OPTIONS EVALUATION REPORT (OER)

TL Public Safety Compliance

OER- N2425 revision 0.0

Ellipse project no(s):
TRIM file: [TRIM No]

Project reason: Compliance - Regulatory obligation
Project category: Prescribed - Replacement

Approvals

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Change history

Revision	Date	Amendment
0	1st November 2021	Initial Issue

Executive summary

TransGrid's transmission line network is located within easements on both private and public third-party property, and as a result there is the potential for interactions with the general public at large within the various communities through which the lines traverse. In managing the network, TransGrid is required to comply with a range of legislative instruments, regulatory instruments and industry standards for network safety across the jurisdictions it operates including:

- Utilities (Technical Regulation) (Electricity Transmission Supply Code) Approval 2016 (No 1) (ACT);
- Australian Standard AS5577-2013: Electricity Network Safety Management Systems;
- NSW Government Electricity Supply (Safety and Network Management) Regulation 2014; and
- National Guidelines for the Prevention of Unauthorised Access to Electricity (ENA Document 015:2006).

Under these regulations, standards and guidelines, TransGrid is required to demonstrate that it has taken all reasonably practicable steps to ensure that network safety is addressed as a component under its Electricity Network Safety Management System (ENSMS). One of these components of network safety is public safety. Public safety considers safety risks to the general public resulting from TransGrid's operations, including third parties working near TransGrid's network assets, and covers both urban and rural locations. A key control under the ENSMS is the application of the relevant technical standards in the design and installation of its assets. It follows that the need relating to this project is for compliance.

Transmission line asset inspections have identified several public safety issues in relation to ineffective climbing deterrents throughout the network. Currently, these climbing deterrents that have been identified require modification to satisfy the latest TransGrid's standard. This will improve the effectiveness of the climbing deterrent and reduce the likelihood of unauthorised access to transmission towers.

The modification of climbing deterrents has been prioritised as per the following criteria:

1. Climbing deterrents with spikes as they are easy to defeat when compared to the climbing deterrents that satisfy current industry and/or TransGrid's standard.
2. Public Safety Risk Categorisation in accordance with Public Safety Criticality Model.

Only one feasible option has been identified, given the nature of the need and project. An assessment of the option that is considered feasible and able to address the need/opportunity appears in Table 1.

Table 1 - Evaluated option[1]

Option	Description	Direct capital cost ($m)	Network and corporate overheads ($m)	Total capital cost[2] ($m)	Weighted NPV (PV, $m)	Rank
Option A	Remediation of all climbing deterrent not aligned with the latest TransGrid's standard design	21.8	3.2	25.1	-9.1	1

It is recommended that Option A is to be scoped in detail to align with the latest technical design standards and reduces the public safety risk throughout the network to As Low As Reasonably Practicable (ALARP).

[1] Figures in Table 1 may not add due to rounding.

[2] Total capital cost is the sum of the direct capital cost and network and corporate overheads. Total capital cost is used in this OER for all analysis.

1. Need/opportunity

Since 2014, 14 known unauthorised climbing of TransGrid transmission line structures have occurred. Nine of the incidents occurred in locations isolated from urban areas while the other five incidents occurred in urban areas or near motorways. Two of these incidents included children/adolescents recording the process of climbing a TransGrid steel structure located within a national park, who subsequently uploaded this video onto social media. This triggered investigation into the effectiveness of various climbing deterrents used across the network.

National Guidelines for the Prevention of Unauthorised Access to Electricity Infrastructure (ENA Document 015:2006)[3] requires that poles and towers should be constructed to prevent climbing without the use of greater than normal agility, tools or climbing aids. It also states that approach to within the safe approach distances to live conductors should be limited by primary control measures such as:

