Approach to Low Span Remediation

Revised Revenue Proposal

Approach to Low Span Remediation

Capital Expenditure – Low Spans Remediation Portfolio

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Introduction

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. The term used to describe the distance between the ground, objects and the high voltage conductor is called “clearance”.

The clearance provided for in the relevant standards allows for people, animals, vehicles, plant and equipment to safely pass under the conductors of the transmission line. The clearance takes into account the height of the person or object and the distances that the electricity can jump under various circumstances.

TransGrid has identified, using modern survey technology and line modelling techniques, over 2000 spans that, based on accurate measurement, do not meet the minimum safety clearances between the transmission line conductors and ground. These assessment of clearances has been calculated on the basis of design and technical standards that applied when the assets were built (which may be different from present standards). The variation of clearance deviations is between 0.4 to over 3 meters.

The risk TransGrid and the public are exposed to as a result of low spans is:

- Injury/Fatality - resulting from people and/or vehicles passing under or near transmission line low spans. Unlike household power supply, TransGrid’s power lines can cause injury when people are close to (as well as in contact with) conductors.
- Bushfire Risk - The risk that vegetation (eg trees) will make contact with power lines and cause a spark potentially initiating a fire.

TransGrid believes, consistently with the Work Health and Safety Act 2011, that this risk is not acceptable and actions are required to minimise this risk as low as reasonably practicable.

TransGrid has proposed capex to address 712 of these low spans assessed as higher priority. The availability of high accuracy survey information becoming available in the previous RCP has enabled the identification of high risk transmission line low spans. The resulting remediation works identified have led to a significant increase in the low span remediation expenditure compared to that in previous regulatory control periods.

In the revenue proposal, TransGrid proposed $78.5m to remediate the higher priority low spans in 2014/15-2017/18. This equates to an annual increase of approximately 37 cents per year for an average residential bill.

Summary of Draft Decision

In the draft decision, the AER reduced the scope of the low spans safety program by 85%, stating the value of bushfire and personal safety risk didn't justify the cost of the remediation program. The AER accepted that the driver for the low spans program of works was valid, but questioned the basis of TransGrid's assessments including:

- High level risk calculation – the AER felt that this should have been assessed at a more granular asset risk level rather than at a low span program level
- safety clearance distance calculations and whether TransGrid had used the appropriate technical and design standards to determine these
- the number of spans proposed to be rectified in the remediation works and the options considered to do this (for example, why temporary solutions were dismissed as unsuitable long term solutions)
- whether there any consideration of deferral of works tospread the work load over a longer time period and
- whether there was there an assessment of the appropriateness of the level of expenditure compared to the risks of leaving the assets in their current state

The AER's rationale assumes that because TransGrid's assets haven't resulted in serious injury, fatality or started a bushfire until now, that TransGrid doesn't have a legitimate need to mitigate the risk of these serious consequences occurring.

Response to Draft Decision

TransGrid does not accept the AER's draft decision in relation to low spans. TransGrid asserts that the program of works is both prudent and efficient to meet TransGrid's duty of care and public responsibilities. TransGrid adopted sound practices to ensure the integrity of a detailed technical assessment that led to a prioritised risk based program that best meets the needs of consumers and contractors, taking into account TransGrid's duty of care[1] for their safety. This program of works was externally reviewed by expert engineering firm GHD, prior to the submission of the revenue proposal, to ensure it was appropriate, targeted and prudent.

The process for determining the program of Low Span Remediation works was extensive and is set out as follows:

1. Modelling Transmission Lines

TransGrid commenced the works by determining the rating of it's transmission lines based on design and technical standards applicable at time of construction. The application of a new technology, Aerial Laser Survey (ALS), allowed detailed data collection and modelling.

TransGrid commenced the works by using the ALS to model transmission lines in the industry standard transmission line design software, PLS-CADD®. Initial surveys were carried out for line project design purposes in 2007, and results from these surveys showed a number of low spans on these lines. The decision was made to expand the surveys to all lines to determine the extent of the low span problem. The surveys and modelling were completed in 2010.

