

Construction Specification

Underground Developments

Info Zone Record Number: R561368

Version Number: 2

Date: November 2016



This Page is Intentionally Blank

Authorisations

| Action | Name and title | Date |
|---------------|--|------------|
| Prepared by | F Pontes | 30.09.2016 |
| Reviewed by | J Goodger – Asset Engineer | 30.09.2016 |
| Authorised by | A. Ketley – Asset Engineering Leader – Primary | 07.10.2016 |
| Review cycle | 1 Year | |

Document control

| Date | Version | Description | Author | Approved by |
|------------|---------|---|--------------|-------------|
| 07/10/2016 | 1 | Original Version | Frank Pontes | A Ketley |
| 03/11/2016 | 2 | Updated category 2 approved materials and clarified backfill requirements | Frank Pontes | A Ketley |
| | | | | |
| | | | | |

Record of revisions

| Section Number | Details |
|----------------|---------|
| | |
| | |
| | |
| | |
| | |

Responsibilities

This document is the responsibility of the Asset Engineering Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Engineering Team with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

© Tasmanian Networks Pty Ltd 2015

Table of Contents

| | | |
|--------|---|----|
| 1. | Purpose | 8 |
| 2. | Scope..... | 8 |
| 3. | References | 8 |
| 3.1 | TasNetworks controlled documents..... | 8 |
| 3.2 | Australian Standards, Laws and Statutory Requirements | 9 |
| 3.3 | Other Authorities | 9 |
| 4. | Definitions, Acronyms, and Abbreviations | 10 |
| 4.1 | Definitions..... | 10 |
| 4.2 | Acronyms and Abbreviations..... | 11 |
| 5. | Security | 11 |
| 6. | Safety and Environmental Considerations..... | 12 |
| 7. | Codes, Acts, Laws, Regulations and other requirements | 12 |
| 7.1 | Acts, Laws and Regulations..... | 12 |
| 7.2 | Codes of practice | 13 |
| 8. | Extent of Work..... | 13 |
| 8.1 | General..... | 13 |
| 8.2 | Adjacent to TasNetworks Assets..... | 13 |
| 8.3 | Access to the TasNetworks Distribution System | 14 |
| 8.4 | Installation coordination with TasNetworks..... | 15 |
| 9. | Variation from Issue for Construction Documentation | 15 |
| 10. | Preliminary Meeting | 16 |
| 11. | Electricity Footpath Allocation and Alignments | 16 |
| 12. | Audit Points and Final Inspection | 16 |
| 12.1 | General..... | 16 |
| 12.2 | During Construction..... | 17 |
| 12.2.1 | Electrical related construction..... | 17 |
| 12.2.2 | Civil related construction..... | 17 |
| 12.3 | Notice of Works Completion | 18 |
| 12.4 | Faults/Non-Conformances Found During TasNetworks Inspections..... | 18 |
| 13. | Materials and Equipment | 19 |
| 14. | Existing Underground Concealed Services..... | 19 |
| 14.1 | Existing Services..... | 19 |
| 14.2 | Existing TasNetworks Assets..... | 20 |
| 15. | Damage to Property..... | 20 |
| 15.1 | Recording the condition of existing above ground Infrastructure | 20 |
| 15.2 | Damage..... | 20 |
| 16. | Electrical Works | 21 |
| 16.1 | Conduits..... | 21 |

| | | |
|---------|--|----|
| 16.1.1 | Conduit Installation..... | 21 |
| 16.1.2 | Conduits crossing other underground services | 22 |
| 16.1.3 | Electricity Footpath Conduits | 22 |
| 16.1.4 | Service and Street Light Conduits | 22 |
| 16.1.5 | Polymeric Cable Protection and Warning Tape | 22 |
| 16.1.6 | Road Crossing Conduits | 22 |
| 16.1.7 | Cleaning and Draw Cords/Wires..... | 23 |
| 16.2 | Cables..... | 23 |
| 16.2.1 | Coordination | 23 |
| 16.2.2 | General..... | 23 |
| 16.2.3 | Installation | 23 |
| 16.2.4 | Direct Buried Cables..... | 25 |
| 16.2.5 | Polymeric Cable Protection and Warning Tape | 25 |
| 16.2.6 | Cables crossing other underground services..... | 26 |
| 16.2.7 | Cable Joints | 26 |
| 16.2.8 | Cable Terminations | 26 |
| 16.2.9 | Minimum Cable Bending Radius | 26 |
| 16.2.10 | Maximum Cable Pulling Tension..... | 27 |
| 16.2.11 | Identification of Cables | 27 |
| 16.2.12 | Cable Location Log | 27 |
| 16.2.13 | Electrical Connections..... | 27 |
| 16.3 | LV Turret and Cabinet Installation | 28 |
| 16.3.1 | General..... | 28 |
| 16.3.2 | Terminations and layouts | 28 |
| 16.4 | Kiosk Substation Installation..... | 28 |
| 16.4.1 | Coordination | 28 |
| 16.4.2 | Installation | 28 |
| 16.5 | Public Lighting..... | 28 |
| 16.6 | Numbering of Equipment | 29 |
| 16.7 | Electrical Testing | 29 |
| 16.8 | Earthing..... | 29 |
| 16.8.1 | General..... | 29 |
| 16.8.2 | Off Frequency Current Injection Testing (CIT) | 29 |
| 16.8.3 | Proximity to Telecommunications and other services | 30 |
| 17. | Civil Works | 30 |
| 17.1 | General..... | 30 |
| 17.2 | Trenching | 31 |

| | | |
|---------|---|----|
| 17.2.1 | General..... | 31 |
| 17.2.2 | Breaking of sealed surfaces | 31 |
| 17.2.3 | Grassed Areas | 31 |
| 17.2.4 | Joint Use Trenches | 31 |
| 17.2.5 | Trenching in proximity to TasNetworks Poles and Kiosk Substations | 31 |
| 17.2.6 | Electrical Earthing Trenches..... | 32 |
| 17.2.7 | Special considerations - non-standard trench details | 32 |
| 17.3 | Excavations for cable jointing | 32 |
| 17.4 | Bedding, Backfill and Reinstatement of Excavation | 33 |
| 17.4.1 | Survey | 33 |
| 17.4.2 | Bedding Material General..... | 33 |
| 17.4.3 | Installation of Bedding Material | 33 |
| 17.4.4 | Bedding Material-Special Considerations..... | 33 |
| 17.4.5 | Backfilling..... | 34 |
| 17.4.6 | Backfill in close proximity to proposed ground mounted assets..... | 34 |
| 17.4.7 | Backfill around subsurface cable joints | 35 |
| 17.4.8 | Backfill- Road Crossings | 35 |
| 17.4.9 | Backfilling Around Unterminated Cable Ends – Awaiting TasNetworks..... | 35 |
| 17.4.10 | Reinstatement of Surfaces..... | 35 |
| 17.5 | Conduit/Cable Markers..... | 36 |
| 17.5.1 | Kerb Markers and Markers in paved areas..... | 36 |
| 17.5.2 | Above Ground Cable Markers..... | 36 |
| 17.6 | Concrete Work | 36 |
| 17.6.1 | General..... | 36 |
| 17.6.2 | Preparation and Placement | 36 |
| 17.6.3 | Cement..... | 36 |
| 17.6.4 | Aggregates | 36 |
| 17.6.5 | Water | 36 |
| 17.6.6 | Reinforcement | 37 |
| 17.6.7 | Formwork..... | 37 |
| 17.6.8 | Surface Finishes | 37 |
| 17.7 | Horizontal Directional Drilling..... | 37 |
| 17.7.1 | General..... | 37 |
| 17.7.2 | Bore Log | 38 |
| 17.8 | Public Lighting..... | 39 |
| 17.9 | LV Turret and Cabinets | 39 |