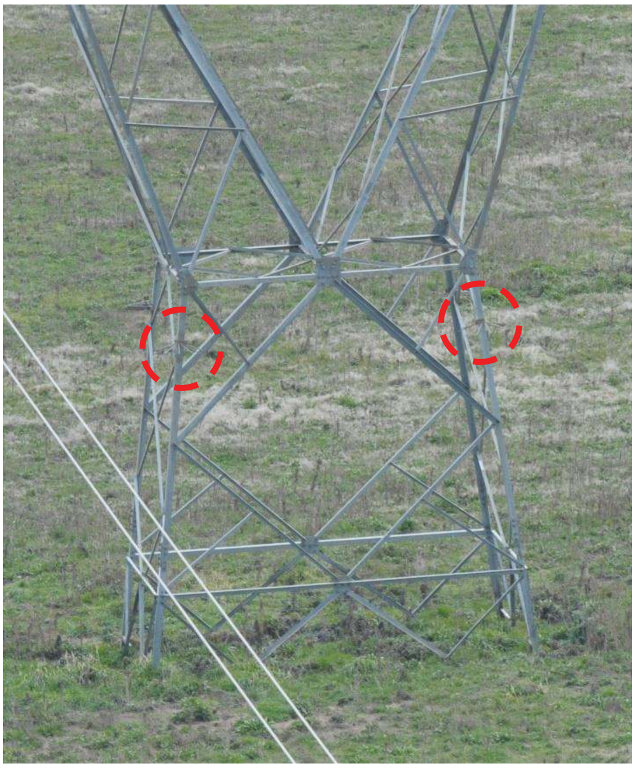
- Anti-climbing devices and danger/warning signs.
- Insulated conductors and electrical equipment.
- Physical barriers.

Figure 4.2 in the ENA Document 015:2006 illustrates a typical climbing deterrent deemed suitable. TransGrid's current tower climbing deterrent design is in accordance with this typical example and is similar to designs used across the industry, both in Australia and overseas.

To improve the effectiveness of climbing deterrent, several climbing deterrents throughout the network require modification to align with the latest TransGrid's standard design and ENA Document 015:2006. The following issues have been identified:

- Steel towers installed with spike type climbing deterrent.

Figure 1 Tower with Spike Type Anti-Climbers



- Climbing deterrent installed without diagonal wires and grid infills.

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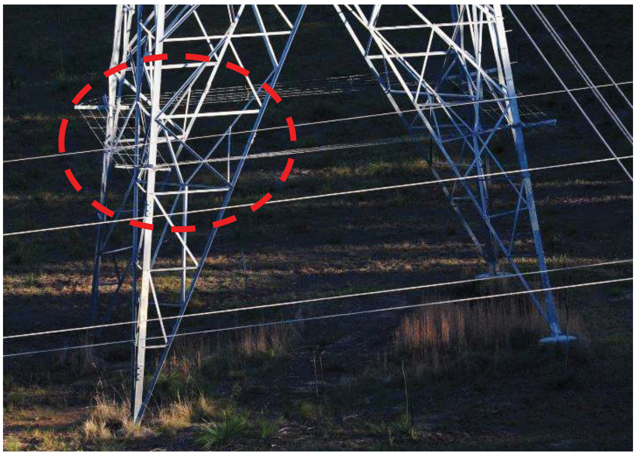
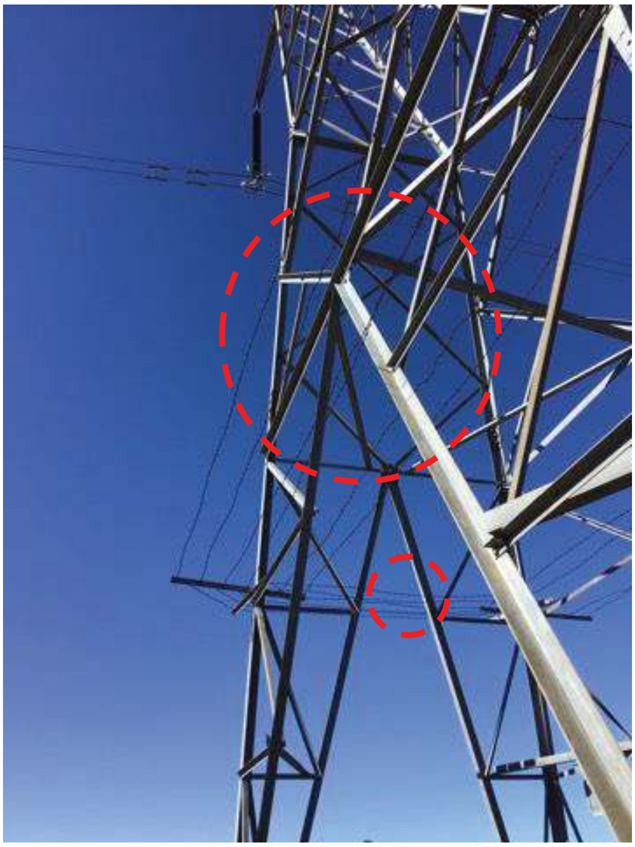
[3] ENA, *National Guidelines for Prevention of Unauthorised Access to Electricity infrastructure*, 2006.