This modelling process included:

[1] Work Health and Safety Act 2011 No 10 19 Primary duty of care

i. *ALS mapping of transmission lines to a relative accuracy of 2cm between laser point measurements.*

ii. *Simultaneously collecting weather data including, wind speed and temperature,*

iii. *Extracting the power flows on the transmission lines at time of survey from TransGrid's SCADA system*

iv. *Using industry standard methodology to match line survey data, weather conditions and line power flows to construct 3D models of the transmission lines in industry standard program PLS-CADD®.*

v. *Use the PLS-CADD® line models to measure the clearances to ground, vegetation, other lines etc at existing published line ratings. A 100mm reduction in ground clearance allowance is made to account for any inaccuracy of the line models.*

Use of ALS is good electricity industry practice. It is extensively used within the NEM including Ausnet Services, Powerlink, TasNetworks and SA Power. Internationally ALS is used in Canadian utilities BC Hydro and Manitoba Hydro. The North American Electric Reliability Council (NERC) required all North American utilities to *"review (clearances) …and take corrective action if necessary…new technologies (ALS/LiDAR)…allow entities to more easily assess their lines."*[2]

2. Identify high risk transmission line spans:

The AER has appears to have misunderstood TransGrid's processes that assess all line clearances against original design standards. This is addressed in the capex documentation, for example OFS (*0595 Central Tower Lines Low Spans _Public.pdf page 5 Section 2.1*):

> *"A span is deemed low if the clearance is lower than was specified in the relevant standards at the time of construction."*

Where lines have been found to be non-compliant, remediation work is proposed to be completed to current AS 7000 standard which in some instances higher and others lower than the original design clearances. AS 7000 is a relevant Australian standard because:

1. Under Clause 13(1) of the *Electricity Supply (Safety and Network Management) Regulation 2014*, the Director General of NSW Trade & Investment has advised TransGrid that it must take into account the *Electricity Transmission and Distribution Asset Management: Code of Practice* in its Network Management Plan. This code of practice cites the guideline C(b)1, which has since been superseded by AS 7000, as a standard that applies to overhead line clearances.

2. Where existing overhead lines are proposed to be altered such that elements of the overhead line may be overloaded or overstressed to the original design standard, then the line is required to be assessed for compliance with the provisions of AS 7000.[3]

The clearances from the laser surveys were compared to both required design clearances and the required clearances during observed historical power flows. Over 2000 spans were identified as having clearances less than the minimum safety clearances and 712 spans were identified as being high priority and requiring remediation in the next five years. Lower priority spans can be prudently deferred to a subsequent regulatory control period, when demand forecasts are more certain.

High priority spans are:

[2] NERC FAC-008 http://www.nerc.com/ accessed 2014-12-10.
[3] AS/NZS 7000:2010, *Overhead Line Design – Detailed Procedures*, 2010, p7.

- spans identified as below original design clearance requirements at existing loadings;
- spans on transmission lines identified in the network capability incentive parameter action plan (NCIPAP) for the installation of dynamic line ratings or uprating of terminal equipment, to ensure that the market benefit of the NCIPAP is not impacted; and
- all low spans on transmission lines where over 50% of the low spans are priority spans.

Ground clearance remediation is only triggered on spans where the clearance at published line ratings is lower than that of the standard at the time of construction, and only then when it is more than 0.1m lower than these requirements to allow for tolerance in the PLS-CADD® model. In the case of a 330kV line built prior to 1991, it is reviewed for clearances lower than 7.6m.

