Network Standard

Document No.
NS268

Title:
Design and construction of waterway crossings

Approved Date	15/06/2026	Revision		2	
Lifecycle Stage	Design; Construct	Internal Use	☒	External Use	☒
Technical Approver		Authorised By			
Name	Duminda Thenuwara	Name		Murray Chandler	
Designation	Senior Engineer	Designation		Head of Network Strategy & Future Grid	

Revision

No	Date	Description	Technical Approver	Authorised By
0	8/04/2016	Initial document	Senior Engineer – Guides, Policies and Standards	Chief Engineer
1	6/06/2017	Clause 8.3.1 – Addition of drawing number 238007 (bidirectional arrangement). Inclusion of Annexures C – Typical waterway crossing span design drawing, and D – List of drawings	Senior Engineer – Guides, Policies and Standards	Manager T&DME
2	15/06/2026	Conversion to new Network Standard template. Inclusion of a new clause for marine charts. The “code” was renamed as “Guide”. Information on mooring added.	Duminda Thenuwara	Murray Chandler

DISCLAIMER

This document is bound to the conditions set out in NS002 Network Standards Disclaimer.

Ausgrid maintains a copy of this and other Network Standards together with updates and amendments online at www.ausgrid.com.au. This document is considered uncontrolled once printed.

Table of Contents

Scope **3**
Reference Documents **3**
Ausgrid Documents **3**
Other Standards and Documents **3**
Acts and Regulations **3**
1 Design and construction **5**
2 Service Mains **10**
3 Private crossings **10**
4 Warning signs **10**
5 Documentation **14**

List of Annexures

Annexure A: Overhead waterway crossing survey specification A-1
Annexure B: Typical waterway crossing span design drawing B-16
Annexure C: List of drawings C-17
Annexure D: Design Height of New Crossing D-18

Unclassified

Scope

This document defines the minimum requirements for designing and constructing waterway crossings of electrical and telecommunication conductors over navigable waters, in accordance with the Boaters' Guide to Electricity Cable Crossings of NSW navigable waters (the Guide) and Australian Standard AS 6947 – Crossing of Waterways by Electricity Infrastructure (AS 6947).

It assists Ausgrid employees and ASPs involved in the design and construction of Ausgrid overhead, trenchless technique and submarine waterway crossings including 132kV, 66kV, 33kV, 22kV, 11kV, LV and communications cables. This document shall be used in conjunction with T0070 which outlines Ausgrid's ongoing management of waterway crossings over navigable waters.

Reference Documents

All work covered in this document shall conform to all relevant Legislation, Standards, Codes of Practice and Network Standards.

Ausgrid Documents

T0070 Management of Waterway Crossings

T0119 Assessment of Waterway Crossing Risks

NS100 Field Recording of Network Assets

NS104 Specification for Electrical Network Project Design Plans

NS145 Asset Inspection – Overhead lines and Poles

NS148 Overhead Line Support, Street Light Column, Pit and Pillar Numbering

NS159 Installation of Cables and Conduits using Trenchless Technologies

NS166 Routine Overhead Line Inspection

NS174 Environmental Procedures

NS179 Vegetation Management

Other Standards and Documents

AS 1101.3 Graphical symbols for general engineering – Welding and non-destructive examination

AS 1170 Structural design actions General principles

AS 1554 Structural steel welding – Welding of steel structures

AS 1743 Road signs – Specifications

AS/NZS 3000 Wiring Rules

AS 4100 Steel Structures

AS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

AS 6947 Crossing of Waterways by Electricity Infrastructure

Boaters' Guide to Electricity Cable Crossings of NSW navigable waters

Service and Installation Rules of NSW

Acts and Regulations

Electricity Supply (General) Regulation 2014

Electricity Supply (Safety and Network Management) Regulation 2014

Environmental Planning and Assessment Act 1979

Fisheries Management Act 1994 (NSW)

Maritime Services Act 1935 (NSW)

Unclassified

Water Management Act 2000 (NSW)

Work Health and Safety Act 2011 & Work Health and Safety Regulation 2025

Unclassified

Clause	Standard Requirements

1 Design and construction

1.1 Waterway crossings for electrical conductors and communications across navigable waters which fall under the jurisdiction of Maritime Authority for New South Wales (Maritime) shall be designed and constructed in accordance with AS 6947 and the Guide.

1.2 The design of each crossing must be based on a risk assessment so that all risks associated with the proposed crossing are identified and addressed such that the residual risk is as Low As Reasonably Practicable (ALARP). For each crossing this risk assessment must be reviewed following any change that may alter the residual risk.

1.3 Any proposal to construct any new, redesigned, reconstructed or relocated crossing must be approved by Ausgrid prior to the commencement of any design or construction work. Work on any crossing that is deemed contestable must comply with appropriate Connection/Relocation Policies and follow the Contestable process.

1.4 The design and construction of a crossing shall consist of the following sequential elements:

1) Approvals;

2) Risk assessment;

- site visit and investigation;
- for overhead crossings: calculation of required minimum conductor height;
- for submarine and trenchless technique crossings: acceptable installation method (e.g.: under-bore, trenched/buried in bed of waterway, direct laid on top of bed of waterway);

3) Preparation of detailed design plans and construction; and

4) Post-construction survey of crossing to confirm construction is in accordance with the design including conductor height(s), cable route, etc as appropriate.

1.5 Crossing identification numbers

1.5.1 Each crossing shall be assigned a unique Crossing number (i.e. “EAXXX”). These numbers shall be issued by Ausgrid.

1.5.2 Overhead crossings with multiple circuits on the same structures, one above the other (e.g. 33kV above 11kV above LV) shall be assigned a single crossing number.

1.5.3 Dual circuit overhead crossings (i.e. with three conductors in vertical construction on each side of the structure) shall be assigned one crossing number however an “A” and “B” shall be added to the Crossing number to create a distinct crossing identifier for each circuit: EAXXXA and EAXXXB. Each circuit shall require a risk assessment where different minimum heights above the waterway are proposed.

1.5.4 Submarine and trenchless technique crossings consisting of cables in a single underbore/trench/conduit/group of conduits shall be assigned a single crossing number.

1.5.5 Submarine and trenchless technique crossings consisting of cables in multiple adjacent underbores/trenches/conduits/groups of conduits shall be assigned separate crossing numbers.

1.5.6 New crossings shall be assigned with new crossing numbers.

1.5.7 Overhead crossings that are rebuilt (i.e. that have poles and or conductors replaced but remain in the same immediate location) shall retain the original crossing number.

1.5.8 Out of service or abandoned crossings shall retain their allocated crossing numbers until all conductors, cables, and associated, signage etc. have been removed, at which time the crossing number must be retired and not reissued.

Unclassified

1.6 Approvals

1.6.1 It is the Designer's responsibility to identify and obtain all approvals which may be required from relevant authorities, including but not limited to:

- Transport for NSW (formerly Roads and Maritime Services),
- NSW Department of Planning, Housing and Infrastructure – Crown Lands,
- NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) as the approval authority for Controlled Activity Approvals under the Water Management Act 2000 (NSW),
- NSW Department of Primary Industries and Regional Development – Fisheries, and
- local councils.

1.6.2 Transport for NSW is the land manager for Sydney Harbour and its tributaries, Botany Bay, Newcastle Harbour and Port Kembla Harbour. Where a crossing is proposed for these waterways, Transport for NSW must be contacted to confirm whether consent is required for the use of the waterway for the purpose of the crossing. If consent is provided, it may be necessary to obtain an easement. This includes works undertaken using trenchless construction methods.

1.6.3 The beds of most tidal waters (including oceans and estuaries) and many non-tidal waters (including rivers, streams and lakes) are Crown land. Works carried out within the bed of a river, lake or estuary, and up to the highest bank, shoreline or Mean High Water Mark (as applicable) may also require a Controlled Activity Approval issued by DCCEEW under the Water Management Act 2000 (NSW). This includes excavation, filling, trenching, directional drilling and installation of infrastructure within or adjacent to waterways. Designers must confirm Controlled Activity Approval requirements with DCCEEW prior to commencing works.

1.6.4 Under the Fisheries Management Act 1994 (NSW), permits may ordinarily be required for dredging, reclamation or harm to marine vegetation. However, Ausgrid is exempt from the requirement to obtain a fisheries permit for authorised electricity works, provided those works are carried out in accordance with the Act and relevant approval conditions. This exemption does not remove the obligation to consult Fisheries NSW where required, nor does it remove the need to avoid or minimise impacts to aquatic habitat and marine vegetation.

1.6.5 Over time, waterway boundaries may change due to natural processes such as erosion or accretion (Doctrine of Accretion). Land titles may not reflect current boundaries. Local councils or other consent authorities may also require development consent depending on the nature and location of the works.

1.7 Risk assessment

For each crossing a risk assessment must be prepared. This is necessary so that all risks associated with the crossing are identified and that appropriate measures can be included in the design stage to mitigate those risks. Risk assessments shall be prepared in a consistent manner in accordance with Ausgrid Technical Guide T0119 Assessment of Waterway Crossing Risks.

1.7.1 Key information arising from risk assessment

1.7.1.1 Overhead crossings

Will include information that may impact on the height of any proposed overhead crossing including but not limited to:

- the height of the highest vessel that is likely to use the waterway in the vicinity of the crossing;
- the maximum wave height at the location (which is different for each location and dependant on nature of waterway i.e. wind, ocean swell, etc);
- the minimum required design height above HAT (or highest water level) at maximum conductor operating temperature;
- the maximum vessel height to be shown on the associated signage; and
- the size, location and orientation of required signage.

Unclassified

Note: Where the determining factor affecting the maximum height of vessels using a waterway is the clearance beneath a bridge (or other structure), the height of the under-side of the bridge above Lowest Astronomical Tide (LAT) at the bridge is to be used as the height of the highest vessel (H_{vessel}).

1.7.1.2 Submarine crossings

For submarine crossings the key information arising from the risk assessment may include but is not limited to information that may impact on a submarine cable e.g.:

- anchoring or mooring of vessels;
- dredging of bed of the waterway;
- strong water currents and/or erosion which may expose buried cable;
- cable protection options e.g. burial; and
- presence of aquatic constraints e.g. seagrass.