Figure 2 Anti-Climbers without Diagonal Wires and/or Grid Infill



> Climbing deterrent installed with inadequate spacers.

Figure 3 Anti-Climbers with Inadequate Spacers Installed



There are 3,577 structures that require modification to climbing deterrents to upgrade their effectiveness in line with the latest TransGrid standard. Improving these structures will reduce public safety risk and the likelihood of unauthorised access to the tower.

The primary driver for this need is to ensure that public safety risks from transmission line towers are reduced to as low as reasonably practicable. TransGrid's Electricity Networks Safety Management System (ENSMS) is designed to be in compliance with NSW and ACT regulatory instruments, more specifically NSW's Electricity Supply (Safety and Network Management) Regulation 2014 (NSW). The primary objectives to be addressed by the ENSMS are, as taken from the regulatory instruments:

(a) the safety of members of the public, and
(b) the safety of persons working on networks, and
(c) the protection of property (whether or not belonging to a network operator), and

(d) the management of safety risks arising from the protection of the environment (for example, preventing bush fires that may be ignited by network assets), and

(e) the management of safety risks arising from loss of electricity supply.

Table 2 below identifies extracts from other regulatory instruments, standard and guidelines that state the need to protect the safety of members of public.

Table 2 Regulatory Compliance Requirements

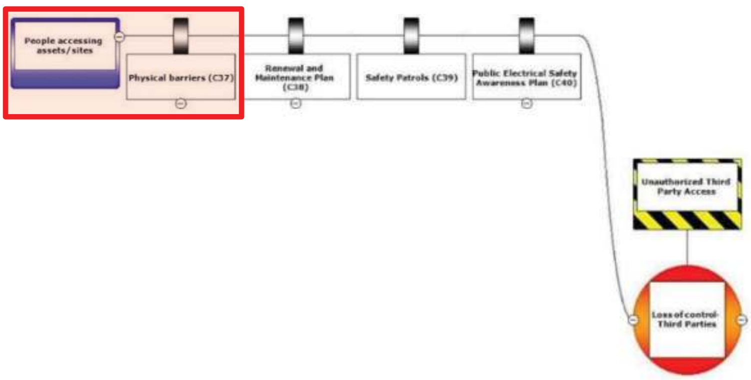
Identified need	*Regulatory Instruments*
Regulatory compliance examples (non-exhaustive)	**Network safety** - Obligation for network operators to ensure safety of transmission systems under: **1. Electricity Supply (Safety and Network Management) Regulation 2014 (NSW)** > Section 5: 'A network operator must take all reasonable steps to ensure that the design, construction, commissioning, operation and decommissioning of its network (or any part of its network) is safe.' **2. Utilities (Technical Regulation) (Electricity Transmission Supply Code) Approval 2016 (No 1) (ACT)** > 2.2 (3): Ensure the safe management of the electricity transmission network to avoid injury to any person or damage to property and the environment. > Section 5.1: An electricity transmission utility must have an electricity network safety management system consistent with the principles and requirements set out in AS 5577 Electricity Network Safety Management Systems. (2) These principles and requirements are summarised as, but are not limited to: (a) the protection of the electricity transmission network; (b) the safety of persons working on or near the electricity transmission network; (c) the safety of the public and the protection of any property near the electricity transmission network; > Section 5.2 (2): Planning and design considerations by the electricity transmission utility must include but are not limited to: (a) issues such as safety of persons; **3. Australian Standard AS5577-2013: Electricity Network Safety Management Systems** > A3.1 Risk Identification: The Formal Safety Assessment shall identify electricity network hazards that could cause an electricity related incident and, as a minimum, consider – … (g) intentional and unintentional human activities. > 4.3.4.1 Published national or international technical standards: If the Network Operator chooses not to use an applicable relevant standard or chooses not to comply with particular provisions of that standard, the Network Operator shall document— (i) the reason for the non-use of or non-compliance with the standard; and (ii) the alternative provisions for the design, construction, commissioning, installation, operation, maintenance and decommissioning of network assets that will ensure a level of safety in relation to those activities that is at least equal to or greater than the level of safety that would ensue from compliance with that standard.

