Options Evaluation Report (OER)

Main Grid - Low Spans
OER- **N2609** revision **2.0**

Ellipse project no(s):

TRIM file: [TRIM No]

Project reason: Reliability - To meet overall network reliability requirements

Project category: Prescribed - Replacement

Approvals

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Change history

Revision	Date	Amendment
0	09/11/2021	First Issue
1	12/10/2022	Update analysis and evaluation including: • Update on cost and risk with FY22 values • Update on discount rates • Amendment of environmental disproportionality factor • Removal of reputational risk
2	31/10/2022	Revision number updating

Executive summary

Overhead transmission lines are designed and constructed to achieve standard minimum electrical clearances to the conductor. The presently accepted industry standard AS/NZS 7000:2016 – Design of Overhead Lines takes into account a range of safety and environmental factors, including thermal expansion of the conductor (known as sag) and movement of the conductor position due to wind (known as blowout). The minimum electrical clearances that should be achieved when the conductor reaches its maximum operating temperature is commonly referred to as the line design temperature.

Several transmission lines with spans below AS/NZS 7000 minimum clearances, referred to as low spans, exist on TransGrid's network. The term "span" refers to the wire (conductor) between two poles or towers of a transmission line. When referring to the term "low spans", this means that the distance between the lowest point of the conductor and the land, vegetation and infrastructure is less than (lower) than the distance specified in the design.

Lines built before 1991 had less stringent clearance requirements, for example, 7.6m to ground at 330kV compared to the 8.0m clearance specified in later standards, including AS/NZS 7000. Lines compliant to standards when they were built (but not later standards) do not require any remediation under grandfathering provisions in AS/NZS 7000. However, if these lines are non-compliant to the clearances under the grandfathered standard, then remediation is required under AS/NZS 7000.

The identified transmission lines would require their low spans to be remediated to the design temperature of the transmission lines per the Low Span Risk Assessment Methodology. This will allow for their continued operation at their design ratings while reducing the public safety and bushfire risk associated with non-compliant conductor clearances.

The main driver for the need is to:

- address the legacy non-compliant conductor clearance to reduce the public safety and bushfire risk;
- manage network safety risk levels "As-Low-As Reasonably-Practicable" following the regulatory 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 the design, construction, commissioning, operation and decommissioning of its network (or any part of its network) are safe.

A total of fifteen 500/330 kV lines from TransGrid's entire fleet were identified as having low spans based on the design temperature. The remediation of low spans has been prioritised based on the utilisation of the lines, which indicates the likelihood of breaching the clearance requirement under credible contingency scenarios on the network. The five 330 kV lines with high utilisation line that requires remediation are listed in Table 1 below.

Table 1 – 330kV lines with high utilisation

Line	From	To
1	Upper Tumut	Stockdill
2	Ravine	Yass
3L	Yass	Collector
4	Collector	Marulan
5	Yass	Marulan

The assessment of the options considered to address the need/opportunity appears in Table 2.

Table 2 - Evaluated options

Option	Description	Direct capital cost ($m)	Network and corporate overheads ($m)	Total capital cost[1] ($m)	Weighted NPV (PV, $m)	Rank
Option A	Remediate low spans per TransGrid's low span risk assessment methodology to the line design temperature	41.04	2.76	43.8	(18.09)	2
Option A1	Remediate low spans, **on lines with high utilisation**, per TransGrid's low span risk assessment methodology to the line design temperature	17.69	1.61	19.3	0.80	1

The preferred option is Option A1, as these lines are of a higher likelihood to breach clearance requirements, which are required to be addressed under TransGrid's ENSMS obligation to reduce safety risks to ALARP and to address the legacy non-compliant conductor clearance. Option A1 also has the highest weighted NPV result and is technically and commercially feasible. It is therefore recommended that Option A1 be scoped in detail and progressed from DG1 to DG2.[2]

[1] 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.
[2] DG stands for 'decision gate' that forms a part of TransGrids investment decision process.

