

OPTIONS EVALUATION REPORT (OER)



Making the Grid Smarter - Emergency Capacitor Voltage
Controls Gunnedah, Orange and Taree

OER 000000001412 revision 3.0

Ellipse project description: Provide Automatic Voltage Control of Capacitor Banks at Gunnedah
TRIM file: [TRIM No]

Project reason: Imposed Standards - Control Systems to meet NER requirements

Project category: Prescribed – Augmentation

Approvals

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Date submitted for approval	30 November 2016	

1. Need/opportunity

As referred to in NOS-1412, the present National Electricity Rules (NER) system requirements make it necessary for TransGrid to maintain voltage at any connection point within 10% above or below its nominal voltage. This can be achieved by the switching of reactive plant at the location of the voltage excursion, or via load shedding.

Most of TransGrid's shunt reactive plant is fitted with automatic controls that will switch the plant in or out in response to high or low voltages. The purpose of these controls is to prevent voltage collapse (and thereby secure the network).

In the absence of automatic control schemes, load shedding schemes are employed at Gunnedah, Cadia Mine (supplied from Orange), and Taree Substation. However, there are existing projects under for DCN-208 and DCN-530 which include in their scopes of work upgrading the control systems on the capacitors at Orange and Taree. Therefore this opportunity only applies to upgrading the control system at Gunnedah Substation.

There is an opportunity to avoid the loss of load by implementing smart auto-tripping of the Gunnedah capacitors following a critical contingency.

For further details, refer to [NOS-1412](#).

2. Related needs/opportunities

- > NOS 1520 – Over Voltage Control After AUFLS Event
- > DCN-208 – Rebuild of Orange 132/66 kV Substation
- > DCN-530 – Taree Secondary Systems and 33 kV Switchyard Replacement

3. Options

Base case

The base case for this Need is to continue operating the network “as is”.

The primary risk of TransGrid not addressing this need is a cost of unsupplied demand to customers at Gunnedah.

For critical outage scenarios, one of two situations can arise; an under-voltage event or an over-voltage event, as described in Table 2 of [NOS-1412](#).

Therefore, the risk cost is calculated as follows:

$$\text{Risk cost} = P_{\text{under-voltage}} * VCR$$

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$$\therefore \text{Risk cost} = 0.0841/\text{yr} * 13.3 \text{ MW} * 24 \text{ hrs} * \$38.35/\text{kWh}$$

$$\therefore \text{Risk cost} = 26.76 \text{ MWh} * \$38,350/\text{MWh}$$

$$\therefore \text{Risk cost} = \$1.03 \text{ million per year}$$

Option A — Provide Automatic Voltage Control of Capacitor Banks at Gunnedah

This option involves the provision of automatic voltage control of the capacitor banks at Gunnedah Substation.

The expected capital cost for this option is \$64.8k ± 25% (in un-escalated 2016-17 AUD). The scope of works included in this option is outlined in [OFS-1412A](#).

The provision of automatic voltage control on the capacitors at Gunnedah Substation is not expected to materially change the existing ongoing operations and maintenance costs of the capacitor or control systems.

The post-project risk cost of Option A is assessed to be \$0 per year. This is driven by the automatic control scheme removing the need for the load shedding schemes.

Non-Network Solutions

No feasible non-network solutions have been identified to address this Need.

4. Evaluation

Commercial Evaluation

Both the Base Case and Option A are technically feasible. However, as seen below, implementing the base case of “Do Nothing” would generate a risk cost to TransGrid of \$2.09 million per year, for every year the Need is not addressed.

In contrast, Option A would reduce the risk to \$0 per year.

The commercial evaluation of the technically feasible options is set out in Table 1.

The full financial and economic evaluations are shown in Appendix A.

Table 1

Option	Description	Capex (\$m)	Opex (\$m)	Post project risk cost (\$m)	Economic NPV (\$m) @10%	Financial NPV (\$m) @10%	Rank
Base case	“Do Nothing” (O&M continues)	N/A	N/A	1.03	N/A	N/A	-
A	Provide Automatic Voltage Control of Capacitor Banks at Gunnedah	0.065	0	0	7.77	(0.06)	1

The commercial evaluation is based on:

- > a 10% discount with sensitivities based on TransGrid’s current AER-determined pre-tax real regulatory WACC of 6.75% for the lower bound and 13% for the upper bound provided in Appendix A.
- > The applied sensitivities on the discount rate give the following economic NPVs of the preferred option, A:

Discount Rate (%)	Economic NPV (\$m)
6.75	9.47
13.00	6.59

Preferred Option

The preferred option to address the capacitors at Gunnedah substation that do not have the provision for voltage controlled switching is Option A - Provide Automatic Voltage Control of Capacitor Banks at Gunnedah, as it significantly reduces TransGrid’s risk exposure and yields the most benefits, as calculated using TransGrid’s NPV Calculation Tool (Appendix A) and Risk Tool.

ALARP Evaluation

An ALARP assessment is triggered by the following hazard with the associated disproportionate factor:

- > Unplanned outage of high voltage equipment – 3 times the safety risk reduction and taking 10% of the reliability risk reduction as applicable to safety.

However, as this will only produce 30% of the benefit derived in the commercial evaluation, a full ALARP evaluation will not produce an alternative preferred solution.

Capital and operating expenditure

The installation of automatic voltage control on the capacitors at Gunnedah is not expected to materially change the existing ongoing operations and maintenance costs of these capacitors.

Regulatory Investment Test

The RIT-T is not required as this is a minor network augmentation project with the cost of the preferred option under \$6 million.

5. Recommendation

Based on the economic evaluation above, Option A is the preferred option to address the Need as it reduces the risk cost to TransGrid of \$1.03 million per year to zero.

It is therefore recommended that a RPS be completed for the provision of automatic voltage control of capacitor banks at Gunnedah by June 2023.

Appendix A – Financial and Economic Evaluation Reports

Project_Option Name

Automatic Voltage Control at Gunnedah

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-\$0.06m	NPV / Capital (Ratio)	-0.98
NPV @ upper bound rate	13.00%	-\$0.06m	Pay Back Period (Yrs)	-0.17 Yrs
NPV @ lower bound rate (WACC)	6.75%	-\$0.06m	IRR%	-16.52%

2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)

NPV @ standard discount rate	10.00%	\$7.77m	NPV / Capital (Ratio)	119.54
NPV @ upper bound rate	13.00%	\$6.59m	Pay Back Period (Yrs)	Not measurable
NPV @ lower bound rate (WACC)	6.75%	\$9.47m	IRR%	1584.62%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.03m
Systems (reliability)	\$1.03m	\$0.00m	\$1.03m	ENS Penalty	\$0.00m
Financial	\$0.00m	\$0.00m	\$0.00m	All other risk benefits	\$0.00m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.03m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.00m
Environment	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$1.03m
Total Risk benefits	\$1.03m	\$0.00m	\$1.03m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$1.03m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m	-\$0.07m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.00m	Re-investment capital	\$0.00m
Capitalisation period	1.00 Yrs	Start of the re-investment period	0.00 Yrs