Network Standard

Document No.
NS159

Title:
Installation of Cables and Conduits using Trenchless Techniques

Approved Date	7/12/2022	Revision		5	
Lifecycle Stage	Plan/Design/Construct	Internal Use	☒	External Use	☒
Technical Approver		Authorised By			
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Designation	Senior Engineer	Designation		Head of Asset Risk and Performance	

Revision

No	Date	Description	Technical Approver	Authorised By
0	18/02/2015	BMS Conversion	Duminda Thenuwara	Chief Engineer
1	26/02/2018	Inclusion of a new Clause on detailed designs and requirements, and shared underbores; additional information provided on grouts, testing of conduits/pipes, recording of location of conduits and/or cables.	Meenit Charan	Bill Woods
2	19/10/2021	New NS template and cable selection table for cables up to and including 11kV. Additional information provided on design requirements, CCTV use, hydrostatic testing, characteristics of grouts. Requirements included for adding on-site water to grout, sample testing of grout, bore spacers, chamfering conduits / pipes, potholing to locate existing underground services.	Bruce Webster	Mark Ragusa
3	6/07/2022	Remove reference to Dial Before You Dig and replace with designated underground asset information provider.	Bruce Webster	Dean Starkey
4	7/12/2022	Included the requirements for: a grouting design / methodology document to be prepared for large scale and / or complex bores; the Constructor to measure and record the quantity of drilling fluid removed and the quantity of grout injected into a bore; the creation and submission of inspection and test plans (ITPs) to Ausgrid.	Bruce Webster	Dean Starkey
5	13/02/2024	Modified requirements for simple bores in Cl 1.6.1 to cover new industrial and greenfield estates.	Joseph Metti	Jacob Bayley

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Scope

This Network Standard is to be used for the installation of underground cables and conduits by trenchless techniques where such techniques are either specified by Ausgrid or have been requested by a third party and reviewed by Ausgrid on a project specific basis. This Standard covers underground cables of all voltages.

Trenchless techniques include, but are not limited to, micro-tunnelling, horizontal directional drilling (HDD), auger boring, guided boring, impact moling, rotary moling, rod pushing, pipe ramming, thrust boring and jacking. For the purpose of this Standard, tunnelling using road headers or tunnel boring machines falls outside the scope of this document.

Reference Documents

All work covered in this document shall conform to all relevant Legislation, Standards, Codes of Practice and Network Standards. Current Network Standards are available on Ausgrid's Internet site at www.ausgrid.com.au.

ASPs and other persons external to Ausgrid are responsible for sourcing the manufacturer's instructions and manuals.

Ausgrid Documents

NS001 Glossary of Terms

Electrical Safety Rules

NS100 Field Recording of Network Assets

NS100 External Annexure C

NS130 Laying Underground Cables up to and including 11kV

NS156 Working Near or Around Underground Cables

NS161 Specification for Testing of Underground Cables

NS172 Design Requirements for Cable Jointing Pits and Vaults

NS181 Approval of Materials and Equipment and Network Standard Variations

NS181 Approved Material List (AML)

NS272 Underground Cable Rating

Other Standards and Documents

AS 1742.3 Manual of uniform traffic control devices – Traffic control for works on roads

AS/NZS 2053.2 Conduits and fittings for electrical installations – Rigid plain conduits and fittings of insulating material

AS/NZS 4130 Polyethylene (PE) pipes for pressure applications

AS 4799 Installation of underground utility services and pipelines within railway boundaries

CIGRE TB770 Trenchless Technologies

Master Access Deed for Railway Crossings 2002

NSW Streets Opening Coordination Council (SOCC) Guide to Codes and Practices for Streets Opening

Roads and Maritime Services Technical Direction on Trenchless Excavation within the Easement of Roads and Maritime Infrastructure

SafeWork NSW Work Near Underground Assets – Guide

Transport for NSW SPC 207 Track Monitoring Requirements for Undertrack Excavation

WorkCover Code of Practice, Tunnels Under Construction 2006

Acts and Regulations

Electricity Supply (General) Regulation 2014 (NSW)

Electricity Supply (Safety and Network Management) Regulation 2014 (NSW)

Work Health and Safety Act 2011 (NSW)

Work Health and Safety Regulation 2017 (NSW)

Clause	Standard Requirements

1 Planning and Design

1.1 For larger scale projects, especially where the route is made complex by service congestion or variable ground conditions, careful planning and design of the contracted works (including selection of most appropriate technology) shall be undertaken by suitably experienced persons. For example, it may be appropriate to engage consultants to assist in route and technology selection, so that it is easier for the Constructor to quote for the works, while ensuring that the installation achieves the key criteria of cable ratings, accessibility and constructability (for both drilling constructors and cable installers).