The following references detail the clearance deviations:

i. 0593 Northern Tower Lines Low Spans _Public.pdf
ii. 0596 Central Pole Lines Low Spans _Public.pdf
iii. 0598 Southern Pole Lines Low Spans _Public.pdf
iv. 0594 Northern Pole Lines Low Spans_Public.pdf
v. 0597 Southern Tower Lines Low Spans _Public.pdf
vi. 0595 Central Tower Lines Low Spans _Public.pdf
vii. 0129 Line 992 Burrinjuck to Tumut Low Spans Remediation_Public.pdf
viii. Line 97K Cooma to Munyang Low Span Remediation
ix. 0379 97G Murray-Guthega 132kV TL Remediation_Public.pdf
x. 0129 Line 992 Burrinjuck to Tumut Low Spans Remediation_Public.pdf
xi. 0131 Line 993 Gadara to Wagga Pole Replacements_Public.pdf
xii. 0532 4-5 Yass - Marulan 330kV Line Remediation_Public.pdf
xiii. 0533 Snowy-Yass - Canberra Line Remediation_Public.pdf

TransGrid's analysis has identified a foreseeable risk to injury of persons and property as a result of high risk low spans. TransGrid is obligated to take action as outlined below.

3. Incorporate Regulatory and Statutory Requirements

TransGrid operates under the National Electricity Rules (NER). The NER requires TransGrid to "*maintain and operate … all equipment that is part of its facilities in accordance with:*

1. relevant laws; - WHS Act 2011, EPA Act

3. good electricity industry practice and relevant Australian Standards. "[4]

The relevant standards in assessing the remediation on transmission lines are both

xiv. the standard that applied at the time of construction (*C(b)1 published 1974, C(b)1 1991* depending on time of construction) and

xv. the current standard *AS 7000 Overhead line design—Detailed procedures*.

TransGrid has assessed all of its transmission lines to identify spans that do not meet their original design clearances between the conductors and ground. Some transmission lines were

[4] NER www.aemc.gov.au; Section 5.2.1(a) 'Obligations of Registered Participants'

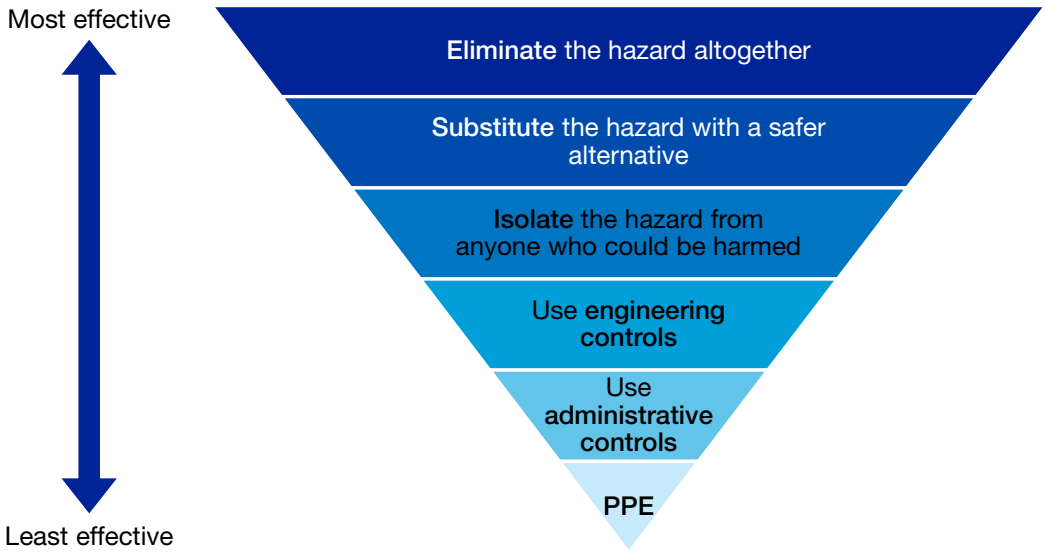
built under previous design standards that specified lower clearances than AS 7000. TransGrid does not propose to remediate spans that meet their original design standards.

Where TransGrid has identified transmission line spans that do not meet their original design standards, it has an obligation to remediate those spans to ensure compliance with the original design standards. However, when remediating those spans, if there is potential for them to be overloaded or overstressed to the original design standard, they are required to be assessed for compliance with the provisions of AS 7000, as noted above.

TransGrid is bound by the Work Health and Safety Act 2011. The Act states that *"A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking*[5]*."* Workcover defines *"reasonably practicable"* as *"doing what is effective and possible to ensure the health and safety of workers and others"*[6].

