# Essential Energy

## 10.03.07 Augex Cootamundra Line Upgrade Investment Case

**November 2022**

## Distribution Major Project

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|---|---|
| Project: | 10.03.07 Augex Cootamundra Line Upgrade Investment Case |
| Date: | Nov 2022 |
| Author: | [redacted] |
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### Approvals

| | Name | Division | Title & Function | Date |
|---|---|---|---|---|
| 1. | [redacted] | Assets & Operations | Manager Network Planning | 14/12/22 |
| 2. | | | | |

### Revisions

| Issue Number | Section | Details of Changes in this Revision |
|---|---|---|
| 1. | | Initial Issue |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |

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# 1. Executive Summary

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|---|---|
| **Major Project** | 10.03.07 Augex Cootamundra Line Upgrade Investment Case |
| **Description** | Increase the Design Temperature of the 66kV Line 836 from the Murrumburrah Transgrid Substation to Cootamundra. |
| **Drivers for Investment** | The driver of the investment is to reduce risk caused by the overloading of line 836 to meet NER 6.5.7 capital objectives. Cootamundra load is forecast to continue increasing into the future, which will increase the corporate risks each year.<br>Safety:<br>Overloading the 836 line causes the clearance to ground to fall below statutory clearance levels. Upgrading the line will minimise the risk of a member of the public contacting the line.<br>[redacted]<br>Bushfire<br>There is an increased chance of a bushfire being started when the line is overloaded by either the conductors clashing or being contacted due to low clearance.<br>[redacted]<br>Reputation<br>There is a risk of damage to reputation if a member of the public contacts the overloaded line or if the overload causes a bushfire.<br>[redacted]<br>Network risk: $1.9M over 40 year NPV |
| **Investment Options** | Several options were considered to reduce the risk of overload on the 836 line to Cootamundra<br>- Reconductoring and increasing the design rating of the line.<br>- Due to the financial cost of this project an Expression of Interest (EOI) for non-network solutions will be advertised prior to project initiation to enable the private sector to submit non-network options for evaluation.<br><br>The option recommended from the Net Present Value of cost and benefit is as follows:<br>- Increasing the design temperature of the line to 75 degC (NPV $2.6m) |

| **Estimated Expenditure $FY24** | 2024/25 | 2025/26 | 2026/27 | 2027/28 | 2028/29 |
|---|---|---|---|---|---|
| | [redacted] | $0 | $0 | $0 | $0 |

*Note: All values are in middle of the year 2023-24 real dollar terms*

## 2. Network

Normal supply to the Cootamundra 66/11kV Zone Substation is from the 66kV line 836 from Transgrid's 132/66kV Substation at Murrumburrah, with an alternate supply available from Junee. Bethungra is normally supplied at 66kV over the 823/5 line, which connects to the Cootamundra Zone Substation via a 66kV circuit breaker so faults on the 850 line do not interrupt the Cootamundra load. Alternate supply to Cootamundra and Bethungra is available from and open circuit breaker at the Junee Zone Substation, meaning supply can be remotely restored from Junee following the loss of the 836 line to Cootamundra. The normal supply to Cootamundra is shown in Figure 1 with the Alternate supply shown in Figure 2.