1.2 During the planning, design and tender preparation stages, the following items shall be considered:

- Is the bore to be straight or are changes of direction required.
- Number and size of cables or conduits to be installed.
- Is the bore to be accessible (i.e. will people be expected to enter the bore to install cables or conduits, during construction, or at a later date).
- Service congestion – may determine which techniques are suitable for a project, and lead times for negotiations with other utilities, rail, etc.
- Ground conditions – will determine achievable cable ratings, need for lining, grouting, ability to adjust the bore route, frac-out (refer to Clause 6.10) etc.
- Approvals from affected asset owners such as utilities and property owners etc.

1.3 Site Inspection and Evaluation

1.3.1 The Designer shall arrange a site visit in order to assess likely routes for a bore, suitable locations for send and receive pits (if necessary), and options for alternative solutions, such as attachment to existing or planned bridges over waterways, or use of existing road or service tunnels.

1.3.2 The presence of obstacles or hazards including waterway crossings, significant changes in ground levels or ground conditions shall be considered.

1.4 Service Searches

1.4.1 For all projects, as a minimum, preliminary enquiries shall be undertaken by the Designer into the location of services using a designated underground asset information provider and availability of geotechnical information for the proposed route, to assist bore constructors in preparing quotations for the works and to minimise the risk of unknown constraints.

1.4.2 If the proposed cable route involves close approach to high value assets such as high-pressure gas mains, major telecommunications links or electrical transmission cables etc, the Designer and/or bore constructor shall notify Ausgrid and provide documentation as to how the drilling process will incorporate the asset owner's requirements to ensure its assets are protected from damage. Refer also to Clause 6.3 of this Standard.

1.5 Geotechnical and Other Assessments

1.5.1 Available geotechnical and contaminated land information for the route of the proposed bore shall be collected by the Designer and reviewed for likely project risks. If the route involves areas of contaminated land, acid sulphate soils or crossings of major roads, railways and waterways, additional geotechnical information may be required.

1.6 Design

1.6.1 The Designer shall provide a detailed design for all larger scale projects (e.g. where the route is made complex by service congestion or variable ground conditions) and for projects that require a review of the cable ratings by Ausgrid (refer to Clause 1.8). A detailed design is not required for simple bores such as those crossing:

- existing minor roads (<12m kerb to kerb),
- new roads in industrial/commercial estates and greenfield estates (<24m kerb to kerb),
- driveways.

1.6.2 This detailed design shall be undertaken in consultation with an accredited bore specialist who has been suitably trained in all aspects of the works, and shall include:

- a cross section showing the details of the conduits in the underbore,
- full longitudinal profile providing bore depths along the entire length,
- details of the entry and exit pits,
- any other information considered necessary to minimise any unexpected issues and costs that may arise during the construction phase.

1.6.3 The detailed design shall be supported by a written endorsement from an accredited bore specialist confirming that the design can be constructed.

1.7 Depth of Cover

1.7.1 Cables and Conduits Laid Predominantly by Trenchless Techniques

1.7.1.1 Projects involving cables and conduits that are laid by trenchless techniques shall have a minimum depth of cover of one (1) metre to the bore casing, as it is not possible to lay cable protection covers by trenchless techniques.

1.7.1.2 Where the minimum depth of cover as stated above cannot be met, then that portion of the cable route which does not satisfy the above requirements shall be laid by conventional open trenching techniques and shall incorporate cable protection covers in accordance with the requirements of NS130.

1.7.2 Cables and Conduits Laid Predominantly by Conventional Open Trenching Techniques

1.7.2.1 For cable and/or conduit runs that are predominantly laid by conventional open trenching techniques but involve underboring of driveway crossings, the minimum depth of cover of the underbores shall be consistent with the depth of cover of the associated open trenches and the requirements of NS130.