To assist business in interpreting and applying these principals, the NSW Government Workcover body has developed the *"hierarchy of controls"*[7]. The hierarchy of controls outline different ways to deal with health and safety, starting with the most effective means at the top and then detailing the less effective means as the list progresses. Workcover states that

> *"when deciding how to deal with a health or safety issue … (**an) employer should first aim to eliminate the hazard altogether**. When that's not possible, they should aim for the next (most effective) option down the (hierarchy of controls) and so on." [emphasis added] "When that's not possible, they should aim for the next option down the list – and so on"*[7].



Source: TransGrid and Workcover NSW.[8]

[5] Work Health and Safety Act 2011 No 10 http://www.legislation.nsw.gov.au/maintop/view/inforce/act+10+2011+cd+0+N NSW Legislation; Division 2 Primary duty of care Clause 19(2); accessed 12/10/2014
[6] Reasonably practicable http://www.workcover.nsw.gov.au/newlegislation2012/Employersandbusinesses/Pages/reasonablypracticable.aspx NSW Government Workcover; accessed 10/12/2014
[7] Work Health and Safety Risks - Code of Practice; http://www.workcover.nsw.gov.au/formspublications/publications/Documents/how-manage-work-health-safety-risks-code-of-practice-3565.pdf; accessed 10/12/2014
[8] Workcover NSW, Hierarchy of Controls, Catalogue No WC02089.

The identified hazard in relation to low spans is persons, animals, vehicles, plant or equipment under a part of a line that does not meet standard clearances. To eliminate the hazard altogether, TransGrid would de-energise all transmission lines.

To substitute the hazard would mean replacing the asset with a safer alternative asset, for example underground cables. The cost of replacing the asset with a safer alternatie is "grossly disproportionate"[9] to the risk and therefore not reasonably practicable.

Isolating the hazard from anyone who could be harmed requires the transmission lines to meet the required standard ground clearances as this brings the hazard to a standard level for all electrical infrastructure. This requires TransGrid to remediate the lines to meet the required standard ground clearances for any low spans identified at existing loadings.

Essential Energy v Courts[10] *states that "the duty (of care) arises because of the risk of harm posed by the presence of the uninsulated power line(s)".* If TransGrid was able to forsee the risk and didn't implement any controls it would be found negligent and likely to be fined accordingly as the case of *Essential Energy v Courts* demonstrates.

4. Identification of Options

The estimates for the low span program of work are based on techniques that are feasible, practicable, economic and that are compliant with legislation. All the options identified by the AER[11] have already been evaluated in the detailed scoping phase for low span works, specifically landscaping, insulated cross arms, conductor re-tensioning, dynamic rating, de-rating, fencing and signage.

Further the AER has inferred that TransGrid should only pursue options that are less than the cost of risk caused by the assets. This contradicts the Workcover Code of Practice that states that costs get taken into account only after all the other factors (consequence, etc) have been taken into account.

> *"The greater the likelihood of a hazard occurring and/or the greater the harm that would result if the hazard or risk did occur, the less weight should be given to the cost of controlling the hazard or risk. Cost cannot be used as a reason for adopting controls that rely exclusively on changing people's behaviour or actions when there are more effective controls available that can change the risk through substitution, engineering or isolation."* ***Error! Bookmark not defined.***

The AER is proposing mitigation measures that TransGrid has assessed and found not to be compliant with legislation. Each option identified was assessed as per the Code of Practice[12]. A summary of the options are in the table below.

[9] Work Health and Safety Act 2011; Subdivision 2 What is reasonably practicable Clause 18(e)
[10] Supreme Court of New South Wales *"Courts v Essential Energy (aka Country Energy)"* paragraph 51; [2014] NSWSC 1483
[11] Draft decision: TransGrid transmission determination 2015-18 | Attachment 6 Page 6-43
[12] How To Manage Work Health And Safety Risks Code of Practice - http://www.workcover.nsw.gov.au/formspublications/publications/Documents/how-manage-work-health-safety-risks-code-of-practice-3565.pdf Page 15 Accessed 12/12/2014.