By marine law vessels are not permitted to anchor within 200m of submarine cables as indicated on the standard warning signs required by AS 6947. This is because the vessels can drag anchors across the bed of the waterway and damage submarine cables. Therefore, the installation of submarine cables at locations where vessels anchor regularly must be avoided not only to prevent damage to the cable but also to avert conflict with vessel operators.

Submarine cables should not be installed closer than 10m to a permanent mooring however this may vary depending on the depth of the waterway and the length of the mooring chain (i.e. the "rode"). Permanent mooring facilities in locations designated by the Maritime, are less hazardous than an anchored vessel because the mooring present a lower, but not negligible, risk to submarine cables due to movement of the mooring system and chain across the seabed. The mooring can sink into the bed of the waterway or be covered by sediment to a depth of up to approximately 2m and moored vessels will drag the mooring chain (i.e. the "rode") across the bed of the waterway in a circle around the mooring.

1.7.1.3 Trenchless technique crossings

For trenchless technique crossings (i.e. cables installed under a waterway using under-boring, horizontal drilling etc.) The risk assessment may include but is not limited to information that may impact on a trenchless technique cable e.g.:

- mooring of vessels;
- dredging of the bed of the waterway; and
- erosion which may expose trenchless technique cable installations.

Trenchless technique crossings must not have any adverse impact on navigation safety. This is typically achieved by the level of the cable installation being sufficiently beneath the level of the bed of the waterway so that the cable will not affect, or be affected by, vessel anchors or moorings and beneath the level of any potential dredging or channel deepening activities or potential erosion of the bed of the waterway. This is sometimes best achieved by designing the installation to be through bed-rock beneath the bed of the waterway. The location of entry and exit points will need to be investigated to determine whether a trenchless technique is an option. Although trenchless techniques are preferred from a risk perspective, they are not always practicable and can be cost prohibitive compared to other options.

1.8 Preparation of detail design plans and construction

1.8.1 For overhead crossings, given the minimum design height of the proposed crossing above Highest Astronomical Tide (HAT - or highest water level) at maximum conductor operating temperature from Clause 1.7, it will be possible to carry out the necessary sag/tension calculations and determine pole attachment heights, pole strengths, etc, sufficient to include in a design drawing.

Unclassified

1.8.2 For submarine or trenchless technique crossings, the information obtained from the risk assessment as discussed in Clause 1.7 will help determine the most appropriate location and method of installation for the proposed crossing.

1.8.3 The cable installation including route and installation method must comply with any specific requirements of the approval authorities. Marine survey may be necessary to analyse the topography and morphology of the bed of the waterway, water currents and tides along the proposed alignment.

1.8.4 In all cases an environmental assessment of the cable route is required. The cable used shall be designed specifically for submarine applications. Details of the cable design shall be submitted to Ausgrid for approval before procurement. The cable must be installed in one continuous length across the waterway i.e. without joints.

1.8.5 The design drawing must include details of the signage to be provided including location, size, orientation, etc. Each post that supports signage shall be allocated a pole/asset number in SAP to facilitate ongoing maintenance. For overhead crossings, the warning signs must show the maximum vessel height. For trenchless technique crossings warning signs are not required unless the depth of the cable installation beneath the bed of the waterway is insufficient to guarantee that the cable will not be disturbed by vessel anchoring etc.

1.9 Post-construction survey

1.9.1 Overhead crossings

1.9.1.1 For all overhead crossings, the crossing shall be surveyed after completion of construction to confirm that the crossing has been constructed in accordance with the minimum clearance requirements of the design. The survey must be conducted by a registered land Surveyor.

1.9.1.2 The conductors associated with the crossing are to be assumed to be at ambient temperature at the time of survey, and calculation is to be carried out to adjust the surveyed height to account for highest operating temperature. Based on the survey results the Maximum Vessel Height to be shown on signage shall be recalculated and checked against the risk assessment, the design and the height actually shown on the signage. If necessary, the height of the crossing and/or the Maximum Vessel Height shown on the signage is to be adjusted as appropriate.

1.9.1.3 For crossings constructed by Ausgrid the post-construction survey must be conducted approximately one month after completion of the construction works to allow for pole movement, conductor creep, etc.

1.9.1.4 For contestable projects, the ASP is responsible for ensuring that the survey, calculation to account for highest operating temperature, and any necessary adjustments to crossing height and/or signage is to be completed prior to commissioning. The ASP shall also be responsible for any subsequent adjustments due to pole movement, conductor creep, etc during the warranty period.

1.9.1.5 Other survey details shall be as specified in Annexure A:.

1.9.2 Submarine crossings

1.9.2.1 For submarine cables that are to be buried, the location of the cable on the bed of the waterway must be surveyed between laying & burial. After installation the burial depth shall be verified via appropriate technology, e.g. parametric sub-bottom profiling, and bathymetry survey of any rock dumping areas.

1.9.3 Trenchless technique crossings

1.9.4 For trenchless technique crossings a detailed survey of the actual cable route, including the ends of the bore, depth profile, plan drawing and bore logs shall be provided to Ausgrid in accordance with the requirements of NS159.

Unclassified

2 Service Mains

2.1 Overhead service mains must not be installed as a waterway crossing. This is to prevent the height of an Ausgrid waterway crossing being altered through the customer changing the point of attachment.

2.2 Where a prospective customer's Connection Point is to be on the opposite side of a waterway from Ausgrid's distribution mains, Ausgrid's distribution mains must be extended to the opposite side of the waterway such that the poles on both sides of the waterway, and all poles between the crossing and Ausgrid's existing distribution mains, are Ausgrid poles.

2.3 Before any such crossing is constructed it will be necessary for the customer to negotiate with Ausgrid to agree to the construction of the crossing, as Ausgrid distribution mains, as a contestable project. Any such agreement will be subject to assessment and approval by Ausgrid.

Note: For these reasons, the structures (poles), on both sides of the waterway, associated with any particular overhead crossing, must be owned by either Ausgrid (preferably) or the customer - see Clause 3 below. An Ausgrid structure on one side of the waterway must not be connected to a privately-owned structure on the other side of the waterway.

3 Private crossings

3.1 In accordance with the marine legislation (as defined in the Ports and Maritime Administration Act 1995 (NSW)), obstructions and encroachments must not be constructed in, on or over a navigable waterway without the prior approval of Maritime and must not constitute an obstruction to navigation. This applies to overhead, trenchless technique or submarine wiring systems including services, consumers mains, submains or final subcircuits which cross navigable waterways.

3.2 Approvals may also be required from various agencies including but not limited to the NSW Department of Primary Industries - Lands, local councils, etc.

3.3 Where private wiring is to be installed across a waterway it is the responsibility of the customer to make all necessary enquiries to determine whether the waterway is a navigable waterway and to obtain all necessary approvals from Maritime and any other relevant authorities.

3.4 In addition to being approved by Maritime and other relevant authorities, all private wiring across navigable waterways must comply with the requirements of AS/NZS 3000: Wiring Rules, Service and Installation Rules of NSW, AS 6947 and any other conditions specified by Maritime and other authorities. This includes design, construction, and ongoing operation and maintenance.

3.5 If the customer cannot obtain approval from Maritime, or the other relevant authorities, to construct private wiring across a waterway, the customer may negotiate with Ausgrid to agree to the construction of the crossing, as Ausgrid distribution mains. The Ausgrid distribution mains must be supplied directly from Ausgrid's network and the customer's installation will need to be configured accordingly. The work associated with this would be a contestable project. Any such agreement will be subject to assessment and approval by Ausgrid, and approval for the crossing from various agencies including but not limited to the Maritime, NSW Department of Primary Industries - Lands, local councils, etc.

4 Warning signs

4.1 General

4.1.1 Warning signs (where required) shall be installed in accordance with the Guide and AS 6947.

4.2 Signage for multiple adjacent crossings

4.2.1 Where there are multiple adjacent crossings one set of signs only must be installed. This includes dual circuit lines. For overhead crossings, the Maximum Vessel Height to be shown on such signs is the height relating to the lowest crossing in the group.

4.3 Signage for abandoned crossings

4.3.1 Signage must be installed for all crossings including out of service overhead crossings and abandoned submarine crossings where the conductor/cable is still in place. Although there is no electrical hazard associated with out of service crossings, they still represent a physical hazard to

Unclassified

vessels. Signage serves to clarify who owns the crossing and who is responsible for the safety aspects if it is pulled down/up or otherwise damaged or involved in a navigation incident.

4.4 Signage design requirements

4.4.1 General

4.4.1.1 Signs are minor structures; the failure of a sign itself is not likely to endanger human life; and would have small economic, social or environmental consequences. Any failure must be detected and rectified during Ausgrid's routine inspection/maintenance programs. For these reasons, signage shall be designed to have an Importance Level of 1 ("Low" consequence of failure) in accordance with AS/NZS 1170.

4.4.1.2 Signs must be designed to meet the following basic criteria:

- Minimum design life of 25 years;
- Importance Level 1 to AS 1170;
- Wind return period: 50 years;
- 50-year 1-hour average wind speed (V_{50}) = 39 m/sec;
- Steelwork:
  - all structural steelwork to be fabricated and erected in accordance with AS 4100, AS 1554 and AS 1101.3;
  - all steelwork, other than stainless steel, is to be hot dip galvanised to AS 4680 after fabrication;
  - all sections sealed with end or base plates are to be provided with 25mm dia vent hole each end in an inconspicuous location; and
  - welds and areas where galvanising is damaged are to be treated with ZincFix, or equivalent, applied in accordance with manufacturer's specifications.
- Sign blanks:
  - overall sizes shall be in accordance with AS 6947;
  - sign blanks shall be 3 mm thick aluminium sheet alloy Type 5251 or 5052, temper H38 or H36 in accordance with AS 1743, free of cracks, tears and other surface blemishes;
  - the back of each sign blank shall be rendered dull and non-reflective either by mechanical or chemical means and shall be free of scratches and blemishes; and
  - approved anti-graffiti film shall be provided if required by Ausgrid.
- Sign graphics:
  - sign graphics (artwork, colours, layout etc) shall be in accordance with AS 6947 and are to incorporate a full colour Primary Ausgrid logo and 24-hour emergency contact phone number 13 13 88.