1.8 Cable Selection

1.8.1 Cables up to and including 11kV installed using trenchless techniques shall be selected from Table 1 according to the duct arrangement, maximum bore depth and the minimum current rating required for the project. The design information provided by Ausgrid will specify the minimum number of conduits required and the minimum current rating for the project.

1.8.2 Where the maximum bore depth is greater than 3 metres to the bore casing at the lowest point or the project involves sub-transmission cables, a rating assessment shall be completed by the Designer as per NS272 and submitted to Ausgrid for review and approval.

Table 1 – Continuous Current Rating for Cables up to and Including 11kV Installed using Trenchless Techniques

Duct Arrangement	Cable Size	Summer Continuous Ratings (Amps per Feeder)					Comments
		Bore Depth at the Deepest Point of the Bore					
		1.0m to 1.3m	>1.3m to 1.5m	>1.5m to 2.0m	>2.0m to 2.5m	>2.5m to 3.0m	
2 Ducts (Profile 1)	185mm^2 Cu	353	350	343	339	335	1 x empty duct. 1 x conductor loaded to maximum permissible operating temperature of 90 degrees in grout with a TR 1.1.
	240mm^2 Cu	394	390	384	379	374	
	300mm^2 Cu	445	440	433	429	424	
	400mm^2 AL	396	393	386	381	376	
	500mm^2 AL	449	446	435	431	425	
	500mm^2 Cu	541	536	528	520	515	
4 Ducts (Profile 2)	185mm^2 Cu	255	252	245	240	236	1 x empty duct. 3 x conductors loaded to maximum permissible operating temperature of 90 degrees in grout with a TR 1.1.
	240mm^2 Cu	288	284	277	271	267	
	300mm^2 Cu	325	320	314	309	304	
	400mm^2 AL	288	284	277	272	267	
	500mm^2 AL	325	320	311	308	301	
	500mm^2 Cu	396	391	381	373	366	
6 Ducts (Profile 3)	185mm^2 Cu	217	213	206	202	198	1 x empty duct. 5 x conductors loaded to maximum permissible operating temperature of 90 degrees in grout with a TR 1.1.
	240mm^2 Cu	244	241	235	229	225	
	300mm^2 Cu	278	274	266	261	255	
	400mm^2 AL	245	240	235	229	225	
	500mm^2 AL	278	270	263	256	251	
	500mm^2 Cu	337	330	321	314	308	
9 Ducts (Profile 4)	185mm^2 Cu	180	176	170	166	163	1 x empty duct. 8 x conductors loaded to maximum permissible operating temperature of 90 degrees in grout with a TR 1.1.
	240mm^2 Cu	205	201	193	189	185	
	300mm^2 Cu	232	227	222	217	212	
	400mm^2 AL	205	202	194	188	184	
	500mm^2 AL	230	223	218	213	209	
	500mm^2 Cu	281	275	266	259	254	