Construction Specifications

| | | |
|---------|---|----|
| 17.9.1 | General..... | 39 |
| 17.9.2 | Turret Bases | 39 |
| 17.9.3 | Cabinet Bases..... | 39 |
| 17.9.4 | Turret Covers and Cabinets | 40 |
| 17.10 | Kiosk Substations | 40 |
| 17.10.1 | General..... | 40 |
| 17.10.2 | Installation Coordination | 40 |
| 17.10.3 | Normal Installation | 40 |
| 17.10.4 | Special Foundation Installation..... | 41 |
| 17.10.5 | Retaining Walls, Batters and Drainage Installation | 41 |
| 17.10.6 | Retaining Walls, Batters and Drainage Installation | 42 |
| 18. | Clean up on Completion | 42 |
| 19. | As-Built Documentation..... | 42 |
| 20. | Certificate of Completion..... | 44 |
| 21. | Faults Found During Cable Installation | 44 |
| 22. | Defects Liability..... | 44 |
| | Appendix A - Certificate of Completion – Electrical Works | 45 |
| | Appendix B - Certificate of Completion – Civil Works..... | 46 |
| | Appendix C - Applicable Standards and Codes | 47 |
| | Appendix D – Specifications for Cables..... | 51 |
| | Appendix E – Deed of Materials Compliance..... | 55 |

1. Purpose

The purpose of this document is to:

- Define TasNetworks' specific Electrical and Civil Construction requirements for new Underground Developments under the TasNetworks Customer Choice arrangement; and
- Ensure that upon handover of assets from the Developer to TasNetworks that the installation and construction methods adopted during the construction will ensure a reliable, safe, secure and maintainable electrical system throughout the installation's service life.

2. Scope

This specification applies to all electrical and civil works associated with Underground Developments including:

- Installations of High voltage systems equipment and infrastructure;
- Installation of Low voltage systems equipment and infrastructure;
- Underground furniture such as turrets and cabinets
- Kiosk Substations; and
- Public lighting.

For the purposes of clarification, an Underground Development does not include the following:

- Building Type substations;
- Fence type substations;
- Ground Mounted reclosers;
- Shopping centres;
- Large point loads;
- Embedded generation; and
- Overhead networks including interface or transition point such as Overhead to Underground Poles.

All construction, installation and erection must be carried-out in accordance with best engineering practice and workmanship to the relevant specifications, Australian Standards and TasNetworks' standards and specifications.

3. References

3.1 TasNetworks controlled documents

This construction specification is not a standalone document and shall be read in conjunction with TasNetworks' documentation listed below under the TasNetworks Customer Choice arrangement for Underground Developments.

It is the Developers' responsibility to make themselves fully aware of, and compliant with, the following TasNetworks' controlled documents:

Construction Specifications

- Issue for Construction documentation;
- The Developer Guide for Underground Developments;
- TasNetworks Distribution Construction Drawings;
 - Kiosk Construction Drawings
 - Underground Construction Drawings
 - Public Lightning Construction Drawings
- TasNetworks Distribution Construction Specifications and Standards;
 - TasNetworks Electrical Testing Specification
 - TasNetworks Materials and Assemblies Document
 - TasNetworks Distribution Construction Audit Specification
- TasNetworks' Environment & Heritage Design and Construction Standard;
- <http://www.tasnetworks.com.au/safety/safety-at-work/>; and
- Guidelines when working near TasNetworks electrical assets.

Where conflicting information is found to exist between this specification and the listed TasNetworks documents the Liaison Officer shall be contacted to provide comment and instruction.

3.2 Australian Standards, Laws and Statutory Requirements

The Developer/Contractor must comply with all relevant Australian Standards, Laws and relevant statutory requirements. Refer Appendix C - Applicable Standards and Codes.

3.3 Other Authorities

The Developer must ensure that all works undertaken consider the specific requirements of other authorities where applicable. Other Authorities that may be applicable within Tasmania includes:

- Telstra Australia;
- Department of Primary Industries, Parks, Water and Environment (crownland and reserves);
- Wellington Park Trust;
- Transport Traffic Signals & Cabling (Department of State Growth DIER);
- Main Classified Roads (Department of State Growth DIER);
- Local Council (Drainage, street furniture including trees and all roads except classified roads);
- TasWater (Water and Sewage);
- Railways ;
- Gas Transmission and Reticulation; and
- TasNetworks for their underground cables, ground mounted assets and overhead conductors.

4. Definitions, Acronyms, and Abbreviations

4.1 Definitions

As-built Documentation: The Issue for Construction documentation to which approved variations and other required information during the course of construction has been added.

Audits: Checking for compliance with the applicable TasNetworks specifications and drawings, and relevant legislation as applicable.

Authorisation/s: Approval, consent, permits, clearance, licence or other preconditions required in relation to the Project.

Certificate of Acceptance: A certificate issued by TasNetworks, following successful final commissioning, advising the work as detailed on the Certificates of Completion – Civil and Electrical Works has been inspected, commissioned and accepted by TasNetworks.

Certificate of Completion - Electrical Works: A certificate from the Project Manager advising all works undertaken by the Developer have been completed in accordance with the design and TasNetworks requirements.

Certificate of Completion - Civil Works: A certificate from the Project Manager advising all works undertaken by the Developer have been completed in accordance with the design and TasNetworks requirements

Contractor: A company or person (including a subcontractor engaged by the Contractor); selected to undertake construction associated with the project on behalf of the Developer.

Where necessary in this specification, reference may be made to the Civil Contractor (undertaking the associated civil works) and the Electrical Contractor (undertaking works in accordance with this specification) for the purpose of coordination during construction as necessary.

Designed by TasNetworks: A project where TasNetworks is responsible for the design of the works and the Developer responsible for construction.

Designed by Developer: A project where a Developer is responsible for the design.

Designer: A company or person approved by TasNetworks and selected by the Developer to undertake design of the proposed works.

Developer: Any person or company which enters into an agreement with TasNetworks for the civil works.

Development: Works within an area which the Developer has entered into an agreement with TasNetworks for the Electrical Reticulation works.

Electricity Footpath Allocation: The corridor in the footpath (between the back of the curb and the property boundary) allocated by the local authority for the installation of electric cables and equipment.

Electrical Reticulation: Any works directly associated with the supply of electricity to the subdivision and/or subdivided lots.

Issue for Construction documentation: Construction issue drawings or documentation that have been assessed as compliant by TasNetworks and certified by the CPEng, or nominated representative, for use in construction of the Project.

Kiosk Substation: A ground mounted substation where all the equipment is installed within a single enclosure, usually consisting of the enclosure, high voltage switchgear, transformer(s) and low voltage switchboard. The substation is usually supplied as a complete assembly and is installed or

replaced as a unit. The equipment is enclosed in a common weatherproof housing with limited access. Provision is made for replacement of individual components.

Laws: Includes legally binding law, legislation, statute, acts, ordinances, regulations, by-laws, orders, awards and proclamations that are enacted, issued or published by the State of Tasmania or any relevant local authority.