Unclassified

4.4.1.3 Refer to Ausgrid drawing No. 252151 for examples of detailed sign designs.

4.4.1.4 Signs must be installed above the intertidal zone with the bottom edge of the sign at a nominal mounting height of 2200mm above ground level. Signs installed in the waterway, within the intertidal zone or on cliffs immediately beside the waterway must be installed with the bottom edge of the sign at a nominal mounting height of 1000mm above HAT.

4.4.1.5 Wherever practicable signage associated with crossings over waterways subject to flooding must be located above the 1-in-10-year flood level, or as high as reasonably practicable above the 1-in-10-year flood level, so it does not become submerged in floods. However, this must not be at the expense of keeping the signage clearly visible from the waterway during non-flood conditions.

4.4.1.6 To facilitate ongoing maintenance, each post that supports signage must be allocated a pole/asset number in SAP, in accordance with NS148, and each post is to have its number affixed on the bottom edge of the sign immediately adjacent to the post. The location of each post and any other details as appropriate must be recorded in GIS in accordance with NS100. Inspection / maintenance requirements shall be in accordance with the current line inspection and pole inspection processes for steel poles as required by Network Standards NS166 and NS145 and Network Technical Maintenance Plans HO101, HO102, HO103, HO105, HO108 and HO109. For each waterway crossing sign support the following information is required for entry into SAP:

i) Pole number including map prefix

ii) Material type – Stainless Steel post - sign, Steel post - sign

iii) Pole size – Unknown, Footing and Soil Type

iv) Location

v) Street no. to be entered as waterway crossing number e.g. EA09.

vi) Waterway crossing number and waterway name (to be entered in the comments field)

vii) A field recording / location sketch is required to be provided for entry / update of the GIS (when *constructed).*

4.4.1.7 Vegetation associated with warning signs shall be managed in accordance with the relevant requirements of NS179 and Ausgrid's Environmental Guidelines and Standards.

4.4.1.8 Signage installations may need to be the subject of an environmental impact assessment (EIA) in accordance with the State Environmental Planning Policy (Infrastructure) 2007 and NS174 Environmental Procedures. These must be referred to Ausgrid for assistance and advice. Situations which may require an EIA include but are not limited to:

- disturbance of soil,
- clearing or trimming of vegetation.

Unclassified

4.4.2 Overhead crossing signage design requirements

4.4.2.1 Overhead waterway crossings shall be designed, constructed and maintained to comply with the Guide and AS 6947 regarding the Maximum Vessel Height, which above everything else is the most important risk mitigation factor. The Maximum Vessel Height to be shown on warning signs is to be determined according to the following calculation:

Table 1 – Overhead Crossing Signage Design Requirements

H_{sign} = ($H_{crossing}$ - S - E – W) rounded down to next whole metre,

where:

H_{sign}	=	Maximum Vessel Height to be shown on signage (refer Note 1 below)	
$H_{crossing}$	=	Minimum height of crossing conductors above HAT (or highest water level (refer Note 2 below)) at maximum operating temperature.	
S	=	Safety margin (= 2.2m in all cases)	
E	=	Electrical clearance	= 0.3m for voltage ≤ 33kV (including communications cables)
			= 0.8m for 33kV < voltage ≤ 132kV
W	=	Allowance for wave height (as determined during the site visit and investigation discussed in Clause 1.7)	

Notes:

1) It may be prudent to wait and confirm the final minimum height of crossing conductors as determined by the post-construction survey before calculating H_{sign} and installing signage.
2) For tidal waterways the crossing is to be designed so that the conductors achieve the minimum height above HAT. For non-tidal waterways the highest water level will need to be determined and the crossing is to be designed so that the conductors achieve the minimum height above this level which is generally relative to AHD rather than HAT.

4.4.3 Complementary flooding signs

4.4.3.1 Complementary flooding signs as specified in AS 6947 must be attached to the signage associated with overhead crossings in waterways subject to flooding.

4.5 Submarine crossing signage requirements

4.5.1 Submarine crossings (trenched and direct laid cables) must have warning signs installed in accordance with the Guide and AS 6947.

4.6 Trenchless technique crossing signage requirements

4.6.1 Crossings consisting of cables installed by trenchless techniques (i.e. under-boring, horizontal directional drilling, etc) need not have warning signs installed provided that the cables are installed at a depth beneath the bed of the waterway or through bed-rock, that eliminates the risk of the cable being disturbed by anchoring of vessels, dredging, etc.

Unclassified

4.7 Alteration of signage

4.7.1 Whenever the height of an overhead crossing is altered the risk must be reassessed and the maximum vessel height shown on the associated signage must be recalculated and amended accordingly.

4.7.2 Where the existing signage has reached the end of its useful life or is not economical to amend it must be replaced completely with new signage. Otherwise, the preferred method of amending the height shown is to overlay the old number(s) with new numbers printed/painted on sheet metal such that the new number(s):

- Completely cover the old/incorrect number(s),
- Have the same colour font style and size as the old number(s) (as per AS 6947Figures A4 or A5)
- Align properly on the sign with any existing number(s) (as per AS 6947Figures A4 or A5)
- Printed/painted on sheet metal that is the same base material as the sign
- Are attached permanently with appropriate corrosion resistant fixings
- Have no burs or sharp edges
- Manufactured and attached with materials and of surface finish giving similar life expectancy as the sign.

5 Documentation

5.1 The documentation to be provided for each waterway crossing shall consist of:

- risk assessment,
- overhead line, submarine or trenchless technique cable design drawing,
- post-construction survey drawings,
- post-construction sag calculation drawing for overhead crossing,
- marine charts.

5.2 Risk assessment

5.2.1 Risk Assessment documents shall be prepared by the designer in accordance with T0119, in MS-Word, generally in the same format as existing risk assessments.

5.2.2 Where a revised version of an existing risk assessment is required, the preceding version is to be retained and the new version is to be saved as a separate revision, so that the history of each crossing is maintained and can be easily followed. Superseded versions shall be marked as such and shall include a reference to the current/revised version.

5.2.3 A .pdf version of the current version shall be kept in Ausgrid's SharePoint under the "Waterway Crossings" subject heading and appropriate region sub-heading.

5.3 Design drawings

5.3.1 Design drawings must be in accordance with NS104, in the appropriate format suitable for construction.

5.3.2 In addition to normal design drawings a separate design drawing is to be provided showing pertinent details of just the crossing itself. For overhead crossings this is to include but limited to: the poles/structures on either side of the waterway, the crossing span, an outline of the banks of the waterway, HAT, etc - refer to Figure C1 – Typical Waterway Crossing Span Design Drawing for a typical example. For submarine or trenchless technique crossings the drawing is to include but not limited to: cable entry/exit locations, location of UGOHs if adjacent to crossing, installation method (trenched, trenchless technique), depth of cover beneath bed of waterway, etc.

Unclassified

5.3.3 For non-contestable projects all waterway crossing designs are to be prepared by Mains Engineering Function, Project Development. Copies of any new or revised design drawings shall be kept in the appropriate corporate drawing/document management system in a folder under the project name. Revised design drawings shall be kept in appropriate corporate drawing/document management system as a separate revision of the preceding version so that the history of each crossing is maintained and can be easily followed. Superseded versions shall be marked as such and shall include a reference to the current/revised version. A .pdf version of each approved drawing is to be published in the CAD drawing management system as required.

5.3.4 For contestable projects, the separate drawing showing just the crossing must also include a drawing number allocated from Ausgrid's CAD drawing management system. Ausgrid will attach a copy of the approved drawing(s) to the CAD drawing management system as required.

5.4 Survey drawings

5.4.1 Waterway crossing survey drawings shall be prepared in AutoCAD, generally in the same format as existing survey drawings which are held in the CAD drawing management system. Each drawing shall be assigned a unique CAD drawing management system drawing number. Refer to Annexure A for further details.

5.4.2 Where a revised survey drawing is required, it must be prepared as a revision of the preceding version (i.e. a new drawing shall not be issued). The revised drawing and preceding version(s) shall be retained in the CAD drawing management system so that the history of each crossing is maintained and can be easily followed.

5.4.3 .pdf versions of all survey drawings shall be kept in CAD drawing management system for use by general CAD drawing management system users as required.

5.5 GIS

5.5.1 GIS is to show:

- the crossing
- warning signs
- sign posts
- crossing number EAXXX
- height at maximum sag above HAT (or highest water level).

5.6 Marine charts

5.6.1 Cable route for submarine or overhead lines shall be supplied to the Hydrographic Office for inclusion on marine charts.

5.6.2 Process to send the data to Hydrographic Office:

Updated information for charts can be sent by submitting a Hydrographic Note - https://www.hydro.gov.au/feedback/AA217160-hydro-note.pdf - or by sending details of the changes or discrepancies to datacentre@hydro.gov.au.

Unclassified

Annexure A: Overhead waterway crossing survey specification

A1 General

The field survey of an overhead crossings of a navigable waterway is to determine:-

a) The location of the poles and relevant points of attachment.

b) The edge of the waterway.

c) Existing warning signs.

d) The extent of mangroves or other growth that may obscure warning signs.

e) The AHD level of a number of observations along the catenary of the lowest conductor.

f) Water level at the time of survey.

The data from the survey will be used in conjunction with further electrical calculations to determine/confirm the maximum vessel height that can safely pass under the overhead mains.

The data may also be used in the re-design of overhead crossings that do not comply with the requirements of the Boaters' Guide to Electricity Cable Crossings of NSW navigable waters (the Guide).

The required survey will be a mixture of profile and detail survey and where warranted, boundary definition.

Specific Ausgrid codes and layers are to be used as per the provided point codes shown in clause A17.

The codes used must be exactly as shown in the file and are case sensitive.

All data must be presented on M.G.A. grid co-ordinates and A.H.D.

A2 Provision of information by Ausgrid

Upon request Ausgrid will provide:-

- example Crossing drawing file e.g.: EA NSW MARITIME CROSSING TEMPLATE .dwg,
- example Crossing pdf file e.g.: EA NSW MARITIME CROSSING TEMPLATE .pdf
- RL for the appropriate tidal/water level plane.