Hazard Reduction Method	Level of Control	Effectiveness at reducing risk
Decommission transmission line	*1 Eliminating the hazard and associated risks*	*The most effective control measure is to eliminate the hazard and associated risk.* *This is not feasible as the hazardous asset is required to provide transmission services*
Increase Height: • ***landscaping,*** • ***conductor re-tensioning,*** • ***insulated cross arms,*** • ***increasing tower/pole height***	*2.Isolate the hazard from people and* *Use engineering controls*	*If it is not reasonably practicable to eliminate the hazards and associated risks, the entity should minimise the risks. Increasing the height of the hazard make it very difficult for a person to approach a hazard making the control measure very effective.*
De-rating	*2.Isolate the hazard from people and* *Use engineering controls*	*Reducing the rating of the line increases the clearances during operation of the equipment and is also an effective control measure.*
Fencing	*2.Isolate the hazard from people and* *Use engineering controls And* *3. Administrative controls (relying on people to not dismantle fencing, drive through it, etc).*	*Less effective than placing a physical barrier (isolation control) keeping people away from the hazard. However, fencing is reliant on the integrity of the fencing to be maintained. To use fencing as a control it would need to be permanent and non-trafficable similar to substation fencing with monitoring i.e. security cameras.*
Signage	*3. Administrative controls (i.e. train the public to not approach low spans)* *"Exclusive reliance on administrative controls and PPE must only occur where other measures are not reasonably practicable or as an interim control while the preferred control measure is being implemented."*[13]	*Least effective. These control measures do not control the hazard at the source. They rely on human behaviour and supervision, and used on their own, tend to be least effective in minimising risks.* *For example signage relies on the person to make the decision to take action observe and read the sign.*
Insurance, taking on risk	*Not an acceptable hazard control.*	*Cost cannot be used as a reason for doing nothing and where the risks are extreme (death or serious injury likely) it is unlikely that Workcover would view the cost of control as disproportionate to the risk and thus the best option would be to cease the activity or implement a more effective control measure.* ***Error! Bookmark not defined.***

Table 1 – Risk Assessment as per WHS 2011 Act

[13] Managing Electrical Risks In The Workplace Code Of Practice http://www.workcover.nsw.gov.au/formspublications/publications/Documents/managing-electrical-risks-code-practice-3836.pdf

The suitability of low level controls for high risk assets was questioned in the NSW Supreme Court following an electrocution of a truck driver in 2008:

> *"Justice Christine Adamson found Country Energy, which installed the power line, had a duty to take reasonable precautions to prevent contact between people, vehicles and the line.*
>
> *He said the accident would not have happened had the power line been six metres high, in accordance with Country Energy's own design guidelines."*

The NSW Supreme court decision demonstrates that forseeing the risk and inaction, signage, or other level 3 controls are inadequate for hazards associated with electricity assets.

The AER should consider TransGrid's obligations under the law, as demonstrated in the recent case Courts v Essential Energy.

A reasonable person in the position of (a electricity utility) would have taken that precaution because (of) the likely seriousness of the harm (death by electrocution or serious electric shock), the burden of taking such precautions …(is) not prohibitive and the social utility of the provision of electricity (requires) … their use[14].

Further the failure to take the reasonable precaution … so as to give a ground clearance in accordance with its design was negligent and caused an immediate risk of harm to persons passing under the line[15]. That the risk of harm did not ensue for a period of … years following its construction was a matter of chance and neither undermines the risk of harm, nor its seriousness.

In summary the court found that it is not acceptable for electricity utilities that are aware of their assets having high risk low spans to not remove the risk on the basis that there is a low likelihood of an incident occurring and should undertake remedial action to increase the height of the spans.

5. Selection of Options

TransGrid's Network Investment Process involves two stages of feasibility and estimating studies. The first stage involves desktop estimates used to evaluate options against each other and identify the most economical solution in the case of lines or sections of low spans. These estimates include assumptions that are based on previous detailed estimates and similar projects in progress or completed.