Liaison Officer: The TasNetworks Officer who forms the direct point of contact for the Developer to TasNetworks during construction and may carry out from time to time inspection of materials procured and/or construction. Sometimes referred to as TasNetworks' Site Manager.

Project: All works to be undertaken for installation of electrical reticulation and associated infrastructure and includes a Development.

Project Manager: A company or person approved by TasNetworks, selected by the Developer to facilitate, manage and coordinate installation and construction works for the Project on behalf of the Developer.

Public Body: A Public Body is defined as the following;

- Council regional authority
- Department of State Growth
- Other Government Departments and Public Authorities

Public Lighting: Public lighting installed as part of the Project to Australian Standards and/or applicable Public Body requirements and as approved by that Public Body.

Site Manager: The Developers site representative with authority to deal directly with the Developer or others on the Developers' behalf as required for completion of the Project. The Site Manager also has authority to submit and sign the Certificate of Completion – Civil Works and accompanying certificates.

TasNetworks' Customer Representative (TCR): The TasNetworks officer who is responsible for facilitating connection of the Development to the TasNetworks electrical network.

4.2 Acronyms and Abbreviations

CMEN - Common Multiple Earthed Neutral

CPEng - Chartered Professional Engineer

FCR - Fine Crushed Rock

HV - High Voltage $\geq 1000V_{AC}$

LV - Low Voltage $< 1000V_{AC}$

5. Security

The Developer is responsible for site security within the Development until the Certificate of Acceptance has been completed by both parties. This includes the securing of turrets, cabinets and kiosk substations.

TasNetworks will fix their required locks after the Certificate of Acceptance has been completed by both parties (following asset handover).

6. Safety and Environmental Considerations

The safety and environmental considerations for the electrical works are the responsibility of the Developer.

The Developer must document and implement a safety management system that complies with all relevant Laws. Refer Section 7.

The safety of personnel and equipment must be paramount at all times.

It is the responsibility of the Developer and the Accredited Service Providers (for design and construction) to ensure that environmental due diligence is followed and all reasonable efforts are made to minimise impacts to the environment.

TasNetworks' Environment & Heritage Design and Construction Standard defines the environmental and heritage requirements for design and construction in underground developments. The standard provides TasNetworks' approach to environmental due diligence in design and construction for underground developments, as reflected through its legislative and regulatory obligations and strategic plans. It is the minimum expectation in relation to environment and heritage due diligence.

7. Codes, Acts, Laws, Regulations and other requirements

7.1 Acts, Laws and Regulations

The developer shall be responsible for the compliance of the works with all relevant Government (Local, State or Federal) and Statutory Authority Acts Laws and Regulations, including but not limited to:

- Tasmanian Electricity Code 1998;
- Work Health and Safety Act 2012;
- Occupational Licensing Act 2005;
- Electricity Industry Safety and Administration Act 1997;
- Electricity Supply Industry Act 1995;
- Environmental Management and Pollution Control Act 1994;
- Water Quality Management Act 1997;
- Forest Practices Act 1985;
- Historic Cultural Heritage Act 1995 and Aboriginal Relics Act 1975;
- Land Use Planning and Approvals Act 1993;
- Environment Protection and Biodiversity Conservation Act 1999;
- Nature Conservation Act 2002; and
- Weed Management Act 1999.

7.2 Codes of practice

The Developer shall be responsible for understanding and applying relevant codes of practice including but not limited to:

- Construction work;
- Demolition work;
- Excavation work;
- First aid in the workplace;
- Hazardous manual tasks;
- Managing Work Health and Safety Risks;
- Managing Electrical Risks;
- Managing the Risk of Falls;
- Managing the Risks of Plant;
- Managing the Work Environment and Facilities;
- Preparation of Safety Data Sheets for Hazardous Chemicals;
- Managing Risks of Hazardous Chemicals in the Workplace;
- Forest Practices Code;
- Managing Welding Processes; and
- Work Health and Safety Consultation, Cooperation and Coordination.

The Developer must consider all risks associated with work, not only those for which regulations and codes of practice exist.

All codes of practice may be accessed through the Work Safe Tasmania web site worksafe.tas.gov.au.

8. Extent of Work

8.1 General

Unless advised otherwise in writing, details of the location and extent of work for the Project shall be included in the Issue for Construction documentation. To assist in project coordination with TasNetworks the Developer must provide a project schedule to TasNetworks prior to construction works beginning.

8.2 Adjacent to TasNetworks Assets

Where the worksite is adjacent to existing TasNetworks' assets, consideration must be given to maintaining operational and maintenance access to these assets. Any potential impacts are to be discussed with the Liaison Officer prior to implementation.

Refer to <http://www.tasnetworks.com.au/safety/safety-at-work/> and Guidelines when working near TasNetworks electrical assets.

Refer also to Section 14 for further information.

8.3 Access to the TasNetworks Distribution System

The Developer shall not have access to the TasNetworks distribution system unless specifically authorised in writing by TasNetworks. The following tables define responsibility for supply and installation of materials for connection to the TasNetworks distribution system associated with the Project.

TasNetworks shall notify in writing, on a case-by-case basis, where supply of material and installation as detailed in the following tables does not apply.

Where cable is required to be installed to an existing TasNetworks asset for TasNetworks to complete the termination works, the cable must be of appropriate length with sufficient excess length to allow for easy fit off to existing infrastructure. These cables must be capped with a heat shrink end cap to prevent moisture ingress.

Table 1: Construction Interface Points for LV assets

| TASNETWORKS LV | | |
|---|--|---|
| Description | Material Supply | Construction |
| New Turret/Cabinets to existing Turret/Cabinets | Developer supplies LV cable between Turrets/Cabinets & terminations for New Turret/Cabinets TasNetworks supplies terminations for existing Turret/Cabinets (Developer pays) | Developer installs LV cables in both Turrets/Cabinets & terminates in New Turret/Cabinets TasNetworks terminates in existing Turret/Cabinets (Developer pays) |
| New Turret/Cabinets to existing Kiosk | Developer supplies LV cable between Turrets/Cabinets & Kiosk, also terminations for Turrets/Cabinets TasNetworks supply termination for Kiosk (Developer pays) | Developer installs LV cable & terminates in Turrets/Cabinets. TasNetworks installs LV cable into Kiosk and terminates. (Developer pays) |
| New Turret/Cabinets to pole | Developer supplies LV cable between Turrets/Cabinets & pole, also terminations for Turrets/Cabinets TasNetworks supply pole termination, cable guard, earthing etc. for pole. (Developer pays) | Developer installs LV cable & terminates in Turret/Cabinets. TasNetworks fit to pole, install earthing, pole termination etc. (Developer pays) Note: Developer shall not have access to or work on pole. |
| New Kiosk to pole | Developer supplies LV cable between Kiosk and pole, also terminations for Kiosk TasNetworks supply pole termination, cable guard, | Developer installs LV cable & terminates in Kiosk. TasNetworks fit to pole, install earthing, pole termination etc. |

| | | |
|-----------------------------|--|--|
| | earthing etc. for pole. (Developer pays) | (Developer pays) Note: Developer shall not have access to or work on pole. |
| New Kiosk to existing Kiosk | Developer supplies LV cable & termination for new Kiosk TasNetworks supply termination for existing Kiosk (Developer pays) | Developer installs LV cable & terminates in new Kiosk TasNetworks inserts and terminates LV cable in existing Kiosk (Developer pays) |