**Figure 1: Subtransmission Network supplying Cootamundra**

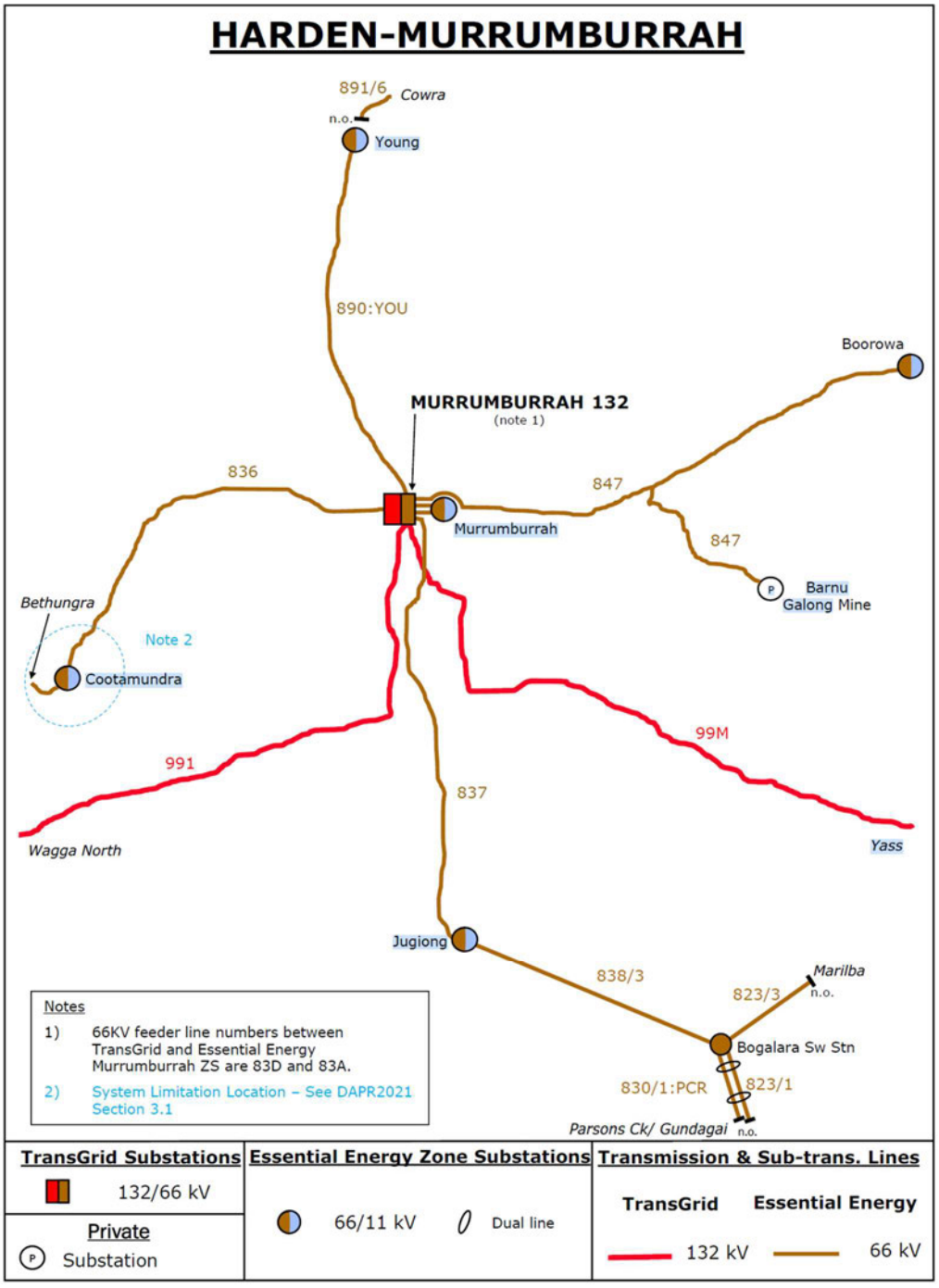
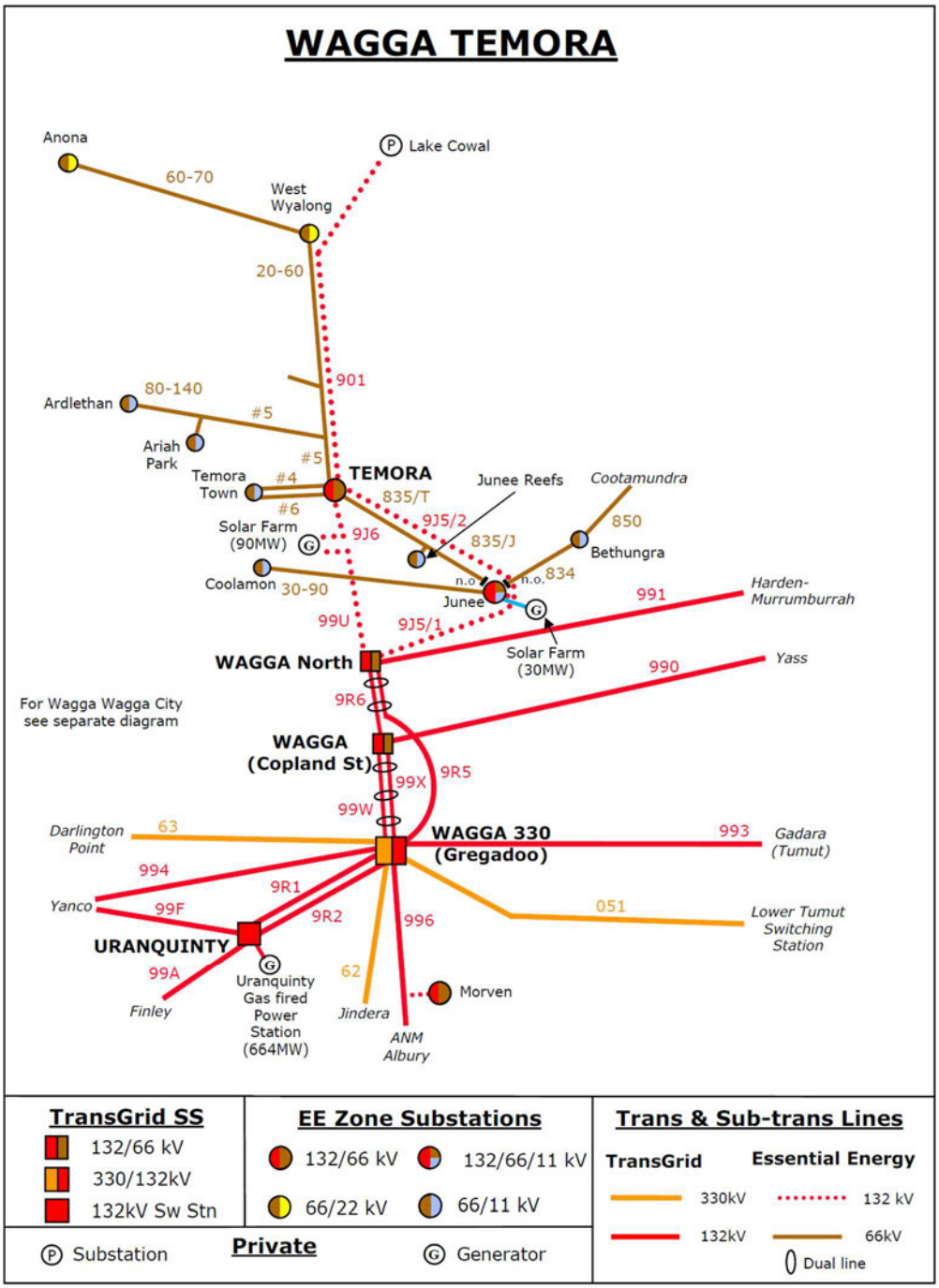


