TS 03740:2.0

T HR EL 00004 ST

Standard

Buildings and Structures Under Aerial Lines

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Document information

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Document history

Revision	Effective date	Summary of changes
1.0	08/05/2014	First issued as T HR EL 00004 ST version 1.0.
1.0	29/10/2021	Renumbered as TS 03740:1.0. Version number recommenced in line with new designation. Changes to previous content include • updates to reflect organisational changes and resulting changes in responsibilities • minor amendments and clarification to content • conversion of the standard to AMB numbering, format and style.
2.0	10/06/2025	Second issue revisions include addition of a risk assessment process, and changes to the document title and scope to improve clarity.

Preface

This standard is the second issue as TS 03740.

This document sets requirements for all buildings and structures under TfNSW aerial lines within and outside the rail corridor.

This document provides an understanding of the minimum considerations when conducting a risk assessment for buildings and structures under aerial lines and provides references to the relevant standards.

The changes from the previous issue include:

- change in title from Buildings and Structures under Overhead Lines to Buildings and Structures Under Aerial Lines
- changes to the scope to provide clarity on structures and buildings and application of standard
- a risk assessment process added to give clarity on the risk analysis, mitigation control and SFAIRP design.

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1 Scope

This document provides requirements for the identification and management of risks related to buildings and structures under aerial lines. This document includes provisions in relation to the risk assessment process, stakeholder consultation and the governance roles of both the AMB and the relevant ENO.

The words building and structure in this document are interchangeable and refer to, but are not limited to, the following:

- permanent or temporary buildings and structures either open or enclosed where members of the public or workers can occupy or congregate, for example,
    - railway station buildings and platform structures, train depots and maintenance facilities
    - structures frequented by members of the public, for example, building awnings, bus shelters and interchanges, pedestrian footbridges
    - walk-in signalling equipment huts, telecommunications equipment rooms and substation buildings
- structures that have the possibility of transferring voltages, for example:
    - bridges with galvanically attached buildings (such as through structural connections, lighting circuits, water pipes or through proximity)
    - metallic enclosures (such as padmount substations that supply high-risk public locations, for example, railway stations)
- high risk structures such as above ground conductive water or fuel tanks.

  Note: although other conductive structures such as parallel fencing and buried services in the vicinity of aerial lines have the potential to transfer EPR in the event of a fallen conductor they typically do not carry the same risk as buildings or conductive structures which are a high risk of direct contact in the event of a fallen conductor.

For low-risk conductive structures under aerial lines such as fencing and buried structures these shall be assessed by an earthing and bonding design TAO to ensure that the minimum practicable measures are in place where required.

2 Application

This document applies to the following newly constructed or modified assets:

- TfNSW buildings, structures under any TfNSW or third-party aerial lines or TfNSW aerial lines over any buildings or structures
- privately owned buildings and structures under existing TfNSW aerial lines
- shared poles that support the aerial lines managed by both the Asset Steward – operate or maintain and third-party ENO. In such cases the relevant third-party ENO requirements will also apply. Any conflicting requirements may be managed via the concession process.
- both HV and LV aerial lines.

  Note 1 for the purpose of this document the area under an aerial line is inclusive of blowout conditions. If, when using this document, it is considered that the intent of a stated requirement is not clear, a clarification should be sought from the Director Energy Networks & Systems, AMB.

  Note 2 any new or modified third party aerial lines crossing TfNSW may comply with industry guidelines and rules of the third-party ENO but will require stakeholder consultation with the TfNSW Asset Steward responsible for the building or structure.

This document is not applicable to the following structures and buildings:

- OHW portals, cantilever masts and gantries
- non walk-in signalling or telecoms assets
- underground structures such as tunnels
- emergency works to existing assets under emergency situations which are covered under the ENSMS of the ENO. Where the emergency works result in a non-compliance to this standard AMB shall be notified as soon as practicable for determination.
- temporary structures such as scaffolding and mobile plant and equipment which are covered under the ENSMS of the ENO.