1. Need/opportunity

Overhead transmission lines are designed and constructed to achieve standard minimum electrical clearances to the conductor. The presently accepted industry standard AS/NZS 7000:2016 – Design of Overhead Lines takes into account a range of safety and environmental factors, including thermal expansion of the conductor (known as sag) and movement of the conductor position due to wind (known as blowout). The minimum electrical clearances that should be achieved when the conductor reaches its maximum operating temperature is commonly referred to as the line design temperature.

Several transmission lines with known spans below AS/NZS 7000 minimum clearances, referred to as low spans, exist on the network. The term “span” refers to the wire (conductor) between two poles or towers of a transmission line. When referring to the term “low spans”, this means that the distance between the lowest point of the conductor and the land, vegetation and infrastructure is less than (lower) than the distance specified in the design.

Lines built before 1991 had less stringent clearance requirements, for example, 7.6m to ground at 330kV compared to the 8.0m clearance specified in later standards, including AS/NZS 7000. Lines compliant to standards at the time they were built (but not later standards) do not require any remediation under grandfathering provisions in AS/NZS 7000. However, if these lines are non-compliant to the clearances under the grandfathered standard, then remediation is required under AS/NZS 7000. It follows that there is a compliance need to address low “low spans” on certain lines to bring them up to AS/NZS 7000 standards.

The identified transmission lines would require their low spans to be remediated to the design temperature of the lines per the Low Span Risk Assessment Methodology. This will allow for their continued operation at their design ratings while reducing the public safety risk associated with non-compliant conductor clearances.

Four main factors are taken into consideration in determining the overall risk level of a particular low span which are:

1. Land use – Purpose to which the land cover is committed.
2. Violation temperature – the percentage of required operating temperature when the span first starts to go below the required minimum clearances.
3. Violation amount – how far below the minimum clearances a particular span is at the required operating temperature of the line.
4. Violation area – the size of the land/ground that is exposed to conductors below their minimum clearances at the required operating temperature.

Based on the above, the suggested risk treatment for each risk level is outlined below.

Table 3 - Risk level

Risk Level	Risk Treatment
High	Low span must be remediated to remove clearance violation
Medium	Low span must be remediated to remove clearance violation
Low	Low span to be remediated if the cost of doing so was considered reasonable for the benefit gained
Very Low	Low span to be remediated if the cost of doing so was considered reasonable for the benefit gained.

The primary driver for this need is to ensure the public safety and bushfire risks from low spans is reduced to as low as reasonably practicable.

TransGrid's Electricity Networks Safety Management System (ENSMS) is designed to be in compliance with the 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 network assets may ignite); and
(e) the management of safety risks arising from loss of electricity supply.

Appendix C identifies other regulatory instruments, standards and guidelines that state the need to protect the safety of members of the public.

Lines with high utilisation run hotter causing the conductor to sag lower. Low spans in these situations are likely to occur. The critical threat of this hazard occurs under the scenario in which people accessing our transmission line easements in areas where low spans exist encroach safe approach distances resulting in flashover. This could be to a vehicle or plant (such as a harvester) or a person in extreme cases.

The list of main grid lines which require low spans remediation is listed in Table 4.

Table 4: Main Grid Low Spans Lines

Line	From	To	Max Design Rating (MVA)	Max Design Temperature (°C)	Utilisation (MVA)	Conductor Temperature at utilisation (°C)	Utilisation N-1 Contingency (% of Line rating)
5A6	Mt Piper	Bannaby	3394	120	679	46	20%
5A7	Mt Piper	Bannaby	3394	120	679	46	20%
1	Upper Tumut	Stockdill	995	85	967	83	94%
2	Ravine	Yass	995	85	796	72	80%
6X	Upper Tumut	Ravine	995	85	796	72	80%
3L	Yass	Collector	880	68	836	75	95%
4	Collector	Marulan	880	68	1,012	92	115%
5	Yass	Collector	880	68	942	72	107%
23	Munmorah	Vales Point	1429	120	1,143	84	80%
24	Eraring	Vales Point	1260	120	655	60	52%
76	Wallerawang	Sydney South	1262	120	795	65	63%
77	Wallerawang	Ingleburn	1428	120	843	67	59%
9W	Tomago	Waratah West	1215	120	328	53	27%
11	Sydney South	Dapto	1428	120	857	67	60%

