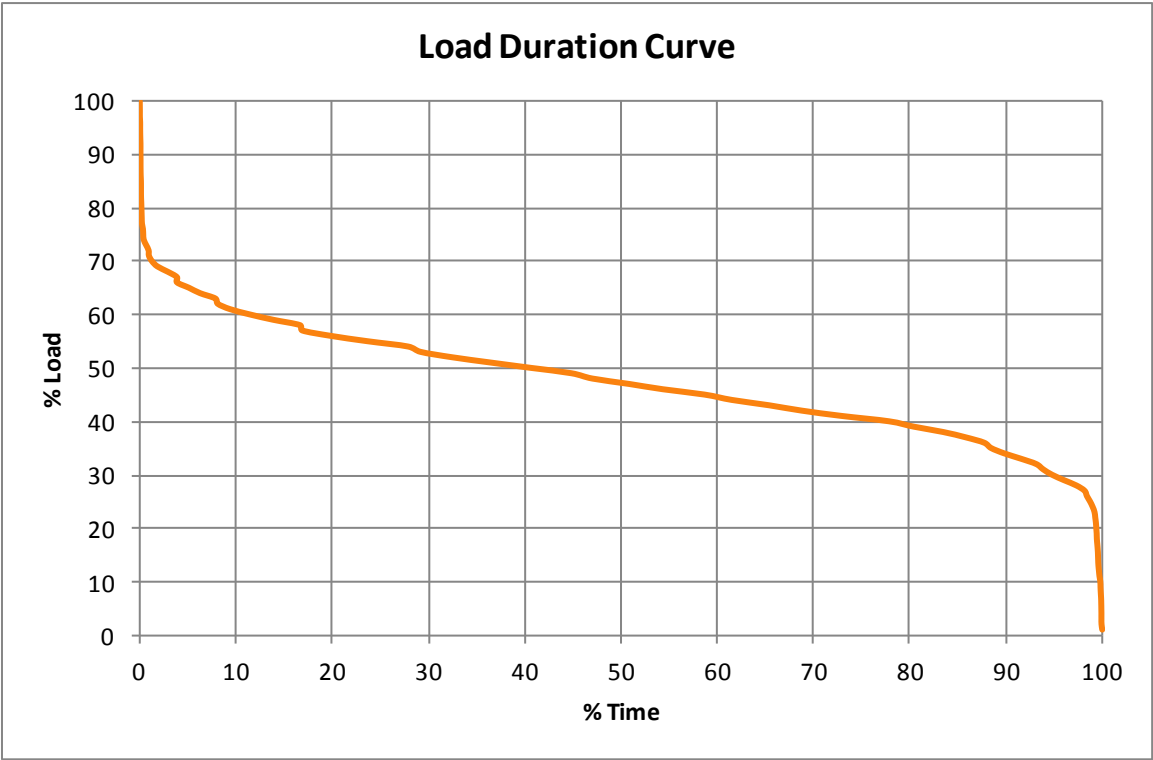


Figure 4: Kangaroo Island Load Duration Curve

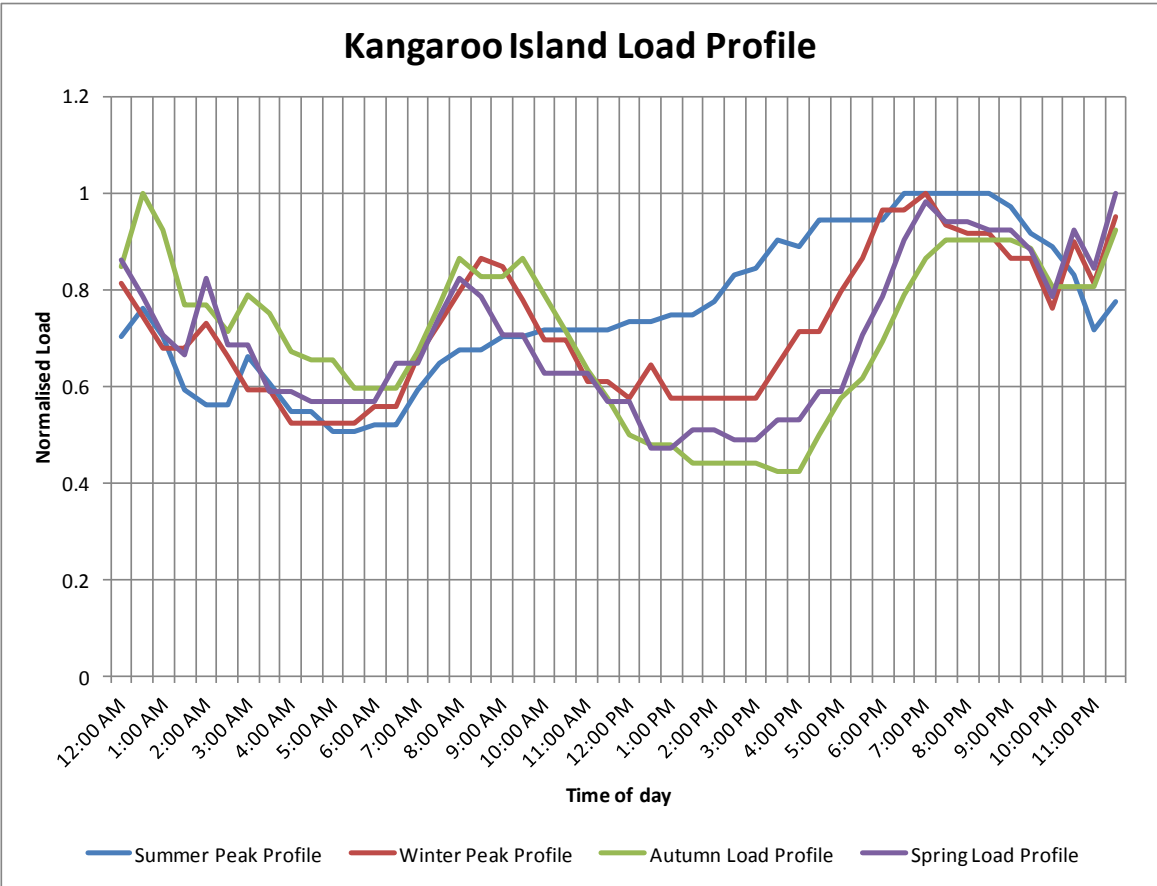


Figure 5: Daily Kangaroo Island Load Profile

Figure 5 shows the typical load profiles on Kangaroo Island during peak summer (16th January 2014), peak winter (17th July 2014), average autumn and spring period. The load profiles indicate some PV penetration with a fairly sharp peak between 15:00 and 20:00 followed by a gradual decline in demand after this time, possibly caused by the onset of a cooling sea breeze reflecting the sea side locality. The time of peak currently occurs at approximately 19:30, hence additional PV will have a negligible impact on forecast peak demand (ie solar PV output is near zero at 20:00).

Based on peak summer (16th January 2014), the load above 85% of peak occurs between 16:30 and 22:00 and is above 95% of peak between 18:00 and 21:00. The load profiles for winter, autumn and spring have similar load curves with morning peaks followed by evening and hot water peaks typical of a predominantly residential load profile.

Figure 6 shows the measured peak load of 7.6MW and estimated native load (ie with PV generation removed) during the peak load summer day in 2014. Consideration of PV impact is included within the forecast information provided in Table 2.

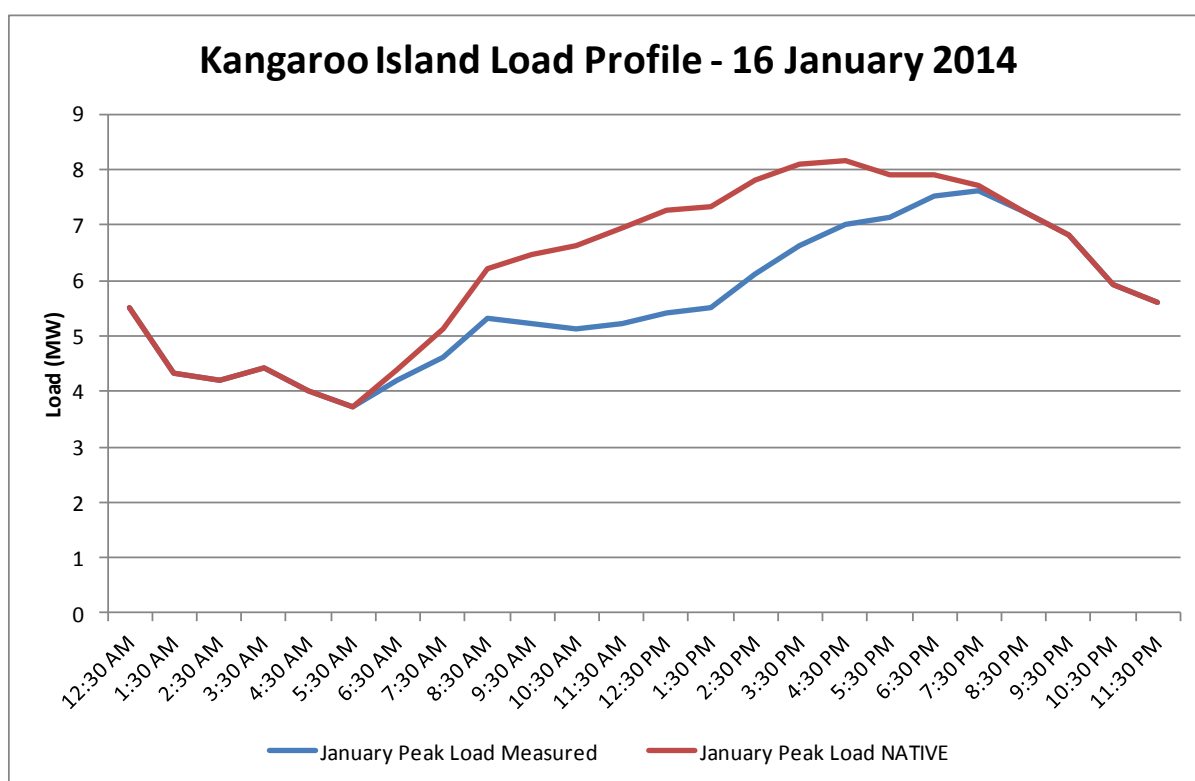


Figure 6: Kangaroo Island January Load Profile

3.5 Committed Augmentations

SA Power Networks is unaware of any committed transmission, sub-transmission or distribution projects within the area that may have an impact on the projected system limitations.

3.6 Existing and Committed Generation

SA Power Networks is unaware of any existing or committed embedded generation other than existing PV within the area whose operation may potentially influence the identified network need. The biggest commercial PV system on Kangaroo Island is a 50kW dual-axis solar array system that was commissioned in 2013 at Kingscote Airport. In addition, a 14kW roof mounted array was installed at the Kangaroo Island's Council Chambers in Kingscote as part of the Kangaroo Island Visible Solar Project in 2013.

3.6.1 Kingscote Power Station

SA Power Networks has a standby diesel powered power station installed at Kingscote on Kangaroo Island. The standby Kingscote Power Station has three Caterpillar 3516B HD generating units each rated at 2MW standby capacity with an LV (415V) brushless alternator, each coupled to individual 11/0.4kV 2MVA step-up transformers connected to the Kingscote 11kV substation bus via an 11kV ring main unit.

The existing power station's 6.0MW standby capacity is capable of energising the Kangaroo Island 33kV sub-transmission network via the Kingscote Substation's 33/11kV transformers and circuit breaker to supply the existing load on Kangaroo Island via the remaining substations at McGillivray, American River and Penneshaw. The Kingscote Power Station is designed as a standby plant and normally operates for a few hours per year, to provide network support in the event of a fault or during operational maintenance and testing of the generators on SA Power Networks distribution network. In the evaluation, both network and non-network solutions have access to the Kingscote Power Station as backup or for emergency use.

A fourth 2MW standby capacity diesel generator was installed at Kingscote in late 2016 to meet peak load demand and mitigate the risk of long duration load shedding at such times.

3.6.2 Existing Embedded Generation

There are no known significant embedded generation installations permanently connected to the network on Kangaroo Island other than domestic and commercial PV. SA Power Networks is not aware of any existing or committed embedded generation augmentations that could potentially impact on the load or distribution network serving Kangaroo Island.

4. Description and Assumptions Made of the Identified Need

The existing radial 33kV cable is nearing the end of its expected average life of 30 years. An underwater inspection of the existing cable was completed in 2012 to assess its condition. Physical evidence of those portions of the cable that could be visually inspected demonstrated damage to the outer armoured sheath had commenced with visible evidence of minor corrosion. This is evidence of the early signs of the cable's deterioration.

In the event of a cable failure, the expected duration of an outage to repair the 33kV submarine cable between Cuttlefish Bay and Fishery Beach is from three to twelve months (for a deep sea cable repair). The extended period for repair is a result of:

1. the difficulty in obtaining a replacement section of cable;
2. the limited availability of cable laying and repair ships in Australia;
3. the difficulty in locating the fault; and
4. the adverse weather and sea conditions.

The estimated cost for the repair of a mid ocean cable fault excluding the operating cost of running the Kingscote Power Station's generators is estimated at approximately \$8.32 million.

Ultimately, the existing submarine cable will fail. When it does, it may or may not be repairable. In order to ascertain this, it will be necessary to locate the fault (if possible), carefully raise the cable from the sea floor using a suitable ship and/or barge with cranes, cut the at the fault location, and raise the two sections of cable to the surface then remove water affected sections (assuming it is repairable). A new section of cable is then required to be jointed to the remaining two sections of cable. Care must be taken to avoid bending or stressing the cable, which could result in further damage (and consequently faults) to the submarine cable.

If the structural integrity of the armour of the cable has been damaged or significantly corroded, any attempt to lift the cable to effect repairs is likely to further stress the cable's cores and damage other sections of the cable. In such a case, the cable would need to be abandoned and a replacement of the cable would be required. The normal delivery and installation time for a new cable is approximately twenty-four (24) months from order placement which includes design, construction and installation. It should be noted that installation is subject to suitable sea conditions to conduct such an operation in the waters concerned, which are only present at certain times of the year.

In the event of a failure of the 33kV cable, the short term electricity demand on Kangaroo Island will solely rely on the reliability of supply of SA Power Networks existing back-up diesel power station at Kingscote Substation. However, these generators alone would be insufficient to supply Kangaroo Island in the event of a protracted outage, as would occur for a failure of the submarine cable.

For every 10 days of continuous operation, each of the existing generating units must be taken out of service whilst SA Power Networks undertakes the manufacturer's recommended programmed maintenance works. In addition, SA Power Networks expects a number of outages will occur due to generator operation related faults (eg failure of a generator or control scheme) during the period of operation which is for up to a twelve month (12) operating period. Such generator related faults may result in the need for load shedding/rationing.

To maintain the required generation capacity to meet demand at peak load times, additional temporary mobile generation would need to be installed at Kingscote Power Station. In addition, additional operating and maintenance staff would be required to operate the power station and the additional generators. This additional generation capacity would permit any single generating unit of the existing three (four from 2017) to be out of service for routine maintenance or repair, whilst still maintaining sufficient generation capacity for continuity of supply. Considerable logistical and economic issues would also be associated with providing adequate fuel and urea supplies (urea is

required to maintain environmental compliance of the power station) in the event of a protracted outage.

The cost estimate for the long term and sustained operation of the Kingscote Power Station is more than would be expected for a similar base (prime power) power station as the generators were installed for standby operation not for sustained base load operation. The total additional cost to maintain supply to Kangaroo Island for 12 months without the use of the submarine cable is estimated to exceed \$25.4 million with fuel costs being the most significant portion of this cost.