This document should be read in conjunction with:

- TS 03770 which provides requirements for buildings and structures under HV aerial lines
- TS 03743 which provides requirements for earthing and bonding at overbridges and footbridges in DC traction networks with HV bare aerial conductors located above
- TS 00103.2 which provides requirements for earthing and bonding at overbridges and footbridges in AC traction networks.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Australian standards

AS 5577 *Electricity network safety management systems*

AS/NZS 7000 *Overhead line design*

Transport for NSW standards

TS 00003.1 *Concessions to Transport Standards – Part 1 Concession Process*

TS 00006 *HV Earthing Design*

TS 00103.2 *25 kV AC Traction System – Part 2 Earthing and Bonding*

TS 03743 (T HR EL 12005 ST) *Bonding for 1500 V DC Traction Systems*

TS 03756 (T HR EL 20009 ST) *Testing of HV AC and 1500 V DC Cables*

TS 03769 *Management of Activities Within Sydney Trains Distribution System Easements and Close to the Sydney Trains HV Distribution System*

TS 03770 (T HR EL 10001 ST) *HV Aerial Line Standards for Design and Construction*

TS 04982 *TfNSW Risk Criteria for External Organisations*

TS 04985 (T MU MD 20003 GU) *Quantified Safety Risk Assessment*

Legislation

Rail Safety National Law (NSW) 2012 (NSW)

Work Health and Safety Act 2011 (NSW)

Other referenced documents

Department of the Prime Minister and Cabinet, The Office of Impact Analysis, 2024, *Value of statistical life*

Energy Networks Australia *ENA Doc 025-2022 Power System Earthing Guide (EG-0) Part 1: Management Principles*

Industry Safety Steering Committee, ISSC 20 *Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure*

Sydney Trains, SP D 79035 *Sydney Trains Electricity Distribution Network Management Plan*

TfNSW, 2023, *TfNSW Cost Benefit Analysis Guide – For all TfNSW Divisions and Agencies*

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document.

ABC aerial bundled cable

aerial lines bare aerial lines including LV, 11 kV, 33 kV, 66 kV and 132 kV

AMB Asset Management Branch

Asset Steward the entity responsible for:

- procuring assets from investment decision to commissioning
- delivering the benefits
- translating requirements from the client and managing delivery outcomes
- selecting the most appropriate supplier(s) to meet project objectives

Asset Steward – operate or maintain the entity responsible for the day-to-day operations and maintenance of assets once commissioned. May be a part of the asset custodian division or a separate entity. Operator and maintainer of the assets might be separate entities.

Blowout aerial line conductor horizontal sag inclusive of insulator swing component determined for the electrical power frequency clearance condition.

Cable an insulated wire or wires used for transmitting electricity

CAPEX capital expenditure

dc direct current

DNSP distribution network service provider. ENO or NO of a distribution system only.

ENO or NO the energy network operator or network operator is a transmission operator or distributor who operates any electricity transmission system or distribution system.

Emergency means an emergency due to an actual or imminent occurrence (such as fire, flood, storm, earthquake, explosion, terrorist act, accident, epidemic or warlike action) which:

- endangers, or threatens to endanger, the safety or health of persons or animals
- destroys or damages, or threatens to destroy or damage, property
- causes a failure of, or a significant disruption to, an essential service or infrastructure.

Emergency works for the purposes of this document emergency works includes any of the following:

- prevention in relation to an emergency includes the identification of hazards, the assessment of threats to life and property, and the taking of measures to reduce potential loss to life or property

- preparation in relation to an emergency includes arrangements or plans to deal with an emergency or the effects of an emergency
- response in relation to an emergency includes the process of combating an emergency and of providing immediate relief for persons affected by an emergency
- recovery in relation to an emergency includes the process of returning an affected community to its proper level of functioning after an emergency.