Line	From	To	Max Design Rating (MVA)	Max Design Temperature (°C)	Utilisation (MVA)	Conductor Temperature at utilisation (°C)	Utilisation N-1 Contingency (% of Line rating)
12	Liverpool	Sydney South	1429	120	700	62	49%

2. Related needs/opportunities

The following needs are related. Outage clashes may prevent concurrent delivery. Addressing the low spans need on lines with a refurbishment project may marginally reduce the refurbishment scope should a structure replacement be required.

- Need 1556 – Low Spans Stage 2
- Need N2616 – 132kV Transmission Lines Low Spans
- Humelink – Snowy 2.0 Network Augmentation.
- VNI – Network Augmentation.
- Need N2522 – Line 1 Refurbishment
- Need N2521 – Line 2 Refurbishment
- Need N2537 – Line 3L Refurbishment
- Need N2524 – Line 4 Refurbishment
- Need N2517 – Line 5 Refurbishment
- Need 1408 – Line 23 Refurbishment - should the line replacement proceed, it will address the requirements for this line in Option A.
- Need 1348 – Line 24 Refurbishment
- Need N2520 – Line 24/90 Refurbishment
- Need N2476 – Line 12/76 Refurbishment
- Need N2477 – Line 76/78 Refurbishment
- Need N2493 – Line 76/77 Refurbishment
- Need N2500 – Line 94/9W Refurbishment
- Need N2499 – Line 9W/96 Refurbishment
- Need 1600 – Line 11 Tower Replacement - should the line replacement proceed, it will address the requirements for this line in Option A.
- Need 1271 – Line 12 Refurbishment

3. Options

In developing the options to address this need, TransGrid considered the following:

- A Base case for this assessment is a ‘do nothing’ scenario, where the low spans are left unaddressed, and no control measures are implemented.
- Option A targets addressing low spans per TransGrid’s low span risk assessment methodology to the line design temperature.
- Option A1 targets addressing low spans per TransGrid’s low span risk assessment methodology to the line design temperature and excludes some lines based on current utilisation.

3.1 Base case

The base case is to ‘do nothing’, that is not to remediate the low spans. The safety risk cost comes from the consequence of electric shock from exposure to a low span with a clearance breaching the standard requirements.

Leaving all these low spans unaddressed will leave TransGrid at the risk of not meeting its obligations under legislation and regulation to operate a safe electricity network. Public safety risk management would also not be as low as reasonably practicable.

For lines with high utilisation, the likelihood of low spans existing is credible, a do-nothing option is not acceptable as TransGrid will not be compliant with the obligations set out in its ENSMS.

3.2 Options evaluated

Option A — Remediate low spans per low span risk assessment methodology to the line design temperature [NOSA N2609, OFS N2609A].

Option A involves remediation of the main grid low spans on the network where the risk was considered "medium" or above. Remediation can include mid-span structure installation, "dummy strain" insulator arrangements or landscaping. Remediating the low risk spans would be disproportionate and not meeting ALARP. Some individual spans may only marginally breach clearances so could be made safe by restricting vehicle access (which reduces clearance requirements), or installing warning signage.

It is estimated that this option would cost $43.8 million ± 25% ($2021-22).

Option A1 - Remediate low spans, **on lines with high utilisation**, per low span risk assessment methodology to the line design temperature. [NOSA N2609, OFS N2609A].

The lines in option A have been further prioritised based on the expected maximum utilisation, indicating the likelihood of breaching the clearance requirement under credible contingency scenarios on the network.

Based on the prioritisation, only Lines 1, 2, 3L, 4 and 5 remain in the scope of work for 2024-2028 Regulatory Period due to the high utilisation of the lines. This assessment is detailed in Appendix D.

It is estimated that the total costs for Option A1 would be $19.3 million ± 25% ($2020-22).