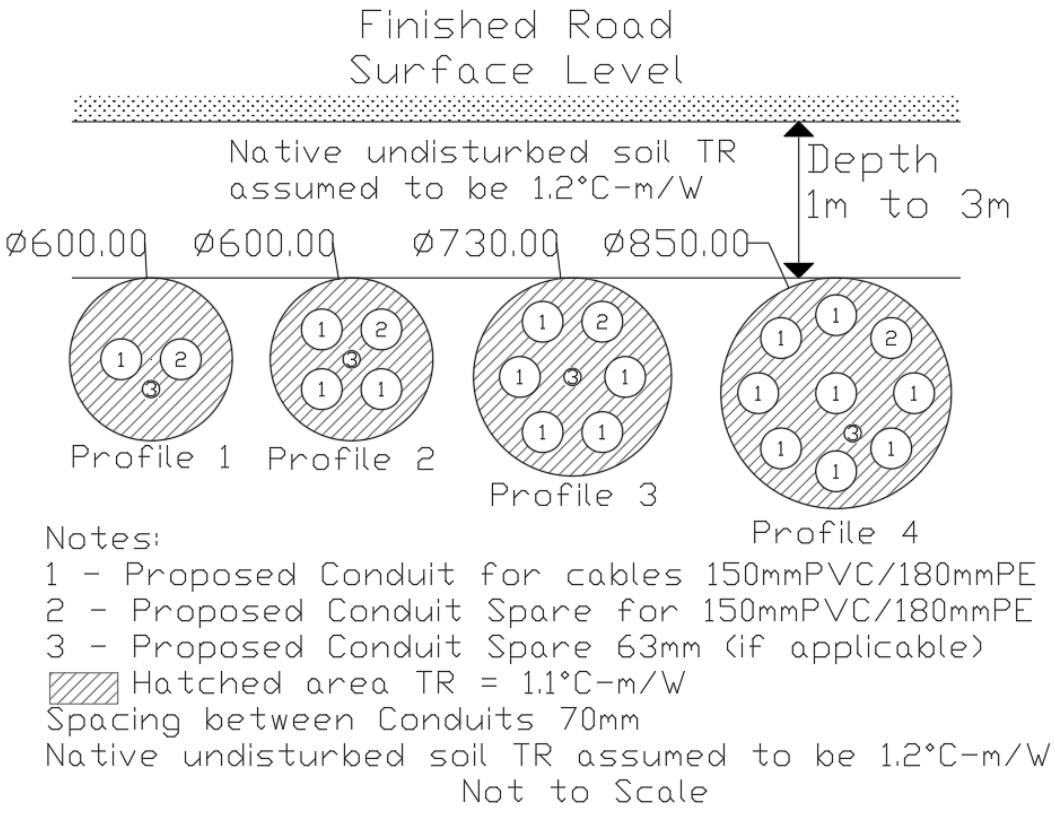

Figure 1 – Duct Arrangement

1.9 Easements and Property Tenure

1.9.1 Any cables or conduits installed by trenchless techniques on private land shall comply with the requirements of NS143 and Clause 6.6 of this Standard.

2 Shared Underbores

2.1 Prior to the design stage, approval from Ausgrid shall be obtained for shared underbores.

2.2 All third party conduits shall go left or right immediately after leaving the shared underbore and proceed along their own separate alignment that is not shared with Ausgrid.

2.3 All third party conduits shall be located at the top of the underbore so that any access that is required has a minimum impact on Ausgrid's conduits below.

2.4 The design shall state any and all third parties using the shared underbore and what type of conduit and cable will be installed.

2.5 As the underbore is shared, written approval from all parties shall state that the separation distances as detailed in the NSW Streets Opening Coordination Council (SOCC) Guide to Codes and Practices for Streets Opening and in AS/NZS 3000 do not need to be met.

2.6 The third party conduits and cables shall not affect Ausgrid's cable ratings.

2.7 All details for shared underbores shall be clearly recorded on Ausgrid’s Geographical Information System (GIS).

3 Carriageway Underbores

3.1 All carriageway crossings where distribution cables are to be installed shall be perpendicular to the carriageway unless specifically approved by Ausgrid.

3.2 For sub-transmission cables, carriageway crossings may not be perpendicular to the carriageway.

3.3 Carriageway crossings associated with Transport for NSW roads shall comply with the Roads and Maritime Services technical direction on “Trenchless Excavation within the Easement of Roads and Maritime Infrastructure”.

4 Railway Undertrack Crossings

4.1 All proposed rail undertrack crossings undertaken by Ausgrid shall be completed in accordance with the Master Access Deed for Railway Crossings. This Deed governs all work undertaken by Ausgrid and its subcontractors on or near rail infrastructure.

4.2 All contestable work involving rail crossings shall be negotiated by the ASP/3 with the owner of the rail corridor.

4.3 Railway undertrack crossings associated with Transport Asset Holding Entity of New South Wales (TAHE) shall comply with the Transport for NSW SPC 207 Track Monitoring Requirements for Undertrack Excavation.

5 System Components

5.1 Grouts

5.1.1 Use and Characteristics

5.1.1.1 Grout shall be designed and installed to meet the following requirements:

- minimise air voids between the conduits / pipes / casing and the surrounding soil to reduce the risk of soil displacement and potential ground subsidence.
- reduce the risk of conduit movement / damage due to localised soil displacement when using uncased bores.
- achieve the required Thermal Resistivity (TR) value.