ENSMS electricity network safety management systems

HV high voltage

insulated aerial lines insulated low voltage aerial lines and 11 kV screened aerial bundled cable

LV low voltage

NPV Net present value

OHEW overhead earth wire

OHW overhead wiring

QSRA quantified safety risk assessment

RIM rail infrastructure manager; in relation to rail infrastructure of a railway, means the person who has effective control and management of the rail infrastructure, whether or not the person –

a. owns the rail infrastructure

b. has a statutory or contractual right to use the rail infrastructure or to control, or provide, access to it.

(Source: Rail Safety National Law (NSW) 2012)

SFAIRP so far as is reasonably practicable; the degree of risk in a particular situation that can be balanced against the time, trouble, cost and physical difficulty of taking measures to avoid the risk.

TAO Technically Assured Organisation

TfNSW Transport for NSW

TNSP transmission network service provider

UGOH underground to overhead

VPF value of preventing a fatality

5 General requirements

5.1 General

An ENO is required to have an ENSMS in accordance with AS 5577 and manage risks across the whole of life of their electrical network SFAIRP including risks related to buildings and structures under aerial lines.

All risks related to buildings and structures under aerial lines shall be identified and managed in accordance with this document and the relevant ENO ENSMS by a design TAO with authorisation in earthing and bonding and aerial line design. All risks shall be noted on the ENO risk register.

5.2 New buildings or structures under aerial lines

SFAIRP new bare aerial lines shall not pass over buildings or structures and new buildings or structures shall not be constructed under existing aerial lines.

5.3 Existing buildings or structures under aerial lines

Where modifications are required to an existing building, structure or aerial line that impact on the configuration and risk of a building or structure beneath an aerial line the design TAO shall first seek to eliminate the risk by one of the following methods:

- relocation of the asset to remove the intersection (inclusive of a maximum blowout)
- permanent removal of either the building, structure or the aerial line
- replacement of the aerial line with cable.

  Note: A like for like replacement of parts on an aerial line, building or structure under maintenance provisions are not considered a modification or a configuration change toto an existing aerial line.

Where a whole-of-life cost benefit analysis demonstrates that it is not practicable eliminate the risk a SFAIRP design shall be implemented in accordance with the risk management process detailed in Section 8.

Risks shall be identified in accordance with this document and the following documents:

- TS 03770 which provides requirements related to buildings and structures under HV aerial lines
- TS 03769 which provides general requirements and guidance for electrical infrastructure within TfNSW easements
- TS 03743 which provides requirements regarding restrictions for bare aerial lines installed over bridges and specific earthing and bonding risks

- ISSC 20 which provides guidance on the following:
  - typical activities impacting on electricity easements and infrastructure
  - aerial power lines – which outlines permitted, controlled and prohibited activities within electricity easements
  - application guide – which provides frameworks to consider existing and proposed encroachments onto electricity easements
- SP D 79035 which provides requirements for objects on, under or in the vicinity of aerial lines
- TS 04982 which sets out the risk criteria to be used for assessing risks for which TfNSW is or will be the owner or part owner
- TS 04985 which provides guidance on QSRA for the development of SFAIRP arguments to support safety acceptance requirements.

6 Insulated lines up to and including 11 kV

For voltages up to and including 11 kV, insulated aerial lines may be considered where the provisions of Section 5 have been followed and it can be demonstrated that there are no practicable alternatives for removal or relocation of either asset. In such circumstances an approved screened ABC shall be used.

The constraints related to the retention or introduction of insulated lines over buildings and structures shall be adequately demonstrated by the design TAO and identified as spatial, financial, safety, legal or other. When justifying spatial constraints, on-site investigations such as site surveys, potholing, trenching and so on should be conducted to supplement any desktop analysis.

The assessment of insulated aerial lines shall follow the process outlined in Figure 1.

7 So far as is reasonably practicable

The *Rail Safety National Law (NSW) 2012* and the *Work Health and Safety Act 2011* contain provisions related to the legal duty of care for all designers. The *Rail Safety National Law (NSW) 2012* and the *Work Health and Safety Act 2011*, along with industry regulations and guidelines, mandate the elimination of all reasonably foreseeable hazards or the reduction of risks SFAIRP where the cost of elimination is not grossly disproportionate to the benefit gained.