Prior to the installation of the generators at Kingscote in 2006, Kangaroo Island relied entirely on supply from the mainland via the submarine cable and the radial 33kV sub-transmission line. Maintaining security of supply on the 33kV sub-transmission had been a difficult task due to the frequent stormy conditions experienced on Kangaroo Island. These conditions are reflected in the average minutes without supply of 726 minutes experienced by customers on Kangaroo Island during the period 2002 – 2006 due to loss of the 33kV sub-transmission system. Since the installation of the backup generators, the average minutes off supply between 2008 and 2016 has reduced to 73 mins. In the event of a cable failure, Kangaroo Island may return to the reliability levels experienced prior to 2006 as the 33kV lines on the island will be radially supplied from Kingscote Substation to Penneshaw.

The key driver of the identified need is to maintain security of supply to Kangaroo Island, not for reliability corrective action. As such, in order to satisfy the requirements of the RIT-D assessment, any proposed solution needs to provide a positive net market benefit.

As the existing Kingscote Power Station only provides short term network support in the event of a fault or during maintenance and testing of plant on SA Power Networks distribution network, the standby Kingscote Power Station is to be used as a backup or emergency use to all options in the RIT-D evaluation i.e. both network and non-network solutions have access to Kingscote Power Station. Therefore, all options in the evaluation are treated equally when the chosen solution fails.

5. Assessment Methodology and Assumptions

5.1 Planning Criteria

As a Distribution Network Service Provider (DNSP) within the National Electricity Market, SA Power Networks must comply with technical standards contained within the National Electricity Rules and in particular to the requirements relating to the reliability and system security contained in Schedule 5.1. In addition, as a licensed distributor in South Australia, SA Power Networks is required to comply with the service obligations imposed under the South Australian Electricity Distribution Code (EDC or Code).

We have developed specific planning criteria relating to the rating of equipment, quality of supply and system security to ensure that we meet our obligations under both the NER and EDC. These criteria are described in the Distribution Annual Planning Report (DAPR) available from our website.

5.2 Reliability Standards

Under our Electricity Distribution License, we must use our best efforts to maintain feeder category standards for reliability that are defined in the Electricity Distribution Code. For the purposes of the EDC this region is mostly categorised as ‘Long Rural’ apart from those feeders designated as KI31, KI32 and KI57, which are supplied from Kingscote Substation and classified as ‘Short Rural’. A summary of this reliability standard is shown in Table 3.

| Area Supplied | Average Supply (SAIDI) | Minutes Off per annum | Average Number of Supply Interruptions per customer per annum (SAIFI) |
|---------------------|------------------------|-----------------------|---|
| Long Rural Feeders | 300 | | 1.95 |
| Short Rural Feeders | 220 | | 1.85 |

Table 3: Relevant Reliability Standards

Please note that SA Power Networks still needs to report its reliability performance against the previous ESCOSA region of Kangaroo Island, as ESCOSA still monitors our performance against our historical (average) performance, which is presently 285 SAIDI minutes⁴ per annum. Whilst SA Power Networks is permitted to meet its service obligations by means of distribution network augmentation, or by procuring support services from an alternative network service provider, generator, retailer or customer, SA Power Networks is still responsible for meeting the service standards and will incur any penalties associated with not doing so.

5.3 Evaluation Test Period

The evaluation period for the RIT-D evaluation is driven by the need to obtain the most cost effective solution(s) over a reasonable time frame, allowing for uncertainties associated with future network developments and load and generation patterns. Therefore, a 25-year evaluation period has been used in undertaking the assessment of all credible options.

⁴ This reliability measure excludes the impacts of Major Event Days (MEDs), with there being on average three MEDs per annum.

6. Network Options

Network option costs shown in this report exclude costs common to all options such as pre-project commitment costs, business overheads, contingencies and GST.

6.1 Network Options Considered

Network options considered for replacement of the existing submarine cable include:

1. Install new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018.
2. Base option - run the existing cable to failure and operate Kingscote Power Station until the cable is repaired or replaced.
3. Run the existing cable to failure but provide the capital and operating expenditure including additional spare cable to reduce the time to repair the cable (4 months).
4. Run the existing cable to failure with pre-purchase of submarine cable to reduce the cable replacement time.
5. Install new 66kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 (added since publication of DPAR).

6.2 Preferred Network Option

SA Power Networks preferred and recommended solution is undertaking Option 1 which will see the installation of a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018, prior to the existing cable's failure.

6.2.1 Option 1: Install new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018

This option includes:

1. Installing a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 including management cost (\$21.9 million).
Note: Capital cost used for 33kV cable supply and installation is the average tender price from six turn-key contract tenders received in July 2016 including network management cost.
2. Termination site upgrades at Fishery Beach and Cuttlefish Bay in 2018 to provide fast switching between both cables (\$3.47 million).
3. Raise the design temperature of the 33kV American River to MacGillivray line from 50°C to 60°C in 2023 to provide adequate line thermal capacity (\$0.4 million).
4. Installing a 20MVA 33kV voltage regulator at Penneshaw Substation in 2036 to provide voltage support (\$1.76 million).

Advantages

1. Maintaining security of supply to Kangaroo Island by mitigating the risk of failure of the existing cable.
2. Increases supply capacity to Kangaroo Island and resolves the voltage constraint by providing adequate voltage levels along the Penneshaw to American River 33kV Line for 33/19kV SWER Isolating transformers.
3. Impact on customers is significantly reduced based on value of lost load (VCR).
4. Route is within the Special Purpose Area 7 (SPA-7) which provides an overlay to the zoning that allows ongoing operation of submarine cables with minimal impact on sensitive cultural heritage and flora/fauna areas.
5. Provides an option for future telecommunication link to Kangaroo Island via fibre optic integrated within the submarine cable (not included in financial evaluation).
6. Minimal environmental impact such as greenhouse gas, noise pollution or fuel transportation issues (not included in financial evaluation).
7. Potential export of renewable energy from Kangaroo Island to mainland via cable (not included in financial evaluation).

Disadvantages

1. Capital expenditure in 2015-20 regulatory period.

6.3 Other Network Alternatives Considered

Other network alternatives to the replacement of the existing submarine cable were considered by SA Power Networks and have been included in the RIT-D analysis such as running the cable to failure as well as storage of a replacement cable. However, these have been shown in the RIT-D analysis not to be viable compared to the preferred network solution.

6.3.1 Option 2: Base option - run existing cable to failure

This is not a recommended option. This is the base option against which all other options are compared to in the RIT-D.

This base option includes:

1. Running the existing cable to failure before repairing and installing a new submarine cable and upgrading termination sites at Fishery Beach and Cuttlefish Bay.
Note: In the event of a cable failure, the cable replacement (\$21.9 million) process is executed in parallel with the repair time (\$8.32 million) to allow the full cable replacement within 2 years and to limit the generation cost (\$25.4 million) to the duration of the cable repair (1 year if repairable).
2. Raise the design temperature of the 33kV American River to MacGillivray line from 50°C to 60°C in 2023 to provide adequate line thermal capacity (\$0.4 million).
3. Installing a 20MVA 33kV voltage regulator at Penneshaw Substation in 2026 to provide voltage support (\$1.76 million).

Advantages

1. Lower capital expenditure in the 2015-2020 regulatory period, depending when the cable fails. Likelihood of failure increases each year (the cable's life expectancy of 30 years is reached in 2023).

Disadvantages

1. This is not a prudent option as the likelihood of cable failure is higher as it ages with major consequences (the cable's life expectancy of 30 years is reached in 2023).
2. A catastrophic failure of this cable could take up to 12 months to locate and repair or up to 24 months if the cable had to be replaced.
3. Lower customer service – reflected in value of VCR value within market benefits.

6.3.2 Option 3: Run to failure but provide the capital and operating expenditure including additional spare cable to reduce the time to repair the cable (4 months)

This is not a recommended option.

This option includes:

1. Running the existing cable to failure before repairing and installing a new submarine cable and upgrading termination sites at Fishery Beach and Cuttlefish Bay but provide additional capital and operating expenditure to provide reduced repair time (i.e. 4 months).
Note: In the event of a cable failure, the cable replacement (\$21.9 million) process is executed in parallel with the repair time (\$5.4 million) to allow the full cable replacement within 2 years and to limit the generation cost (approximately \$9.2 million) to the duration of the cable repair (4 months).
2. A number of pre-planning activities have to be put in place to enable a 4-month repair time:
 - Purchase of new spare cable and cable joints in 2017 (3km of spare cable, 2 sets of spare joints, 1 set of surge arrestors and 1 set of termination joints) (total \$1.2 million)
 - Submarine cable storage (warehouse purchase with security system) including annual cable testing.
 - Annual retainers with fault locator company, repair company, barge company and power station operating company for their commitments to have their services available if they become needed to meet the response time.
 - New all-weather safe track to Cuttlefish Bay for small truck and bi-annual maintenance to allow fast access on Cuttlefish Bay (\$5 million).
 - Replacement of existing short lived power station assets including protection and control.
3. Raise the design temperature of the 33kV American River to MacGillivray line from 50°C to 60°C in 2023 to provide adequate line thermal capacity (\$0.4 million).
4. Installing a 20MVA 33kV voltage regulator at Penneshaw Substation in 2026 to provide voltage support (\$1.76 million).

Advantages

1. Lower capital expenditure in the 2015-2020 regulatory period, depending when the cable fails.

Disadvantages

1. This is not a prudent option as the likelihood of cable failure is higher as it ages with major consequences (the cable's life expectancy of 30 years is reached in 2023).
2. A catastrophic failure of this cable could take up to 4 months to repair with pre-planning activities in place.
3. Lower customer service – reflected in value of VCR value within market benefits.

6.3.3 Option 4: Run to failure with pre-purchase of submarine cable to reduce the cable replacement time (4 months)

This is not a recommended option.

This option includes:

1. Running the existing cable to failure before installing a new submarine cable and upgrading the cable termination sites at Fishery Beach and Cuttlefish Bay but provide additional capital and operating expenditure to provide faster response time (4 months) (Cost excluding purchase of cable is \$20.2 million).
2. A number of pre-planning activities have to be put in place to enable a 4 months' repair time:
 - Purchase full length of submarine cable and cable joints in 2017 (15km of cable, 1 set of spare joints, 2 sets of surge arrestors and 2 set of termination joints) (\$5.2 million)
 - Submarine cable storage (warehouse purchase with security system) including annual cable testing.
 - Annual retainers with fault locator company, repair company, barge company and power station operating company for their commitments to have their services available if they become needed to meet the response time.
 - New all-weather safe track to Cuttlefish Bay for small truck and bi-annual maintenance to allow fast access on Cuttlefish Bay (\$5 million).
 - Replacement of existing short lived power station assets including protection and control.
3. Raise the design temperature of the 33kV American River to MacGillivray line from 50°C to 60°C in 2023 to provide adequate line thermal capacity (\$0.4 million).
4. Installing a 20MVA 33kV voltage regulator at Penneshaw Substation in 2026 to provide voltage support (\$1.76 million).

Advantages

1. Lower capital expenditure in the 2015-2020 regulatory period, depending when the cable fails.

Disadvantages

1. This is not a prudent option as the likelihood of cable failure is higher as it ages with major consequences (the cable's life expectancy of 30 years is reached in 2023).
2. A catastrophic failure of this cable could take up to 4 months to install (depending on time of year) with pre-planning activities in place.
3. Lower customer service – reflected in value of VCR value within market benefits.
4. It is not practical to purchase the 15km (one length) of cable required for the full cable installation, store the cable under controlled conditions until the existing cable fails, and then find an acceptable method (to the cable supplier) of transferring the cable from storage to a cable laying ship. This is because these types of cables are normally loaded directly onto a specifically designed cable laying ship and then installed. Cable vendors advised against loading the cable onto a ship, then off the ship for storage and then back onto a cable laying ship as it would be an inefficient practice. In addition, we understand that there would be significant risk of damaging the cable during these extra handling operations. Contractors would try to avoid increasing the transshipment operation to minimise the risk of unexpected damage.
5. Insurance and warranty of the cable may expire depending on how long they are stored which further complicates this option.

6.3.4 Option 8: Install new 66kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 (added since publication of DPAR)

This option includes:

1. Installing a new 66kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 including management cost (\$23.8 million) but energised at 33kV initially.
Note: Capital cost used for 66kV cable supply and installation is based on the average tender price from six turn-key contract tenders received in July 2016 including network management cost.
2. Termination site upgrades at Fishery Beach and Cuttlefish Bay in 2018 to provide fast switching between both cables (\$3.47 million).
3. Raise the design temperature of the 33kV American River to MacGillivray line from 50°C to 60°C in 2023 to provide adequate line thermal capacity (\$0.4 million).
4. Installing a 20MVA 33kV voltage regulator at Penneshaw Substation in 2036 to provide voltage support (\$1.76 million).

Advantages

1. Maintaining security of supply to Kangaroo Island by mitigating the risk of failure of the existing cable.
2. Increases supply capacity to Kangaroo Island (double the capacity of a 33kV cable) and solves the voltage constraint by providing adequate voltage levels along the Penneshaw to American River 33kV Line for 33/19kV SWER Isolating transformers.
3. Impact on customers is significantly reduced based on value of lost load (VCR).
4. Route is within the Special Purpose Area 7 (SPA-7) which provides an overlay to the zoning that allows ongoing operation of submarine cables with minimal impact on sensitive cultural heritage and flora/fauna areas.
5. Provides option for future telecommunication link to Kangaroo Island via fibre optic integrated into the submarine cable.
6. Minimal environmental impact such as greenhouse gas, noise pollution or fuel transportation issues.
7. Potential export of renewable energy from Kangaroo Island to mainland via cable.

Disadvantages

1. Capital expenditure in 2015-20 regulatory period.

7. Summary of Submissions Received in Response to the Non-Network Options Report

7.1 Non-Network Options Received

As required by the National Electricity Rules (NER), SA Power Networks must complete a formal Regulatory Investment Test – Distribution (RIT-D) prior to committing to a credible solution to solve the identified need. In April 2016, SA Power Networks commenced the formal RIT-D consultation process via a formal Non-Network Options Report (NNOR) seeking submissions from non-network providers on potential credible options to address the identified security constraint.

In order for a non-network solution to be considered viable for Kangaroo Island, it must by itself or in combination with other non-network solutions or traditional network solutions, demonstrate that it:

- resolves all of the identified network constraints;
- is of equal security performance (availability) to the proposed network solution (new cable);
- is economically viable (cost effective);
- be technically feasible in that it is possible that sufficient supply will be provided by the option to meaningfully address or defer the preferred network option; and
- is achievable within the required timeframe to resolve the identified need.

In response to this consultation, SA Power Networks received eight non-network submissions in July 2016 ranging from a combination of proven technologies such as biomass, bio-diesel, solar and wind generation, battery storage to unproven concepts, technologies and consultancy offers.

SA Power Networks has short listed three credible and compliant submissions where the proponents have provided adequate information required for RIT-D evaluation including work required by SA Power Networks and where the submissions are likely to meet the minimum requirements such as financial, technical viability, timeliness and the use of proven technology. The names of the short listed proponents have been redacted as part of this report.

7.2 Potential Credible Non-Network Options Received

The three technically credible non-network options identified that are technically comparable in addressing the identified need are as follows:

1. Applicant 1 proposed a combination of biomass, solar and diesel generation solution.
2. Applicant 2 proposed a generation solution consisting of wind, solar and diesel generation combined with short-term battery storage.
3. Applicant 3 proposed a generation solution consisting of solar and diesel generation combined with short-term battery storage. Applicant 3 also proposed a turn-key solution for the design, supply, delivery, installation and commissioning of a permanent 10MVA submarine cable across Backstairs Passage in the event of a failure of the existing submarine cable.

Non-network option costs shown in the report exclude common costs to all options such as pre-project commitment costs, business overheads, contingencies and GST.

7.2.1 Generation Proposal by Applicant 1

Applicant 1 proposed to connect approximately 16.5MW of generation to SA Power Networks Distribution Network at Kingscote Substation. The generation system proposed consists of the following generation technologies and capacities:

- 7.5MW of biomass generation (33kV connection to Kingscote Substation);
- 8.96MW of diesel generation (33kV connection to Kingscote Substation); and
- 1MW of solar PV generation (33kV connection to Kingscote Substation).