Table 2: Construction Interface Points for HV assets

| TASNETWORKS HV | | |
|-----------------------------|--|--|
| Description | Material Supply | Construction |
| New Kiosk to existing Kiosk | Developer supplies HV cable & termination for new Kiosk TasNetworks supply termination for existing Kiosk (Developer pays) | Developer installs HV cable & terminates in new Kiosk TasNetworks inserts and terminates HV cable in existing Kiosk (Developer pays) |
| New Kiosk to Pole | Developer supplies HV cable & termination for new Kiosk TasNetworks supply Pole termination, cable guard, earthing etc. for pole. (Developer pays) | Developer installs HV cable & terminates in new Kiosk TasNetworks fit to pole, install earthing, pole termination etc. (Developer pays) Note: Developer shall not have access to or work on pole. |

8.4 Installation coordination with TasNetworks

Scheduling and coordination of installation and construction work to be completed at construction interface points (the Developer to TasNetworks) is the responsibility of the Developer. The Developer should also be aware of any notice periods that may apply. Refer to Section 12.2.

9. Variation from Issue for Construction Documentation

All variations proposed from the Issue Construction documentation shall be communicated to the Liaison Officer, prior to commencement, for approval. The Liaison Officer will determine whether approval by the Designer or a re-design is necessary. Details on all variations must be included in the As-Built documentation. Required information shall be added to the Issue for Construction documentation in a neat and legible manner to enable the information to be easily understood.

Major variations should allow sufficient time for assessment/approval and re-issue prior to construction.

Prior to proceeding with construction related to the variation approval must be gained from the Liaison Officer.

Changes shall be marked-up in red and be to scale and dimensioned; 'freehand' sketches are unacceptable.

10. Preliminary Meeting

Prior to the commencement of site work a meeting will be required. The meeting shall be arranged and facilitated by the Developer or nominated representative and involve as a minimum the Developer, Liaison Officer and representatives of any other authorities involved in the Project.

The meeting shall be scheduled as soon as practicable after receipt of the Issue for Construction documentation to allow sufficient time for all issues that may be raised to be resolved prior to the commencement of site work.

Unless advised otherwise by the Developer the meeting shall be held in conjunction with the pre-start meeting for civil construction/installation works.

11. Electricity Footpath Allocation and Alignments

In underground developments the Developer shall provide a reasonably level footpath allocation to Local Government requirements for the installation of electricity assets. The footpath allocation shall be free of all obstructions such as trees and stumps etc.

The Developer shall ensure that final pegging for each property has been completed and that block numbers and final footpath levels have been established prior to construction works beginning. Any variations to levels or boundaries shall be handled as per Section 9 of this document.

Equipment incorrectly located relative to the final boundary locations will be rejected by TasNetworks. Alternatively, TasNetworks may specify that an easement on those properties is to be registered at the Developer's cost.

All conduits and cables shall be installed as shown on the Issue for Construction documentation.

12. Audit Points and Final Inspection

12.1 General

The Developer shall be responsible for ensuring construction complies with this specification, TasNetworks Standard Construction Drawings and Issue for Construction documentation; however at stages during construction TasNetworks will audit certain elements of the installation and construction in accordance with the TasNetworks Construction Audit Process.

Witness/Acceptance points required during the construction program will be specified prior to site mobilisation.

12.2 During Construction

The Developer or its representative shall notify the Liaison Officer at the stages of construction listed below and, whilst notification is mandatory, witnessing may be carried out at the discretion of TasNetworks.

In order to be present onsite for witnessing TasNetworks normally require two (2) working days' notice. Additional notice may apply where significant travel is required from the relevant TasNetworks Depot. Extended notice periods shall be agreed with the Liaison Officer.

Notification that the site is ready for witnessing / acceptance shall be issued to the Liaison Officer.

Requests shall be made for witnessing at the following construction stages:

12.2.1 Electrical related construction

- **Cable Installation** - when all cable hauling equipment is on site and prior to initial cable installation.
- **HV Cable Terminations / Joints** - at commencement of cable terminations/ joints.
- **Kiosk Substation Sites** - after the installation of earthing and prior to backfilling, also after installation and connection of cables and prior to backfilling.
- **Turret/Cabinet Installation** –
 - at initial turret/cabinet base installation;
 - panel fitting; and
 - crimping of lugs.
- **Earthing Installation Testing** –
 - at commencement of installation;
 - at commencement of testing; and
 - as subsequently directed by the Liaison Officer.

12.2.2 Civil related construction

- **Trenches:** after the installation of conduits and / or cables and prior to backfilling.
- **Kiosk Substation Sites:** as defined below
 - after the installation and compaction of FCR, prior to laying the foundation
 - after the installation of the foundation, conduits, earthing, and prior to installation of the substation
- **Existing TasNetworks Assets:** Where excavations will enter in proximity (as defined below) to TasNetworks Assets
 - underground assets - 1 metre
 - above ground assets - 2 metres
 - for poles or stays - 3 metres
- **Where connection is required to an existing Kiosk Substation Sites:** during excavation for conduit/cable within 2 m of the Substation.

- **Public Lighting and service cabinet foundations:** after the installation of conduit bend, hold down bolts, formwork, and prior to concreting (cast in situ foundations only).
- **Bedding material (nonstandard)** – Prior to delivery on site, where specific nonstandard bedding material has been specified for the purpose of improving the thermal properties of the cable installation

Should the Liaison Officer not be notified at the above mentioned stages of work the Liaison Officer may require the Developer to uncover cables or conduits, remove heat shrink on terminations, or undertake such other work as is deemed necessary to witness that the work has been completed in an acceptable manner.

It is recommended in any case that the Developer keep detailed photo records of all the aforementioned stages of construction.

TasNetworks may direct the Developer to take other photos not defined above at certain stages of construction when no one is available to complete an audit/inspection.

The Contractor shall conduct intermediate and final inspections during the various stages of the project to ensure that works have been performed in accordance with TasNetworks requirements and Australian Standards.

Additional random witnessing may be undertaken throughout the course of construction at the discretion of the Liaison Officer.

Note that TasNetworks shall not be liable for rectification works or replacement of materials due to erosion or subsidence, or damage from any other cause, to excavations and/or materials that may result from excavations being left open pending witnessing by the Liaison Officer.

12.3 Notice of Works Completion

The Developer shall notify TasNetworks' Liaison Officer of expected electrical/civil work completion dates, 12 weeks in advance (or a mutually agreed timeframe) and the date must be firmed up 6 weeks out from completion (or as mutually agreed). This will allow TasNetworks to programme the work to have supply available to continue the continuity of work from receipt of the Certificate of Completion – Electrical Works and Certificate of Completion – Civil Works to commissioning and issuing the Certificate of Acceptance.

Note that TasNetworks shall only accept the Certificate of Completion - Electrical Works together with the Certificate of Completion – Civil Works once the approval of both respective works has been completed.

12.4 Faults/Non-Conformances Found During TasNetworks Inspections

Faults or non-conformances found shall be rectified by the Developer as soon as possible, at the Developer's cost, in a manner acceptable to the Liaison Officer.

Delays in the programme to allow for rectification work may result in significant delays for rescheduling TasNetworks final connection works.