The breakdown of low spans for the lines listed in the revised scope is shown in Table 5.

Table 5 - Option A1 (Modified) Line and Low Span Quantity Breakdown

Line Number	Equipment Location	Number of spans in scope for remediation	Number of low risk low spans (no remediation)	Total Project Cost ($m)
1	Upper Tumut to Stockdill	41	7	10.79
2	Ravine to Yass	9	5	2.48
4 and 3L	Yass to Collector (3L)	14	5	3.44
	Collector to Marulan (4)	4	7	0.95
5	Yass to Collector	4	6	1.63
Total		**72**	**33**	**19.30**

3.3 Options considered and not progressed

Table 6 - Options considered and not progressed

Option	Reason for not progressing
Remediate all low spans on selected lines to the line design temperature.	This option would have remediated all low spans to maximum operating temperature regardless of the risk. This capital cost was not considered to be proportionate to the risk and therefore not considered economically feasible.
Derating lines to extent where low span risk is acceptable	Derating lines specified in Option A1 would be unacceptable as there is high market impact for the lines with high utilisation. Hence, this option is not considered feasible for the lines selected in Option A1. There is a potential option for de-rating of line for the remaining listed outside Option A1.

4. Evaluation

4.1 Commercial evaluation methodology

An economic assessment undertaken for this project is not performed as the result does not impact TransGrid's decision to execute this project as it is required to satisfy network safety regulatory obligations.

The relevant parameters used in this commercial evaluation:

Table 7 - Scenario parameters

Parameter	Parameter Description	Value used for this evaluation
Discount year	Year that dollar values are discounted to	2021/2022
Base year	The year that dollar value outputs are expressed in real terms	2021/2022 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	35 years – most of the solutions are D-string insulators. If these are composite longrod insulators then 35 years is expected.
ALARP disproportionality (repex only)	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 the technically feasible options is set out in Table 8. Details appear in Appendix A and B.

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	36.94	(20.38)	(33.54)	1.95	(18.09)	2
Option A1	16.25	(1.29)	(10.30)	16.09	0.80	1

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'), per the regulatory 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) are safe.' TransGrid maintains an Electricity Network Safety Management System (ENSMS) to meet this obligation.[3]

Further, as part of the ENSMS, TransGrid as a network operator should comply with industry standard and best practice. Where TransGrid chooses not to comply the alternative provisions applied must provide an equal or greater safety benefit. 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.

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.

4.4 Preferred option

The lines selected for remediation in this option are of a higher likelihood to breach clearance requirements, which need to be addressed under TransGrid's obligations in tis ENSMS to reduce safety related risks to ALARP and address the legacy non-compliant conductor clearance

The following lines are to have the low span addressed.

Table 9 – Lines in Scope

Line	From	To	Utilisation (% of Line Rating)	Total Capital Cost ($m)
1	Upper Tumut	Stockdill	94%	10.79
2	Ravine	Yass	80%	2.48
3L	Yass	Collector	95%	3.44
4	Collector	Marulan	115%	0.95
5	Yass	Collector	107%	1.63
Total				**19.3**

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

Capital and Operating Expenditure

The required capital expenditure is $19.3 million ($2021-22).

Regulatory Investment Test

If there is uncertainty in the application of a RIT-T, such as for programs, state that 'The program and estimate allow for the appropriate regulatory approvals as required

5. Optimal Timing

In consideration of the delivery requirements and the economic benefit NPV analysis for the need, its optimal timing is 2025/2026

The optimal timing approach undertaken assists in identifying the optimal commissioning year for the preferred option, where net benefits including avoided risk costs and safety disproportionality tests of the preferred option, exceed the annualised costs of the option. The optimal timing assessment considers the delivery requirements of the project and the estimated delivery timeline in the Option Feasibility Study (OFS).

The commencement year is determined based on the required project disbursement to meet the commissioning year based on the OFS.

The results of optimal timing analysis is:

- Optimal commissioning year: 2025/2026
- Commissioning year annual benefit: $1.25 million
- Annualised cost: $1.27 million

Based on the optimal timing, the project is expected to be completed in the 2024-2028 Regulatory Period to address the legacy non-compliance conductor clearance.