Identified need	*Regulatory Instruments*
	4. National Guidelines for the Prevention of Unauthorised Access to Electricity (ENA Document 015:2006) > 2.2.1 Risk and the community Infrastructure owners and operators have a responsibility to prevent unauthorised access to hazardous sites/situations within their control.

TransGrid's Electricity Network Safety Management System (ENSMS) is regulatory document that demonstrates how network safety is minimised to as low as reasonably practicable in the network. A key component of the ENSMS is TransGrid's Public Safety Formal Safety Assessment (FSA). This FSA demonstrates TransGrid's network-wide public safety risk assessment. This FSA identifies Unauthorised Third Party Access as a key hazard to public safety risk, as illustrated in Figure 4.

The key threat to this hazard is people accessing our assets/sites, in this case our high voltage transmission line structures. The key to preventing the threat from realising is ensuring physical barriers is fully effective at all times. Physical barriers for high voltage transmission line structures are climbing deterrents.

Figure 4 Unauthorised Access/ Third Party Interference Bowtie (Appendix G in Public Safety FSA)



The lines listed in Table 3 have climbing deterrent that need to be improved in line with the latest TransGrid's standard climbing deterrent design.

Table 3 Transmission line and count of structures in scope

Line Number	Approximate Geographical Location	Ellipse Line Equipment Location	Number of structures in scope
1	Cabramurra to Holt	SYT1211	276
4	Goulbourn to Cullerin	SYT1214	254
		SYT1215	4
9	Holt to Yass	SYT1217	105
65	Cabramurra to Khancoban	SWT1265	111
66	Talbingo to Khancoban	SWT1266	174
84	Calala to Muswellbrook	NNT1087	190
		NTT1087	129
85	Tamworth to Armidale	NTT1127	232
87	Armidale to Coffs Harbour	NTT1245	294
88	Tamworth to Muswellbrook	NNT1088	127
		NTT1088	149
965	Armidale to Kempsey	NTT2132	6
966	Armidale to Koolkhan	NTT2133	6

Line Number	Approximate Geographical Location	Ellipse Line Equipment Location	Number of structures in scope
999	Cowra to Kangiara	SYT2041	253
35/36	Bannaby to Marulan	SYT1045	50
5A1/5A2	Eraring to Kemps Creek	NNT0021	132
		CMT0021	180
5A3/5A4	Liddell to Portland	NNT0028	228
		COT0028	44
5A3/5A5	Wollar to Portland	COT0301	256
5A6/5A7	Portland to Bannaby	COT0302	192
		SYT0302	137
5B1/5B2	Eraring	NNT0096	8
87/89	Karangi	NTT1030	6
9W0	Grafton East to Koolkhan	NTT2376	3
U1	Cabramurra	SWT1251	16
U3	Cabramurra	SWT1252	15
	TOTAL		**3,577**

2. Related needs/opportunities

There are no related need/opportunities at this stage.

3. Options

3.1 Base case

The base case for this assessment is a ‘do nothing’ scenario where existing climbing deterrents that are not aligned with TransGrid’s standard design are not modified. This would not improve the effectiveness of climbing deterrents or better prevent unauthorised access to towers. Subsequently public safety risk would not be managed to an ‘as low as reasonably practicable’ standard. These towers would not be deemed to have an acceptable level of residual risk in line with the latest ENA industry guidelines.

The base case risk cost is approximately $190,000 per annum which is mostly attributed to public safety risk. This cost is based on the assumption of a 50% probability that the climbing deterrents in their current state will not deter the public from climbing the towers.