Should faults or non-conformances be found after submitting the Certificate of Completion for either Electrical Works or Civil Works, the respective certificates shall be cancelled and returned to the Developer to enable access for rectification purposes. Upon rectification of non-conformances a new Certificate of Completion shall be submitted for each relevant part (Civil and/or Electrical) and a repeat inspection shall be conducted.

Where it is found that the installation does not meet the requirements of TasNetworks and remedial actions are deemed necessary, the cost of additional inspections to reach final acceptance will be charged to the Developer by TasNetworks in accordance with TasNetworks approved service fees.

13. Materials and Equipment

All materials for installation and construction work are to be procured by the Developer or its contractors and must be in accordance with TasNetworks' Materials and Assemblies document. All materials and goods must be new, free from defects, of merchantable quality, fit for the specified purpose, and conform fully to the requirements of TasNetworks.

To ensure the maintenance of appropriate reliability and safety standards during the transition period to contestability, TasNetworks' Materials List will have the following three categories of materials:

1. **Prescribed Materials** – These items must be from the specified manufacturer and have the listed part number in TasNetworks Materials and Assemblies document. Example items include kiosk substations.
2. **Approved Materials** – For each type of material or good in this category, product details are specified together with approved suppliers. A process will be developed for TasNetworks to assess the suitability of additional products and suppliers. If a product is assessed as meeting TasNetworks' requirements (including being of sufficient quality and compatible with the distribution network), they will be added to the Approved Materials List. Further information including timelines and associated fees will be released at a later date.
3. **Consumable Materials** – Any product that complies with the listed specification or standard (e.g. Australian Standards) may be used. Example items include PVC electrical insulation tape, nuts, bolts and washers.

The Developer must complete the Deed of Materials Compliance form, found in Appendix E – Deed of Materials Compliance.

14. Existing Underground Concealed Services

14.1 Existing Services

Information shown on Issue for Construction documentation, or otherwise provided, detailing the existence and location of existing underground services such as electricity, communications, gas, water, storm water and sewerage is provided as a guide only and site specific information shall be obtained from the relevant authority.

The services of "Dial Before you Dig" (phone No 1100) shall be utilised where the relevant authority is a subscriber.

To confirm the locational information is correct from the above sources the Developer shall undertake onsite investigation including but not limited to:

- Pot holing using careful excavation (hand digging, no mechanical excavation) where necessary to confirm the location of services;
- Ground Penetrating Radar (GPR) survey; and
- Water lances and vacuum trucks.

Temporary marking the location of existing underground services shall follow the colour code requirements as indicated in AS 1345.

14.2 Existing TasNetworks Assets

Where it is known that construction is to be undertaken in proximity to existing TasNetworks underground assets such locations should be discussed and addressed during the Preliminary Meeting as defined in Section 10.

As a guide the following clearance to TasNetworks underground and ground mounted assets apply:

- 1 metre – for underground assets;
- 2 metres – for above ground assets; and
- 3 metres – for poles or stays.

Unless otherwise authorised by TasNetworks Liaison Officer.

In any case the Developer shall comply with all relevant safety requirements including the Electrical Safety Acts and Electrical Safety Regulations, together with the applicable Codes of Practice and TasNetworks requirements. Further information regarding TasNetworks' specific requirements in regards to working near TasNetworks assets please refer to the "Guidelines when working near TasNetworks Electrical Assets" which may be accessed from the TasNetworks web site www.tasnetworks.com.au/safety/safety-at-work/working-near-powerlines.

Note that any cable or conduit uncovered during the work shall be treated as "live" until advised otherwise by the Liaison Officer.

Temporary marking the location of existing underground TasNetworks services shall be marked as Orange as indicated in AS 1345.

15. Damage to Property

15.1 Recording the condition of existing above ground Infrastructure

The Developer shall keep detailed photo records demonstrating the condition of existing above ground assets prior to beginning construction.

15.2 Damage

Damage to above ground or below ground existing assets or services attributable to work by the Developer, their agents or employees during the course of the work shall be immediately reported to the Liaison Officer and authority involved. Rectification shall be undertaken in accordance with the requirements, and to the satisfaction, of the relevant authority or landowner at no cost to TasNetworks.

16. Electrical Works

16.1 Conduits

16.1.1 Conduit Installation

Conduit installation work is to be carried out using a person licensed to perform electrical installation work as required under relevant legislation including the Electrical Safety Act. The only exception to this is as per the Occupational Licensing (Electrical Work – Trade’s Assistant – Licensing Exemption) Order 2012 which allows for the placing or laying out of conduit (but not the connection or bonding of conduit lengths) to be completed by a trade’s assistant supervised by a practitioner.

Conduits shall be installed in accordance with, but not limited to, the following:

- TasNetworks’ formal witness point(s);
- Issue for Construction documentation;
- Conduit shall be continuous between cable termination points and approved cable pits (with exception to HV cable road crossings);
- Conduit shall be laid straight and evenly supported along their length on bedding material and with trench sections in accordance with the Issue for Construction documentation;
- Conduit must maintain a 75mm clearance between the underside of the conduits and the bottom of the trench. Note conduit sockets may be disregarded for the purpose of measuring clearances between conduits, sides and the bottom of the trench;
- To produce watertight joints the joint surface (male and female ends) shall be cleaned of surface contaminants, dried and a PVC primer applied prior to application of PVC solvent cement (refer to manufacturer’s instructions);
- The top of the conduits or cables below finished ground shall not be less than the minimum dimensions specified on relevant Trench sections detailed in the TasNetworks Standard Construction Drawings and Issued for Construction documentation;
- At the end of each conduit ‘run’ (including conduits in cabinets, turrets and public lighting) all conduit ends shall be cleanly and squarely cut and capped with PVC conduit caps with the aim of eliminating ingress of water and contaminants in the conduits prior to the installation of cables. Where fitting of conduit caps is impeded by the draw wire both ends of each conduit shall be sealed with expanding polyurethane foam. In instances where cables are installed within conduits, such conduits shall also be sealed with polyurethane expanding foam;
- All conduit bends shall be long radius bends in accordance with the Issue for Construction documentation ensuring that minimum cable bending radii are maintained;
- Where conduits terminate into pits or precast trenches conduit ends must be fitted with a bell end; and
- PVC conduit that is unduly faded and/or damaged by exposure to UV shall not be used.

If the standard conduit depths cannot be met due to ground conditions or physical obstructions, the Developer is to contact the Liaison Officer for advice.

Where new construction adjoins existing assets and detail is not shown on the Issue for Construction documentation the Developer shall consult the Liaison Officer to ascertain TasNetworks requirements.

16.1.2 Conduits crossing other underground services

Conduits which cross other services shall pass underneath with a preferred clearance of 300mm. If the required depths (in accordance with the Issue for Construction documentation) cannot be met, or it is not practical to pass under a large service (e.g. storm water pipe), approval from the Liaison Officer shall be obtained before proceeding with the installation. No conduits shall pass through water main concrete anchor blocks.

Suggested installation practices when required depths cannot be met are detailed below.

The conduit may pass over the other service provided special mechanical protection is installed above the conduits/cover strips (e.g. 75mm thick concrete) and the depth to the conduit exceeds those listed below.

- 300mm for LV cables;
- 750mm for 11 and 22kV cables; and
- 900mm for 33kV cables.