There is approximately 4,000ha of pine and 15,000ha of eucalyptus plantations representing 2.4 million green tonnes of wood that may be capable of supplying a 10MW generator for up to 17 years⁵. Applicant 1 proposes to utilise biomass fuel from wood and the Kangaroo Island Council's waste stream by constructing a biomass power plant at the Kangaroo Island Council waste transfer depot which is approximately 3km from Kingscote Substation. Export from the power plant to the mainland is likely to be limited however export to the mainland is not required for ongoing operation of the plant as described in proponent's proposal. In the event of a submarine cable failure, the cable is not repaired or replaced with the plant running "islanded" to provide the primary supply to Kangaroo Island indefinitely. The thermal biomass power plant will be capable of providing up to 7.5MW, with augmentation from reciprocating diesel units providing up to 16.5 MW of generation capacity for the next 25 years. In the event of a failure of either proponent's power plant or the 33kV connection from proponent's power plant to Kingscote Substation, then the existing Kingscote standby generators would be operated to maintain supply to Kangaroo Island.

The connection of the proposed generating systems will have significant impact on the Network and hence require augmentation works to be undertaken to avoid a material degradation in the security of supply to SA Power Networks customers.

Capital costs incurred by SA Power Networks:

1. Kingscote Substation upgrade for new 33kV generation connection for proponent including major reconfiguration of the 33kV switchyard, 33kV bus extension, 33kV circuit breakers, dynamic reactive plant and a new control building. Line protection upgrade will also be required for lines between Kingscote, American River and MacGillivray Substations in 2018. The total capital cost for the substation upgrades is approximately \$6.7 million.
2. Approximately 3km of dedicated 33kV underground cable connection from proponent's power plant to Kingscote Substation in 2018 (\$1.3 million). Underground cable connection has been preferred over an overhead line 33kV connection due to existing vegetation issues on North Coast Road and the high reliability and security of supply that can be achieved when installing an underground cable as opposed to an overhead solution particularly considering this proposal recommends segregation of the island from the NEM post failure of the submarine cable.

Operating costs incurred by SA Power Networks:

1. A standing charge payable to Applicant 1 for basic network support for duration of the evaluation period (\$1.95 million per annum, escalating at CPI).
2. An hourly fee of \$300 per MWh (escalating at CPI) paid to Applicant 1 when demand is in excess of 7.5MW which requires the use of diesel generator sets to provide network generation capacity.
3. Technical evaluation, connection and support agreements, commissioning, project management and engineering excluding design costs for the connection assets in 2017 (\$0.65 million).

⁵ Earth Systems, 2012, Bioenergy Resource Analysis and Technology Feasibility for Kangaroo Island: Phase 1 – Resource Analysis and Technology Shortlist, Pg15 and 37.

4. Operational management for the duration of the evaluation period (\$0.2 million per annum).
5. Additional fuel cost when operating the Kingscote Generators when the proponent's power plant or 33kV connection from proponent's power plant to Kingscote Substation fails. The Kingscote Power Station as a standby plant is a benefit to non-network solutions as it reduces the high VCR cost that may be incurred otherwise.

Advantages

1. Reduction in 33kV line losses on Kangaroo Island.
2. A "green" renewable based solution.
3. The provision of employment both within the power plant and the associated fuel supply businesses. Note that these are not considered in the final evaluation.
4. Potential reduction in costs for the Kangaroo Island Council due to the use of waste stream in the fuel supply. Note that these are not considered in the final evaluation.
5. Enhancement to the KI water supply availability by use of waste heat for sea water distillation. Note that these are not considered in the final evaluation.

Disadvantages

1. Loss of access to NEM once existing cable fails, with the consequence of potential uncertainty in retail function and cost to customers. Note that these are not considered in the final evaluation.
2. Lower customer service – reflected in value of VCR value within market benefits.
3. The 33kV network on Kangaroo Island will be exposed to higher interruption and reliability issues as the 33kV line will be connected radially from Kingscote Substation to Penneshaw Substation in the event of a cable failure (islanded scenario). If 33kV line from Kingscote to Penneshaw fails, all supply except Kingscote is lost.
4. Increased environmental impact such as greenhouse gas, noise and dust pollution from the running of biomass and diesel power plant. Note that these are non-financial impacts not considered in the final evaluation.
5. Additional maintenance of the Kangaroo Island road network for freight delivery of bioenergy products to support the approximately 2 tons per hour/ 48 tons per day of fuel required for the plant. Note that these are not considered in the final evaluation.
6. Potential connection limitation of new generation. Note that these are non-financial impacts not considered in the final evaluation.

7.2.2 Generation Proposal by Applicant 2

Applicant 2 proposed to connect a total of 16.6MW of generation capacity to SA Power Networks Distribution Network at Penneshaw and Kingscote Substations consisting of:

- 3MW of solar PV generation (33kV connection to Penneshaw Substation);
- 6MW of wind generation (33kV connection to Penneshaw Substation);
- 7.6MW diesel generation (11kV connection to Kingscote Substation); and
- 1MWh/ 2MW short term battery storage (11kV connection to Kingscote Substation).

Applicant 2 proposed to construct a wind/solar site approximately 4.5 to 5km from Penneshaw Substation along Cape Willoughby Road. A new diesel generator plant with a total capacity of 7.6MW was proposed to be located very close or adjacent to the existing Kingscote Substation. Applicant 2 proposed to supply over 50% of annual Kangaroo Island load via renewable generation with diesel generation running as base load generation to provide load, voltage and frequency stability. Therefore, it is anticipated that diesel generation will operate with a minimum output of 14,100MWh annually. Prior to the failure of the existing submarine cable, excess renewable generation is planned to be sold to the NEM. In the event of a cable failure, the cable may not be repaired and proponent's Wind-Solar-Diesel hybrid generation will provide the primary supply to Kangaroo Island indefinitely.

The connection of the proposed generating systems will have significant impact on the Network and hence require augmentation works to be undertaken to avoid a material degradation in the security of supply to SA Power Networks customers.

Capital costs incurred by SA Power Networks:

1. Penneshaw Substation upgrade for new 33kV connection of solar/wind generation including dynamic voltage support management in 2018.
2. Approximately 5km of dedicated 33kV overhead line connection from proponent's power plant to Penneshaw Substation in 2018 (\$1.7 million).
3. Kingscote Substation upgrade for new 11kV diesel generation connection in 2018 including new 11kV bus extension, one 11kV circuit breaker and new control building. Note: 11kV line or cable connection from diesel power plant to Kingscote Substation has not been costed in the evaluation due to the proposed site location.
4. Upgrade the 33kV line protection for lines between Kingscote, American River and MacGillivray Substations in 2018.

Note: Total 2018 capital cost for all substation upgrades on Kangaroo Island is approximately \$8.3 million.

Operating costs incurred by SA Power Networks:

1. Capacity payment charge payable to Applicant 2 for basic network support for duration of the evaluation period (\$4.27 million per annum, fixed).
2. Capacity payment charge (Fixed O&M) payable to Applicant 2 for duration of the evaluation period (\$0.75 million per annum, escalating at CPI).
3. Energy payment of \$315 per MWh (fuel and variable O&M) (escalating at CPI) payable to Applicant 2 for the use of diesel generator sets to provide base load.
4. Technical evaluation, connection and support agreements, commissioning, project management and engineering excluding design costs for the connection assets in 2017 (\$0.65 million).
5. Operational management for the duration of the evaluation period (\$0.2 million per annum).

Advantages

1. Reduction in 33kV line losses on Kangaroo Island.
2. A "hybrid" renewable based solution.
3. The provision of employment both within the hybrid power plants and the associated fuel supply businesses. Note that these are not considered in the final financial evaluation.
4. Maintains reliability of the 33kV network with two main supply injections from either end of the island at Penneshaw and Kingscote in the event of an islanded scenario.

Disadvantages

1. Loss of access to NEM once existing cable fails, with the consequence of potential uncertainty in retail function and cost to customers. Note that these are not considered in the final evaluation.
2. High operating expenditure.
3. Increased environmental impact such as greenhouse gas, noise and dust pollution due to the increased running of proposed diesel generators and potential negative visual impact from wind farms. Note that these are non-financial impacts not considered in the final evaluation.
4. Potential connection limitation of new generation. Note that these are non-financial impacts not considered in the final evaluation.

7.2.3 Generation Proposal by Applicant 3

Applicant 3 proposed to connect a total of 13MW of generating systems to SA Power Networks 11kV Distribution Network. Proponent's solution consists of the following:

- 8MW of diesel generation (2MW each adjacent to Kingscote, MacGillivray, American River and Penneshaw Substations);
- 5MW solar PV generation (4MW and 1MW adjacent to Kingscote and American River Substations respectively);
- Short term battery storage (if required); and
- Turn-key solution by Applicant 3 for the design, supply, delivery, installation and commissioning of a 10MVA three core submarine cable across the Backstairs Passage in the event of a failure of the existing submarine cable. Submarine cable will be procured in 2018 and stored at an undercover location in Port Adelaide.

The proponent's solution does not propose separation (islanded operation) from the National Grid and National Energy Market (NEM). The generation is proposed to be available for the national spot market use when rates are economical.

The primary purpose of the generation system is to supply the total load on Kangaroo Island during a cable failure. Upon failure of the cable, Applicant 3 proposes to provide a turn-key solution for the design, supply, delivery, installation and commissioning of a 10MVA three core submarine cable across the Backstairs Passage using existing terminations at Fishery Beach and Cuttlefish Bay terminations stations. Applicant 3 has indicated that the power stations comprising diesel and solar PV generation) will supply the island during the cable installation timeframe at approximately 3 months according to Applicant 3. Applicant 3 will continually monitor and install new generators if required to meet summer or J tariff peak during the cable failure period.

The connection of the proposed generating systems will have significant impact on the Network and hence require augmentation works to be undertaken to avoid a material degradation in the security of supply to SA Power Networks customers.

Capital costs incurred by SA Power Networks:

1. Kingscote, MacGillivray, American River and Penneshaw Substation upgrades for new 11kV diesel/solar generation connection in 2018 (\$7.8 million).
Note: Cost of 11kV line or cable connections from diesel generator plant to each substation will be covered by Applicant 3.
2. Raise the design temperature of the 33kV American River to MacGillivray line from 50°C to 60°C in 2023 to provide adequate line thermal capacity (\$0.4 million).
3. Installing a 20MVA 33kV Voltage Regulator at Penneshaw Substation in 2026 to provide voltage support (\$1.76 million).

Operating costs incurred by SA Power Networks:

1. Capacity payment charge payable to Applicant 3 for basic network support for duration of the evaluation period (\$2.7 Million per annum, escalating at CPI).
2. Technical evaluation, connection and support agreements, commissioning, project management and engineering excluding design costs for the connection assets in 2017 (\$0.65 million).
3. Operational management for the duration of the evaluation period (\$0.2 million per annum).

Advantages

1. Resolves the voltage constraint by providing adequate voltage support along the Penneshaw to American River 33kV Line for 33/19kV SWER Isolating transformers.

Disadvantages

1. Increased environmental impact such as greenhouse gas, noise and dust pollution due to the increased running of diesel generators. Note that these are non-financial impacts not considered in the final evaluation.
2. A catastrophic failure of this cable could take many more months to install than expected. This may be due to limited cable laying ships in Australia and adverse weather and sea conditions. Note that these are not considered in the final evaluation.
3. The new cable replacement in the event of the existing cable failure remains constrained to 10MVA due to the cable size proposed by Applicant 3. With loads on KI expected to exceed 10MVA in 2028 based on standard growth scenario, the proposed 10MVA will not meet the load requirements on the island within the next 25 years unless proponent's generators run in parallel. Note that these are not considered in the final evaluation.
4. The proponent managing the turn-key cable design and installation of the submarine project must be capable to undertake the work with acceptable methodology, environmental and safety management system. Without the supervision and full management from SA Power Networks, the quality of cable design, construction and installation may be compromised hence affecting the security of supply to Kangaroo Island. Note that these are not considered in the final evaluation.
5. This solution ultimately connects SA Power Networks mainland and Kangaroo Island network with a privately owned and operated cable which will have regulatory implications which will need to be agreed and formalised. Note that these are not considered in the final evaluation.
6. Significant risk of damaging the cable during extra handling operations from storage to cable vessel needing utmost care and expertise. Note that these are not considered in the final evaluation.
7. Insurance and warranty of the cable may expire depending on how long they are stored which further complicates the option. Note that these are not considered in the final evaluation.

7.3 Non-Credible Submissions

The following proposals received but have been assessed as being non credible proposals by not satisfying the minimum criteria detailed in the Non-Network Options Report (NNOR), the criteria that was not met was either using unproven technology, an inability to deliver a solution by December 2018 or the lack of adequate risk management (the names of proponents have been redacted):

1. Applicant 4

Development of a thermal energy storage system (TESS) which stores electrical energy thermally in molten silicon with proposed installation of 2MW of solar PV, 10MW of wind generation and 1MW of biomass generation. A commercial TESS prototype has been constructed and is currently undergoing testing and commissioning at Tonsley Park in South Australia.

2. Applicant 5

Development of 6MW modular solar thermal technology with energy storage system including 5MW of wind generation. The system comprises a parabolic trough concentrating thermal solar steam generator, energy storage system utilising steam accumulators and proprietary reciprocating steam piston engines for power generation. The power station can also be modified to operate from combustion generated steam via a steam boiler. The technology has not been implemented commercially however a prototype has been developed and constructed in California, USA.

3. Applicant 6

Applicant 6 proposed a hybrid system consisting of 5.4MW of Solar Thermal generation, 4MW of solar PV generation, 16MW of wind generation and an isentropic management system. A 27 months' construction period was indicated as being required for engineering detailed design, approvals, installation, testing and commissioning of plant and equipment.

4. Applicant 7

Submission from Applicant 7 was not a non-network proposal but a response for consultancy services to defer the cable project by implementing non-network technologies.

5. Applicant 8

Development of a 3.5MW bio-fuel facility utilising steam powered generator, 1MW of bio diesel generators and 1MWh battery storage units at each of Kangaroo Island's substations, 3MW of wind generation and a distributed community storage system or peer to peer network that will allow local energy trading within the existing Kangaroo Island network with claims of potentially reducing 50% of the electricity demand.

8. Summary of Submissions Received in Response to the Draft Project Assessment Report

8.1 Submissions Received

On 2nd November 2016, SA Power Networks published the Draft Project Assessment Report (DPAR), summarising the evaluation of proposals received in response to the Non-Network Options Report (NNOR) along with SA Power Networks own network solutions in accordance with the Regulatory Investment Test – Distribution (RIT-D) to address the identified need.

Interested parties together with those registered on SA Power Networks Demand Side Engagement Register were invited to submit a response to the DPAR by Wednesday, 14th December 2016. Consequently, SA Power Networks received two submissions in response to the DPAR, from:

- Office of the Commissioner for Kangaroo Island and Kangaroo Island Council; and
- South Australian Renewable Energy Policy Group (SAREPG) with Solar Citizens, SA Branch.

SA Power Networks responses to the issues raised in these submissions are contained in this section. Copies of the submissions received in response to the DPAR are attached in Section 16.

8.2 Difference between Initial Budget Estimate versus Direct Cost of Cable Supply and Installation

In October 2015, the AER's Final Determination⁶ included \$45.6 million for the supply and installation of a new cable and associated works between the mainland and Kangaroo Island. The initial project estimate of \$45.6 million was based on budget estimates from five major cable suppliers received in 2014 via an external consultant on behalf of SA Power Networks and includes SA Power Networks line costs, business costs, equipment spares and pre project decision costs.