3.2 Options evaluated

Option A — Remediation of all climbing deterrents not aligned with the latest standards [NOSA N2425, OFS N2425A]

The scope of works involves modifying climbing deterrents on 3,577 structures which are provided in Table 3.

TransGrid has developed a public safety model to prioritise the structures based on the safety risk level (High, Medium, Low, Very Low) of a member of public that is a “Fun Seeker” and “Self Harmer”. Fun Seeker refers to young people as major contributors and therefore transport to the location is the key consideration. Any tower within 5-10km of an urban area is likely to meet this classification. The 14 public safety incidents are used as a basis for identifying the terms “Fun Seeker” and “Self Harmer” in the public safety model.

The Public Safety Criticality Model – Model Framework report describes how each structure is categorised.

The distribution of the structures listed in Table 3 into the Fun Seeker and Self-Harmer Categories is provided in Table 4. The modification of climbing deterrents on the structures are prioritised in the following order:

1. Fun Seeker Category: High; Self-Harmer Categories: High and Medium. Total Structures: 797
2. Fun Seeker Category: High; Self-Harmer Categories: Low and Very Low. Total Structures: 473
3. Fun Seeker Category: Medium; Self-Harmer Categories: Low and Very Low. Total Structures: 1224
4. Fun Seeker Category: Low; Self-Harmer Category: Low. Total Structures: 91
5. Fun Seeker Category: Very Low; Self-Harmer Category: Very Low. Total Structures: 992

The above five prioritisation groupings based on risk categorisation are presented with red outlines in Table 4.

Table 4 Prioritisation matrix based on structure risk categorisation

		Fun Seeker Categories				
Self-Harmer Categories		**High**	**Medium**	**Low**	**Very Low**	
	High	797 (FY2024)	-	-	-	
	Medium		-	-	-	
	Low	473 (FY2025)	1,224 (FY2026 and FY2027)	91 (2029-2033 Regulatory Period)	-	
	Very Low			-	992 (2029-2033 Regulatory Period)	
	GRAND TOTAL	**1,270**	**1,224**	**91**	**992**	**3,577**

Structures which use spikes as the primary form of climbing deterrents pose a higher public safety risk than the other structures in scope as they are not aligned with TransGrid standards. Consequently, structures with spikes are prioritised for upgrade.

The number of structures that have spikes and which are prioritised for upgrade are presented in Table 5.

Table 5 Count of structures with spikes as climbing deterrents by risk category

		Fun Seeker Categories				
		High	Medium	Low	Very Low	GRAND TOTAL
Self-Harmer Categories	High	1 (Line 999)	-	-	-	**1 (Line 999)**
	Medium	2 (Line 1) 21 (Line 999)	-	-	-	**2 (Line 1)** **21 (Line 999)**
	Low	1 (Line 1) 3 (Line 999)	8 (Line 1) 4 (Line 999)	30 (Line 1)	-	**39 (Line 1)** **7 (Line 999)**
	Very Low	23 (Line 1) 12 (Line 999)	29 (Line 1) 45 (Line 999)	-	135 (Line 1) 42 (Line 999)	**187 (Line 1)** **99 (Line 999)**
	GRAND TOTAL	63	86	30	177	356 (addressed in FY2024)

The timing of climbing deterrent remediation has been triaged based on risk categories and is presented in Appendix B Capital expenditure timeframe . It is anticipated structures with spikes would be replaced with the standard climbing deterrents in the first year of the 2024-2028 regulatory period.

It is estimated that this option would cost $25.07 million ($2020-21) including:

> $18.02m which will be delivered in 2024-2028 Regulatory Period.

> $7.05 million will be delivered in 2029-2033 Regulatory Period.

3.3 Options considered and not progressed

No other options are considered as the only option to ensure TransGrid and other standards, guidelines and regulations are met is to remediate all non-standard climbing deterrents to be aligned with current TransGrid and industry standards.

4. Evaluation

4.1 Commercial evaluation methodology

The economic assessment undertaken for this project includes three scenarios that reflect a central set of assumptions. This first is based on current information that is considered the most likely to eventuate (central scenario), a second which is a set of assumptions that give rise to a lower bound for net benefits (lower bound scenario), and finally a set of assumptions that give rise to an upper bound on benefits (higher bound scenario).