16.1.3 Electricity Footpath Conduits

Footpath conduits shall be installed in accordance with the Issue for Construction documentation and council requirements. The distance out from the property boundary to conduits shall be within the dimension shown on the Issue for Construction documentation and in no instance shall conduits be located outside the Electricity Footpath Allocation. Required minimum clearances to other services shall be maintained.

16.1.4 Service and Street Light Conduits

Service and Street Light conduits shall be installed in accordance with the Issue for Construction documentation.

For service conduits, the conduit shall extend 600mm into the customer's property and the end left above ground and capped for future extension by the customer's electrical contractor. The conduit shall be laid along the bottom of the trench with a 600mm-radius 90-degree bend connected to it at the customer's property end. The bend is not to be glued. A short section of conduit is to be attached to the bend, so that the end protrudes above ground level for a distance of 300mm. Refer to D-UG1-0640-SD-001.

16.1.5 Polymeric Cable Protection and Warning Tape

Polymeric cable cover (mechanical protection) and warning marker tape requirements are detailed in Section 16.2.5.

16.1.6 Road Crossing Conduits

Refer to Issue for Construction documentation for the requirements of road crossing conduits.

Requirements, approach and scheduling of installation of conduit across roadways shall be discussed during the Preliminary Meeting.

16.1.7 Cleaning and Draw Cords/Wires

To aid in installation and ensure that cables are not damaged during installation once conduits have been installed, conduits shall be cleaned of all dirt and foreign matter and shall have a synthetic draw cord or galvanised steel draw wire installed. Draw cords/wires shall be continuous in each conduit run and extend beyond the end caps by at least 500mm. This requirement applies also to spare conduits that have been specified.

Unclean conduits or improperly installed draw cords/wires will be rejected by TasNetworks.

16.2 Cables

16.2.1 Coordination

The Electrical Contractor shall liaise with the Developer and Civil Contractor to coordinate installation of cables.

16.2.2 General

Cable shall be installed by a suitably experienced and qualified licenced electrical contractor in accordance with best industry practice. All cables shall be installed as detailed in the Issue for Construction documentation including the type of cable, location (within easements where applicable), use of the specified bedding material, warning marker tape and polymeric cable cover.

The Occupational Licensing (Electrical Work – Trade’s Assistant – Licensing Exemption) Order 2012 shall be complied with. This order allows for the installation of marker tape or mechanical protection during back filling to be completed by a trade’s assistant supervised by a practitioner.

The contractor shall be equipped with all trade tools, including specialised tools and crimping devices, necessary to perform works.

All LV and HV terminations and joints shall be performed in accordance with the manufacturer’s details, good industry practice, the Issue for Construction documentation and TasNetworks Standard Construction Drawings.

HV cable terminations and joints shall be made by a suitably qualified cable jointer and holding the appropriate licenses. Additionally, cable jointers shall be trained in application of the brand and type of kit being installed and provide evidence to confirm such.

The Contractor shall take all precautions necessary to ensure cables, terminations and joints are not contaminated by moisture or other contaminants.

The Liaison Officer may at any time inspect all tools, including crimping devices, dies, etc. and periodically witness jointing and terminating. Refer Section 12.

Prior to the installation of the cable into conduits the Contractor shall ensure the conduit is clean and clear of any foreign matter.

Survey marks required for construction purposes, easements, footpath levels, cable routes, etc. and other services, are the responsibility of the Contractor and shall be established and verified by a licensed surveyor.

16.2.3 Installation

As stated above, all cables shall be installed by a suitably experienced and qualified licenced electrical contractor in accordance with best industry practice.

TasNetworks Liaison Officer may at any time request proof of qualifications and licences of any person undertaking installation and construction work.

The Contractor shall be responsible for carrying out a visual inspection for cable damage on receipt of cable prior to installation. Should damage or moisture be detected the cable shall not be installed and the Liaison Officer shall be immediately notified.

All cut cables (including those ready for termination) shall be resealed by fitting a heat shrink end cap over a cleaned cable sheath.

Where cable sheath or end seal damage has occurred following receipt of cable, e.g. during installation, the Liaison Officer shall be immediately notified. Repair shall be undertaken as directed by the Liaison Officer, or the cable replaced if so directed. All costs associated with repair or replacement shall be borne by the Contractor.

The Contractor shall ensure water does not enter the cable during installation.

Cables shall be visually checked for any signs of damage as it leaves the drum. Ensure stones, rubble, or other contaminants are not drawn into conduit during installation.

All conduit cable entry and exit points require suitable rollers and support to prevent damage to cables and conduits due to friction or contact with sharp edges.

Where cable is to pass around a corner and a pit is required, special corner rollers and/or skid plates shall be used. Take care to ensure the cable does not exceed the applicable bending radius during installation or leave the cable rollers. Cables shall not be dragged across the ground or in the cable trench but shall be properly supported on cable rollers and with rollers or skid plates placed at corners in the cable run. Every part of the cable shall be under surveillance during the pull including the cable leaving the drum.

Where cable may be installed from either end of a route, reduction of the necessary cable pulling tension is possible by taking into account the location of bends and the net difference in elevation between ends of the route. Cable pulling shall not be completed on any cables with joints installed.

Conduit ends shall be sealed around cable immediately upon completion of cable pulling, with expanding polyurethane foam to prevent entry of dirt or other foreign matter.

Extreme care shall be exercised at all times when handling and laying cables. Any damage, however slight, to the cable detected during installation shall be reported to the Liaison Officer who will inspect it to ascertain if the work can proceed.

Standing on cables after installation shall be avoided. Care must also be taken to avoid damage to cables by sharp tools or falling objects.

Refer to TasNetworks Standard Construction Drawings for further information on cable pulling.

16.2.4 Direct Buried Cables

Direct buried cables are to be installed as shown on the Issue for Construction documentation.

Depths, separations, bedding protection method and overlap shall apply for all trenched installations.

Cable depth shall be defined as the distance between the final ground surface and the top of the cable. The normal horizontal separation between cables shall be 300mm between inner edges of the cables unless nominated otherwise on the Issue for Construction documentation.

Standard cable depths are given in Table 3 below.

Table 3 - Standard Cable Depths

| Voltage | Cable Depth (mm) |
|----------------|-------------------------|
| Low voltage | 600 |
| 11 kV | 900 |
| 22 kV | 900 |
| 33 kV | 1200 |

If the standard cable depths cannot be met, approval from the Liaison Officer shall be obtained before proceeding with the installation. Suggested installation practices when standard cable depths cannot be met are detailed below.

- The cable shall be covered by a minimum 75mm thick continuous concrete pour which shall not be less than 150mm wide and not more than 600mm wide, with a minimum overlap of 60mm on each side of the cable.
- Warning tape shall be placed 150mm below the concrete
- Polymeric cover strip laid 75mm above the top of the cable and
- The minimum depth to the top of the cable cover strip and below the concrete allowable with this arrangement shall be:-
 - 300mm for LV cables
 - 750mm for 11 and 22kV cables
 - 900mm for 33kV cables

In every case, higher voltage cables shall be laid below lower voltage cables and cables of different voltage ratings shall not be laid at the same horizontal level.

No other underground services shall be laid under concrete pours over reduced depth cables.

16.2.5 Polymeric Cable Protection and Warning Tape

All conduits and direct buried cables have a polymeric cable protection cover installed 75mm above the cable and warning marker tape installed approximately half way between the finished surface level and the top of the cable/conduit.