The broad range of installation prices received in 2014 reflected the large number of uncertainties and variables surrounding the cable installation. The risks associated with such a unique project is one of the main reasons why budget quotes potentially vary from those values received during a competitive tender process, along with changes in exchange rate and world competition.

Subsequently, SA Power Networks has performed a preliminary evaluation of six formal tenders received for the supply and installation of the proposed cable to enable a direct comparison to any non-network proposals. Hydrographic survey of the sea floor along the proposed route and seismic survey of the sub-surface geologic structure were completed and provided to the potential tenderers to assist in the tender proposal. Based on the average prices received as a result of this competitive tender process, the average total cost for the supply and installation of a 33kV submarine cable is estimated to be \$25.6 million in present value terms which equates to an annualised cost over 25 years of approximately \$2.60 per customer per annum.

Please note that the \$25.6 million cost excludes business overheads, contingencies, pre decision project costs and GST. Further savings were achieved by modifying the technical specification of the submarine cable to reflect the future forecast growth requirements on Kangaroo Island. The cost is consistent and within the range of the potential network capital cost that was published in the Non-Network Options Report (NNOR) for Kangaroo Island of \$45 million (+10%, - 50%).

SA Power Networks operates under an incentive-based regulatory framework, set by the Australian Energy Regulator (AER). One component of this framework is the Capital Expenditure Sharing Scheme (CESS), whereby SA Power Networks is rewarded / penalised for any under / over spend of our total

⁶ <https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/sa-power-networks-determination-2015-2020/final-decision>

capital expenditure allowance. Seventy percent (70%) of any savings are passed back to customers and 30% are retained by SA Power Networks. In conclusion, the cost reduction for the supply and installation of the proposed cable is a significant advantage to all South Australian customers, if it assists SA Power Networks in reducing total capital spend in the 2015-20 regulatory period.

8.3 Rating of Submarine Cable (66kV or 33kV)

The Kangaroo Island Asset Management Plan (AMP2.1.03) published in October 2014⁷ that formed part of SA Power Networks 2015-20 Regulatory Proposal stated that the long-term security performance of Kangaroo Island should be rated at 66kV but energised at 33kV initially to allow for long term capacity upgrades. The Office of the Commissioner for Kangaroo Island and Kangaroo Island Council are in support of the proposal for the use of a larger rated cable (66kV) to ‘future proof’ the island and potential allow future surplus renewable energy to be exported to the mainland.

However, the 2014 customer demand forecast used in the Kangaroo Island Asset Management Plan has changed. As published in the 2016 version of AEMO’s National Electricity Forecasting Report (NEFR)⁸, AEMO is now forecasting a 20-year decline in the state-wide demand forecast based on the impact of population growth, appliance growth, appliance efficiency, industry conversion from manufacturing to commercial, and the forecast uptake of solar and storage technology. Taking this demand forecast into account, a range of customer demand growth scenarios for Kangaroo Island were considered in the evaluation, including flat growth, positive growth and potential large spot loads.

Under all customer demand scenarios, including future local development projects considered, the proposed 33kV cable, is sufficient to supply Kangaroo Island for the next 30 years.

8.4 Inclusion of Additional Network Option Scenario (Option 8)

The Office of the Commissioner for Kangaroo Island and Kangaroo Island Council have proposed SA Power Networks reconsider the installation of a 66kV cable as stated in the Kangaroo Island Asset Management Plan instead of the recommended 33kV cable. For completeness, SA Power Networks has included the original 66kV cable option as an additional network option scenario (Option 8). As described in Section 11, this option provides a higher net market benefit when compared with all the non-network alternatives, but is not as cost effective as the preferred Option 1 (33kV cable).

8.5 Clarification of Privately Owned Cable under Option 7

As described in the generation proposal by Applicant 3, the proponent proposes to provide a turn-key solution for the design, supply, delivery, installation and commissioning of a 10MVA three core submarine cable across Backstairs Passage using existing terminations at Fishery Beach and Cuttlefish Bay termination stations in the event of a cable failure. This solution ultimately connects SA Power Networks mainland and Kangaroo Island networks via a privately owned and operated cable. In this case, the privately owned cable will have to adhere to new regulatory implications which will need to be agreed and formalised as it is no longer managed by SA Power Networks as the sole distributor in South Australia.

⁷ <https://www.aer.gov.au/system/files/SAPN%20-%2020.38%20PUBLIC%20-%20SAPN%20Kangaroo%20Island%20%28AMP%202.1.03%29.pdf>

⁸ <http://www.aemo.com.au/Electricity/Planning/Forecasting/National-Electricity-Forecasting-Report>

8.6 Sensitivity Analysis

Sensitivity analysis conducted in relation to the weightings applied to each of the options indicate that the RIT-D evaluation is robust to a wide-range of alternative weightings. The scenario analysis incorporated in the RIT-D assessment is also the means by which uncertainty in relation to future outcomes is addressed. There will always be uncertainty in relation to key parameters such as the future demand level on Kangaroo Island, condition and probability of failure of the existing submarine cable, the development of new renewable technologies and future regulatory framework.

SA Power Networks considers that the range of assumptions adopted in the reasonable scenarios used for this analysis adequately addresses future uncertainties including different growth scenarios, and ensures that the investment decision is robust across potential different futures.

9. Risks and Benefits

9.1 Risks of Non-Network Solutions

It is critical to ensure the selected solution is not only the best choice for our customers economically but also meets the minimum requirements in terms of network security, customer reliability and the ability to manage future customer demand increases and generation connections such as PV.

This section describes some of the potential risks of implementing non-network solutions on Kangaroo Island which have not been considered as part of the RIT-D analysis but which need to be resolved before commitment to such solutions.

9.1.1 Regulatory Framework and Barriers

If a non-network, islanded solution is implemented as some proponents have proposed for Kangaroo Island (ie Off Grid), the National Electricity Law and National Energy Retail Law is unlikely to apply once it is islanded. An islanded solution would require considerable stakeholder consultation (SA Government, Kangaroo Island Council, AER and ESCOSA) to determine the form of regulation and who would oversee that regulation. The finalisation of the regulatory framework that would apply under an islanded solution may take considerable time.

If required, SA Power Networks would engage with the relevant regulatory bodies and assist within our abilities or influence to arrive at a regulatory framework. However, SA Power Networks are committed to strictly adhering to the NER's RIT-D requirements and the stated operational timeline of 2018. Under these circumstances, it is unlikely that the rule makers can develop and/ or finalise an agreed regulatory framework for Kangaroo Island within this time.

9.1.2 Retail Price Control and Management

Should Kangaroo Island be ultimately islanded from the National Grid, then the form of regulation established post stakeholder consultation would determine the form of price control. It is anticipated that pricing for energy consumers on Kangaroo Island may be impacted pending the regulatory framework applied as there may not be effective retail competition to supply electricity to Kangaroo Island. A price regulation framework needs to be in place prior to an islanding event to avoid the misuse or abuse of electricity suppliers having a monopoly position due to lack of retail competition.

9.1.3 Development of Renewable Solution within Timeframe

All non-network options that can be considered must be capable of being operational by 1 December 2018. This timeframe may be considered challenging due to the complications of developing and constructing infrastructure to implement the associated non-network solution with acceptable site procurement, planning and environmental approvals. Any non-network generator option must meet all relevant EDC and NER requirements related to grid connection, including if required under the NER, AEMO registration and ESCOSA licensing. Impacts on flora and fauna (potential loss of habitat) in particular cutting of tree plantations for the biomass energy solution and emissions from running diesel generators as part of the non-network solutions also need to be assessed and approved by relevant environmental departments or action groups.

9.1.4 Sustainable Long Term Biomass Fuel Supply

In an islanded scenario, non-network options must be capable of providing solutions to the identified need for an indefinite period. Therefore, investment in any biomass energy solution must be based on the ability of securing a long term biomass fuel supply. However, the proposed complete clearing of forest on Kangaroo Island does not support operating the power plant for an indefinite period. With the environmentalism or ecology on Kangaroo Island being increasingly protected, it may not be possible to secure alternative fuel sources once the existing stock is exhausted, to ensure the security of supply for a bioenergy solution⁹. A potential bushfire may also terminate the supply of bioenergy resources (ie wood) leaving the island without a secure fuel source.

9.2 Additional Benefits of Submarine Cable

This section describes some of the potential benefits of installing a new submarine cable and however not considered as part of the RIT-D analysis.

9.2.1 Optical Fibre in Submarine Cable

Optical fibre is a communication technology for voice and data transmission which is generally not subject to electromagnetic interference. Optical fibre communication cables have been proposed to be incorporated within the proposed submarine cable. These optic fibres could be used by third parties to improve telecommunication access to Kangaroo Island residents. As only certain costs and benefits of a solution are allowed to be considered within the RIT-D, the potential benefit of the inclusion of optical fibre communication cables have not been considered within the evaluation.

9.2.2 Opportunity to Export Surplus Energy to South Australia's Electricity Grid

The development of renewable energy resources on Kangaroo Island should be explored as it brings potential local economic development whilst enhancing Kangaroo Island's prospective green image as a tourist destination. However, it is important to note that if Kangaroo Island has good renewable resources, Kangaroo Island would limit its future possibilities by removing connection to the South Australia's electricity grid via the submarine cable to export any surplus renewable energy.

Without the submarine cable connection, Kangaroo Island will no longer be connected to the National Electricity Market (NEM). Therefore, Kangaroo Island may no longer have access to the NEM generation and retail market and potentially limit future development of renewable energy due to limited economic return on investment for the owners.

A recent report titled 'Towards 100% Renewable Energy for Kangaroo Island' and published by the Institute for Sustainable Futures examined Samso, an island in Denmark which is similar to a certain extent to Kangaroo Island in terms of local and tourist population, peak demand and cable distance from the mainland¹⁰. The Danish island of Samso is known as the first island in the world to be completely powered by renewable energy and is now exporting extensive renewable energy into the Danish grid¹¹. Kangaroo Island could potentially follow the lead of Samso in the development and export of renewable energy resources provided the connection to the mainland remains, suitable capacity exists and voltage limits aren't exceeded. This conclusion is further supported by the American River Progress Association.

⁹ Earth Systems, 2012, Bioenergy Resource Analysis and Technology Feasibility for Kangaroo Island: Phase 1 – Resource Analysis and Technology Shortlist

¹⁰ UTS:ISF Report - Towards 100% Renewable Energy for Kangaroo Island, Page 57

¹¹ <http://ecowatch.com/2014/05/01/samso-renewable-energy-island-sustainable-communities/>

10. Market Scenarios and Benefits Considered

10.1 Quantification of Costs

10.1.1 Construction Costs

For all other costs incurred by SA Power Networks in all options, SA Power Networks has used a unit costing methodology to estimate the capital costs of an option. These costs are based on actual historical values spent on similar items in the recent past with any exceptional circumstances taken into account. Therefore, it represents an expected average value with an equal chance of actual costs being higher or lower than the standard figure which in turn are accounted for through the performance of sensitivity analysis.

The capital cost used for supply and installation of the 33kV submarine cable in 2018 is the average tender price from six turn-key contract tenders received in July 2016.

Note that we included within the estimated capital cost all elements associated with the project that we are entitled to include in our Regulated Asset Base if we were to build that option.

Exclusions: Option costs shown in the report exclude common costs to all options such as pre-project commitment costs (until end of 2016), SA Power Networks business overheads, contingencies and GST.

10.1.2 Standard Operations and Maintenance Expenditure

Operating and maintenance (O&M) costs to be incurred by SA Power Networks have been derived as a fixed proportion of the initial capital cost based on average historical levels for all assets constructed by SA Power Networks other than the cable (1.5% per annum). SA Power Networks considers this approach to be reasonable as:

- The majority of costs in O&M are fixed in nature and therefore it is entirely appropriate to apply them over the whole of the asset base;
- For the submarine cable, an O&M equal to 0.5% of capital cost has been used as a typical proportion for the first 25 years of a long life asset with minimal O&M expenditure until the cable ultimately fails. The capital cost used for the network cable option also includes cost of spare cable, joint and terminations.

10.1.3 Other Expenditure

Where specific Operating and Maintenance costs apply to an option such as fuel costs or licence costs for an embedded generator these are applied individually to the option in the expected year that they will be incurred.

Where payments to third parties are made – for instance in terms of an annual facilities fee, these payments reflect the expected contractual payments to be made in constant (real) dollars; that is no inflation multiplier is added even if one is provided for in the contract authorising the payment. In addition, these fees are assumed to include an allowance to cover any ongoing O&M costs by the proponent and are therefore not separately allowed for within the analysis.

10.2 Quantification of Market Benefits

10.2.1 Introduction

Under clause 5.17.1 (c) (4) of the NER, we must consider whether or not the following potential market benefits are material to the identification of the preferred option and if material, describe the methodology we have used to determine the benefit or cost arising from each one:

- (i) *changes in voluntary load curtailment;*

- (ii) *changes in involuntary load shedding and customer interruptions caused by network outages, using a reasonable forecast of the value of electricity to customers;*
- (iii) *changes in costs for parties, other than the RIT-D proponent, due to differences in:*
 - (A) *the timing of new plant;*
 - (B) *capital costs; and*
 - (C) *the operating and maintenance costs;*
- (iv) *differences in the timing of expenditure;*
- (v) *changes in load transfer capacity and the capacity of Embedded Generators to take up load;*
- (vi) *any additional option value (where this value has not already been included in the other classes of market benefits) gained or foregone from implementing the credible option with respect to the likely future investment needs of the National Electricity Market ;*
- (vii) *changes in electrical energy losses; and*
- (viii) *any other class of market benefit determined to be relevant by the AER.¹²*

10.2.2 Voluntary Load Curtailment

Voluntary load curtailment occurs where a customer (or group of customers) agrees to reduce their demand on the network for a period in response to a network constraint. The value (a negative market benefit) is evaluated by setting the value of lost production equal to the cost of the Network Support Agreement signed by or on behalf of the customer. This method results in a stream of annual costs which in turn are converted to a NPV.

This follows the method mandated by the AER in their RIT-D guidelines, a copy of which is available from their website.

Voluntary load reduction is not considered a viable standalone non-network option as it must be able to support the Kangaroo Island total demand once the Kangaroo Island cable has failed.

10.2.3 Involuntary Load Curtailment

The value due to differences in expected network reliability between the various options has been included in the analysis. This benefit is calculated by:

- Estimating the expected reliability of that part of the network impacted by any of the proposed options.
- Calculating the expected MWh of electrical consumption that will not be supplied due to loss of supply as a result of any unplanned outages.
- Multiplying this lost consumption by a value per MWh (obtained from AEMO) reflecting the economic costs of the loss of supply. Any uncertainty in this value is encapsulated by using a wide band of potential values within the sensitivity analysis evaluation.
- Converting the stream of annual costs to an NPV.

Note: This benefit excludes the value of any reliability or performance scheme payments accrued or paid by SA Power Networks such as Guaranteed Service Level payments or STPIS benefits or penalties. Changes in the expected levels of these payments are excluded from the RIT-D as they represent transfers of economic surplus between Market Participants.

¹² Clause 5.17.1 (c) (4) of the NER

10.2.4 Changes in Other Party Costs

We interpret this clause in the context of:

- The costs must be solely related to that parties' participation in the electricity market; and
- The party must be identifiable (ie an actual party as distinct from a potential party);

Under this interpretation, SA Power Networks believes that there are no parties whose investment decisions, capital costs, or operating and maintenance costs will be impacted other than as included fully under other market benefits.