A3 Survey requirements

- Survey control stations and recovery marks should be of a substantial nature and location so they can be utilised for future, regular check surveys on the crossings.
- Do not place stakes at survey stations where they are located in pedestrian areas or where they may affect livestock.
- Do not place large paint markings on Ausgrid poles as they may conflict with markings used by pole maintenance crews.
- Minimise the use of spray paint on roadway and pavement areas.
- Ausgrid requires that only minimal vegetation trimming be allowed to assist in the survey.

A4 Survey accuracy

- Survey control and traverse stations to appropriate survey standard.
- Conductor and Point of Attachment observations: + / - 50mm horizontally and vertically.
- Detail survey observations: + / - 50mm horizontally and vertically.
- Final boundary definition: +/ - 100mm.

A5 Methodology

Where appropriate the surveys should be undertaken by direct observations. However, sound geometric positioning of observation stations should be sought, to avoid acute angle observations.

Some sites will require positioning of observation stations a long distance from the conductors. In these instances, it may be impractical for direct observations. Horizontal and vertical angle observations may be the appropriate method to employ in these instances.

Care should be taken with long distance observations to conductors so that the correct conductor is identified and observed.

A6 Pole identification

Each pole is to be referenced by its Ausgrid asset number e.g. ET-0073.

Occasionally the field numbering of existing poles does not include “zeros”, hence ET-73.

Where a Ausgrid GIS extract is provided, please check and confirm that the pole numbers shown on drawings are the same as the GIS. If there is a genuine difference in the field pole numbering arrangements are to be made to rectify the discrepancy.

The following are to be located in x,y,z format.

- The centre of the base of each power pole at ground level.
- All other, higher, points of attachment or crossarms.
- The top of the pole (observation may be taken by reflectorless observation to face of pole).
- All associated stay poles and ground anchor entry points (where survey access at ground level is difficult these points may be located approximately by reference to the crossing pole position).

A7 Catenary observations and points of attachment

A7.1 Catenary

Where the lowest conductor is clearly identifiable, catenary observations are to be along that conductor, and no other catenary observations are required on any other spans or conductors.

Where the conductors are in a horizontal construction and it is difficult to determine which conductor is actually the lowest, observation and calculations will be required on all of the possible lowest conductors to determine which actual conductor is lowest. Only information on the lowest conductor is to be included in the AutoCAD model and the CSV file in this situation.

Occasionally crossings are constructed so that the conductor configuration changes from one side of the crossing to the other. For example, the conductors may start on one side as horizontal construction and finish on the other as vertical (or delta) construction. In these situations, Ausgrid requires all three conductors to be surveyed, and the results shown on three separate CSV files. Each CSV file will contain all ground points and all pole points and points for one conductor only. It will also be necessary on each conductor to take an additional observation close to each point of attachment (this allows for attachment points to be correctly identified in the overhead line design software (e.g. TLPro) model). The drawing should show only the conductor which the surveyor considers to be the lowest.

In all cases, each conductor surveyed requires a minimum of five catenary observations approximately equally spaced, along the entire span of the conductor.

If “marker balls” have been placed on the lowest conductor, make sure that observations are also taken to the conductor adjacent to the “marker ball”. If the “marker balls” are appropriately spaced, the observations near them will contribute to the minimum requirement of five equally spaced observations.

The following data is to be observed/recorded and entered into the “Catenary Observation” table in the drawing title block.

- Ambient: the ambient air temperature in degrees Celsius.

- Atmospheric Conditions: The condition of the weather - sunny, light cloud, overcast, dark and stormy, etc.
- Wind Speed: wind speed in meters per second with comment on whether the wind is still, gentle breeze, strong breeze, gusty.
- Wind Angle: the angle of the wind relative to the conductor, in degrees. A value of 90 degrees would indicate that the wind is blowing perpendicular to the conductor. A single indicative wind direction arrow, showing the angle of the wind to the conductor should be shown on the plan. See Ausgrid example Crossing drawing.
- Local Time: the time of day.
- Solar Day: the date of the Survey.
- Conductor observations should not be undertaken in strong breezes or wind.

On some sites it will be necessary to undertake the required catenary observations at either significantly different times and/or from different control stations. In these cases, separate "Catenary Observation" tables will be required. See Ausgrid example Crossing drawing.

Note: occasionally dual circuit crossings will be encountered with vertical conductors, three on one side and three on the other side of the structure. In these cases, each circuit or feeder (consisting of three vertical conductors) will be treated as a separate crossing. Two PDF drawings and two CSV files will be required. One AutoCAD file will suffice with a layout tab for each drawing identified as "A" and "B". There will be one crossing number and one drawing number, however there will be an "A" and "B" added to the Crossing number to create two distinct crossing identifiers, EAxxxA and EAxxxB.

A7.2 Points of attachment

The points of attachment where the lowest conductor (that passes over the waterway) attaches to the two poles/towers/insulators are to be surveyed.

It is important to identify if the lowest Ausgrid conductor attachment point is via. a termination at the pole or crossarm or is in suspension via a pin or suspension insulator.

- Termination – If both ends are terminated, there is no additional survey requirements along the pole line.
- Suspension – If one or both ends are in suspension, the x,y location of the pole is required, along the pole line, up to the next termination or for three spans.

See Figure B1 – River Crossing Survey Requirements for clarification.

Where sub-transmission (22kV, 33kV, 66kV and 132kV) insulators are terminated, there is an additional requirement to also observe those parts of the insulator as indicated on the photos in Clause B19.

There are no additional requirements relating to sub-transmission insulators in suspension.

See Clause B19 for photos showing examples of termination, pin and suspension insulators.

A7.3 Plan drawing

- The extent of the plan on the drawing is to be such that it shows only the entire lowest span that crosses the waterway and the supporting poles.
- The location of any additional poles, additional traverse, connections to pole bases or tops, etc, is to be shown only in "Model Space" and in a non-plotting layer.
- The plan should be drawn, following normal convention, such that the north point is drawn up the page. If possible, the plan and profile should be drawn so that the profile view is looking upstream.
- See Ausgrid example Crossing drawing.

A7.4 Profile drawing

The extent of the profile on the drawing is to be such that it shows only the entire lowest span that crosses the waterway and the supporting poles.

The profile should be drawn, following normal convention, such that it is correctly orientated with the above plan. Wherever reasonably practicable, the plan and profile should be drawn so that the profile view is looking upstream.

The location and values of the catenary observations is to be shown in the same manner as that on the Ausgrid example Crossing drawing.

Additionally, the location and RL of the calculated low point of the conductor is to be placed on the profile and attention paid to the drawn catenary so that the linework passes through the calculated low point. All references to the calculated low point are to be placed in a non-plotting layer.

If more than one “Catenary Observation” table is required, they should be shown as on the Ausgrid example Crossing drawing.

A7.5 CSV file

The csv file is to contain only the information relative to:

- The lowest conductor,
- The subject poles, points of attachment and additional crossarms etc,
- The ground profile including the surveyed edges of water and any false profile points,
- Additional poles if required.

A7.6 Locality plan

This should be prepared if required - ideally, an extract from the digital UBD with the crossing shown. Other detail relating to locked gates, access requirements and other relevant information to assist others visiting the site should be added.

A8 Edge of waterway and location

The location of the edge of the waterway and the water level at the time of survey is to be located under the subject conductor. Where terrain/vegetation permits, additional observations should be obtained to allow the depiction of the edge of the waterway for a short distance either side of the crossing.

See Example Crossing drawing for depiction of edge of water by survey and by approximation.

A9 Ground profile

Where practical, a single line profile of ground observations is required, directly under the subject conductor, (as best determined), from five metres behind the subject poles to the water’s edge.

Where it is impractical to survey a complete ground profile, the following processes may be used:-

- Transfer the approximate terrain from a suitably scaled topographic map.

Where additional poles need to be captured, the additional ground profile is not required if the terrain/vegetation is difficult. However, a false profile is to be created and extended, based on the ground height at the nearest crossing pole, to the next termination or three spans onward (whichever is shortest).

See Figure B1 – River Crossing Survey Requirements for clarification.

Also see “Model Space” in Example Crossing drawing.

A10 Detail survey

The following are to be located in x,y,z format :-

- Any structures located under the powerlines.
- The Ausgrid “warning” signs relating to the overhead mains. Some of these signs will be located on the bank and others within the waterway.
- Any road traffic signs that are higher than 2 metres and larger than 1m^2 located under the existing powerlines.
- Any boat ramps that are in the immediate vicinity.
- The location of and underside RL of any bridges or pipelines that span the waterway in the nearby vicinity. The underside RL may be shown in a statement within the “Notes” box if the bridge or pipeline location cannot be shown in the available plan area.

A11 Tidal or water level planes

A number of different planes may be used:

- Highest Astronomical Tide – For tidal waters.
- Mean Water Level – For non-tidal waters.
- Maximum Water Level – for impounded waters.

For each site Ausgrid will provide an RL for the appropriate Tidal / Water Level Plane.

A12 Photographs

Photographs of the poles are required to assist the engineers in calculating the maximum sag.

High quality images are required to enable closer visual inspection of the conductor attachments, etc.

As a minimum the following three photographs of each pole or structure are required:

- close up showing the structure identification detail (number plaque),
- the complete extent of the pole with as little foreground foliage as possible and
- detail of the pole construction (crossarms, points of attachment etc).

Notes: The pole photographs should be named XX1234a, XX1234b, XX1234c, etc. For example: the photographs of pole ET-0073, (or ET-73 as it may be marked in the field) would be named ET0073a, etc.

An indicative directional arrow of each photograph taken shall be recorded on the CAD drawing in “Model Space” only.

A13 Survey searches

The surveyor is to undertake all cadastral, status and survey control searches and retain them for possible latter reference by Ausgrid.

A14 Boundary definition

- Where a cadastral boundary is within the vicinity of the crossing the boundary is to be defined to enable an offset to be shown + / - 100mm.
- Investigate and show any easements, rights of way or other interests in favour of Ausgrid or other parties and authorities that are in the vicinity of the surveyed line.
- Do not mark any boundaries.

A15 Existing services

- Locate any visible services manholes, pits, etc in the immediate vicinity of each pole.
- a designated asset information service provider utility services search is not required.

A16 Presentation of data

Photographs are to be provided on a Digital storage device.