**Figure 2: Alternate Supply to Cootamundra and Bethungra**



The 836 line is 34km in length, constructed from 7/.104HDBC with a design temperature of 50degC and runs from Transgrid Murrumburrah 132/66kV substation over agricultural land to supply Cootamundra as shown in Figure 3.

**Figure 3: 836 line from Murrumburrah Transgrid Substation to Cootamundra Zone Substation**


## 3. Load Forecast

Peak summer and winter demand on the 66kV line 836 to Cootamundra is forecast to moderately increase over the next regulatory period. The forecast shown in **Table 1** combines the forecast by Frontier Economic **(Attachment 11.01)** with an additional 6.75MVA expected from an abattoir that is in the process of connecting.

**Table 1: Forecast Peak Demand – Line 836 (Cootamundra and Bethungra)**

| Financial Year | Summer (MVA) | Winter (MVA) |
|---|---|---|
| 2024 | 19.0 | 16.5 |
| 2025 | 19.3 | 16.7 |
| 2026 | 19.4 | 17.0 |
| 2027 | 19.5 | 17.3 |
| 2028 | 20.0 | 17.4 |
| 2029 | 19.9 | 17.5 |

An example summer load profile from 2020 is shown in **Figure 4** and 5 below.

**Figure 4: Line 836 Forecast Demand for 2024**

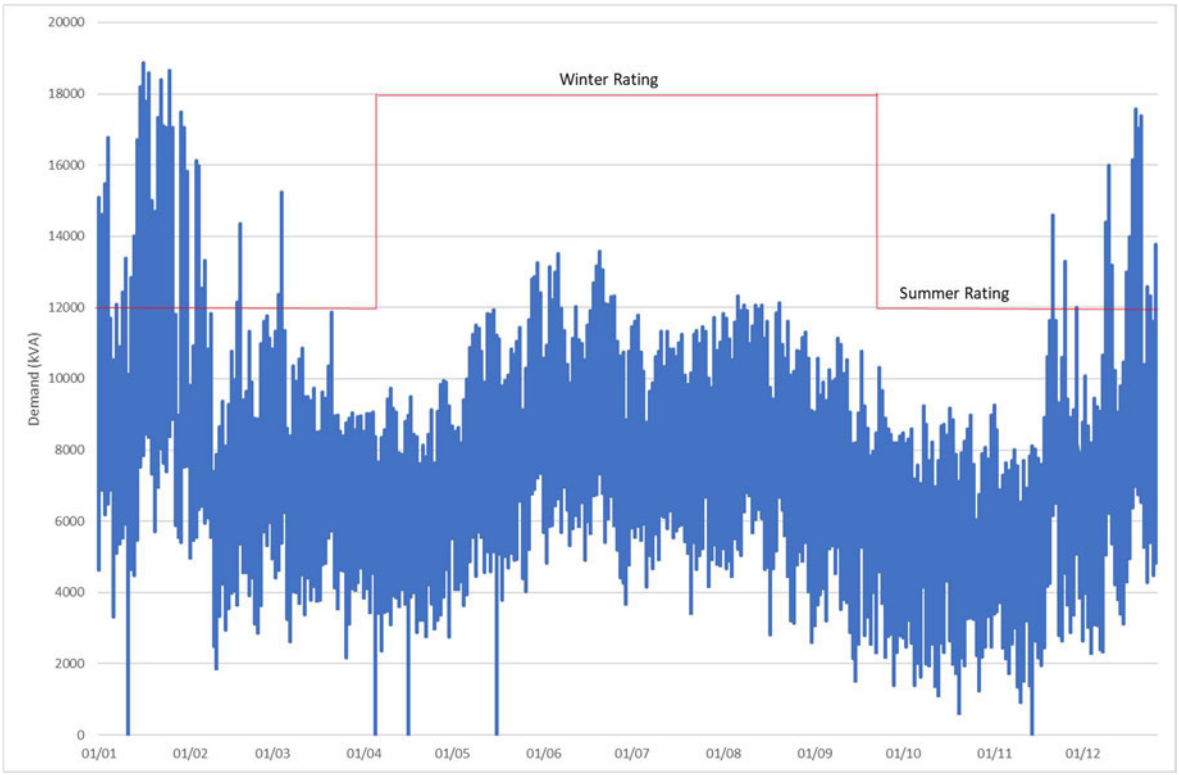
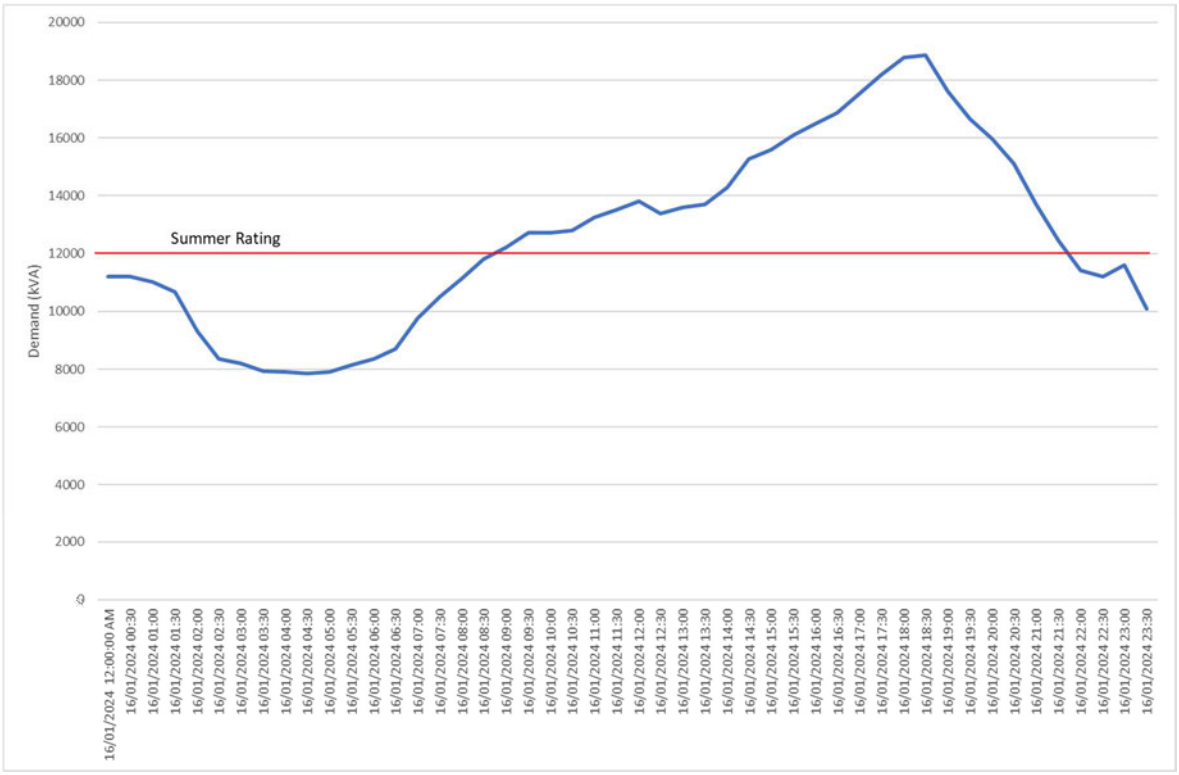