TransGrid evaluates the cost effectiveness of control measures during the detailed feasibility and estimating stage. For example during the scoping of line 97G Murray to Guthega and 97K Munyang to Cooma it found a combination of control measures were most cost effective to achieve the required safety clearances.

Assessment of options during options evaluation

At the conclusion of the Aerial Laser Survey contract, there were 2,800 spans identified with clearance violations at maximum design temperature spread across 82% of TransGrid's transmission lines. A database was then developed to prioritise the portfolio by identifying high priority spans with clearance violations at existing power flows. This short listing process resulted in 712 high priority spans identified for remediation in the next five years. The estimated remediation measures for each of these spans was assumed based upon ranges of clearances required. On steel tower lines (generally 330kV), insulator rearrangements were considered appropriate for violations under 1.5m, and costed as being required on towers either side of the violating span, but a single structure replacement was costed for span violations greater than 1.5m. On pole lines (generally 132kV), insulator rearrangements are

[14] Supreme Court New South Wales, Courts v Essential Energy (aka Country Energy), 29 October 2014, paragraphs 51
[15] Cf. Sydney Water Corporation v Turano [2009] HCA 42; 239 CLR 51 at [49]

generally not suitable for gaining clearance , so structure replacements were considered as the only option for initial pricing estimates. The detailed project scoping phase will consider the detailed design of specific treatments of individual structures.

A summary of the various methods are detailed below:

i. Landscaping

Landscaping involves civil works to displace soil and rock from underneath a high risk span. Landscaping is a viable solution where the area to be landscaped is less than less than 100 meters squared and not in environmentally sensitive areas such as national parks, state forests, environmental conservation areas.

Landscaping may not be an option where the land is used for agriculture. The agreement with landowners, an easement[16], allows TransGrid to undertake particular activities for example access to inspect and maintain its lines and TransGrid would need agreement from the landowner to undertake landscaping. Such an agreement may not be reached as landscaping would disrupt the use of the land, for example agriculture.

ii. Fencing

Fencing as a safety control is viable when the fixtures are permanent, non-trafficable (not able to be breached to prevent theft, thoroughfare of landowners and so forth).

TransGrid does not own the majority of the land where its transmission lines are located, and is allowed to access the private properties to inspect and maintain the lines through an 'easement' agreement. These provide TransGrid with a right of way over a person's property. However, easements do not provide TransGrid with the right to permanently restrict access to any area of a person's property. Consequently, this precludes the installation of permanent fencing in some areas of low span violations. For fencing to be feasible alternative land tenure rights would need to be agreed with property owners. The most common form of obtaining suitable land tenure to install permanent fencing (and restrict access to a property) would be by means of acquisition of portions of land where fencing would be installed. This increases the costs for permanent fencing as in addition to the cost of erecting permanent fences the following are also required:

The compensation costs to land owners for acquisition of land for each violation site

- Reasonable costs incurred for valuations of land by TransGrid and the land owner for each respective fencing location
- Resources to negotiate with land owners and facilitate acquisition process.
- Legal costs for land owner negotiations and executing Transfer documentation for registration by the NSW Land & Property Institute (LPI)
- Surveying of properties to prepare and submit Plan of Acquisitions.
- Lodgement and Stamp Duty costs for submission of Plan of Acquisition and Transfer documentation to the NSW LPI
- Ongoing costs associated with ongoing maintenance and serveilance of the newly acquired land and constructed fencing.

[16] Easements, NSW Government Land and Property Information - http://rgdirections.lpi.nsw.gov.au/land_dealings/dealings_involving/easementsgeneral. Accessed 24/12/2014.

In instances where TransGrid has erected fencing approval has been granted by the landowner on the basis that it is temporary and understanding that it will be replaced by a permanent solution, i.e. increasing the clearance by methods i, iii, iv and v.

iii. Conductor Re-Tensioning, Insulator Rearrangements, Increasing Tower/Pole Height

Where feasible and economical, these are effective control measures as they increase the height of the conductor above the trafficable land with the minimum disruption.