A TAO shall make a reasonable determination of the risk associated with the likelihood and consequence of a particular hazard as described in Section 8.2. This determination includes undertaking the following, as a minimum:

- requesting information from the suppliers and manufacturers of network components

- requesting information from the ENO and Asset Steward – operate or maintain for information in relation to network data or any existing non-conformances
- conducting independent investigations to support the risk assessment, WOL options analysis and design process.

8 Risk management process

A TAO shall implement a risk management process for all new or modified assets. The risk management process is shown in Figure 1. Sections 8.1 to 8.5 provide requirements for the following parts of the risk management process:

- stakeholder engagement
- initial assessment
  - hazard analysis
  - options analysis
  - whole of life costings
- detailed risk assessment
  - the risk variables
  - risk assessment criteria.
- SFAIRP design and cost benefit analysis.

8.1 Initial assessment and consultation

The design TAO shall identify any risks associated with buildings or structures under aerial lines as part of their initial investigation and hazard analysis. Where existing risks and non-conformances are identified the TAO shall ensure all the relevant stakeholders are engaged as early as practicable and prior to the commencement of a concept design.

A preliminary risk assessment and options analysis shall be conducted in consultation with the ENO and all Asset Stewards. The options analysis shall be a multicriteria analysis and will require input from the appropriate SME for each of the options considered. The risk assessment shall be conducted with up-to-date information in accordance with Section 7. The options analysis shall consider the whole of life costs for all options to eliminate or mitigate the risk.

The TAO shall seek agreement from the ENO and the Asset Steward – operate or maintain for a proposed solution. Where modifications are required to an existing scope of works to facilitate a solution this shall be agreed with the relevant ENO and all Asset Stewards.

Following consultation and agreement with stakeholders on the initial assessment, an initial consultation with AMB shall be undertaken to confirm the preliminary risk assessment, options analysis, and the risk management approach.