5.1.1.2 Only approved grouts shall be used. Ausgrid’s Approved Material List (AML) provides a list of suppliers of grout mixes and their product codes. Whenever one or more ingredients are to be sourced from a different location or supplier additional testing and approval is required.

5.1.1.3 Grout shall have the following characteristics:

- Nominal thermal resistivity of 1.1K.m/W or less[1] fully dried,
- Compressive strength to suit the ground conditions (typically 2 - 4MPa after 28 days of curing),
- High pumpability to ensure all air voids are filled,
- Low drying shrinkage to prevent cracks / air voids forming during the grout drying process, tested in accordance with the relevant standard, and
- Low heat of hydration that avoids the deformation of conduits / pipes.

5.1.1.4 Higher strength grouts will be considered provided suitable testing / analysis is provided to Ausgrid to confirm that the conduits / pipes are not affected by elevated temperatures. The proposed use of special control measures, e.g. water being circulated through the conduits / pipes, shall be submitted to Ausgrid for review on a project specific basis.

[1] Some projects will require a lower TR value

5.1.1.5 Grout mixes from other suppliers not listed in the AML can also be submitted to Ausgrid for consideration. In this case, the Constructor shall provide Ausgrid with the following information for review:

- TR test report,
- Compressive Strength test report,
- evidence to indicate low heat of hydration, low drying shrinkage and high pumpability,
- mix design / recipe including any proposed additives to be used (see Clause 5.1.2).

5.1.1.6 The Constructor shall provide a copy of the grout delivery docket to Ausgrid for every batch of grout mix supplied and shall demonstrate compliance with the AML, or the project specific approval that was granted.

5.1.1.7 The addition of significant water on-site (other than to make up for evaporation losses etc.) is a change to the grout mix design and may adversely impact both grout strength and TR. Where water needs to be added (for pumpability etc) it shall be approved by the grout supplier. Any on-site sampling of the grout (Clause 5.1.3.2) shall be undertaken after the addition of water.

5.1.2 Additives

5.1.2.1 Any additives proposed for use with the grout mix design shall meet the requirements of relevant Australian Standards and shall be submitted for approval in writing to Ausgrid.

5.1.3 Installation

5.1.3.1 For larger scale and / or complex bores (refer to Clause 1.6.1), the Designer shall provide a grouting design / methodology as a separate document to the electrical design.

5.1.3.2 The following details shall be provided as a minimum in the separate grouting design / methodology:

- volume of grout required to fill all voids between the conduits / pipes and surrounding casing / soil for the length of the bore (i.e. the annulus volume),
- method of injecting the grout (using a tremie or other method) for the length of the bore,
- cross section drawings of the bore showing the injection method, and
- method of air removal to minimise the risk of air voids from around the conduits / pipes.

5.1.3.3 Where tremie pipes are used, additional information such as spacer drawings showing the orifice for the tremie pipe, material of the tremie pipe and the inner and outer diameter of the pipe shall be submitted as part of the grouting design / methodology.

5.1.3.4 The Constructor shall measure and record the quantity of the drilling fluid removed from the bore length and the quantity of grout injected into the bore length, excluding any changes in the entry and exit pits. The results shall be recorded in a table format and provided to Ausgrid at the completion of the grouting process and shall be used to estimate the percentage of the annulus volume that has been filled with grout. The structure of the table of results shall be in a similar format to the example below.

Table 2 – Example of the Results Table

	Design Parameters	As-Built Results
Bore Length (m)		
Volume of Grout Injected (m^3)		
Volume of Drilling Fluid Removed (m^3)		

5.1.4 Testing

5.1.4.1 For effective grout performance, periodic tests are required to ensure that:

- the specified mix ingredients continue to be used, and "similar" ingredients are not substituted without approval, and
- the grout mixes achieve their designated function, including thermal and mechanical characteristics.

5.1.4.2 On-site sampling and testing for thermal resistivity (TR) and 28 day compressive strength is only required for bores that exceed 12m in length and shall be performed as follows:

- Bores greater than 12m but less than 50m long - one sample per bore location.
- Bores greater than 50m long - one sample per 50m length of bore or part thereof, based on the pro-rata volume pumped and with the sample timings being equally spaced during grout installation.