**Figure 5: Cootamundra and Bethungra Forecast Summer Demand Profile**



# 4. Identified Need

The 836 line has a summer thermal rating of 108A and winter thermal rating of 164A as shown in Table 2

**Table 2: Rating of 66kV Line 836**

| Summer Day Rating | Winter Day Rating |
|---|---|
| 108A / 12MVA | 164A / 18MVA |

From the demand forecast the peak load shown in Figure 4 corresponds to a normal summer for the 2024 load forecast. In this case demand exceeded the 12MVA summer thermal rating of the 836 line for 325 hours, with a peak exceedance of 5MVA. The line runs through a P2 bushfire risk area, giving a risk value of $29,000 in 2024.

Reliability data for the last 7 years shows the fault rate on the line is twice the average for 66kV, with the fault data showing that the aged 66kV copper breaking contributes roughly half the faults in this time period. For an outage on the 836 line there is the ability to remotely switch to the Junee supply, dramatically reducing outage times for faults on the 836 line. Based on the load and call out costs it is estimated that the increased failure rate caused by the condition of the 836 line from Murrumburrah to Cootamundra has a Net Present Cost of $1.9M with details provided in Appendix B – Value of Reliability from 66kV Line Faults

The identified need is a thermal constraint on the 66kV line 836. We need to alleviate the constraint in order to meet or manage the expected demand.

# 5. Options Analysis

Below are the feasible options that were considered to address the line rating issue.

## 5.1 Option 1 – Thermal Upgrade of line 836

Lifting the conductor on the Murrumburrah to Cootamundra 836 line to a 75 degC design profile would give the circuit a summer rating of 25MVA, alleviating the summer thermal constraint for the foreseeable future. This would reduce the risk of bushfire, safety and reputational impact to Essential Energy from low clearance and conductor clashing. This investment is planned to start in FY23, with [redacted] allowed in FY23 and [redacted] allowed in FY24.