All polymeric cable protection covers and warning tape must be marked with the words "ELECTRIC CABLE" or similar along its length.

An exception to the above requirements for polymeric cable protection applies to conduits installed for the purpose of supplying LV servicing and street lighting. However warning tape is still required.

In all instances the Issue for Construction documentation, TasNetworks Standard Construction Drawings and AS 3000 requirements shall be adhered to.

16.2.6 Cables crossing other underground services

Cables which cross other services shall pass underneath with a preferred clearance of 300mm. If it is not practical to pass under a large service (e.g. storm water pipe) the cable may pass over the other service, given prior approval from TasNetworks' Liaison Officer.

The Liaison Officer will specify requirements for mechanical protection and minimum depth. No cable shall pass through water main concrete anchor blocks.

16.2.7 Cable Joints

For LV and HV installations cable joints are not acceptable unless detailed on the Issue for Construction documentation. In general, joints in cables are to be minimised and cables shall be installed in lengths as long as possible to reduce the necessity for joints.

Where new cables joints are required that are not detailed on Issue for Construction documentation such joints require prior approval by the Liaison Officer.

For all joints the 'Jointing Record' template shown in Appendix D – Specifications for Cables must be completed.

Refer to TasNetworks Standard Construction Drawings for standard HV and LV cable jointing excavations.

Installation of joints must be completed as per the manufacturer's installation instructions and recommendations. This includes usage of correct parts as described by the manufacturer, and usage of correct methods according to the manufacturer with all final values being adhered to (e.g. bolt tightening torque requirements, dimensions etc.).

16.2.8 Cable Terminations

Cable terminations must be completed as per the manufacturer's installation instructions and recommendations. This includes usage of correct parts as described by the manufacturer, and usage of correct methods according to the manufacturer with all final values being adhered to (e.g. bolt tightening torque requirements, dimensions etc.).

For HV cable terminations, trifurcation of the cable is to be completed outside of the substation, immediately before the conduit bend, with single cores brought into the HV switchgear for termination.

For LV cable terminations, trifurcation of the cables is to be completed within the substation, turret or cabinet.

Refer to TasNetworks Standard Construction Drawings for further requirements and guidance on cable terminations.

16.2.9 Minimum Cable Bending Radius

The minimum bending radius for all cables shall not exceed the manufacturer's specifications.

16.2.10 Maximum Cable Pulling Tension

The maximum pulling tension when installing cable by mechanical equipment, by means of a cable stocking grip on the sheath(s) or pulling directly on the conductor(s), shall not exceed the manufacturer's specifications. The means employed to ensure the allowable cable pulling tension is not exceeded shall be to the satisfaction of the Liaison Officer.

Where sleeve or stocking pulling methods have been used to pull the cable, the installer shall remove a minimum of 500 mm (or length recommended by the manufacturer) from the end of the sleeve section on the cable to avoid compressed and damaged cable termination sections.

16.2.11 Identification of Cables

All cables shall be labelled with their destinations point in the system, as per TasNetworks' Standard Construction Drawings and the Issue for Construction documentation. The label shall be permanent type (e.g. Traffolyte), be installed on the relevant switch or circuit breaker at a kiosk substation, or be cable tied to LV cables before the trifurcation in turrets and cabinets. The Contractor shall ensure that cables at each substation are clearly labelled to provide the street name and turret/cabinet number, or service destination of each cable.

16.2.12 Cable Location Log

A cable log certificate shall accompany the As-Built documentation to confirm depth and alignment of cables direct buried and installed in conduits. The certificate shall confirm all cables have been installed to correct alignment and depth and within any easement registered or to be registered. The actual log if requested shall be neat and legible, presented in tabular form. Information provided on the log shall include all installed cables and as a minimum:

- Project name and location;
- Construction Issue Plan No;
- Contractor details ;
- Date;
- Street name;
- Size and No. of conduits installed;
- Depth below finished surface level to the top of the cables at appropriate spacings;
- Alignment from property boundary; and
- Other information considered necessary by either the Contractor or Liaison Officer.

Note: If the cable location log identifies any cables that are not installed to the appropriate specification they shall be rectified prior to issuing the Certificate of Completion – Electrical Works.

For further detail on associated witness points and As-built documentation requirements refer to Section 12 and Section 19.

16.2.13 Electrical Connections

'Greasing' of bolted connections is essential to prevent ingress of corrosive elements and oxidation of conducting surfaces.

Install crimp lugs, shear off bolt connectors, splice crimps and joiners in accordance with the manufacturer's requirements. Following crimping, inspect lugs and joiners for sharp protrusions and remove by filing where required.

Tightening torques shall be completed as per the manufacturer's installation instructions or recommendations. Should a tightening torque not be specified in the Issue for Construction documentation or TasNetworks' Standard Construction Drawings all bolts and screws shall be securely tightened.

Compression tool and dies used shall be as recommended by the compression fitting manufacturer. Approved compression fittings are detailed on TasNetworks' Materials and Assemblies document.

Dies are to be engraved so that the manufacturer's brand or trademark and the designation or sizes are both clearly visible on the compressed fitting.

For a list of standard fittings and equipment refer TasNetworks' Materials and Assemblies document.

16.3 LV Turret and Cabinet Installation

16.3.1 General

Installation of LV turrets and cabinets shall be in accordance with the Section 17.9, the Issue for Construction documentation and TasNetworks' Standard Construction Drawings.

16.3.2 Terminations and layouts

TasNetworks' requirements for cabinet and turret layouts and terminations are detailed in TasNetworks' Standard Construction Drawings.

16.4 Kiosk Substation Installation

16.4.1 Coordination

The Electrical Contractor shall liaise with the Developer and Civil Contractor during foundation construction to ensure all earthing and conduits are installed prior to site finish.

16.4.2 Installation

The Kiosk substation, including switchgear, all cabling and terminations, shall be installed on the site in accordance with the Issue for Construction documentation. The installation shall be installed within the specified easements where applicable.

16.5 Public Lighting

Public Lighting columns shall be installed in accordance with the Issue for Construction documentation and applicable TasNetworks Standard Construction Drawings. Supply cables shall be installed from the turret or cabinet in accordance with the Issue for Construction documentation, with the fuse link disconnected and left in the column ready for connection when the luminaire is installed.

All luminaires and wiring from the luminaire to the column fuse panel shall not be installed by the AEC and coordination between local council is required after hand over.

Foundations are installed as part of the civil construction works, refer to section 17.8 for more information.

16.6 Numbering of Equipment

Electricity distribution system assets are numbered to permit recording for maintenance and other purposes.

The Designer shall allocate numbers to:

- Kiosk Substations
- Cable Joints
- Turrets and cabinets
- Public Lighting

The Developer shall ensure that equipment identification labels are installed for the following types of assets using aluminium plates with black numbering on reflectorised backgrounds.

16.7 Electrical Testing

Electrical testing shall be conducted in accordance with the UD Electrical Testing Specification. This document details minimum test requirements, including pre-commissioning, commissioning and staged energisation tests, and the required timing for these.

All testing documentation shall be included as part of the As-Built documentation. In general terms, all testing shall be completed after the installation of the relevant equipment, e.g. after the cable is installed and terminated with the trench backfilled, or after the installation of the kiosk substation. Where the equipment is altered (e.g. the termination is changed), or works occurs that may impact on the installation (e.g. the trench is dug up), the equipment shall be retested.