Retensioning – involves shortening the length of the cable between two structures. This is a viable solution when the structure is in good condition and has sufficient strength to take the increased tension caused by a shorter (tighter) conductor.

Insulated cross arms – this involves installation of an extension to the cross arms or replacement with a longer arm where there is not adequate strength. Insulators are then used to lift up the conductors rather than hanging (suspending) underneath. Alternatively, instead of the conductors being vertically on top of each other, the top insultated arm can be lengthed so that the three conductors are horizontally spaced at the top of the pole.

Increasing Pole Height – this involves raising the earthwire (lightning protection wire) above the top of the pole using an insulated riser and moving the cross arms up the pole. In some cases this involves improving the access of construction vehicles (eg mobile platforms) by modifying the access tracks to the structures.

iv. Pole Replacement

Pole replacement increases the height of the conductor above the trafficable land by replacing a shorter structure with a taller one. Previous studies (for example, Line 96C Armidale to Coffs Harbour Uprating) have shown that structures need to be replaced to gain large height increases. For example, on 132kV transmission lines in order to achieve an increase of height of greater than 1.5m clearance to ground, pole replacement is required. In the instance of line 96C this option was economic for 28 of 227 spans requiring remediation.

v. De-rating, Dynamic Line Rating

TransGrid has over 14,650 spans that were assessed by ALS and of these 2000 did not meet the relevant design standards. De-rating is suitable for the spans not included in the priority portfolio as the reduced ratings allow the transmission network to deliver the forecast load. However reducing the rating of spans included in the priorty portfolio may impose constraints on the electricity market as they do not meet safety clearances on the basis of PLSCADD modelling using historical loading (peak energy demand).

Dynamic line rating will result in variable line ratings based upon observable weather conditions and the ALS clearances. Use of dynamic line ratings would need to be where spans are not remediated and adjusted for the ALS data resulting in a reduction of the range of line capacity. For spans not assessed as high priority, dynamic line rating is a credible option.

TransGrid uses a combination of methods are used to increase line clearances, for example projects 96C Armidale – Coffs Harbour Uprating and 97K Munyang – Cooma Rehabilitation use landscaping, conductor re-tensioning, insulated cross arms, tower/pole extensions methods. These are documented in the detailed scoping studies submitted with the revenue proposal.

6. Basis of the proposed program of work

In a basic sense, the current standard for overhead line design is AS/NZS 7000:2010 – "Overhead Line Design – Detailed Procedures". The extent that this standard applies to existing assets states is:

> *"where existing overhead lines are proposed to be altered such that elements of the overhead line may be overloaded or overstressed to the original design standard; then the overhead line shall be assessed for … compliance with the provisions of this Standard."*

The majority of requirements in this standard relate to providing the physical requirements for the overhead line design to make sure that it can withstand the various environmental conditions that it will be subject to in its lifetime. It is *"not intended to be retrospectively applied to routine maintenance and ongoing life extension of existing overhead lines"*, and TransGrid is not applying this standard to the maintenance and life extension of existing lines.

Whilst TransGrid's high level scoping and estimates assume AS 7000 as the projects progress to detailed design and scoping stage consideration is given to the most economic option taking into account compliance with AS 7000 but also the original design standard, the current strength of the existing line (as this changes over time) and the expected operating conditions. In particular, Line 97K, for which the remediation work is in detailed design phase, has the remediation work designed to original design standard as this is the most economic and prudent solution factoring in the anticipated service conditions.

With regard to low span remediation, any work that involves raising the conductors (i.e. insulator rearrangements, pole extensions, replacement poles) can introduce additional loadings to the physical requirements for the overhead line, generally through increased line tensions. This can result in a requirement for reassessment of the line. Once this detailed review is undertaken, the requirements of the standard in terms of ground clearances also applies.