Each test shall consist of assessment against the criteria specified in Clause 5.1.1.

5.1.4.3 The location and timing of the sampling must be accurately recorded and provided with the grout test results to Ausgrid no later than six (6) weeks after the sampling, who will submit them to:

- gis@ausgrid.com.au for incorporation into Ausgrid's Geographic Information System (GIS), and
- TR_and_TSB_results@ausgrid.com.au for ongoing review of the grout performance characteristics and incorporation into Ausgrid's ThermalRes database.

5.1.4.4 For thermal resistivity testing requirements and procedures refer to NS 130 Annexure L.

5.2 Conduits

5.2.1 Horizontal Directional Drill (HDD) Bores

5.2.1.1 Polyethylene (PE) pipes are required for HDD bores and are to be selected in accordance with AS4130. Most common pressure pipe would be:

- DN180mm OD (min. 150.4mm ID) SDR 13.6 PE100 PN12.5 (orange)
- DN225mm OD (min. 188.2mm ID) SDR 13.6 PE100 PN12.5 (orange)
- DN63mm OD (min 54.4mm ID) SDR 17 PE100 PN10 (orange)

5.2.1.2 Other pipe sizes, pressure ratings and colour may be required according to specific project requirements. It is the responsibility of the Designer to specify the required conduit properties.

5.2.2 Case Bores, Micro Tunnels, Thrust Bores and Bed Bores

5.2.2.1 Conduits for electrical installations are generally to be selected in accordance with the following requirements:

- 100mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
- 125mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
- 150mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
- 200mm PN6 Rigid UPVC (orange) conduit to AS/NZS 1477
- 50mm Heavy Duty (HD) UPVC (orange) conduit to AS/NZS 2053.2

5.2.2.2 Other pipe sizes, wall thicknesses and construction may be required according to specific project requirements. It is the responsibility of the Designer to specify the required conduit properties.

5.3 Bore Spacers

5.3.1 Bore spacers shall be of the type that has a sufficient number of equally spaced centralizing points that contact the circumference of the bore to help:-

- centre the spacer during the installation and curing process,
- prevent the conduits from floating,
- maintaining the spacer in a vertical position, and
- prevent the rotation of the conduits.

5.3.2 Bore spacers shall be selected and spaced appropriately to hold the conduits together and maintain spacing of the conduits in accordance with NS130 for the full length of the bore, whilst at the same time allowing the easy flow of grout to fill the voids between conduits and wall of the bore. No metal bore spacers are permitted in Ausgrid's underbore projects.

5.3.3 All bore spacer details along with the method to be used to fasten the conduits to the bore spacer shall be submitted to Ausgrid for review before installation.

5.4 Adaptors

5.4.1 Where applicable, a suitable adaptor shall be installed to enable a smooth transition from a Polyethylene (PE) pipe to a PVC conduit at each end of a bore. Refer to Clause 6.12. All adaptor details shall be submitted to Ausgrid for review before installation.

5.5 Bore Lining

5.5.1 Where the conditions require the ground to be supported during boring operations, a technique which incorporates the installation of a lining or casing shall be adopted. This would normally be appropriate where several conduits are to be installed in a single bore and the ground is not naturally self-supporting, or where loads above the bore require a minimum standard of support (for example, under major roads or rail crossings).

6 Construction

6.1 Location of Services

6.1.1 The latest services information from all relevant authorities shall be obtained from a designated underground asset information provider.

6.2 Approvals and Notifications

6.2.1 Statutory approvals and notification shall be obtained prior to the construction of any works on site. Notification is required even if no open trenching is involved. This notification is over and above any requirements for traffic management plans, and the information provided as part of the notification does not replace any of the requirements of AS1742.3 for traffic management.

6.3 Working Near Existing Underground Assets

6.3.1 Ausgrid Assets

6.3.1.1 Undertaking boring works in the vicinity of existing electrical assets can be extremely hazardous. Persons undertaking such activities shall complete sufficient risk assessments to ensure the task can be carried out in a safe manner.