**Option 1 has estimated capital cost of [redacted] giving a Net Present Value of $2.8M.**

## 5.2 Option 2 - Reconductor 66kV line 836

This option involves replacing the aged 7/.104 Cu conductor with 19/3.75AAAC and increasing the design temperature of the line to 65degC. This would increase the summer thermal rating of the line to 44MVA, alleviating the risks involved with the thermal constraint for the foreseeable future and eliminate faults caused by the condition of the old copper conductor on the 836 line. The ability to replace the conductor on the existing poles and crossarms would be dependent on a design review.

**Option 2 has estimated capital cost of [redacted] giving a Net Present Value of $0.2M.**

## 5.3 Option 3 - Market led Non-Network Solution

The requirement to avoid a thermal constraint on the 66kV line 836 from the Murrumburrah to Cootamundra may be advertised to the market via an EOI process to enable the market to respond with alternative non-network solutions. The response from the market could include another option not previously investigated by Essential

Energy and could include other market benefits driven from 3rd party owned solutions. The basis of the EOI will be to request alternative energy storage or devices that can provide demand reduction and alternate supply under any business model and operation conditions to ensure all new solutions can be assessed. Because of this approach, submissions may need to be reviewed against any applicable regulatory rules and if a solution is deemed to be economically viable, engagement with regulators may be required. Solutions from this market exercise will then be assessed against network solutions.

As such Option 3 does not have NPV analysis at this stage but will be considered as part of the project development.

### 5.4 Recommended Option

In recommending a preferred option, the initial capital costs are considered along with the NPV analysis of overall 40-year benefit which is primarily based on improved reliability

Option 2 to reconductor the 836 line shows the most benefit, but in this case is not the best value due to the high capital cost involved in reconductoring the line.

Option 3 will be evaluated prior to Essential Energy commencing the project to ensure up to date market pricing and solutions are used in the final evaluation.

Option 1 is the recommended option as it shows the best value over 40 years.

## 6. Risk Framework

Essential Energy's Corporate Risk Management Procedure (**Attachment 6.03.01**) and Network Risk Management Manual (A**ttachment 6.03.02**) underpins network investments in line with the risk Appraisal Value Framework (**Attachment 6.03.03**) and provide a consistent approach to network asset risk management and augmentation evaluation. The purpose of the procedures is to estimate the level of risk via probability of failure, likelihood of consequence and evaluate cost of consequence for network investments. The framework looks at overall network risk across six key areas: Safety, Network (Reliability), Environment, Compliance, Reputation and Financial.

### 6.1 Safety

Safety consequence considers the risk to both public and Essential Energy personnel. In this case there is a risk to the public when load exceeds the thermal rating of the line the conductor will sag below statutory ground clearance, with the associated risk of a member of the public coming into contact with the line.

### 6.2 Environmental

All businesses must manage the risks their activities may pose to human health and the environment from pollution or waste. There is no environmental risk that needs to be addressed with this constraint.

### 6.3 Compliance

Compliance risk is assessed for issues that may arise because of not complying to relevant Standards, Acts or Guidelines. When the line becomes overloaded the clearance from the conductor to ground falls below the statutory clearance requirement. This project aims to minimise the risk of compliance related costs.

### 6.4 Reputation

Reputational consequences are categorised as those risks associated with the tarnishing of the company's reputation. If the line is overloaded and the conductors clash there is the possibility of a sustained outage, or the ignition of a bushfire in a P1 rated area (refer 6.04.01 Bushfire Prevention Strategy (CERM8022.03)) that would

have a reputational impact on the company. Another case could be a member of the public coming into contact with the line when it has sagged below statutory clearance, impacting the reputation of the company.

### 6.5 Financial

There are no financial implications for customers or the company in this case beyond the investments captured in the business case.