The data is to be presented in the following file formats and the files must be named using the following conventions:

a) S19xxx.csv [S19xxxA.csv and S19xxxB.csv for dual crossing] – Containing all x,y,z, observations, using only the codes shown below in clause B17. The columns in the file are to be Easting, Northing, Elevation, Feature Code and Description. The “Description” column may contain comments such as the pole number, etc.

b) S19xxx.dwg – The file must be created in AutoCAD format and be a 2D drawing incorporating the provided EA Crossing plan form and based on the provided example Crossing drawing. Do not show voltages of conductors however surveyed points need to be stated. i.e. cross arm king bolt or insulator.

c) See “Model” in the example Crossing drawing for depiction of additional traverse, connections and poles that may have been surveyed or the required statement if additional poles are not surveyed.

d) S19xxx.pdf (S19xxxA.pdf and S19xxxB.pdf for dual crossing).

A17 Ausgrid survey code/layer codelist

Ausgrid Codelist

Code/Layer	Description
bd Prefix Building	
bdAWN	Building Awning
bdBDC	Building Corner
bdBDL	Building Line
bdBUS	Bus Shelter
bdBWL	Brick Wall
bdCOL	Building Column
bdCONC	Concrete Pad
bdDOOR	Building Door
bdFAC	Building Fascia/Eave
bdFCE	Fence
bdFCEC	Fence - Conductive
bdFL	Floor Level
bdFLGP	Flag Pole
bdFLGP	Flag Pole Top
bdFP	Fence Post
bdGTE	Gate
bdOPASS	Overpass
bdPATIO	Patio
bdRR	Roof Ridgeline
bdRWB	Brick Retaining Wall
bdRWC	Concrete Retaining Wall
bdRWL	Rock Wall
bdRWM	Metal Retaining Wall
bdRWR	Rock Retaining Wall
bdRWT	Timber Retaining Wall
bdSGN	Advertising Sign
bdTBOX	Telephone Box
bdVER	Building Verandah
bdWHF	Wharf
bdWI	Wall Intersection
cm Prefix Communications	
cmCBT	Comms Cabinet
cmCM	Comms Marker
cmCT	Comms Cable Tray
cmPIL	Comms Pillar
cmPIT	Comms Pit
cmCP	Comms Pole
cmCPTop	Comms Top of Pole
cmOC	Comms Overhead Cable
cmRM	Comms Reference Marker
cmSCB	Comms Signal Cable
cmUC	Comms Underground Cable
cmX	Comms Crossing
cmCPGA	Comms Ground Anchor
cmOC-BYDA	Comms Overhead cable as per BYDA
cmUC-BYDA	Comms Underground cable as per BYDA

Code/Layer	Description
ea Prefix Energy Australia	
eaABC	Aerial Bundle Conductors
eaADSS	Fibre Optic
eaCOM	Communications/Pilot Cable
eaKSUB	Kiosk Substation
eaMS	Mid Span
eaOHBB	Overhead Bus Bar
eaOHC	Overhead Conductor
eaOHEW	Overhead Earth Wire
eaOHFB	Overhead Feeder Bay
eaOHPA	Overhead Point of Attachment
eaPIL	Pillar
eaPowerline	Line Joining Pole Centres
eaPP	Power Pole
eaPPAtt	Power Pole Attachment
eaPPEG	Pole Peg
eaPPGA	Ground Anchor
eaPPLV	Low Voltage Power Pole
eaPPSL	Street Light Pole
eaPPTop	Top of Power Pole
eaPStay	Stay Pole
eaSign	Waterways or other EA Sign
eaSLAtt	Street Light Attachment Point
eaSWire	Stay Wire at Power Pole
eaTOD	Tee Off Direction
eaUGC	Underground Cable
eaUGCPIT	Underground Cable Pit
eaUGCDUC	Underground Cable Duct
eaUGJBAY	Underground Joint Bay
eaUGJT	Underground Joint
eaUGLV	Underground Low Voltage
eaUGOPF	Underground Optical Fibre
eaUGC-BYDA	Underground Cable as per BYDA
eaOHC-BYDA	Overhead Conductor as per BYDA
eaUGTCL	Underground Trench Centreline
eaUGTE	Underground Trench Edge
eaXARM	Crossarm
eaXARME	End of Crossarm
el Prefix Electrical	
elOHAT	Electrical Overhead Attachment
elOHC	Electrical Overhead Conductor
elPIL	Electrical Pillar
elPP	Electrical Power Pole
elTWCL	Electrical Tower Centreline
elTWL	Electrical Tower Leg
elUGC	Electrical Underground Cable

Code/Layer	Description
dr Prefix Drainage	
drCUL	Drainage Culvert
drDD	Dish Drain
drDIP	Drainage Inlet Pit
drGRT	Drainage Grate
drHW	Drainage Headwall
drNW	Drainage Invert
drKIP	Kerb Inlet Pit
drMH	Drainage Man Hole
drOL	Drainage obvert Level
drPIPE	Drainage pipe
drPIPE-BYDA	Drainage pipe as per BYDA
drPIPE-NOSVY	Drainage pipe (where there is no BYDA)
drSIP	Drainage Surface Inlet Pit
drWC	Water Course
drWL	Water Line
ra Prefix Railway	
raBGTE	Boomgate
raCAT	Catenary
raKMP	Kilometre Post
raOHC	Overhead Conductor
raPP	Railway Power Pole
raRAIL	Top of Railway Rail
raRX	Rail Crossing
raSP	Signal Pole
raSS	Signal Shed
raSW	Signal Wire
raTRKCL	Railway Track Centreline

Code/Layer	Description
ga Prefix Gas	
gaGM	Gas Marker
gaGMT	Gas Meter
gaPIPE	Gas Pipe
gaPIPE-BYDA	Gas Pipe as per BYDA
gaGV	Gas Valve
gaGX	Gas Crossing
gt Prefix Geotechnical	
gtBH	Borehole
gtCPT	Cone Penetrometer
gtTPIT	Test Pit
ms Prefix Miscellaneous	
msMH	Manhole
msPIPE	Pipe
msPIT	Pit
sv Prefix Survey	
svAPLUG	Aluminium Plug
svCB	Concrete Block
svDH	Drill Hole
svDHW	Drill Hole & Wing
svDPY	Dumpy
svGIN	Galvanised Iron Nail
svGIP	Galvanised Iron Pipe
svMARK	Survey Mark
svNAIL	Nail
svPEG	Peg
svPM	Permanent Mark
svRT	Reference Tree
svSSM	State Survey Mark
svSTK	Stake
svSTN	Station
svTS	Trig Station

Code/Layer	Description
rd Prefix Road	
rdBIT	Bitumen Spot Height
rdBKB	Back of Kerb
rdBOL	Bollard
rdBRG	Bridge
rdBRS	Buttress
rdCHPeg	Chainage Peg
rdCLB	Centreline Bitumen
rdCLC	Centreline Concrete
rdCLG	Centreline Gravel
rdDWY	Driveway
rdDWYCL	Driveway Centreline
rdEB	Edge of Bitumen
rdEC	Edge of Concrete
rdEG	Edge of Gravel
rdER	Edge of Road
rdGPST	Guidepost
rdGR	Gurad Rail
rdGUT	Gutter
rdGVL	Gravel Spot Height
rdHR	Hand Rail
rdLKB	Lip of Kerb
rdMS	Median Strip
rdPMT	Parking Meter
rdPRY	Pramway
rdPTM	Parking Ticket Machine
rdPVR	Paved Surface Spot Height
rdPX	Pedestrian Crossing
rdRLL	Road Lane Lines
rdSGN	Sign
rdSPH	Speed Hump
rdTKB	Top of kerb
rdSIG	Traffic Signals

Code/Layer	Description
tg Prefix Transgrid	
tgOHAT	Transgrid Overhead Attachment
tgOHC	Transgrid Overhead Conductor
tgTWCL	Transgrid Tower Centre
tgTWL	Transgrid Tower Leg
tgUC	Transgrid Underground Cable
to Prefix Topography	
toBB	Bottom of Bank
toTB	Top of Bank
toCG	Change of Grade
toEGUL	Edge of Gully
toGDN	Edge of Garden
toNS	Natural Surface
toCLNS	Centreline Natural Surface
toSCRUB	Edge of Scrub
toSH	Spot Height
toTR	Tree
toTRL	Tree Line
wa Prefix Water	
waHYD	Hydrant
waPIPE	Water Main Pipe
waSTN	Water Pumping Station
waSV	Stop Valve
waTAP	Tap
waWMT	Water Meter
waWX	Water Crossing
waPIPE-BYDA	Water Main Pipe BYDA
se Prefix Sewer	
seINSPT	Sewer Inspection Point
seMH	Sewer Manhole
sePIPE	Sewer Pipe
seSPT	Septic Tank
seSRM	Sewer Rising Main
seSTN	Sewer Pumping Station
seSUMP	Sewer Sump
sePIPE-BYDA	Sewer Pipe as per BYDA
seSVT	Sewer Vent
seTPA	Transpiration Area

CAD lager = Survey code

It is essential that any csv file contains only codes from the above list.
The codes are case sensitive.