6.3.1.2 Adequate clearances for the safe installation and future maintenance of assets shall be maintained. The Designer / Constructor shall undertake a risk assessment as to the location of existing utility assets.

6.3.1.3 Potholing shall be used to locate existing underground services to ensure adequate clearances are maintained between services and to locate other service crossings. Potholing at each affected service crossing and at regular spacing along services shall be performed unless exempted by NS156 or by the underground asset owner.

6.3.1.4 Where there is any concern as to the safe undertaking of the boring activities near existing electricity assets, an electrical isolation of these assets may be necessary.

6.3.1.5 All existing cables that are required to be electrically isolated shall be tested before commencement and after completion of the works to verify their integrity. The tests shall be carried out in accordance with the requirements of NS161.

6.3.1.6 For further information on working near Ausgrid cables refer to NS156.

6.3.2 Other Assets

6.3.2.1 Refer to the relevant Utility / Service Provider for specific requirements regarding close approach to other assets.

6.4 Footway Allocation

6.4.1 All bore holes for cables shall be contained within the agreed electricity allocation as detailed in NS130. If it is necessary to occupy part of the pathway usually allocated to another Authority, or part of the roadway for laying cables, refer to the requirements of NS130.

6.5 Marking of Cable Route

6.5.1 The cable route shall be “pegged” out, using temporary markers as the pilot hole is opened, and the markers shall be left in place until the installation has been inspected and reviewed to ensure it is in accordance with the proposed design.

6.6 Survey Plan

6.6.1 Where cables are to be located on private property, a survey (lease / easement) plan (also known as a Red Line Plan) is required to establish easements or a lease to cover the electrical works. A copy of this plan is to be provided to Ausgrid showing the following additions in red ink:

- The centreline of electricity cables (or cable conduits if used) with offsets to the easement boundaries.
- Signature by the Registered Surveyor with an accompanying statement to certify that the information shown in red ink has been accurately located to their satisfaction.

6.7 Multiple Conduits in a Single Bore

6.7.1 All bores with multiple conduits shall have spacers unless indicated otherwise by Ausgrid.

6.7.2 For specific details of spacing between conduits refer to NS130 and / or the project specification (if applicable) and the design drawings.

6.8 Multiple Bore Hole Separation

6.8.1 For multiple bore holes at one location, a minimum separation of 500mm shall be maintained from the outer edges of each bore hole. Sandy soils may need a greater separation.

6.8.2 Each bore hole shall be regarded as a new hole and is independent of any other adjacent bore hole for the purposes of compliance with the requirements of this Network Standard.

6.9 Grouting of Voids

6.9.1 Grout is essential to keep conduits in position, ensure heat generated by the cables is effectively transferred to the walls of the bore and in some cases, to provide additional support to the surrounding ground.

6.9.2 All bores shall be grouted unless indicated otherwise in the project specification.

6.9.3 Bentonite slurries are frequently required to provide lubrication for the boring head. For short single shot bores only (e.g. short driveway crossings) bentonite may be used as the grout, provided that it suitably fills the air voids and meets the requirements of Clause 5.1.

6.10 Frac-out

6.10.1 Where underboring is used, there is a risk that “frac-out” can occur at locations where the ground conditions are weak, fractured or otherwise unsuitable.

6.10.2 Where frac-out is identified as a risk, a containment procedure shall be put in place and made available at the site for implementation. This applies where there is a risk that bentonite slurry or grout could frack out and enter a gutter, drain, waterway or other sensitive environmental area.

6.11 Waterway Crossings

6.11.1 For underboring of waterways, there is a risk of frac-out which could have significant environmental implications. The Designer / Constructor shall carry out a risk assessment on each project.

6.11.2 Where frac-out has been identified as a risk, a containment procedure shall be put in place and made available at the site for implementation.

6.11.3 For specific cable design requirements refer to NS130.

6.12 Conduit / Pipes

6.12.1 The Australian Standard for PE pressure pipes (AS4130) differs from the PVC Standard (AS2053) in that it nominates pipe sizes by the external diameter rather than the internal diameter. If a project calls for conduit to AS2053, any section of the job to be bored using PE pipe must use pipe selected so that the internal diameter is no less than the ID of the specified PVC conduit. For example, a job calling for 150mm PVC conduit (ID 150.4-152.1 mm) would require the use of 180mm PE pipe (Pressure rating, PN12.5 and Standard Dimension Ratio (SDR), 13.6).