10.2.5 Differences in the Timing of Expenditure

No specific identifiable value for this class of benefits has been calculated as:

- Differences caused by the initial timing of expenditure are fully included in the evaluation of the costs of each option through the NPV analysis.
- As this cable is reaching near its end of life, and condition being one of the key indicators of asset life¹³, the risk of a cable failure unceasingly (and significantly) increases with time. This risk directly correlates to the risk of maintaining the security of supply as required by our obligations under both of the South Australian Electricity Distribution Code (EDC) and National Electricity Rules (NER). Therefore, based on the associated risk of the predicted service life of the cable and the materiality of the economic impact upon a failure of this cable, our analysis has demonstrated that it would be prudent and efficient to install a second undersea cable by December 2018, by which time the existing cable will be approximately 25 years old. In supporting this analysis, the Australian Energy Regulator's (AER) in its final decision for SA Power Networks 2015-20 price determination, have stated that their own analysis supported that it would be prudent to install a second undersea cable by December 2018¹⁴.
- Differences in value caused by the differing life of the installed assets are resolved in the NPV analysis by adding back into each option the remaining life of the assets (as represented by the remaining depreciated value of the assets) deployed in the solution.

10.2.6 Changes in Load Transfer Capacity

There are no specific values attributed to this class of benefits as differences in load transfer capacity between options during the study period are included in:

- The timing of capital expenditure where these changes allow the deferral of expenditure (eg by allowing load to be transferred from a heavily loaded substation to one less heavily loaded); or
- Changes in Involuntary Load Curtailment where load can be transferred temporarily to another source of supply following a network outage.

It is believed that the study period applied is long enough for differences that may allow deferral or improvements outside of the period to be small enough to be non-material to the outcome.

10.2.7 Changes in Embedded Generation Capacity

There are no embedded generators within the area of the study suffering from network capacity constraints as a result of the network configuration during the period of the study.

The value of the loss of residential sized PV generation caused by involuntary load shedding has been calculated by adding back to the shed load, an estimate of the amount of lost generation during the loss of supply event. For instance: Substation A has a measured load of 15MW which includes an

¹³ Due to the physical limitation of inspecting the underground cable, condition inspection is very difficult, however, in 2012 SA Power Networks were able to carry out a condition assessment on some exposed sections. These sections have identified corrosion being evident with derogation of the cable's outer sheath.

¹⁴ Australian Energy Regulator, Final Decision SA Power Networks Determination 2015-20, Attachment 6 – Capital Expenditure, Oct 2015, pg 68-71.

estimated 1MW of PV generation. When calculating the value of involuntary load shedding a load of 16MW (15MW measured + 1MW lost PV generation) is used for the load at Substation A.

10.2.8 Electrical Losses

The value due to changes in the level of electrical losses has been included in the evaluation of the options. This value is calculated by:

- Estimating the expected peak loss for the network for each option for each year of study;
- Converting the loss into an annual MWh quantity by multiplying by a calculated loss load factor specific to the area of the network under consideration;
- Multiplying the estimated total annual MWh of system losses within the relevant system by the average cost of generation in the South Australian market; and
- Converting this stream of annual costs to an NPV

Note that the average market price tends to vary from year to year depending on the fuel mix and level of government taxes and subsidies¹⁵. This uncertainty is encapsulated by using a wide band of potential values in the sensitivity analysis as described in Section 10.3.6.

10.2.9 Impact On Market Behaviour

Under the RIT-D, changes in market behaviour caused by differences between the options should be considered. These impacts include changes in the bidding behaviour of generation companies and the level of voluntary load shedding during system peaks. These changes are driven both by changes in the level of market competition and by changes in the average cost of production. In this case, SA Power Networks has deemed that there will be no material change in market behaviour due to:

- Any diesel powered generation in the options considered is only likely to displace other diesel powered generation rather than other generation sources.
- The size of the proposed power stations is immaterial when compared to the overall peak demand in the South Australian market and therefore any proposed generation does not threaten to displace any other planned or existing generation within the state or NEM.

10.2.10 Other Market Benefits

No other market benefits have been considered within the evaluation.

¹⁵ Data sourced from <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data-dashboard>

10.3 Parameters Subject to Variation Within the Sensitivity Analysis

10.3.1 Basic Case

The basic case consists of the mid-range value of each varied element below. This represents the most likely expected outcome.

10.3.2 Demand Forecasts

As changes in demand are the major determinant in the timing of network augmentations, two high level scenarios have been included, reflecting standard and flat (nil) growth rates. Within each demand growth scenario further variations have been chosen to further test the sensitivity of the results. These minor variations have been applied equally to each growth scenario as described in Section 11.

Standard Growth

This is the case with the highest probability in which growth in the network follows its forecast values. For details of the methodology used to derive this case please refer to Section 3.1 within the Distribution Annual Planning Report (DAPR) published annually on our website.

Flat Growth

In this scenario, growth is held flat (ie 0% growth) beyond 2017.

10.3.3 Discount Rate

The allowed rate of return is the forecast of the cost of funds a network business requires to attract investment in the network. The RIT-D requires the NPV analysis to apply a discount rate appropriate for the analysis of a private enterprise investment in the electricity sector.

The AER has stated that:

- “the regulatory WACC might reasonably be considered the lower boundary of the discounts rate but not the mean value around which sensitivity testing is conducted”; and
- “the discount rate adopted for the purpose of the regulatory test evaluation should be a commercial discount rate in order to ensure network and non-network investments are compared on a competitively neutral basis”.

SA Power Networks has determined that the appropriate real pre-tax weighted average cost of capital for non-regulated work is between 4.0 and 8.5 percent. In assessing whether the rate at the lower or higher end of the range should be applied, consideration should be given to factors such as the period of the investment, counterparty risk, size, complementary business opportunities and other risk strategies and adjustments.

In our view, it is reasonable for this evaluation of credible options to use a base rate of 6.36% with SA Power Networks current real pre-tax Weighted Average Cost of Capital (4.36%) and 8.36% being used as the low and high values (nearly double SA Power Networks pre-tax WACC) respectively.

10.3.4 SA Power Networks Project Costs

SA Power Networks has prepared cost estimates for the work it would have to undertake for each augmentation option. This includes the network changes required to support connection of each third party option to the network. These costs are based on standard historical costs adjusted to current dollar values. These costs do not include any allowance for risk, overheads or contingencies. Variations of 75% and 133% of the base values have been used to assess the potential impact of variations in construction costs and the impact of unforeseen events.

For network options requiring the existing cable to run to failure, please note that the capital contribution is derived as the cost of repair in year “N” and replacement in “N+1” both multiplied by the chance of cable failure in year “N” as this acts as the trigger for the action.

Please note that no capital or operating expenses incurred prior to project commitment have been included as these are considered to be costs common to all scenarios.

10.3.5 Value of Customer Reliability (VCR)

The Value of Customer Reliability (VCR)¹⁶ published in 2015 by AEMO has been used to reflect how much customers are willing to pay to have reliable supply.

When undertaking the assessment of credible options, a base rate of \$38,000 per MWh has been applied. Variations of 70% and 130% of this base value have been used to assess the potential impact of variations in VCR costs (ie \$26,600 and \$49,400 per MWh).

For those network options requiring the existing cable to run to failure and Applicant 1’s non-network proposal, the radial line risk is caused by the 33kV lines from Kingscote to Penneshaw being radially fed from the power station. These have also been adjusted by the probability of the cable’s failure as the risk only occurs when the submarine cable is out of service.

10.3.6 Cost of Losses/ Energy Price

The evaluation has used \$61.67 per MWh as the base value which represents the average price for energy purchases within South Australia for 2016 as published by AEMO on 11 October 2016¹⁷. A rate of \$46.14 per MWh has been used as the low value based on the average Victorian price in 2016 as published on 11 October 2016. A value equivalent to 150% of the base value was used for the high value (\$92.51 per MWh) given the uncertainties in the calculation process and future generation costs.

Market benefits associated with the change in losses have been quantified and multiplied by the energy price relevant to the scenario.

10.3.7 Kingscote Power Station

The operational costs estimate for the ongoing operation of the Kingscote standby 8 MW power station are much higher than would be expected for a similar sized (prime power) power station. The Kingscote power station was designed for provision of standby capacity for short durations of operation for either network support or interruptions in supply. Hence, the generators are only suitable as a short term solution. In addition, when these generators operate, SA Power Networks receives no payment from the market for the energy it generates. Therefore, a base value of \$589 per MWh of generation reflecting SA Power Networks real generation costs have been applied for operation of Kingscote Power Station.

In the event of a cable failure which requires Kingscote power station’s generators to run for an extended period, the generation cost applied in the RIT-D is allocated to the energy cost (fuel/urea

¹⁶ <http://www.aemo.com.au/Electricity/Planning/Value-of-Customer-Reliability-review>

¹⁷ <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM>

cost), fixed mobilisation and demobilisation of leased generators and variable operating time cost per day multiplied by the chance of cable failure in the associated year.

The availability factor of Kingscote power station's generators is predicted to be 99.93% which represents 6.1 hours of interruption of supply per year based on reliability data on remote power stations run by the state government under the Remote Areas Energy Supply Scheme.

No allowance has been included to expand the Kingscote Power Station in the 25-year evaluation period as it is considered to be a common cost for all scenarios.

10.3.8 New Submarine Cable Cost

The average offer price submitted by the cable tenderers (including SA Power Networks network management costs) of approximately \$21.9 million has been used in the RIT-D evaluation.

10.3.9 Probability of Cable Failure

A normal distribution curve based on the standard deviation of the square root of the expected design life of the existing cable has been used to formulate the probability of failure of the existing cable. The RIT-D analysis undertaken scales the annual probability of failure rate by assuming no cable failure prior to 2017.

10.4 Parameters Not Subject to Variation within the Sensitivity Analysis

10.4.1 Third Party Cost

The price offered to SA Power Networks for the supply of network system support services has not been subjected to specific variations in project costs, operating and maintenance costs or depreciation as the risk reflected in these variations is carried by the third party and not the electricity market.

10.4.2 Operating and Maintenance Costs

Operating and maintenance costs have been derived as a fixed proportion of the capital cost. It is considered highly unlikely that any specific elements exist in this instance that would cause a variation from the network average on a systemic basis. Therefore, no analysis has been done for a variation in the O&M costs. As stated previously, no O&M costs have been applied to third party network support offers as these costs are considered to be incorporated within each parties offer.

10.4.3 New Submarine Cable Repair Cost

Although there is a small risk of the new submarine cable failing prior to its design lifetime (minimum of 30 years), it is considered that the operating and maintenance (O&M) costs (0.5% per annum) of the cable will substantially cover the expenses of any cable repair or maintenance within the evaluation period.

SA Power Networks is seeking from the cable tenderers an extended warranty period for the cable following the expiry of the defects liability period for the cable installation works. This will negate any expenses required from SA Power Networks to repair the cable during the infant mortality stage of the new cable.

It is expected that the warranty inclusion will not increase the cost of the cable supply and installation beyond that currently included in the evaluation.

10.4.4 Depreciation

In all cases, the capital cost of each option was depreciated using a straight line method over the life of the asset. The remaining asset life (the depreciated value of the asset) was then added back to the relevant option in the final year of the evaluation as an approximation of the residual value of each augmentation. Each set of assets was split into three cost components and depreciated according to the following asset lives:

- Lines = 50 years
- Substations = 45 years
- Generator Reactive Support = 20 years

No variation has been applied to depreciation rates as it is considered unlikely that a substantial variation in the expected life of the assets will occur.

11. Options Evaluation

This section provides information on the results of the Net Present Value (NPV) analysis for each technically credible option considered as part of the RIT-D evaluation to deliver a solution which provides the highest market benefit to all energy consumers.

The following options were considered as part of the RIT-D evaluation:

- Option 1 Install new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018.
- Option 2 Base Option - Run the existing cable to failure, repair and install a new submarine cable post failure of the existing cable.
- Option 3 Run the existing cable to failure but provide the capital and operating expenditure including additional spare cable to reduce the time to repair the cable.
- Option 4 Run the existing cable to failure with pre-purchase of submarine cable to reduce the cable replacement time.
- Option 5 A non-network solution consisting of biomass, solar and diesel generation as proposed by Applicant 1.
- Option 6 A non-network hybrid solution consisting of wind, solar and diesel generation combined with short-term battery storage as proposed by Applicant 2
- Option 7 A non-network generation solution consisting of solar and diesel as proposed by Applicant 3 with a turn-key solution for the design, supply, delivery, installation and commissioning of a 10MVA submarine cable when the existing submarine cable fails.
- Option 8 Install new 66kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 (added since publication of DPAR).

11.1 Sensitivity Analysis Results

All seven options described in sections 6 and 7.2 were evaluated over a range of scenarios as described in section 10. The sensitivity assessment examines variations in relation to the distribution discount rate, cost of losses/ energy price, value of customer reliability and network capital costs. The tables in this section summarise the outcome of each scenario over the standard and flat growth projections.

The evaluation tables below summarise the outcome of each scenario over the standard and flat load growth projections.

Table 4: Sensitivity Analysis Results (\$'000's) based on standard growth

| Options | Description | Total Costs | Relative Costs | Relative Market Benefit | Net Market Benefit | Rank |
|---------------------------|---|-------------|----------------|-------------------------|--------------------|------|
| Option 1 | Install new 33kV submarine cable | \$25,629 | -\$16,691 | \$7,344 | \$24,035 | 1 |
| Option 2 (Base Option) | Run to failure | \$42,319 | \$0 | \$0 | \$0 | 7 |
| Option 3 | Run to Failure with quick repair time | \$35,343 | -\$6,976 | \$4,899 | \$11,875 | 5 |
| Option 4 | Run to Failure with pre-purchase of full length of cable | \$33,069 | -\$9,251 | \$4,899 | \$14,150 | 4 |
| Option 5 | Applicant 1 - biomass, solar and diesel generation | \$33,558 | -\$8,761 | \$5,645 | \$14,407 | 3 |
| Option 6 | Applicant 2 - wind, solar and diesel generation | \$100,612 | \$58,292 | \$12,522 | -\$45,770 | 8 |
| Option 7 | Applicant 3 - diesel and solar generation and future submarine cable installation | \$42,531 | \$211 | \$7,344 | \$7,133 | 6 |
| Option 8 | Install new 66kV submarine cable but energised at 33kV | \$27,404 | -\$14,915 | \$7,344 | \$22,259 | 2 |

The “Total Costs” is the summation of the direct costs associated with the various NPV of each option’s augmentation costs including total capital, operating and maintenance cost. The results show that installing a new 33kV submarine cable in 2018 (Option 1) delivers the lowest total capital cost followed by the option of installing a new 66kV cable (Option 8). Option 6 has the highest capital cost due to the high operating expenditure (contractual and energy payment) in both growth scenarios.

The “Relative Costs” represents the cost difference of direct costs when compared to the Option 2 (base option – run to failure).

The “Relative Market Benefit” represents the value of the market benefit when compared to Option 2 (base option – run to failure). A higher “Relative Market Benefit” value represents the reduction in losses or improved customer reliability for that option compared to the base option (Option 2). The results show that Option 6 delivers the highest additional benefit due to reduction in network losses and minimal VCR cost. This is followed by Option 7 and the installation of the new submarine cable (Option 1 or 8). It is important to note that although Option 5 delivers a reduction in network losses, the VCR cost incurred is high because the 33kV network on Kangaroo Island will be exposed to increased number of interruptions and reliability issues, as the 33kV line will be connected radially from Kingscote Substation to Penneshaw Substation following failure of the existing submarine cable (islanded scenario) as there would be no backup supply to Penneshaw for a failure of the 33kV sub-transmission system.

The “Net Market Benefit” is calculated in net present value terms by deducting the “Total Costs” from the “Relative Market Benefit” (a negative net benefit represents a cost to the market). The ranking within the “Net Market Benefit” section indicates the most economic option. Based on a standard load growth, the preferred option of installing a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 has been found to be the most economic choice for providing the highest net market benefit.