The code / Lager drPIPE-NOSVY is for those areas on the Central Coast where there is no BYDA documentation or drawings for drainage

A18 Waterway crossing survey requirements

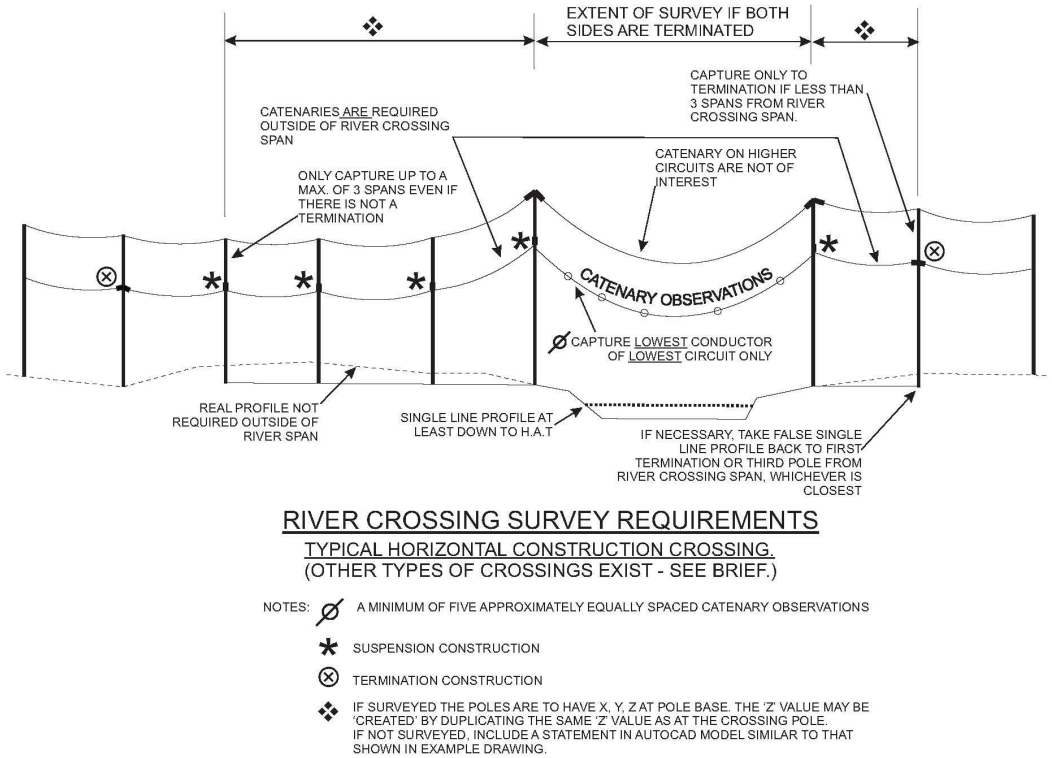


Figure A1 – River Crossing Survey Requirement

A19 Attachment point photos

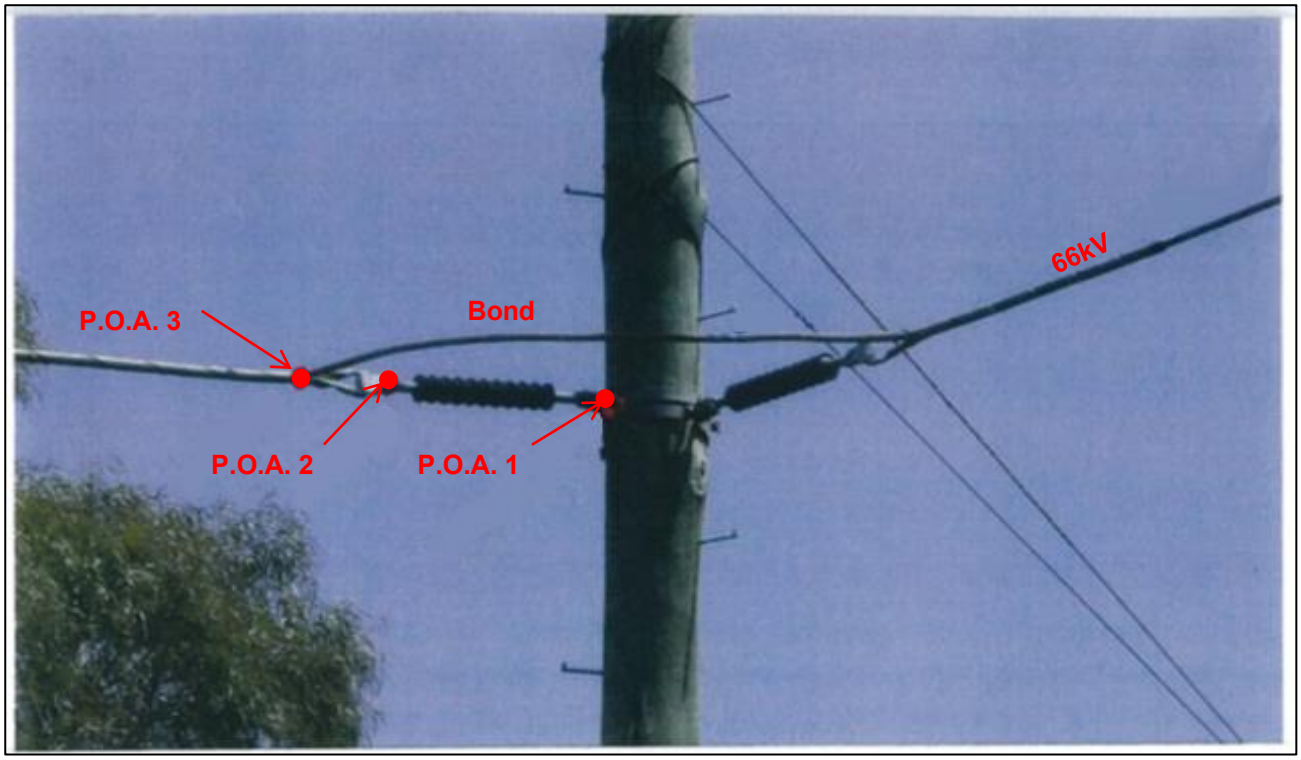


Figure A2: Subtransmission (66kV) Terminations

(all to be coded “eaOHPA”)



Figure A3: Subtransmission (132kV) Terminations

(all to be coded “eaOHPA”)