The changes to ground clearances from earlier standards are only minor relative to the low span violations. The changes to the ground clearance requirements over the prior standards are as follows:

Standard	132kV	220kV	330kV
C(b)1 until 1991	6.7m	7.6m	7.6m
C(b)1 1991 and on AS7000	6.7m	7.5m	8.0m
Variance	0m	-0.1m	0.4m

Table 2 – Comparison of Clearances between AS 7000 and Previous Design Standards.

Ground clearance requirements under these standards remained the same under all revisions up to and including the 1974 C(b)1, in which all lines at voltages greater than 132kV had a single ground clearance requirement. From the publishing of the revised C(b)1 in 1991 to AS7000, the clearances for lines up to 132kV remained the same, but lines greater than 132kV have separate clearance requirements, to account for the increasing risk as voltage increases, for 220kV, 330kV and 500kV lines. The low span program of work includes 132kV, 220kV and 330kV lines which have relatively small changes in required clearances from previous standards.

7. Consideration of Deferral

In prioritising the quantum of spans with safety clearance violations, TransGrid prioritised spans by classifying them as priority spans or eligible for deferral on the following basis:

i. Priority Spans

Spans with clearance violations based on:

- The original design standard - *c(b)1 Guidelines for design and maintenance of overhead lines*
- the last 12 months of power flows for each span

AND either

- Ground/road/track – clearance do not meet AS 7000 clearances
- ORUndercrossings – Clearance does not meet the AS 7000 flashover distance.

ii. Eligible for Deferral

Spans with clearance violations based on:

- the original design standards (c(b)1 Guidelines for design and maintenance of overhead lines)
- design temperature (power flows) and/or forecast power flows.

will be de-rated and deferred until they meet the priority criteria.

N.B. Undercrossings refer to the clearance (distance) between two transmission lines, one of which passes under the other.

This process of prioritisation reduced the 2000 spans requiring remediation to 712 spans over the next five years. Stage one requires High Priority spans to be addressed first as they can not be remediated by de-rating asthey are classified as low under contingent loading and future operating conditions and present a risk under present normal operating conditions

8. Value of Risk

In the draft decision, the AER estimated the risk to which TransGrid is exposed by low spans as $5 million. The estimate was based on information in a report TransGrid had commissioned from Marsh on insurance and self insurance.[17] The methodology used by Marsh considered past loss history and only includes the recorded direct financial impact of past losses relevant to external insurance and self-insurance.

Conversely, TransGrid's risk assessment methodology takes a broader perspective, looking at potential future losses and assesses the risk against a number of categories of risk including cost, operational, reliability, environment and safety to assign a value of risk.

Accordingly, TransGrid's value of risk is a combination of direct and indirect future losses, rather than the value of past direct losses used by the AER. TransGrid considers that its value of risk more appropriately reflects the value of risk from all risk factors.

A recent example of the value of risk by the community is the settlement determined by the Victorian Supreme Court for the 2009 Kilmore East Kinglake (Victoria) bushfire

[17] TransGrid, *Revenue Proposal 2014/15 to 2018/19: Appendix T*, 2 June 2014.

consequences, in which the electricity network was a factor. The court approved a $494 million payout to victims of the deadly 2009 Victorian bushfires.

TransGrid's proposed low span portfolio is in response to its obligations as per its duties as an electricity authority to take reasonable care with respect to construction of power lines to achieve appropriate ground clearance[18] which, unlike the AER's draft determination, has been developed taking into account its duty of care responsibilities.

Concluding comments

TransGrid has a duty of care to provide a safe and reliable electricity network and if action isn't taken to increase the clearance there remains a foreseeable risk[19] that any low span violations may result in injury to persons, property and/or a bushfire risk.

TransGrid rejects the draft decision adjustment to the low span program of works on the basis of risk because it disregards the value consumers place on safety and TransGrid's safety obligations. TransGrid reinforces that a careful, detailed and deliberate analysis of risk has been undertaken resulting in a targeted, prioritised program of work that meets the long term interests of consumers.

[18] Courts v Essential Energy (aka Country Energy) [2014] NSWSC 1483
[19] Civil Liability Act (2002) S 5B:(1) Principles of Negligence