Table 5: Sensitivity Analysis Results (\$'000's) based on flat growth

| Options | Description | Total Costs | Relative Costs | Relative Market Benefit | Net Market Benefit | Rank |
|---------------------------|---|-------------|----------------|-------------------------|--------------------|------|
| Option 1 | Install new 33kV submarine cable | \$25,095 | -\$14,709 | \$5,834 | \$20,543 | 1 |
| Option 2 (Base Option) | Run to failure | \$39,803 | \$0 | \$0 | \$0 | 7 |
| Option 3 | Run to Failure with quick repair time | \$33,703 | -\$6,101 | \$3,892 | \$9,993 | 5 |
| Option 4 | Run to Failure with pre-purchase of full length of cable | \$31,428 | -\$8,375 | \$3,892 | \$12,268 | 3 |
| Option 5 | Applicant 1 - biomass, solar and diesel generation | \$33,146 | -\$6,658 | \$3,756 | \$10,414 | 4 |
| Option 6 | Applicant 2 - wind, solar and diesel generation | \$100,612 | \$60,808 | \$9,113 | -\$51,695 | 8 |
| Option 7 | Applicant 3 - diesel and solar generation and future submarine cable installation | \$41,372 | \$1,568 | \$5,834 | \$4,266 | 6 |
| Option 8 | Install new 66kV submarine cable but energised at 33kV | \$26,870 | -\$12,934 | \$5,834 | \$18,768 | 2 |

Based on a flat load growth, the sensitivity analysis results show that installing a new 33kV submarine cable in 2018 (Option 1) delivers the highest net market benefit followed by the option of installing a new 66kV cable (Option 8) and Option 4. Consistent with the normal growth scenario, Option 6 delivers the lowest net market benefit compared to the base case followed by Option 7.

In each case after the sensitivity assessment for standard and flat load growth, the preferred option of installing a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 is found to be the solution providing the highest net market benefit. This is followed by the installation of a new 66kV submarine cable due to the additional capital cost associated with provision of the higher rated submarine cable.

In conclusion, the sensitivity analysis has demonstrated that installing a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 (Option 1) has the highest net market benefit under all scenarios considered. The full sensitivity analysis results are detailed in Section 15.

12. Conclusions

12.1 Preferred Option

Based on the analysis of all potentially credible options considered and the performance of a sensitivity analysis of those parameters which could have a material effect on the outcome of the analysis, installing a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018 (option 1) has been shown to have the greatest net market benefit and is therefore the preferred option to resolve the identified need.

This recommended option includes:

1. Installing a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018.
2. Termination site upgrades at Fishery Beach and Cuttlefish Bay in 2018 to provide fast switching between both cables.
3. Raise the design temperature of the 33kV American River to MacGillivray line from 50°C to 60°C in 2023 to provide adequate line thermal capacity.
4. Installing a 20MVA 33kV voltage regulator at Penneshaw Substation in 2036 to provide voltage support.

The total project cost of this recommended option is estimated to be \$25.6 million in present value terms¹⁸.

12.2 Next Steps

This Final Project Assessment Report represents the final stage of the consultation process in relation to the application of the formal RIT-D process.

In accordance to Clause 5.17.5 of the NER, registered or interest parties may dispute the recommendations or conclusions made by SA Power Networks contained in this report with the Australian Energy Regulator (AER) within 30 days following publication of this report. Any formal dispute should be raised with the AER in accordance with the requirements of clause 5.17.5 of the NER.

In accordance with the requirements of clause 5.17.5(c)(2) of the NER any dispute notice submitted to the AER must also be submitted to SA Power Networks. Copies of any dispute notice should be sent via e-mail to requestforproposals@sapowernetworks.com.au.

If no formal dispute is raised or following the resolution of any dispute where it is deemed there is no manifest error in the contents of this report, SA Power Networks will immediately commence with the investment activities necessary to proceed with the recommended option contained herein.

Telephone enquiries can be directed to Pat Howard on (08) 8404 5514 or Andrew Lim on (08) 8404 5410. It should be noted that no such enquiries shall be deemed to constitute initiation of a formal dispute.

¹⁸ The \$25.6 million cost is based on a competitive tender process and it excludes corporate business overheads, contingencies, pre project decision cost and GST.

13. Compliance Statement

This Project Assessment Report complies with the requirements of NER Clause 5.17.4. (j) as demonstrated below.

Table 6: Regulation compliance cross reference

| Requirement | Report Section |
|--|----------------|
| (1) a description of the identified need; | 4 |
| (2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-D proponent considers reliability corrective action is necessary); | 3 and 4 |
| (3) if applicable, a summary of, and commentary on, the submissions on the non-network options report | 7 |
| (4) a description of each credible option assessed; | 6 and 7 |
| (5) where a <i>Distribution Network Service Provider</i> has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit for each credible option; | 10 |
| (6) a quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure; | 6 and 7 |
| (7) a detailed description of the methodologies used in quantifying each class of cost and market benefit; | 5 and 10 |
| (8) where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option; | 10 |
| (9) the results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results; | 11 |
| (10) the identification of the proposed preferred option; | 12.1 |
| (11) for the proposed preferred option, the RIT-D proponent must provide: <ul style="list-style-type: none"> (i) details of the technical characteristics; (ii) the estimated construction timetable and commissioning date (where relevant); (iii) the indicative capital and operating cost (where relevant); (iv) a statement and accompanying detailed analysis that the proposed preferred option satisfies the <i>regulatory investment test for distribution</i>; (v) if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent | 6.2 and 12 |
| (12) contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the final report may be directed. | 2.3 and 12.2 |

14. Definitions and Contractions

Words and phrases within this document should be read with the meaning given to them within the National Electricity Rules.

| Term | Meaning |
|-----------------|--|
| AEMC | Australian Energy Market Commission |
| AEMO | Australian Energy Market Operator |
| AER | Australian Energy Regulator |
| Base Case | The case considered most likely used as the reference case when considering alternative plausible market scenarios |
| CPI | Consumer Price Index |
| DAPR | Distribution Annual Planning Report |
| DM | Demand Management |
| DNSP | Distribution Network Service Provider |
| EDC | Electricity Distribution Code |
| ESCOSA | Essential Services Commission of South Australia |
| FPAR | Final Project Assessment Project |
| GST | Goods and Services Tax |
| Identified Need | The objective or purpose of a proposed network investment |
| KI | Kangaroo Island |
| KI31 | Kingscote 11kV feeder |
| KI32 | Brownlow 11kV feeder |
| KI57 | Emu Bay 19kV SWER feeder |
| LLF | Loss Load Factor |
| NEM | National Electricity Market |
| NER | National Electricity Rules |
| NNOR | Non-Network Options Report |
| NPV | Net Present Value |
| O&M | Operating and Maintenance |
| PoE | Probability of Exceedance. The probability that, in any one year, peak demand will exceed the forecast value. For instance demand is expected to exceed a 50% PoE forecast, 1 year in 2. |
| PV | Photovoltaic |
| QOS | Quality of Supply |
| RCA | Reliability Corrective Action |
| RIT-D | Regulatory Investment Test – Distribution |
| Rules | National Electricity Rules (NER) |
| SAIDI | System Average Interruption Duration Index |
| STPIS | Service Target Performance Incentive Scheme |
| SWER | Single Wire Earth Return |
| TNSP | Transmission Network Service Provider |
| Q & A | Question and Answer |
| VCR | Value of Customer Reliability |
| WACC | Weighted Average Cost of Capital |

15. Attachment 1 – Raw Sensitivity Analysis Results

Evaluation Study Results - Standard growth (\$'000's)

| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|--------------|---------|------|--------------------|-------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Default | 1 | 1 | \$23,892.42 | \$25,618.22 | -\$16,616.08 | \$7,276.34 | \$23,383.32 | \$1,964.36 | \$270.53 | \$0.00 | \$20,163.72 |
| Default | 2 | 7 | \$0.00 | \$42,234.30 | \$0.00 | \$0.00 | \$15,500.12 | \$26,463.64 | \$270.53 | \$7,276.34 | \$20,163.72 |
| Default | 3 | 5 | \$11,825.49 | \$35,262.68 | -\$6,971.62 | \$4,853.87 | \$22,670.83 | \$12,321.32 | \$270.53 | \$2,422.47 | \$20,163.72 |
| Default | 4 | 4 | \$14,091.36 | \$32,996.81 | -\$9,237.49 | \$4,853.87 | \$24,087.12 | \$8,639.16 | \$270.53 | \$2,422.47 | \$20,163.72 |
| Default | 5 | 3 | \$14,362.27 | \$33,325.65 | -\$8,908.64 | \$5,453.62 | \$6,600.12 | \$1,341.14 | \$25,384.40 | \$6,654.57 | \$15,331.87 |
| Default | 6 | 8 | -\$45,366.91 | \$99,858.00 | \$57,623.70 | \$12,256.79 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,183.27 |
| Default | 7 | 6 | \$7,269.46 | \$42,241.18 | \$6.88 | \$7,276.34 | \$7,400.07 | \$1,492.85 | \$33,348.25 | \$0.00 | \$20,163.72 |
| Default | 8 | 2 | \$22,115.31 | \$27,395.33 | -\$14,838.97 | \$7,276.34 | \$25,054.66 | \$2,070.14 | \$270.53 | \$0.00 | \$20,163.72 |
| | | | | | | | | | | | |
| Low Discount | 1 | 1 | \$30,062.95 | \$25,578.71 | -\$20,785.57 | \$9,277.38 | \$22,841.90 | \$2,407.50 | \$329.31 | \$0.00 | \$24,376.21 |
| Low Discount | 2 | 7 | \$0.00 | \$46,364.28 | \$0.00 | \$0.00 | \$16,080.76 | \$29,954.21 | \$329.31 | \$9,277.38 | \$24,376.21 |
| Low Discount | 3 | 4 | \$15,343.77 | \$37,208.74 | -\$9,155.54 | \$6,188.24 | \$22,807.71 | \$14,071.73 | \$329.31 | \$3,089.14 | \$24,376.21 |
| Low Discount | 4 | 3 | \$18,315.52 | \$34,236.99 | -\$12,127.29 | \$6,188.24 | \$23,923.07 | \$9,984.62 | \$329.31 | \$3,089.14 | \$24,376.21 |
| Low Discount | 5 | 5 | \$14,093.03 | \$38,979.74 | -\$7,384.54 | \$6,708.49 | \$6,222.59 | \$1,645.05 | \$31,112.10 | \$8,624.13 | \$18,320.97 |

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| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|---------------|---------|------|--------------------|--------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Low Discount | 6 | 8 | -\$59,575.43 | \$121,454.19 | \$75,089.91 | \$15,514.48 | \$7,649.30 | \$2,022.61 | \$111,782.29 | \$0.00 | \$18,139.11 |
| Low Discount | 7 | 6 | \$5,942.83 | \$49,698.83 | \$3,334.55 | \$9,277.38 | \$7,075.04 | \$1,853.30 | \$40,770.48 | \$0.00 | \$24,376.21 |
| Low Discount | 8 | 2 | \$28,293.05 | \$27,348.61 | -\$19,015.67 | \$9,277.38 | \$24,482.58 | \$2,536.72 | \$329.31 | \$0.00 | \$24,376.21 |
| High Discount | 1 | 1 | \$18,865.55 | \$25,462.35 | -\$13,049.36 | \$5,816.19 | \$23,601.93 | \$1,633.46 | \$226.96 | \$0.00 | \$17,028.35 |
| High Discount | 2 | 7 | \$0.00 | \$38,511.70 | \$0.00 | \$0.00 | \$14,652.18 | \$23,632.57 | \$226.96 | \$5,816.19 | \$17,028.35 |
| High Discount | 3 | 5 | \$9,143.33 | \$33,248.52 | -\$5,263.18 | \$3,880.15 | \$22,100.10 | \$10,921.47 | \$226.96 | \$1,936.04 | \$17,028.35 |
| High Discount | 4 | 4 | \$10,774.65 | \$31,617.20 | -\$6,894.50 | \$3,880.15 | \$23,811.57 | \$7,578.68 | \$226.96 | \$1,936.04 | \$17,028.35 |
| High Discount | 5 | 3 | \$14,043.71 | \$29,002.60 | -\$9,509.11 | \$4,534.60 | \$6,787.30 | \$1,112.98 | \$21,102.31 | \$5,225.93 | \$13,084.01 |
| High Discount | 6 | 8 | -\$35,245.31 | \$83,641.55 | \$45,129.85 | \$9,884.54 | \$8,344.48 | \$1,368.43 | \$73,928.65 | \$0.00 | \$12,960.00 |
| High Discount | 7 | 6 | \$7,819.98 | \$36,507.92 | -\$2,003.78 | \$5,816.19 | \$7,508.90 | \$1,224.48 | \$27,774.54 | \$0.00 | \$17,028.35 |
| High Discount | 8 | 2 | \$17,094.83 | \$27,233.07 | -\$11,278.64 | \$5,816.19 | \$25,284.48 | \$1,721.63 | \$226.96 | \$0.00 | \$17,028.35 |
| | | | | | | | | | | | |
| Low Losses | 1 | 1 | \$23,892.42 | \$25,618.22 | -\$16,616.08 | \$7,276.34 | \$23,383.32 | \$1,964.36 | \$270.53 | \$0.00 | \$15,086.01 |
| Low Losses | 2 | 7 | \$0.00 | \$42,234.30 | \$0.00 | \$0.00 | \$15,500.12 | \$26,463.64 | \$270.53 | \$7,276.34 | \$15,086.01 |
| Low Losses | 3 | 5 | \$11,825.49 | \$35,262.68 | -\$6,971.62 | \$4,853.87 | \$22,670.83 | \$12,321.32 | \$270.53 | \$2,422.47 | \$15,086.01 |
| Low Losses | 4 | 3 | \$14,091.36 | \$32,996.81 | -\$9,237.49 | \$4,853.87 | \$24,087.12 | \$8,639.16 | \$270.53 | \$2,422.47 | \$15,086.01 |

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| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|-------------|---------|------|--------------------|-------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Low Losses | 5 | 4 | \$13,145.49 | \$33,325.65 | -\$8,908.64 | \$4,236.85 | \$6,600.12 | \$1,341.14 | \$25,384.40 | \$6,654.57 | \$11,470.94 |
| Low Losses | 6 | 8 | -\$46,621.11 | \$99,858.00 | \$57,623.70 | \$11,002.60 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$11,359.75 |
| Low Losses | 7 | 6 | \$7,269.46 | \$42,241.18 | \$6.88 | \$7,276.34 | \$7,400.07 | \$1,492.85 | \$33,348.25 | \$0.00 | \$15,086.01 |
| Low Losses | 8 | 2 | \$22,115.31 | \$27,395.33 | -\$14,838.97 | \$7,276.34 | \$25,054.66 | \$2,070.14 | \$270.53 | \$0.00 | \$15,086.01 |
| High Losses | 1 | 1 | \$23,892.42 | \$25,618.22 | -\$16,616.08 | \$7,276.34 | \$23,383.32 | \$1,964.36 | \$270.53 | \$0.00 | \$30,245.59 |
| High Losses | 2 | 7 | \$0.00 | \$42,234.30 | \$0.00 | \$0.00 | \$15,500.12 | \$26,463.64 | \$270.53 | \$7,276.34 | \$30,245.59 |
| High Losses | 3 | 5 | \$11,825.49 | \$35,262.68 | -\$6,971.62 | \$4,853.87 | \$22,670.83 | \$12,321.32 | \$270.53 | \$2,422.47 | \$30,245.59 |
| High Losses | 4 | 4 | \$14,091.36 | \$32,996.81 | -\$9,237.49 | \$4,853.87 | \$24,087.12 | \$8,639.16 | \$270.53 | \$2,422.47 | \$30,245.59 |
| High Losses | 5 | 3 | \$16,778.19 | \$33,325.65 | -\$8,908.64 | \$7,869.55 | \$6,600.12 | \$1,341.14 | \$25,384.40 | \$6,654.57 | \$22,997.81 |
| High Losses | 6 | 8 | -\$42,876.68 | \$99,858.00 | \$57,623.70 | \$14,747.02 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$22,774.90 |
| High Losses | 7 | 6 | \$7,269.46 | \$42,241.18 | \$6.88 | \$7,276.34 | \$7,400.07 | \$1,492.85 | \$33,348.25 | \$0.00 | \$30,245.59 |
| High Losses | 8 | 2 | \$22,115.31 | \$27,395.33 | -\$14,838.97 | \$7,276.34 | \$25,054.66 | \$2,070.14 | \$270.53 | \$0.00 | \$30,245.59 |
| | | | | | | | | | | | |
| Low VCR | 1 | 1 | \$21,709.52 | \$25,618.22 | -\$16,616.08 | \$5,093.44 | \$23,383.32 | \$1,964.36 | \$270.53 | \$0.00 | \$20,163.72 |
| Low VCR | 2 | 7 | \$0.00 | \$42,234.30 | \$0.00 | \$0.00 | \$15,500.12 | \$26,463.64 | \$270.53 | \$5,093.44 | \$20,163.72 |
| Low VCR | 3 | 5 | \$10,369.33 | \$35,262.68 | -\$6,971.62 | \$3,397.71 | \$22,670.83 | \$12,321.32 | \$270.53 | \$1,695.73 | \$20,163.72 |