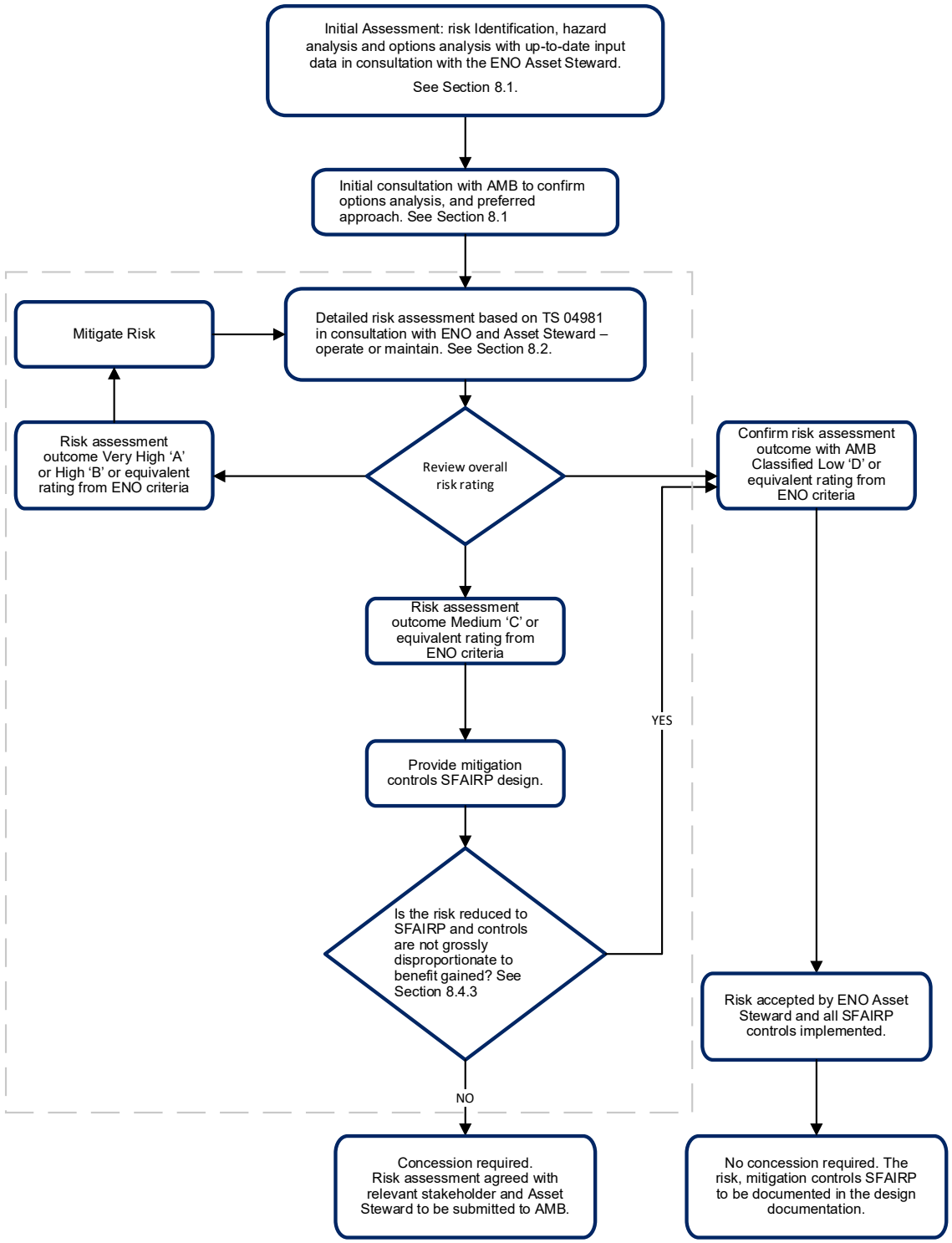

Figure 1 – Risk management process flowchart

8.2 Detailed risk assessment

After consultation with relevant stakeholders a detailed risk assessment shall be undertaken in consultation with the ENO, the Asset Stewards and any third-party ENOs as mandatory stakeholders.

The minimum requirements for conducting a risk assessment are as follows:

- Identify the potential hazards and evaluating the severity considering the probability of the hazard event occurring and the consequence.
- Identify and establish all available elimination and mitigation controls to address the identified risks and eliminate or reduce the likelihood and consequence of risks.
- Conduct a cost-benefit analysis for each control and determine whether the costs associated with implementing and maintaining these controls are justified by the reduction or elimination of the risk.
- Conduct a design to eliminate or mitigate the risk SFAIRP. A particular project cost and scope cannot be used as justification for determining risk controls. The term reasonably practicable extends to controls that are, or were considered at a particular time, reasonably able to be done.

The risk assessment outcome shall be confirmed with AMB. Where a concession is required the submission shall be done in accordance with TS 00003.1. The submission shall include the following as a minimum:

- a completed and signed concession form
- a copy of the options analysis and risk assessment which has been endorsed by all stakeholders
- the design documentation to demonstrate that the proposed solution has been thoroughly assessed and mitigation measures have been carefully considered, justified and agreed upon with all relevant stakeholders including the ENO and the Asset Steward – operate or maintain.

8.3 Hazards to be considered

It is the responsibility of the design TAO to identify the risks associated with buildings and structures under aerial lines. Some of the major risks that can occur when the necessary clearances between buildings or structures and aerial lines are not maintained in accordance with relevant transport standards, include, but are not limited to, the following:

- High-induced voltages on conductive structures such as rooftops or large metallic objects due to the electromagnetic fields from aerial lines causing significant safety risks and potential damage to equipment and structures.

- Electrostatic induction due to the electric field surrounding aerial lines resulting in induced charges on adjacent conductive structures potentially leading to electrical shock hazards for the public.
- Hazardous step and touch voltages on the building and structures resulting from the aerial line earth faults.
- Aerial line conductor break or failure of a component of the aerial line can pose a fallen conductor risk causing damage, injury or fatality due to mechanical force of the fallen conductor or injury or fatality from electrocution due to direct contact with the fallen conductor.