6.12.2 UPVC conduits are to be coupled using spigot and socket arrangements.

6.12.3 A slight chamfer shall be applied to both the inside and outside of the conduit and smoothed so as not to present a sharp edge to the cables that are pulled through the conduit.

6.12.4 A suitable primer shall be used first on both mating surfaces.

6.12.5 PVC blue solvent cement shall then be applied to bond the primed surfaces. All joints shall be properly made to eliminate the entry of grout into the installed conduits.

6.12.6 All PE pipe joints shall be welded using a butt welded method performed by suitably trained and experience operators.

6.12.7 All PE pipe joints shall be de-beaded and made smooth to the internal and external walls and shall be watertight after installation.

6.12.8 PE butt welding quality records for each PE pipe weld shall be provided to Ausgrid.

6.12.9 At the ends of all bores where PE pipe has been used, a PE pipe to PVC conduit adaptor shall be installed.

6.12.10 A slight chamfer shall be applied to both the inside and outside of the pipe / conduit and smoothed so as not to present a sharp edge to the cables that are pulled through the pipe.

6.12.11 A minimum length of one metre PVC conduit must be installed and capped.

6.12.12 The ends of all conduits shall be securely capped to protect them against ingress of foreign matter. Details of conduit plugs approved by Ausgrid are provided in NS130.

6.13 Testing of Conduit / Pipes

6.13.1 All conduits / pipes shall be thoroughly cleaned and mandrelled in accordance with NS130.

6.13.2 Where Ausgrid is concerned with the condition of the conduit / pipe after the use of a mandrel, a CCTV inspection shall be performed to determine the condition of the conduit / pipe.

6.13.3 Hydrostatic or low pressure air testing of PE pipe shall be carried out for waterway crossings and installations that will be below the permanent water table to demonstrate any welds are air tight.

6.13.4 Testing shall be undertaken before installation on the surface and post installation once installed by the HDD Constructor.

6.13.5 Any excess water shall be removed from the pipes prior to final capping.

6.13.6 Mechanical compression seals shall be installed at each end to ensure the pipes remain dry.

6.14 Reinstatement

6.14.1 Temporary site excavations (e.g. sending and receiving pits) shall be backfilled, compacted, and the surface reinstated in accordance with the requirements of NS130.

6.15 Permanent Pits and Other Access Chambers

6.15.1 All permanent pits and other structures that are associated with the underbores shall be constructed in accordance with NS172 and shall comply with the details of the project specification.

6.16 Unused Bore Holes

6.16.1 Dead holes such as trial holes and unsuccessful bore holes shall be filled with a suitable sand / cement mix or slurry mix to eliminate the risk of subsidence and roadway paving failures.

6.17 Recording of Location of Conduits and / or Cables

6.17.1 On completion of the work, a detailed survey of the actual cable route, including the ends of the bore, depth profile, plan drawing and bore logs (including the RAW log file where possible) shall be provided to Ausgrid. A 3D AutoCAD survey plot would be preferred in addition to the RAW log file, but not essential.

6.17.2 Details of the installation including bore logs (RAW log file), the number and type of conduits and cables, and any third party conduits are to be provided to Ausgrid in accordance with the requirements of NS100.

6.17.3 Details shall also be provided of any service crossings that were exposed during the operation, and the separations between all power cables, conduits and any other services at these crossing points.

6.17.4 Bore logs and detailed surveys are generally not required for simple bed bores (e.g. crossing minor roads and driveways). For such cases, standard as-builts shall be provided in accordance with NS100.

6.17.5 All relevant information shall be forwarded to gis@ausgrid.com.au in accordance with the requirements of NS100.

6.18 Inspection and Test Plans

6.18.1 Inspection and test plans (ITPs) shall be prepared to meet the requirements of this Network Standard and shall be submitted to Ausgrid prior to the bore works commencing on site. The ITPs for as-built works shall be submitted to Ausgrid at the completion of the bore.