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| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|-------------------|---------|------|--------------------|-------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Low VCR | 4 | 4 | \$12,635.20 | \$32,996.81 | -\$9,237.49 | \$3,397.71 | \$24,087.12 | \$8,639.16 | \$270.53 | \$1,695.73 | \$20,163.72 |
| Low VCR | 5 | 3 | \$14,134.93 | \$33,325.65 | -\$8,908.64 | \$5,226.28 | \$6,600.12 | \$1,341.14 | \$25,384.40 | \$4,699.00 | \$15,331.87 |
| Low VCR | 6 | 8 | -\$47,549.81 | \$99,858.00 | \$57,623.70 | \$10,073.89 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,183.27 |
| Low VCR | 7 | 6 | \$5,086.56 | \$42,241.18 | \$6.88 | \$5,093.44 | \$7,400.07 | \$1,492.85 | \$33,348.25 | \$0.00 | \$20,163.72 |
| Low VCR | 8 | 2 | \$19,932.40 | \$27,395.33 | -\$14,838.97 | \$5,093.44 | \$25,054.66 | \$2,070.14 | \$270.53 | \$0.00 | \$20,163.72 |
| High VCR | 1 | 1 | \$26,075.32 | \$25,618.22 | -\$16,616.08 | \$9,459.24 | \$23,383.32 | \$1,964.36 | \$270.53 | \$0.00 | \$20,163.72 |
| High VCR | 2 | 7 | \$0.00 | \$42,234.30 | \$0.00 | \$0.00 | \$15,500.12 | \$26,463.64 | \$270.53 | \$9,459.24 | \$20,163.72 |
| High VCR | 3 | 5 | \$13,281.65 | \$35,262.68 | -\$6,971.62 | \$6,310.03 | \$22,670.83 | \$12,321.32 | \$270.53 | \$3,149.21 | \$20,163.72 |
| High VCR | 4 | 3 | \$15,547.52 | \$32,996.81 | -\$9,237.49 | \$6,310.03 | \$24,087.12 | \$8,639.16 | \$270.53 | \$3,149.21 | \$20,163.72 |
| High VCR | 5 | 4 | \$14,589.61 | \$33,325.65 | -\$8,908.64 | \$5,680.96 | \$6,600.12 | \$1,341.14 | \$25,384.40 | \$8,610.13 | \$15,331.87 |
| High VCR | 6 | 8 | -\$43,184.00 | \$99,858.00 | \$57,623.70 | \$14,439.70 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,183.27 |
| High VCR | 7 | 6 | \$9,452.36 | \$42,241.18 | \$6.88 | \$9,459.24 | \$7,400.07 | \$1,492.85 | \$33,348.25 | \$0.00 | \$20,163.72 |
| High VCR | 8 | 2 | \$24,298.21 | \$27,395.33 | -\$14,838.97 | \$9,459.24 | \$25,054.66 | \$2,070.14 | \$270.53 | \$0.00 | \$20,163.72 |
| | | | | | | | | | | | |
| Low Distr Capital | 1 | 1 | \$23,907.71 | \$24,746.57 | -\$16,631.37 | \$7,276.34 | \$22,511.67 | \$1,964.36 | \$270.53 | \$0.00 | \$20,163.72 |
| Low Distr Capital | 2 | 7 | \$0.00 | \$41,377.94 | \$0.00 | \$0.00 | \$14,773.88 | \$26,333.53 | \$270.53 | \$7,276.34 | \$20,163.72 |

Final Project Assessment Report – Kangaroo Island Submarine Cable

| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|--------------------|---------|------|--------------------|--------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Low Distr Capital | 3 | 5 | \$13,194.64 | \$33,037.16 | -\$8,340.77 | \$4,853.87 | \$20,445.31 | \$12,321.32 | \$270.53 | \$2,422.47 | \$20,163.72 |
| Low Distr Capital | 4 | 3 | \$15,464.59 | \$30,767.21 | -\$10,610.72 | \$4,853.87 | \$21,857.52 | \$8,639.16 | \$270.53 | \$2,422.47 | \$20,163.72 |
| Low Distr Capital | 5 | 4 | \$15,155.93 | \$31,675.62 | -\$9,702.31 | \$5,453.62 | \$4,950.09 | \$1,341.14 | \$25,384.40 | \$6,654.57 | \$15,331.87 |
| Low Distr Capital | 6 | 8 | -\$44,194.77 | \$97,829.50 | \$56,451.56 | \$12,256.79 | \$6,085.50 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,183.27 |
| Low Distr Capital | 7 | 6 | \$8,263.12 | \$40,391.16 | -\$986.78 | \$7,276.34 | \$5,550.06 | \$1,492.85 | \$33,348.25 | \$0.00 | \$20,163.72 |
| Low Distr Capital | 8 | 2 | \$22,130.60 | \$26,523.68 | -\$14,854.26 | \$7,276.34 | \$24,183.00 | \$2,070.14 | \$270.53 | \$0.00 | \$20,163.72 |
| High Distr Capital | 1 | 1 | \$23,872.23 | \$26,768.80 | -\$16,595.89 | \$7,276.34 | \$24,533.90 | \$1,964.36 | \$270.53 | \$0.00 | \$20,163.72 |
| High Distr Capital | 2 | 7 | \$0.00 | \$43,364.69 | \$0.00 | \$0.00 | \$16,458.77 | \$26,635.39 | \$270.53 | \$7,276.34 | \$20,163.72 |
| High Distr Capital | 3 | 5 | \$10,018.20 | \$38,200.36 | -\$5,164.33 | \$4,853.87 | \$25,608.51 | \$12,321.32 | \$270.53 | \$2,422.47 | \$20,163.72 |
| High Distr Capital | 4 | 4 | \$12,278.69 | \$35,939.88 | -\$7,424.82 | \$4,853.87 | \$27,030.19 | \$8,639.16 | \$270.53 | \$2,422.47 | \$20,163.72 |
| High Distr Capital | 5 | 3 | \$13,314.62 | \$35,503.69 | -\$7,861.00 | \$5,453.62 | \$8,778.16 | \$1,341.14 | \$25,384.40 | \$6,654.57 | \$15,331.87 |
| High Distr Capital | 6 | 8 | -\$46,914.13 | \$102,535.62 | \$59,170.93 | \$12,256.79 | \$10,791.62 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,183.27 |
| High Distr Capital | 7 | 6 | \$5,957.83 | \$44,683.20 | \$1,318.51 | \$7,276.34 | \$9,842.10 | \$1,492.85 | \$33,348.25 | \$0.00 | \$20,163.72 |
| High Distr Capital | 8 | 2 | \$22,095.12 | \$28,545.91 | -\$14,818.78 | \$7,276.34 | \$26,205.24 | \$2,070.14 | \$270.53 | \$0.00 | \$20,163.72 |

Final Project Assessment Report – Kangaroo Island Submarine Cable

Evaluation Study Results - Flat growth (\$'000's)

| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|--------------|---------|------|--------------------|-------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Default | 1 | 1 | \$20,431.59 | \$25,088.51 | -\$14,645.37 | \$5,786.22 | \$22,975.54 | \$1,886.45 | \$226.51 | \$0.00 | \$18,326.25 |
| Default | 2 | 7 | \$0.00 | \$39,733.87 | \$0.00 | \$0.00 | \$14,536.70 | \$24,970.66 | \$226.51 | \$5,786.22 | \$18,326.25 |
| Default | 3 | 5 | \$9,961.77 | \$33,632.29 | -\$6,101.58 | \$3,860.18 | \$21,707.41 | \$11,698.37 | \$226.51 | \$1,926.04 | \$18,326.25 |
| Default | 4 | 3 | \$12,227.64 | \$31,366.42 | -\$8,367.46 | \$3,860.18 | \$23,123.69 | \$8,016.21 | \$226.51 | \$1,926.04 | \$18,326.25 |
| Default | 5 | 4 | \$10,454.71 | \$32,922.04 | -\$6,811.83 | \$3,642.87 | \$6,600.12 | \$1,341.14 | \$24,980.78 | \$5,192.34 | \$15,277.25 |
| Default | 6 | 8 | -\$51,175.98 | \$99,858.00 | \$60,124.12 | \$8,948.14 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,164.33 |
| Default | 7 | 6 | \$4,430.24 | \$41,089.85 | \$1,355.98 | \$5,786.22 | \$6,436.65 | \$1,304.96 | \$33,348.25 | \$0.00 | \$18,326.25 |
| Default | 8 | 2 | \$18,654.47 | \$26,865.62 | -\$12,868.26 | \$5,786.22 | \$24,646.88 | \$1,992.23 | \$226.51 | \$0.00 | \$18,326.25 |
| Low Discount | 1 | 1 | \$25,804.41 | \$24,972.13 | -\$18,543.78 | \$7,260.63 | \$22,403.02 | \$2,298.53 | \$270.58 | \$0.00 | \$21,891.17 |
| Low Discount | 2 | 7 | \$0.00 | \$43,515.91 | \$0.00 | \$0.00 | \$15,083.46 | \$28,161.87 | \$270.58 | \$7,260.63 | \$21,891.17 |
| Low Discount | 3 | 4 | \$12,972.60 | \$35,386.72 | -\$8,129.18 | \$4,843.41 | \$21,810.41 | \$13,305.74 | \$270.58 | \$2,417.21 | \$21,891.17 |
| Low Discount | 4 | 3 | \$15,944.35 | \$32,414.97 | -\$11,100.94 | \$4,843.41 | \$22,925.77 | \$9,218.63 | \$270.58 | \$2,417.21 | \$21,891.17 |
| Low Discount | 5 | 5 | \$9,408.18 | \$38,376.33 | -\$5,139.58 | \$4,268.61 | \$6,222.59 | \$1,645.05 | \$30,508.69 | \$6,634.12 | \$18,249.07 |

Final Project Assessment Report – Kangaroo Island Submarine Cable

| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|---------------|---------|------|--------------------|--------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Low Discount | 6 | 8 | -\$66,900.66 | \$121,454.19 | \$77,938.29 | \$11,037.62 | \$7,649.30 | \$2,022.61 | \$111,782.29 | \$0.00 | \$18,114.18 |
| Low Discount | 7 | 6 | \$2,327.65 | \$48,448.89 | \$4,932.98 | \$7,260.63 | \$6,077.74 | \$1,600.67 | \$40,770.48 | \$0.00 | \$21,891.17 |
| Low Discount | 8 | 2 | \$24,034.51 | \$26,742.02 | -\$16,773.88 | \$7,260.63 | \$24,043.70 | \$2,427.75 | \$270.58 | \$0.00 | \$21,891.17 |
| High Discount | 1 | 1 | \$16,015.63 | \$25,006.79 | -\$11,318.64 | \$4,696.99 | \$23,236.63 | \$1,576.80 | \$193.37 | \$0.00 | \$15,644.58 |
| High Discount | 2 | 7 | \$0.00 | \$36,325.43 | \$0.00 | \$0.00 | \$13,756.79 | \$22,375.27 | \$193.37 | \$4,696.99 | \$15,644.58 |
| High Discount | 3 | 5 | \$7,653.04 | \$31,806.17 | -\$4,519.26 | \$3,133.78 | \$21,204.71 | \$10,408.09 | \$193.37 | \$1,563.20 | \$15,644.58 |
| High Discount | 4 | 4 | \$9,284.36 | \$30,174.85 | -\$6,150.58 | \$3,133.78 | \$22,916.18 | \$7,065.30 | \$193.37 | \$1,563.20 | \$15,644.58 |
| High Discount | 5 | 3 | \$10,761.29 | \$28,729.68 | -\$7,595.75 | \$3,165.53 | \$6,787.30 | \$1,112.98 | \$20,829.39 | \$4,134.30 | \$13,041.74 |
| High Discount | 6 | 8 | -\$39,919.89 | \$83,641.55 | \$47,316.12 | \$7,396.23 | \$8,344.48 | \$1,368.43 | \$73,928.65 | \$0.00 | \$12,945.34 |
| High Discount | 7 | 6 | \$5,551.41 | \$35,471.01 | -\$854.42 | \$4,696.99 | \$6,613.52 | \$1,082.95 | \$27,774.54 | \$0.00 | \$15,644.58 |
| High Discount | 8 | 2 | \$14,244.91 | \$26,777.51 | -\$9,547.92 | \$4,696.99 | \$24,919.18 | \$1,664.97 | \$193.37 | \$0.00 | \$15,644.58 |
| | | | | | | | | | | | |
| Low Losses | 1 | 1 | \$20,431.59 | \$25,088.51 | -\$14,645.37 | \$5,786.22 | \$22,975.54 | \$1,886.45 | \$226.51 | \$0.00 | \$13,711.26 |
| Low Losses | 2 | 7 | \$0.00 | \$39,733.87 | \$0.00 | \$0.00 | \$14,536.70 | \$24,970.66 | \$226.51 | \$5,786.22 | \$13,711.26 |
| Low Losses | 3 | 4 | \$9,961.77 | \$33,632.29 | -\$6,101.58 | \$3,860.18 | \$21,707.41 | \$11,698.37 | \$226.51 | \$1,926.04 | \$13,711.26 |
| Low Losses | 4 | 3 | \$12,227.64 | \$31,366.42 | -\$8,367.46 | \$3,860.18 | \$23,123.69 | \$8,016.21 | \$226.51 | \$1,926.04 | \$13,711.26 |