When considering risks associated with the HV earthing systems of aerial lines and buildings or structures these shall be assessed in accordance with TS 00006 and AS/NZS 7000. To prevent inadvertent contact with aerial lines, safety clearances between structures and live conductors shall be designed in accordance with AS/NZS 7000 and TS 03769.

8.4 Risk assessment methods and parameters

Further to the requirements of this document, TS 04985 provides guidance on undertaking QSRAs. QSRAs can be used for analysing risks related to aerial lines over buildings and structures, particularly for fallen conductors in high-risk or highly frequented public locations such as stations and interchanges.

ENA EG-0 and AS/NZS 7000 provide examples of QSRA processes for the analysis of earthing hazards. These documents provide a methodology for identifying the likelihood of an earth fault occurring and the likelihood of exposure which is referred to as the probability of coincidence. A similar approach can be used to determine the likelihood of a risk event related to aerial lines over buildings and structures such as a fallen conductor. These methods would require the statistical assessment of the probability of failure associated with the aerial line which could lead to a fallen conductor, determining the contact and exposure scenario, the VPF and the cost for each control, in order to complete a cost benefit analysis to evaluate the required controls in reducing the risk SFAIRP.

The TAO shall make reasonable effort to obtain all available and relevant data on the condition and failure rates of the aerial line to complete a quantitative risk assessment as noted in Section 7. Where the information to support a quantitative risk assessment cannot be obtained or agreed upon by all relevant stakeholders then a semi-quantitative assessment may be conducted.

Further information regarding considerations for determining likelihood and consequences are provided in Sections 8.4.1 and 8.4.2. Risk acceptance criteria for all risk assessments are noted in Section 8.5.

8.4.1 Determining likelihood

The following parameters should be considered when determining the likelihood of hazard events:

- The contact scenario and contact frequency which can include the occupancy of the building or structure and the level of accessibility (public access or restricted to workers).
- The failure rate of the aerial line and fault duration which can include the following:
    - Factors affecting the failure rate may include factors that affect the likelihood of a fallen conductor such as the condition of the line and poles, the termination or suspension arrangement of the aerial line conductors, splices, span length, the cross arm, the insulation level, presence of OHEW and lightning risk, surrounding environment and vegetation and so on.
    - The fault duration or clearing time. Factors that affect the fault clearing time are the type of protection scheme used, the earthing arrangement of the building or structure.
- The purpose of the building or structure (permanent or temporary) and potential ability to maintain clearance to aerial line throughout the asset life cycle.
- The proximity, size and location of buildings and structures in relation to the aerial lines (whether directly underneath or within the maximum blowout) affect the likelihood of contact with a fallen conductor.

8.4.2 Determining consequence

The following parameters should be considered when determining the consequence of hazard events:

- Individual or group fatality due to long term risk of step and touch voltage hazards to a building or structure due to:
    - Inadequate low resistance path for the feeder protection system to operate.
    - Inadequate earthing and bonding provisions.
    - Induced voltages.
- Individual or group fatality due to transfer potential hazard on galvanic conductive paths of the structure or building increasing the exposure and propagation of energised structures thereby significantly increasing the consequence of the hazard event.

Insulated aerial lines also present similar risks but often to a lesser extent. When conducting a risk assessment for insulated aerial lines, consideration shall also be given to the condition of the insulation in accordance with requirements for testing of cables TS 03756.

8.4.3 Iterative process for determining cost benefit

The risk assessment process in

Figure 1 shall be repeated as risk controls are applied in order to reduce the risk SFAIRP. The process for undertaking a whole of life cost benefit analysis to assist in determining the need for SFAIRP controls is illustrated in Figure 2. Guidance on the use of discount rates can be found in *TfNSW Cost Benefit Analysis Guide – For all TfNSW Divisions and Agencies*. Guidance on VSL and VPF calculation can be found in the *Value of statistical life* published by the Australian Government Office of Impact Analysis. Information used to calculate the event likelihood shall be used to determine the net benefit of any proposed controls.