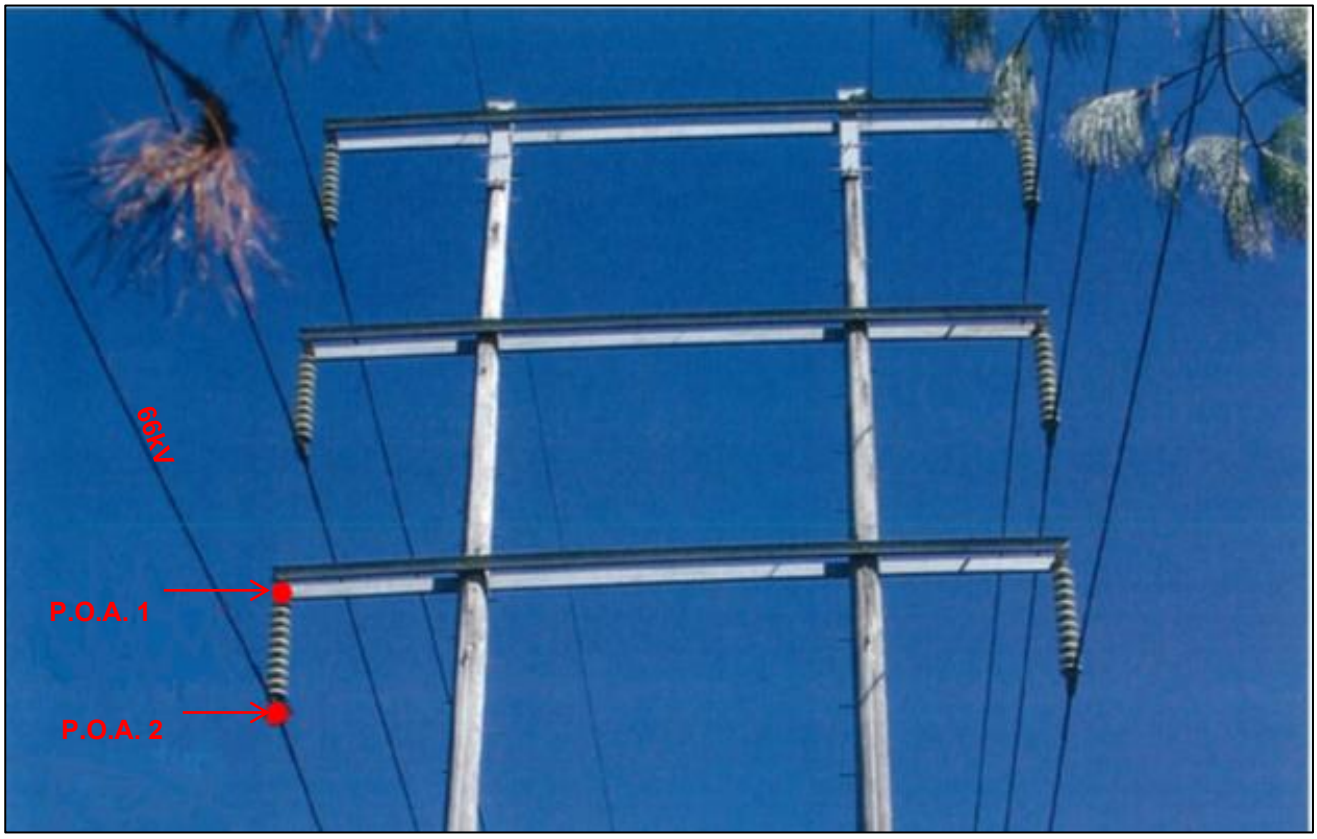


Figure A4: Sub-transmission (66kV) Suspensions

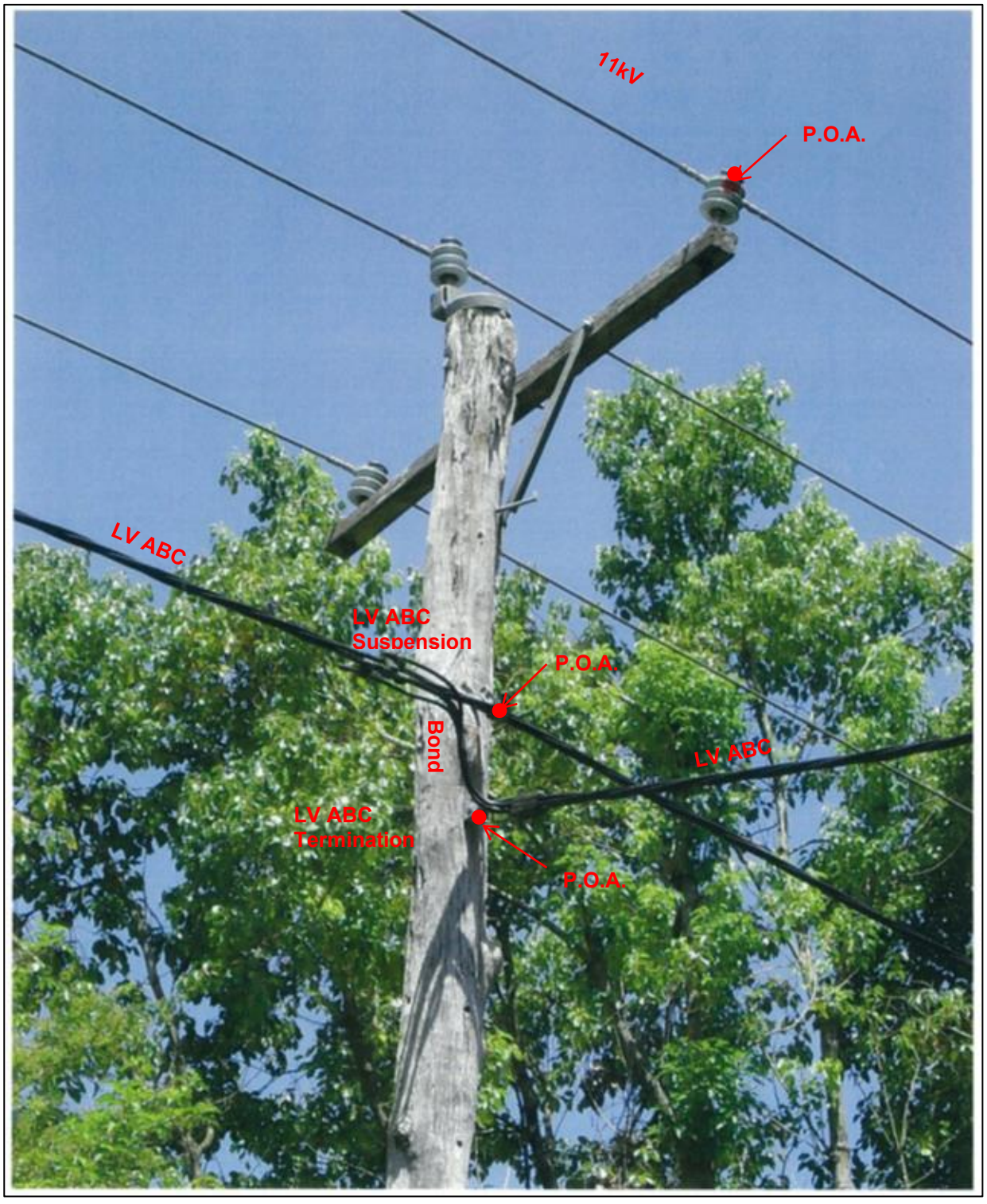


Figure A5: High voltage (11kV) Pin Construction and LV ABC Suspension & Termination