6. Recommendation

A total of fifteen 500/330 kV lines from TransGrid's entire fleet were identified as having low spans based on the design temperature. The remediation of low spans has been prioritised based on the utilisation of the lines, which indicates the likelihood of breaching the clearance requirement under credible contingency scenarios on the network.

The preferred option to address these low spans is Option A1. The lines selected for remediation in this option are of a higher likelihood to breach clearance requirements, which need to be addressed under TransGrid's obligations in its ENSMS to reduce safety related risks to ALARP and address the legacy non-compliant conductor clearance.

It is therefore recommended that this option be scoped in detail. Total project cost is $19.3 million, including $1.5 million to progress the project from DG1 to DG2.

Appendix A – Option A – Full Suite

Project Description	Main grid		
Option Description	Option A - Remediate low spans in accordance with low span risk assessment methodology to the line design temperature		
Project Summary			
Option Rank	*3*	Investment Assessment Period	*25*
Asset Life	*35*	NPV Year	2022
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	-20.38	Annualised CAPEX @ Central Benefit Scenario ($m)	Annualised Capex - Standard (Business Case) 2.85
NPV @ Lower Bound Scenario (PV, $m)	-33.54	Network Safety Risk Reduction ($m)	Network Safety Risk Reduction #N/A
NPV @ Higher Bound Scenario (PV, $m)	1.95	ALARP	ALARP Compliant? #N/A
NPV Weighted (PV, $m)	-18.09	Optimal Timing	Optimal timing (Business Case) -1
Cost (Central Scenario)			
Direct Capex ($m)		Network and Corporate Overheads ($m)	
Total Capex ($m)	43.80	Cost Capex (PV,$m)	36.94
Terminal Value ($m)	12.51	Terminal Value (PV,$m)	2.65
Risk (Central Scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	Reliability Risk (Pre) 0.00	Reliability Risk (Post) 0.00	Pre – Post 0.00
Financial (PV,$m)	Financial Risk (Pre) 0.12	Financial Risk (Post) 0.03	Pre – Post 0.09
Operational/Compliance (PV,$m)	Operational Risk (Pre) 0.00	Operational Risk (Post) 0.00	Pre – Post 0.00
Safety (PV,$m)	Safety Risk (Pre) 19.58	Safety Risk (Post) 5.75	Pre – Post 13.83
Environmental (PV,$m)	Environmental Risk (Pre) 0.00	Environmental Risk (Post) 0.00	Pre – Post 0.00
Reputational ($m)	Reputational Risk (Pre) 0.00	Reputational Risk (Post) 0.00	Pre – Post 0.00
Total Risk (PV,$m)	Total Risk (Pre) 19.70	Total Risk (Post) 5.79	Pre – Post 13.91
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 13.91

Appendix B – Option A1 – Reduce Scope

Project Description	Main grid		
Option Description	Option A1 - Remediate low spans, on specific lines only, in accordance with low span risk assessment methodology to the line design temperature		
Project Summary			
Option Rank	*1*	Investment Assessment Period	*25*
Asset Life	*35*	NPV Year	2022
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	-1.29	Annualised CAPEX @ Central Benefit Scenario ($m)	Annualised Capex - Standard (Business Case) 1.25
NPV @ Lower Bound Scenario (PV, $m)	-10.30	Network Safety Risk Reduction ($m)	Network Safety Risk Reduction 1.27
NPV @ Higher Bound Scenario (PV, $m)	16.09	ALARP	ALARP Compliant? Yes
NPV Weighted (PV, $m)	0.80	Optimal Timing	Optimal timing (Business Case) 2026
Cost (Central Scenario)			
Total Capex ($m)	19.30	Cost Capex (PV,$m)	16.25
Terminal Value ($m)	5.51	Terminal Value (PV,$m)	1.17
Risk (Central Scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	Reliability Risk (Pre) 0.00	Reliability Risk (Post) 0.00	Pre – Post 0.00
Financial (PV,$m)	Financial Risk (Pre) 0.12	Financial Risk (Post) 0.04	Pre – Post 0.08
Operational/Compliance (PV,$m)	Operational Risk (Pre) 0.00	Operational Risk (Post) 0.00	Pre – Post 0.00
Safety (PV,$m)	Safety Risk (Pre) 19.58	Safety Risk (Post) 5.87	Pre – Post 13.71
Environmental (PV,$m)	Environmental Risk (Pre) 0.00	Environmental Risk (Post) 0.00	Pre – Post 0.00
Reputational ($m)	Reputational Risk (Pre) 0.00	Reputational Risk (Post) 0.00	Pre – Post 0.00
Total Risk (PV,$m)	Total Risk (Pre) 19.70	Total Risk (Post) 5.91	Pre – Post 13.79
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 13.79