Final Project Assessment Report – Kangaroo Island Submarine Cable

| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|-------------|---------|------|--------------------|-------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Low Losses | 5 | 5 | \$9,686.89 | \$32,922.04 | -\$6,811.83 | \$2,875.06 | \$6,600.12 | \$1,341.14 | \$24,980.78 | \$5,192.34 | \$11,430.07 |
| Low Losses | 6 | 8 | -\$51,972.23 | \$99,858.00 | \$60,124.12 | \$8,151.89 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$11,345.58 |
| Low Losses | 7 | 6 | \$4,430.24 | \$41,089.85 | \$1,355.98 | \$5,786.22 | \$6,436.65 | \$1,304.96 | \$33,348.25 | \$0.00 | \$13,711.26 |
| Low Losses | 8 | 2 | \$18,654.47 | \$26,865.62 | -\$12,868.26 | \$5,786.22 | \$24,646.88 | \$1,992.23 | \$226.51 | \$0.00 | \$13,711.26 |
| High Losses | 1 | 1 | \$20,431.59 | \$25,088.51 | -\$14,645.37 | \$5,786.22 | \$22,975.54 | \$1,886.45 | \$226.51 | \$0.00 | \$27,489.38 |
| High Losses | 2 | 7 | \$0.00 | \$39,733.87 | \$0.00 | \$0.00 | \$14,536.70 | \$24,970.66 | \$226.51 | \$5,786.22 | \$27,489.38 |
| High Losses | 3 | 5 | \$9,961.77 | \$33,632.29 | -\$6,101.58 | \$3,860.18 | \$21,707.41 | \$11,698.37 | \$226.51 | \$1,926.04 | \$27,489.38 |
| High Losses | 4 | 3 | \$12,227.64 | \$31,366.42 | -\$8,367.46 | \$3,860.18 | \$23,123.69 | \$8,016.21 | \$226.51 | \$1,926.04 | \$27,489.38 |
| High Losses | 5 | 4 | \$11,979.20 | \$32,922.04 | -\$6,811.83 | \$5,167.37 | \$6,600.12 | \$1,341.14 | \$24,980.78 | \$5,192.34 | \$22,915.88 |
| High Losses | 6 | 8 | -\$49,595.02 | \$99,858.00 | \$60,124.12 | \$10,529.10 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$22,746.49 |
| High Losses | 7 | 6 | \$4,430.24 | \$41,089.85 | \$1,355.98 | \$5,786.22 | \$6,436.65 | \$1,304.96 | \$33,348.25 | \$0.00 | \$27,489.38 |
| High Losses | 8 | 2 | \$18,654.47 | \$26,865.62 | -\$12,868.26 | \$5,786.22 | \$24,646.88 | \$1,992.23 | \$226.51 | \$0.00 | \$27,489.38 |
| | | | | | | | | | | | |
| Low VCR | 1 | 1 | \$18,695.72 | \$25,088.51 | -\$14,645.37 | \$4,050.35 | \$22,975.54 | \$1,886.45 | \$226.51 | \$0.00 | \$18,326.25 |
| Low VCR | 2 | 7 | \$0.00 | \$39,733.87 | \$0.00 | \$0.00 | \$14,536.70 | \$24,970.66 | \$226.51 | \$4,050.35 | \$18,326.25 |
| Low VCR | 3 | 5 | \$8,803.71 | \$33,632.29 | -\$6,101.58 | \$2,702.13 | \$21,707.41 | \$11,698.37 | \$226.51 | \$1,348.23 | \$18,326.25 |

Final Project Assessment Report – Kangaroo Island Submarine Cable

| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|-------------------|---------|------|--------------------|-------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Low VCR | 4 | 3 | \$11,069.58 | \$31,366.42 | -\$8,367.46 | \$2,702.13 | \$23,123.69 | \$8,016.21 | \$226.51 | \$1,348.23 | \$18,326.25 |
| Low VCR | 5 | 4 | \$10,244.55 | \$32,922.04 | -\$6,811.83 | \$3,432.71 | \$6,600.12 | \$1,341.14 | \$24,980.78 | \$3,666.64 | \$15,277.25 |
| Low VCR | 6 | 8 | -\$52,911.85 | \$99,858.00 | \$60,124.12 | \$7,212.28 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,164.33 |
| Low VCR | 7 | 6 | \$2,694.37 | \$41,089.85 | \$1,355.98 | \$4,050.35 | \$6,436.65 | \$1,304.96 | \$33,348.25 | \$0.00 | \$18,326.25 |
| Low VCR | 8 | 2 | \$16,918.61 | \$26,865.62 | -\$12,868.26 | \$4,050.35 | \$24,646.88 | \$1,992.23 | \$226.51 | \$0.00 | \$18,326.25 |
| High VCR | 1 | 1 | \$22,167.45 | \$25,088.51 | -\$14,645.37 | \$7,522.08 | \$22,975.54 | \$1,886.45 | \$226.51 | \$0.00 | \$18,326.25 |
| High VCR | 2 | 7 | \$0.00 | \$39,733.87 | \$0.00 | \$0.00 | \$14,536.70 | \$24,970.66 | \$226.51 | \$7,522.08 | \$18,326.25 |
| High VCR | 3 | 4 | \$11,119.82 | \$33,632.29 | -\$6,101.58 | \$5,018.24 | \$21,707.41 | \$11,698.37 | \$226.51 | \$2,503.85 | \$18,326.25 |
| High VCR | 4 | 3 | \$13,385.69 | \$31,366.42 | -\$8,367.46 | \$5,018.24 | \$23,123.69 | \$8,016.21 | \$226.51 | \$2,503.85 | \$18,326.25 |
| High VCR | 5 | 5 | \$10,664.86 | \$32,922.04 | -\$6,811.83 | \$3,853.03 | \$6,600.12 | \$1,341.14 | \$24,980.78 | \$6,718.05 | \$15,277.25 |
| High VCR | 6 | 8 | -\$49,440.12 | \$99,858.00 | \$60,124.12 | \$10,684.01 | \$8,114.00 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,164.33 |
| High VCR | 7 | 6 | \$6,166.10 | \$41,089.85 | \$1,355.98 | \$7,522.08 | \$6,436.65 | \$1,304.96 | \$33,348.25 | \$0.00 | \$18,326.25 |
| High VCR | 8 | 2 | \$20,390.34 | \$26,865.62 | -\$12,868.26 | \$7,522.08 | \$24,646.88 | \$1,992.23 | \$226.51 | \$0.00 | \$18,326.25 |
| | | | | | | | | | | | |
| Low Distr Capital | 1 | 1 | \$20,628.22 | \$24,318.80 | -\$14,842.00 | \$5,786.22 | \$22,205.83 | \$1,886.45 | \$226.51 | \$0.00 | \$18,326.25 |
| Low Distr Capital | 2 | 7 | \$0.00 | \$39,160.80 | \$0.00 | \$0.00 | \$14,051.31 | \$24,882.98 | \$226.51 | \$5,786.22 | \$18,326.25 |

Final Project Assessment Report – Kangaroo Island Submarine Cable

| Variation | Options | Rank | Net Market Benefit | Total Cost | Relative Cost | Relative Market Benefit | Capital Costs | O&M | External Gen | VCR | Losses |
|--------------------|---------|------|--------------------|--------------|---------------|-------------------------|---------------|-------------|--------------|------------|-------------|
| Low Distr Capital | 3 | 5 | \$11,373.35 | \$31,647.63 | -\$7,513.17 | \$3,860.18 | \$19,722.75 | \$11,698.37 | \$226.51 | \$1,926.04 | \$18,326.25 |
| Low Distr Capital | 4 | 3 | \$13,643.30 | \$29,377.68 | -\$9,783.12 | \$3,860.18 | \$21,134.95 | \$8,016.21 | \$226.51 | \$1,926.04 | \$18,326.25 |
| Low Distr Capital | 5 | 4 | \$11,531.66 | \$31,272.01 | -\$7,888.78 | \$3,642.87 | \$4,950.09 | \$1,341.14 | \$24,980.78 | \$5,192.34 | \$15,277.25 |
| Low Distr Capital | 6 | 8 | -\$49,720.56 | \$97,829.50 | \$58,668.70 | \$8,948.14 | \$6,085.50 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,164.33 |
| Low Distr Capital | 7 | 6 | \$5,466.32 | \$39,480.69 | \$319.89 | \$5,786.22 | \$4,827.49 | \$1,304.96 | \$33,348.25 | \$0.00 | \$18,326.25 |
| Low Distr Capital | 8 | 2 | \$18,851.10 | \$26,095.91 | -\$13,064.88 | \$5,786.22 | \$23,877.17 | \$1,992.23 | \$226.51 | \$0.00 | \$18,326.25 |
| High Distr Capital | 1 | 1 | \$20,172.04 | \$26,104.52 | -\$14,385.82 | \$5,786.22 | \$23,991.55 | \$1,886.45 | \$226.51 | \$0.00 | \$18,326.25 |
| High Distr Capital | 2 | 7 | \$0.00 | \$40,490.34 | \$0.00 | \$0.00 | \$15,177.42 | \$25,086.40 | \$226.51 | \$5,786.22 | \$18,326.25 |
| High Distr Capital | 3 | 5 | \$8,098.48 | \$36,252.04 | -\$4,238.29 | \$3,860.18 | \$24,327.16 | \$11,698.37 | \$226.51 | \$1,926.04 | \$18,326.25 |
| High Distr Capital | 4 | 3 | \$10,358.96 | \$33,991.56 | -\$6,498.78 | \$3,860.18 | \$25,748.83 | \$8,016.21 | \$226.51 | \$1,926.04 | \$18,326.25 |
| High Distr Capital | 5 | 4 | \$9,033.13 | \$35,100.08 | -\$5,390.26 | \$3,642.87 | \$8,778.16 | \$1,341.14 | \$24,980.78 | \$5,192.34 | \$15,277.25 |
| High Distr Capital | 6 | 8 | -\$53,097.14 | \$102,535.62 | \$62,045.28 | \$8,948.14 | \$10,791.62 | \$1,648.95 | \$90,095.05 | \$0.00 | \$15,164.33 |
| High Distr Capital | 7 | 6 | \$3,062.61 | \$43,213.95 | \$2,723.61 | \$5,786.22 | \$8,560.75 | \$1,304.96 | \$33,348.25 | \$0.00 | \$18,326.25 |
| High Distr Capital | 8 | 2 | \$18,394.92 | \$27,881.63 | -\$12,608.70 | \$5,786.22 | \$25,662.89 | \$1,992.23 | \$226.51 | \$0.00 | \$18,326.25 |

16. Attachment 2 –Submission Letters Received



Office of the Commissioner for Kangaroo Island

13 December 2016

SA Power Networks
ATT: Doug Schmidt – GM Network Management
GPO Box 77
ADELAIDE SA 5001
Via - requestforproposals@sapowernetworks.com.au

Dear Doug,

The Kangaroo Island (KI) Submarine Cable project is of vital importance to the KI community and we have been actively engaging the community on this very important project. Thank you for presenting the Draft Project Assessment Report (DPAR) to the community forum on December 5th and to responding to our written questions prior to the forum. Thank you also for ensuring that proponents of alternative projects were provided with a copy of the Statement of Community Expectations prepared by our Energy Security Focus Group.

The project is based on investing in energy security for the island before the current submarine cable fails. Overall, the KI community supports SA Power Networks' preferred and recommended solution – a new submarine cable in 2018. The community also welcomes the imminent commissioning of a fourth diesel generator at Kingscote substation¹.

Since the release of the Non-Network Options Report in April 2016, we have been approached by a number of proponents of alternative solutions and participated in a study by the Institute for Sustainable Futures (ISF) from the University of Technology Sydney entitled "Towards 100% Renewable Energy for Kangaroo Island". The ISF Project has been funded by the Australian Renewable Energy Agency (ARENA) and supported by the SA Government's Renewables SA. SA Power Networks participated in a community forum that presented the results of the study at the Ozone Kingscote on September 22nd 2016. Copies of the presentations are available from Council's website².

Our summary view is that the KI community is supportive of a new cable and in developing a renewable energy industry on the island. The alternate proposition – that of developing a renewable energy industry in lieu of a new cable – did not receive much sustained support.

In terms of the process, we have the following comments. The principal area of the recommendation that caused confusion for our stakeholders was the decision to favour a 33kV 19MVA cable instead of one able to be energised at 66kV (and thence 40MVA instead of 20MVA) as discussed in the Regulatory Proposal and Asset Management Plan. We note that the marginal cost of the 66kV option was not included in the DPAR but understand that it was in the order of \$1.5m.

¹ Advised in SAPN letter to Commissioner for KI and Mayor Clements dated 5 December 2016

² <http://kangarooisland.sa.gov.au/page.aspx?u=557&c=14488>

In light of community support for a renewable energy industry on the island (and abundance of resources such as solar, wind, ocean and biomass), we encourage you to include this option in the Final Project Assessment Report (FPAR) and to revisit the assessment of potential market benefits of this option.

We understand that a reason for selecting a lower capacity cable is continuing declines in forecast demand from AEMO. We recommend that this is elaborated on in the FPAR and that SA Power Networks consider that KI is likely to be 'off trend' in this regard with a number of local development projects underway following approval of funding to expand air access to the island. We have sent a copy of our latest Economic Outlook to you recently in support of this³.

We also note that you described the submarine cable on offer as part of Option 7 as being "private" and not necessarily available to transport electricity freely as is currently the case. It is unclear why this is necessarily the case and recommend this is elaborated on further in the FPAR.

An important attribute of a cable solution is the connectivity provided by the integral fibre-optic communications cables. Cost effective access to this capacity will be an important source of community support for the cable. We look forward to further discussions with SA Power Networks on this matter.

Finally, the community is seeking to understand the final total cost to consumers of the preferred option and how the Capital Expenditure Sharing Scheme (CESS) may apply in this case. It is understood that with the considerably lower capital expenditure to that included in the regulatory decision (by approximately \$10m), SA Power Networks could make a considerable financial gain. We recommend that the FPAR include the final cost to consumers (the proposed addition to the Regulatory Asset Base) and an explanation of how the incentives of the CESS work in the consumer interest.

We welcome SA Power Networks investment on Kangaroo Island and have appreciated the willingness to engage with the community on this very important project. We look forward to continuing this engagement during the final decisions, construction and thereafter.

Yours Sincerely



Wendy Campana
Commissioner for Kangaroo Island



Peter Clements
Mayor Kangaroo Island

CC: KI Energy Security Focus Group

³ http://kangarooislandcommissioner.sa.gov.au/publications_and_reports

Submission in response to SAPN Draft Project Assessment Report

Kangaroo Island Submarine Cable 2 November 2016

Prepared by South Australian Renewable Energy Policy Group (SAREPG), and Solar Citizens, SA Branch

SAREPG is made up of academics, former energy industry and public sector energy professionals with a continuing interest in promoting the application of renewable energy in South Australia. Solar Citizens is a national advocacy body representing the interests of individuals and organisations generating and using or seeking to make use of renewable energy.

Submission

The submarine cable supplying electricity to Kangaroo Island is close to the end of its design life. The purpose of the Draft Report is to compare several options to either replace the cable or to enable the Island to be supplied from generation sources on the Island.

The Draft Project Assessment Report Kangaroo Island Submarine Cable 2 November 2016 (p.20) indicates that SAPN's preferred network option is to install a new 33kV submarine cable from Fishery Beach to Cuttlefish Bay in 2018, and that the capital cost used is the average tender price from 6 turn-key contract tenders received in July 2016. This average cost quoted is \$21.9 million, and the report notes that the actual price is expected to reduce during contract negotiation.

SAPN report Asset Management Plan 2.1.03 Kangaroo Island - Network Security Second Undersea Cable 2015 TO 2035, published October 2014, recommended installation of a 66/33kV cable from Fishery Beach to Cuttlefish Bay in 2018 at a cost of \$ 47.5 million, this price was also based on cost estimates from potential providers.

The very large differences in the quoted price for the cable raise questions about how this could arise over such a short time-frame. Part of the answer to that may be that the 2014 quoted price was for a higher voltage 66kV cable, initially to be activated at 33kV. However that does *not* explain the size of the difference in the quotes, as large components of the cost of both options would arise in the cable's installation. An important contextual difference is that when the 2014 report was being prepared no alternative non-network solution was under consideration. In the recent past attractive alternatives have been proposed, under which Kangaroo Island would be supplied by renewable sources on the island itself.

The large change in the quotes for SAPN's preferred cable replacement option in such a short time raises questions about the validity of costs of infrastructure built or proposed by SAPN in general.

We believe that for AER to be able to retain its standing as an effective regulator in the public interest, and for SAPN to retain its public standing as an efficient operator in the South Australian regulated

energy market, it is essential that SAPN provide a substantive explanation for the change in the cable prices between the two reports. We realise that SAPN may say that they had no influence over the quotes, however this would leave the question of why the 2016 quote was so much lower than the 2014 quote unanswered. In the absence of any other explanation it appears most likely that when tendering the 2016 quotes the contractors were aware that they were competing with the Island-based renewables option, and were prepared to accept a much lower return than previously to secure the work. If this were in fact the case, it may suggest that had renewables been sought by SAPN as options in other proposals, lower tenders could have been achieved in those cases also. Regardless of the real explanation, it is clearly in the public interest for it to be ascertained.

Regards



John Rolls, Deputy Convenor, SAREPG, on behalf of:

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