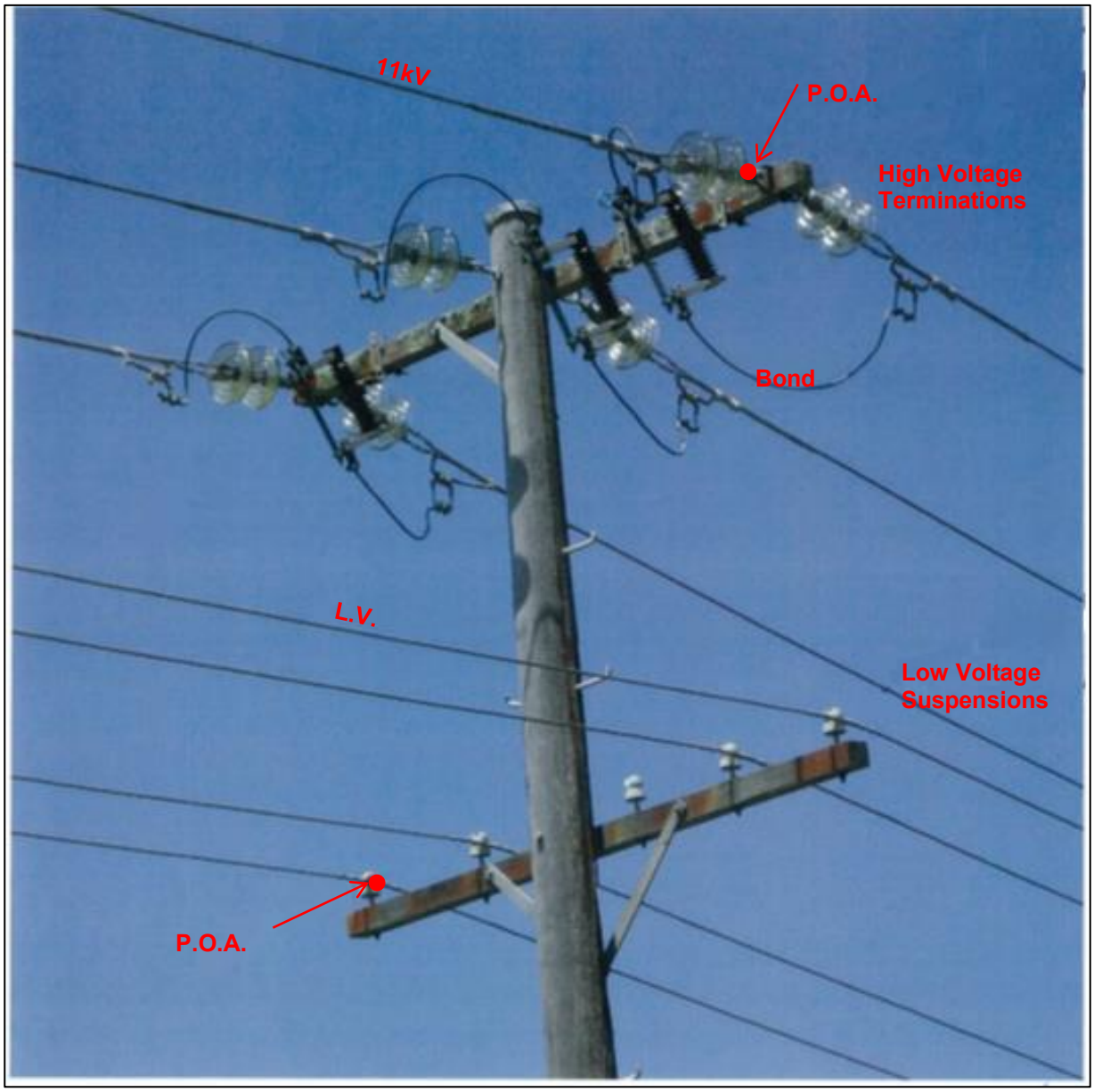


Figure A6: High Voltage (11kV) Terminations and Low Voltage Pins

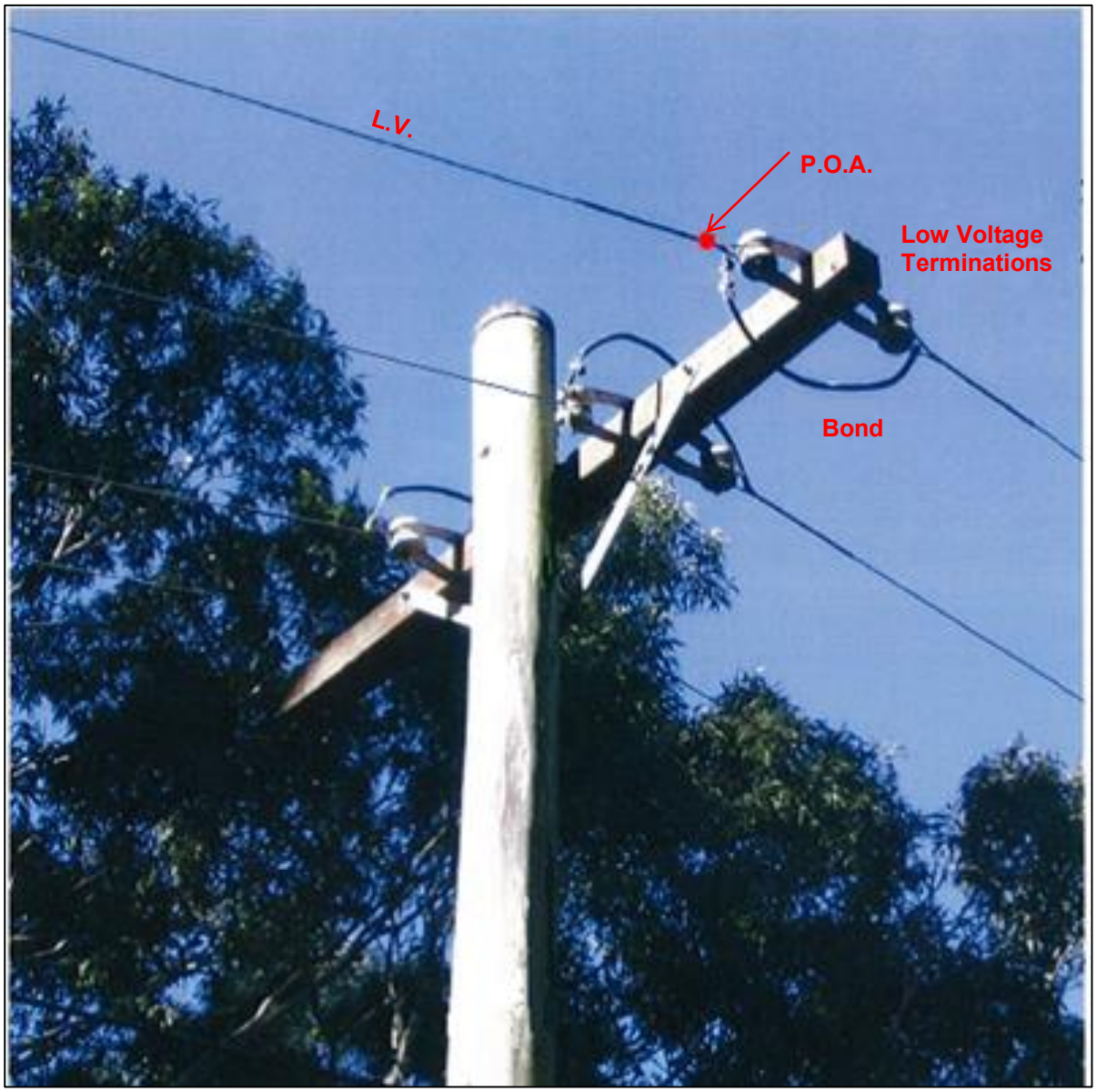


Figure A7: Low Voltage Terminations

Annexure B: Typical waterway crossing span design drawing

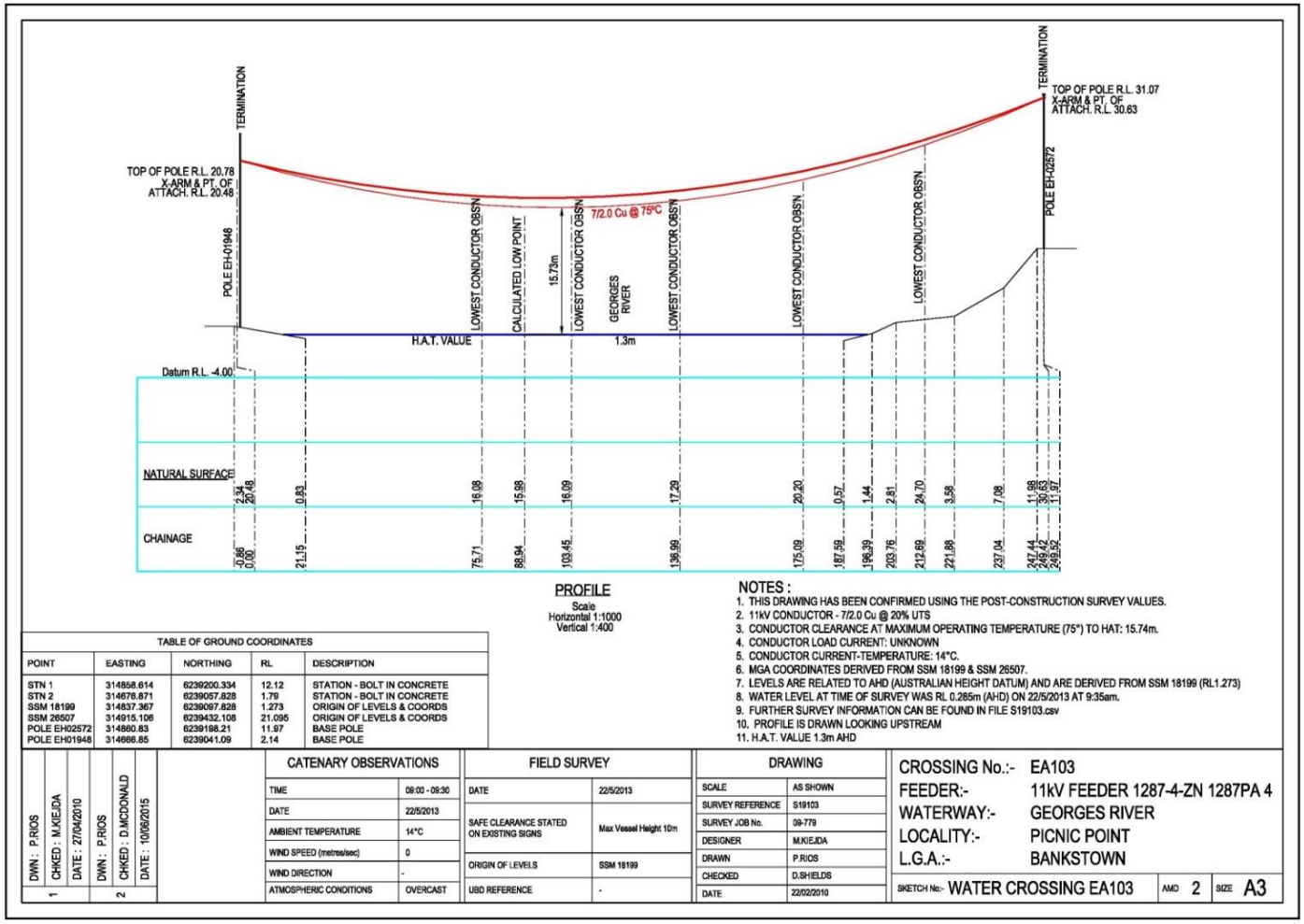


Figure B1 –Typical Waterway Crossing Span Design Drawing

Annexure C: List of drawings

IMPORTANT: Users must ensure that the drawings they are using are the current versions with all amendments.

Table C1 – List of Drawings

Number	Title
252151	Standard Constructions – Signage Supports Structural Standard Notes

Annexure D: Design Height of New Crossing

The design height of a new crossing is to be such that:

$H_{crossing} \geq H_{vessel} + S + E + W + SCF$

where:

$H_{crossing}$	**=**	**Minimum height of crossing conductors above HAT (or highest water level[1]) at maximum operating temperature.**	
H_{vessel}	=	Height of highest vessel known to use the waterway (as determined during the site visit and investigation) rounded up to the next whole metre	
S	=	Safety margin (= 2.2m in all cases)	
E	=	Electrical clearance	= 0.3m for voltage ≤ 33kV (including communications cables)
			= 0.8m for 33kV < voltage ≤ 132kV
W	=	Allowance for wave height (as determined during the site visit and investigation)	
SCF	=	Sag Compensation Factor = a factor that will allow for such things as: construction inaccuracy, survey inaccuracy, pole movement, conductor creep and the fact that the crossing will be subsequently surveyed and assumed to be at ambient temperature when in reality it may be at a higher temperature. The SCF will be determined by the Designer to suit the particular situation.	

Notes:

For tidal waterways, the crossing is to be designed so that the conductors achieve the minimum height above HAT. For non-tidal waterways, the highest water level will need to be determined and the crossing is to be designed so that the conductors achieve the minimum height above this level which is generally relative to AHD rather than HAT.

Note: the maximum vessel height is to be rounded up to the next whole metre and this affects the design height.

For example: if a new 11kV crossing is to be constructed, and investigation reveals that:

- highest vessel to use the waterway is 10.4m and
- maximum wave height on the waterway at the proposed crossing location is 0.5m

The crossing must be designed for a vessel height of 11m (= 10.4m rounded up to next whole metre).

The minimum height to which the crossing must be designed and constructed = 11 + 2.2 + 0.3 + 0.5 = 14.0m PLUS SCF.

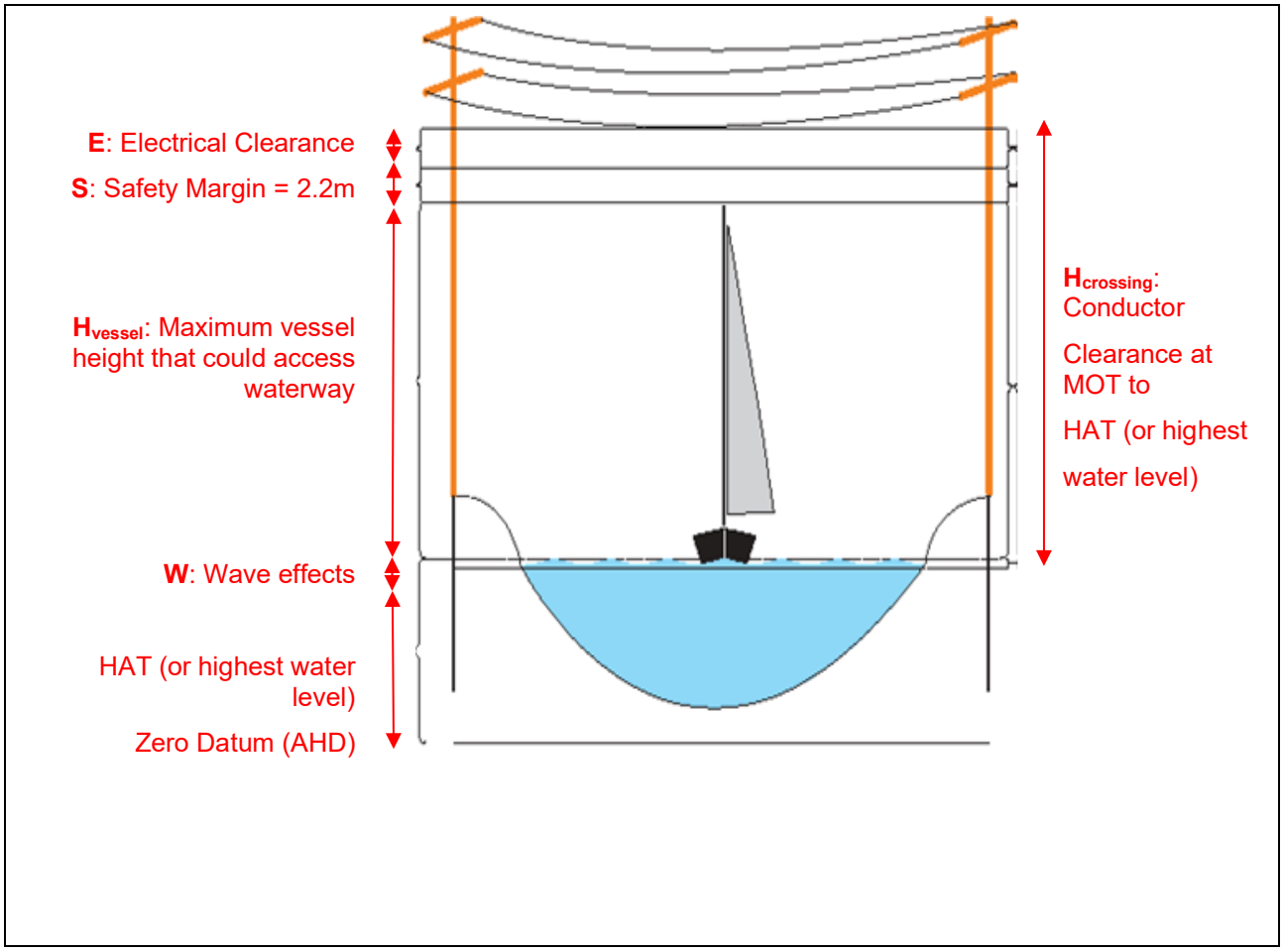


Figure D1: Design Height of New Crossing

The minimum required design height ($H_{crossing}$) is to be maintained, over all parts of the navigable waterway, under all conditions for the life of the crossing except during flood events. Allowance should be made for any planned activities, such as dredging, which has the potential to allow higher vessels to use the waterway. Consideration should also be given to the possibility of a person being the highest point of the vessel, for instance if they are standing on a flybridge or on the top deck of the vessel. If this is likely given the types of vessels which use the waterway, an allowance of 2.45m from the uppermost deck is required.


Ausgrid