## References

| Doc No. | Document Name | Relevance |
|---|---|---|
| 1 | Cootamundra 836 Line Options Comparison NPV.xlsx | NPV Option Analysis |
| 2 | ESS_2_Thermal_Value_Calculator | Calculation method to value high voltages |
| 3 | 6.4.01 Bushfire Prevention Strategy (CERM8022.03) | Reference material |
| 4 | 6.03.01 Corporate Risk Management Procedure | Reference material |
| 5 | 6.03.02 Network Risk Management Manual | Reference material |
| 6 | 6.03.03 Appraisal Value Framework | Reference material, risk evaluation |
| 7 | 11.01 Forecasts of Customer numbers, energy consumption and demand | Reference material |

## Key Terms and Definitions

| Term | Definition |
|---|---|
| $M | Dollars expressed in millions |
| FY | Financial Year |
| MW | Megawatt |
| NER | National Electricity Rules |
| NPB | Net Present Benefit (Benefits over 40-year expressed in present value) |
| NPC | Net Present Cost (Capital and operation costs over 40-year expressed in present value) |
| NPV | Net Present Value |
| NPVM | Net Present Value to Market (NPB subtract NPC) |
| RIT-D | Regulatory Investment Test – Distribution |

| | |
|---|---|
| VCR | Value of Customer Reliability |
| VUE | Value of Unserved Energy |

# Appendix A – Value of Thermal Overload

All figures are based on the ESS_2 Thermal Value Calculator for Distribution lines unless otherwise stated. The likelihood of consequence has been increased by a factor of (line overload)^3 for subtransmission to account for the level of overload seen on the subtransmission network and the highly nonlinear risk of consequence as the clearances reduce. Table 3 shows the risks from thermal overload for FY24, with the values increased in the following years based on the time the line is overloaded and level of overload.

**Table 3: FY24 Risks for Line 836 Overload**

| Safety | Bushfire | Reputation | Annual Cost |
|---|---|---|---|
| [redacted] | | | |

**Safety**

Cost of contacting a low span, calculated based on the time the line is overloaded and value of a safety event in the ESS_2 value calculator. The probability of a safety event is increased by a factor of 2 for a subtransmission line as the likelihood of a serious consequence is greater for contacting subtransmission.

**Bushfire**

Cost to the community of a bushfire starting from conductors clashing or low clearance from the EES_2 value calculator. Likelihood of conductors clashing increased by a factor of two to account for the increased risk of a bushfire starting from the high fault level inherent on subtransmission lines.

**Reputation**

Cost to Essential Energy from complaints due to conductors clashing and low clearance, increased by a factor of two for subtransmission as more customers are affected by faults.

# Appendix B – Value of Reliability from 66kV Line Faults

The improvement in reliability from reconductoring the Murrumburrah Transgrid to Cootamundra 66kV line 836 considers the following:

Table 4: FY24 Value of Reliability for 836 Line Faults

| Winter Peak Demand (MVA) | Average Demand (MW) | Hours at Risk p.a. | Cost Before Switching p.a. | Backup Load at Risk MWh p.a. | Cost After Switching p.a. | Labour Cost of Outage | Faults Related to Condition | TOTAL Condition Cost |
|---|---|---|---|---|---|---|---|---|
| 18.9 | 7.2 | 325 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

Winter Peak Demand from Frontier Economics Forecast plus forecast Cootamundra abattoir load

Average demand from 2020 load profile scaled so the summer peak matches Frontier Economics Forecast, the last two summers have been very mild and do not match the longer term trend.

Hours at risk above the 11MVA backup capability of the Junee supply, calculated from the from scaled 2020 Load Profile

Cost before switching includes a 15 minute period before System Control can remotely operate the circuit breakers at Cootamundra and Junee to restore supply from Junee

Backup Load at Risk is the Cootamundra and Bethungra load from the scaled 2020 load profile that is above the 11MVA backup capability of the supply from Junee.

Cost after switching is the cost of load at risk above the 11VA backup capability in the 6 hour period before the 66kV supply is restored from Transgrid Murrumburrah.

Labour cost of outage is the call out cost for four staff to attend and repair the Cootamundra 66kV line following a conductor fault.

Faults related to condition are faults above the standard outage rate of the line related to the aged copper conductor.

Total Condition Cost is the sum of the cost before switching, cost after switching and labour costs, multiplied by the percent of faults related to condition.