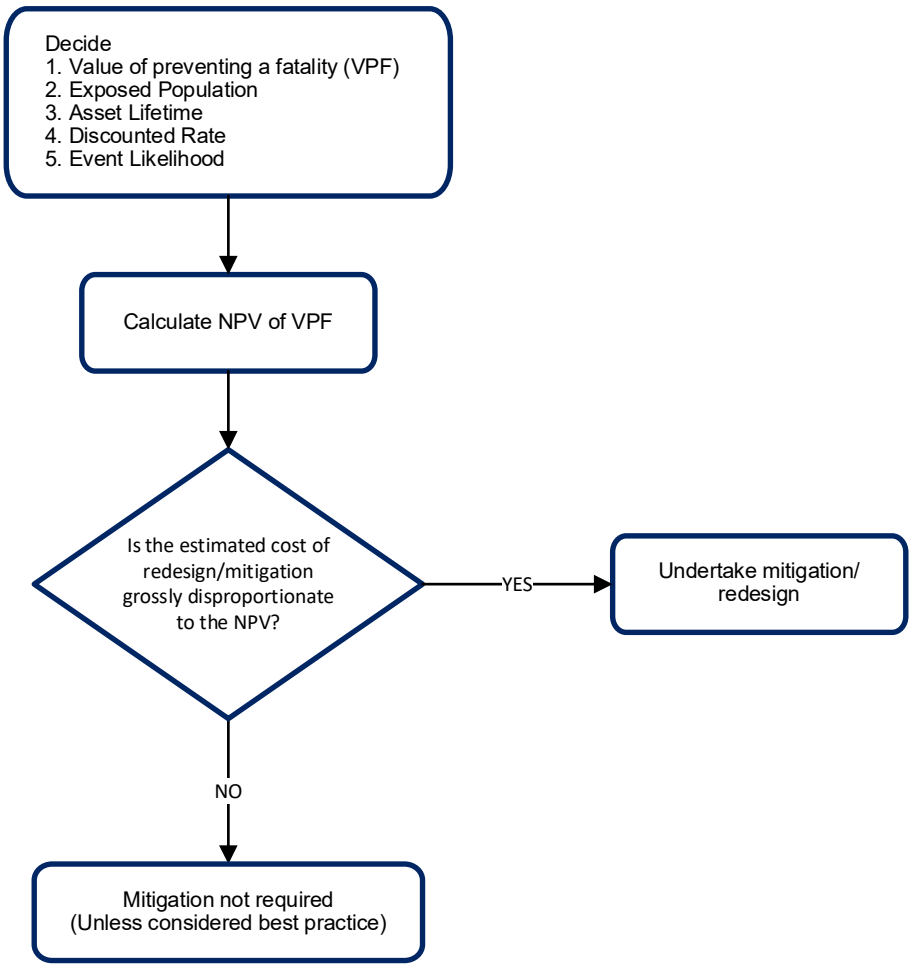

Figure 2 – Cost benefit

8.5 Risk acceptance criteria

Risks associated with buildings and structures under aerial lines that cannot be eliminated shall meet the most onerous of the following criteria:

- “low risk” rating as specified in TS 04982 or as defined by an individual fatality probability of less than 1 in 1,000,000 per year, as outlined in TS 00006.
- “broadly acceptable” risk level as identified in the relevant ENO Enterprise Risk Management framework.

Where a low (or equivalent) risk level has been achieved additional risk treatments may be applied if they are cost effective or considered normal practice.

Where a medium (or equivalent) risk level has been achieved and there are no practicable options to reduce the risk to a low level, or the costs in achieving a low risk are grossly disproportionate to the benefit gained, the design TAO shall request a concession. A concession is not required where it can be demonstrated that the level of risk is low or negligible. In such situations the risk shall still be recorded on the ENO risk register. Concessions will not be considered for a risk rating high or very high (or equivalent ratings).