Commissioning year annual benefit ($k): 1273.78

Appendix C Regulatory Compliance Requirements

Identified need	*Common sources of identified needs*
Regulatory compliance examples (non-exhaustive)	**Network safety** - Obligation for network operators to ensure the safety of transmission systems under: **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.' **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; **Australian Standard AS5577-2013: Electricity Network Safety Management Systems** > Section 4.3.4.2 Industry/company codes If the Network Operator chooses not to comply with particular provisions of an industry or company code the Network Operator shall document – (i) The reason for the non-compliance with the code; and (ii) The alternative provisions for the design, construction, commissioning, operating, maintenance and decommissioning of the 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 code. > 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. **Australian Standard AS7000-2016: Overhead Line Design** > Section 3: Electrical requirements Overhead lines shall be designed with electrical clearances from the energized conductor to surrounding objects to provide safe and reliable operation. These objects can be other energized conductors, structures, constructions, plant, vehicles or vessels (watercraft).

Appendix D – Regulatory Compliance Requirements

Line	From	To	Total Project Cost ($m)	Utilisation (% of Line rating)	Included in 2024-20248 Regulatory Period	Comment
5A6	Mt Piper	Bannaby	3.96	20%	No	The low spans on these lines will not be realised until significant augmentation has occurred. Most of this line route is remote
5A7	Mt Piper	Bannaby	4.46	20%	No	
1	Upper Tumut	Stockdill	9.89	94%	Yes	Significant low spans exist. No previous low span project. Line has very high utilisation.
2	Ravine	Yass	2.27	80%	Yes	Significant low spans exist. No previous low span project. Line has very high utilisation.
6X	Upper Tumut	Ravine	NA	80%	No	Only a small number of low risk low spans exist.
3L	Yass	Collector	3.15	95%	Yes	Low spans project previously targeted road crossings only. Current advice from Network Planning indicates that the nominal rating of the line is 880MVA with an operating temperature of 68°C. This ratings would normally require a higher design temperature. Line has very high utilisation.
4	Collector	Marulan	0.87	115%	Yes	
5	Yass	Collector	1.50	107%	Yes	
23	Munmorah	Vales Point	0.49	80%	No	Low span is a road crossing introduced by distributor undercrossing which has since been relocated. If the low span was introduced it will be address in the proposed rebuild (Need 1408).
24	Eraring	Vales Point	1.23	52%	No	Low utilisation. Violation is minor.
76	Wallerawang	Sydney South	0.73	63%	No	Utilisation below maximum design temperature. Violations are minor. Low access frequency at violation locations.
77	Wallerawang	Ingleburn	3.6	59%	No	
9W	Tomago	Waratah West	0.58	27%	No	Utilisation below maximum design temperature. Only one violation over swampy area between industrial developments.
11	Sydney South	Dapto	3.1	60%	No	Line previously only remediated to 65°C. Low spans will be addressed as part of proposed rebuild (Need 1600).
12	Sydney South	Liverpool	3.54	49%	No	Line previously only remediated to 65°C, current FY2020 TAPR utilisation requires 73°C. "Rural residential", some farmland.
500 kV D-string and structure replacement solution			0.7		No	Not needed until 500 kV ring is built and significantly utilised.