Assumptions for each scenario are set out in the table below.

Table 6 Scenarios

Parameter	Central scenario	Lower bound scenario	Higher bound scenario
Discount rate	4.8%	7.37%	2.23%
Capital cost	100%	125%	75%
Risk costs	100%	75%	125%
Scenario weighting	**50%**	**25%**	**25%**

The relevant parameters used in this commercial evaluation:

Table 7 Key parameters

Parameter	Parameter Description	Value used for this evaluation
Discount year	Year that dollar values are discounted to	2020/21
Base year	The year that dollar value outputs are expressed in real terms	2020/21 dollars
Period of analysis	Number of years included in economic analysis with remaining capital value included as terminal value at the end of the analysis period.	25 years
Expected asset life	Period of depreciation of the asset	30[4] years
ALARP disproportionality	Multiplier of the environmental and safety related risk cost included in NPV analysis to demonstrate implementation of obligation to reduce to ALARP.	Refer to section 4.3 for details.

The capex figures in this OER do not include any real cost escalation.

4.2 Commercial evaluation results

The commercial evaluation of Option A in presented Table 8. Details provided in Appendix A.

Table 8 Commercial evaluation (PV, $ million)

Option	Capital Cost PV	Central scenario NPV	Lower bound scenario NPV	Higher bound scenario NPV	Weighted NPV	Ranking
Option A	19.29	-10.28	-16.48	0.54	-9.12	1

[4] Australian Tax Office Depreciation Rates 2020 for Fencing - https://www.depreciationrates.net.au/fencing

4.3 ALARP evaluation

TransGrid manages and mitigates bushfire and safety risk to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with the regulation obligations and TransGrid's business risk appetite. Under the Electricity Supply (Safety and Network Management) Regulation 2014 Section 5 'A network operator must take all reasonable steps to ensure that the design, construction, commissioning, operation and decommissioning of its network (or any part of its network) is safe.' TransGrid maintains an ENSMS to meet this obligation.[5]

TransGrid considers that ALARP is demonstrated if:

(a) Where reasonably practicable the hazard has been eliminated, or where this is not reasonably practicable:
   (i) All risk treatment options have been considered;
   (ii) A risk treatment option has not been implemented only if the cost of doing so is grossly disproportionate to the benefit gained;
   (iii) Opportunity for further safety improvement has been assessed.

It should also be noted that AS 5577 requires that the option that provides safety risk reduction benefit should be progressed irrespective of cost, until an acceptable level of residual risk is achieved. There is significant uncertainty in the quantification of the safety risk as it relies on probability assumptions around behaviour and it is expected that data on tower climbing incidents does not represent all incidents. It is not considered that Transgrid can demonstrate with confidence that a similar level of safety outcome is being achieved where current good practice controls are not implemented.

On this basis the proposed investment (Option A) is progressed as the treatment option is considered in line with good industry practise that has the opportunity for further safety improvement.

4.4 Preferred option

Capital and Operating Expenditure

The required capital expenditure is $25.07 million, including $18.02 million to be delivered in 2024-2028 Regulatory Period and $7.05 million in the 2029-2032 Regulatory Period.

Regulatory Investment Test

The program and estimate allows for the appropriate regulatory approvals as required.

5. Optimal Timing

In consideration of the delivery requirement and risk prioritisation, the project has been prioritised as per Table 9.

Table 9 Count of structures remediated in the Regulatory Period

Need	2024-2028 Regulatory Period	2029-2033 Regulatory Period	Total number of structures in scope
Remediation of climbing deterrents	2,494	1,083	3,577

[5] TransGrid's ENSMS follows the International Organization for Standardization's ISO31000 risk management framework which requires following hierarchy of hazard mitigation approach

The project is expected to commence in the 2024-2028 Regulatory Period.

6. Recommendation

TransGrid has identified locations of potential increased public safety risk where climbing deterrents do not align with the latest TransGrid standards. TransGrid has prioritised the replacement of these climbing deterrents based on criteria including the proximity of structures in relation to urban locations and the difficulty of 'defeating' existing deterrents for thrill seekers.

The need identified with this project is compliance given the public safety risks identified. Of the options considered, Option A is the preferred option as it ensures the following is satisfied:

- Public safety risk is managed to ALARP as required to satisfy network safety regulatory obligations.
- Demonstrates due diligence in ensuring the safety of the members of the public is protected.

Total project cost is $25.07 million including an amount of $1.0 million to progress the project from DG1 to DG2. $18.02 million to be delivered in 2024-2028 Regulatory Period and $7.05 million in the 2029-2032 Regulatory Period.

Appendix A Option A Summary[6]

Project Description	TL Public Safety Compliance		
Option Description	Option A - Modification to all climbing deterrent not aligned to TransGrid's standard design		
Project Summary			
Option Rank	*2*	Investment Assessment Period	*25*
Asset Life	*30*	NPV Year	2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	-10.28	Annualised CAPEX @ Central Benefit Scenario ($m)	Annualised Capex - Standard (Business Case) 1.59
NPV @ Lower Bound Scenario (PV, $m)	-16.48	Network Safety Risk Reduction ($m)	Network Safety Risk Reduction #N/A
NPV @ Higher Bound Scenario (PV, $m)	0.54	ALARP	ALARP Compliant? #N/A
NPV Weighted (PV, $m)	-9.12	Optimal Timing	Optimal timing (Business Case) -1
Cost (Central Scenario)			
Total Capex ($m)	25.07	Cost Capex (PV,$m)	19.29
Terminal Value ($m)	3.34	Terminal Value (PV,$m)	0.65
Risk (Central Scenario)	Pre	Post	Benefit
Reliability (PV,$m)	Reliability Risk (Pre) 0.00	Reliability Risk (Post) 0.00	Pre – Post 0.00
Financial (PV,$m)	Financial Risk (Pre) 1.10	Financial Risk (Post) 0.45	Pre – Post 0.65
Operational/Compliance (PV,$m)	Operational Risk (Pre) 0.00	Operational Risk (Post) 0.00	Pre – Post 0.00
Safety (PV,$m)	Safety Risk (Pre) 12.83	Safety Risk (Post) 5.19	Pre – Post 7.64
Environmental (PV,$m)	Environmental Risk (Pre) 0.00	Environmental Risk (Post) 0.00	Pre – Post 0.00
Reputational ($m)	Reputational Risk (Pre) 0.14	Reputational Risk (Post) 0.06	Pre – Post 0.08
Total Risk (PV,$m)	Total Risk (Pre) 14.07	Total Risk (Post) 5.70	Pre – Post 8.37
OPEX Benefit (PV,$m)			OPEX Benefit 0.00
Other benefit (PV,$m)			Incremental Net Benefit 0.00
Total Benefit (PV,$m)			Business Case Total Benefit 8.37

[6] Figures have been rounded for simplicity.

Appendix B Capital expenditure timeframe

Line Number	2024	2025	2026	2027	2028	2029-2033 Regulatory Period	Sub Total
1	228	5	12	-	-	31	276
4	67	52	106	-	-	33	258
9	11	29	31	-	-	34	105
65	4	13	13	-	-	81	111
66	4	16	65	-	-	89	174
84	49	52	141	-	-	77	319
85	36	30	85	-	-	81	232
87	29	47	-	125	-	93	294
88	46	30	98	-	-	102	276
965	1	2	3	-	-	-	6
966	4	-	-	1	-	1	6
999	146	16	45	-	-	46	253
35/36	-	3	11	-	-	36	50
5A1/5A2	126	60	-	113	-	13	312
5A3/5A4	20	35	-	82	-	135	272
5A3/5A5	18	29	-	101	-	108	256
5A6/5A7	5	48	-	184	-	92	329
5B1/5B2	-	4	-	4	-	-	8
87/89	3	1	-	2	-	-	6
9W0	-	1	2	-	-	-	3
U1	-	-	-	-	-	16	16
U3	-	-	-	-	-	15	15
Sub Total	797	473	612	612	-	1,083	3,577
Cost	$6.67m	$3.17m	$4.09m	$4.09m	-	$7.05m	$25.07m