16.8 Earthing

16.8.1 General

Earthing shall be installed in accordance with the Issue for Construction documentation.

The Contractor shall be responsible for testing earth installations in accordance with the UD Electrical Testing Specification and the Designer's requirements and is responsible for recording the results of the required tests. All relevant values must be in accordance with TasNetworks requirements.

The Electrical Contractor shall liaise with the Developer and Civil Contractor to ensure installation of site earthing during cable and foundation installation.

16.8.2 Off Frequency Current Injection Testing (CIT)

Where the designer stipulates a CIT is required for verification of the earthing system design, the AEC will need to establish during testing the earthing system configuration assumed by the designer, for example additional MEN system interconnections. Therefore the AEC and Liaison Officer will need to jointly coordinate, where necessary, a temporary connection to existing earthing systems. This may require a temporary connection to the LV distribution MEN via an existing open point such as cabinet or pole top arrangement. Note that the procedure for temporary connection shall be applied in accordance with TasNetworks' Power System Safety Rules. Additional Earthing

Where the standard earthing systems do not achieve the required values as detailed in the Issue for Construction Documentation, the Contractor shall obtain direction from the Designer and notify the Liaison Officer. Prior to proceeding, approval on the proposed amendments must be obtained by TasNetworks.

Any changes to the earthing system shall be recorded on the As-Built documentation and a retest conducted after any system augmentation has taken place. Both the initial test results and any additional test results must be included as part of the As-Built documentation.

16.8.3 Proximity to Telecommunications and other services

The Developer must be aware that certain earth system clearances to telecommunication assets and other services apply. Such clearances will be detailed on the Issue for Construction documentation. If services are located on site within close proximity to the earthing installation but clearances are not detailed on the Issue for Construction documentation the Contractor shall obtain direction from the Liaison Officer.

17. Civil Works

17.1 General

The Developer is responsible for undertaking the civil construction works using suitably qualified and competent construction personnel.

The Developer must be aware that under the construction scope there is a requirement for the installation of electrical conduits and subsurface earthing systems. This work is to be carried out using a person licensed to perform electrical installation work under relevant legislation including the Electrical Safety Act.

TasNetworks Liaison Officer may at any time request proof of qualifications and licences of any person undertaking or supervising installation and construction work.

The safety of personnel and equipment must at all times be paramount.

Environmental best practice principals must be followed with the aim of minimising environmental impacts. This includes:

- Erosion and sedimentation mitigation;
- Noise pollution;
- Prevention of leakages and spills of controlled substances;
- Vegetation and threatened species protection; and
- Biosecurity management for *Phytophthora cinamomi* and weeds.

Survey marks required for construction purposes, easements, footpath levels, cable routes, etc. and other services, are the responsibility of the Developer and shall be established and verified by a licensed surveyor.

17.2 Trenching

17.2.1 General

Alignment of trenching is to be in strict accordance with the Issue for Construction documentation.

The accuracy of property boundary pegs and/or survey marks, and finished surface levels shall be established before excavation and installation of conduits. Trenching/conduits not installed in accordance with the Issue for Construction documentation and applicable TasNetworks standard drawings shall be rejected.

Trenches shall be kept as straight as possible and within the Electricity Footpath Allocation along public footpaths with minimum dimensions in accordance with the Issue for Construction documentation.

Note, where physical obstructions such as other services prevent achievement of the minimum depth requirements, the Liaison officer shall be contacted prior to further progression of work. Environmental impacts of realignment must be considered at this stage.

For guidance on variations from Issue for Construction documentation please refer to Section 9

17.2.2 Breaking of sealed surfaces

The breaking of bitumen, asphalt, concrete, paved or tiled surfaces of footpath and roadways shall be in accordance with the requirements of the local authority, and elsewhere in consultation with the owner and TasNetworks.

In general sealed surfaces shall be cut neatly and cleanly prior to excavation to avoid jagged edges and extended cracking.

17.2.3 Grassed Areas

Excavations shall be neatly cut and care exercised to minimise damage or disruption to the surrounding surface. Care should be taken to avoid the spread of weeds.

17.2.4 Joint Use Trenches

No services other than those shown on the applicable Issue for Construction documentation shall be permitted in TasNetworks trenches or within TasNetworks alignment. Installing additional services not detailed on the Issue for Construction documentation constitutes a variation to the Issue for Construction documentation and the requirements set out in Section 9. For general separation clearance details to other underground services refer to TasNetworks Standard Construction Drawings.

17.2.5 Trenching in proximity to TasNetworks Poles and Kiosk Substations

In general the project requirements for trenching in proximity to TasNetworks poles and Kiosk Substations should be discussed during the Preliminary meeting (Refer Section 10).

For information regarding TasNetworks specific requirements in regards to working near TasNetworks assets please refer to the "Guidelines when working near TasNetworks Electrical Assets" which may be accessed from the TasNetworks web site

www.tasnetworks.com.au/safety/safety-at-work/working-near-powerlines.

17.2.6 Electrical Earthing Trenches

17.2.6.1 Supply of Earth Conductor and Installation Coordination

The Civil Contractor shall liaise with the Electrical Contractor to ensure any required earth conductor is made available prior to trench excavation. Note that the location and extent of earth cable, where required, shall be shown on the Issue for Construction documentation. Refer also to section 16.8 for further details.

17.2.6.2 Additional Earth Conductor

The Developer should be aware that in areas which have ground conditions that exhibit poor electrical properties a horizontal bare earth conductor may be specified by the Designer to be installed within the cable trench along with other electrical supplies. If deemed to be necessary for the design its location, extent and requirements for suitable backfill and compaction levels will be detailed on the Issue for Construction documentation and TasNetworks Standard Construction Drawings are to be referenced.

17.2.7 Special considerations - non-standard trench details

In certain locations special considerations may need to be given to the arrangement of the cable trenches to improve cable ratings. Instances where special considerations may apply may be where one or more major feeder cables occur or where cable design ratings are of specific concern. Such details will be contained within the Issue for Construction documentation.

17.3 Excavations for cable jointing

The construction of temporary excavations installed for the purpose of underground cable jointing shall be as per TasNetworks Standard Construction Drawings. Refer to Section 17.4.7 for details regarding backfill around cable joints.

The following requirements apply for jointing pits (refer to the Excavation Work – Code of Practice for further information):

- Battering, benching or shoring must be provided for excavations greater than, or equal to 1.5m deep and less in bad ground conditions;
- Joint pit edges must be chamfered to allow pit rescue; and
- Stairs or a ramp shall be cut into the pit to allow simple access and egress for cable jointers.

In general the Developer must ensure that cable joints are located so they:

- Have adequate space around them for initial excavation of a jointing pit and for the jointer to work safely on the cables;
- Are readily accessible for re-excavation or access should future repairs be required;
- Are not beneath roadways, driveways or landscaping features; and
- Are in dry, well-drained sites.

17.4 Bedding, Backfill and Reinstatement of Excavation

17.4.1 Survey

Before the Developer undertakes backfilling of the trenches a survey (vertical and horizontal accuracy of 100 mm) of cables and conduit positions and cable joints is required to fulfil the requirements of As-Built details (refer section 19). If adequate notification is not given to surveyors, or all required information is not made available in accordance with section 19, part or all of the installation may be re-excavated, at the expense of the Developer.

17.4.2 Bedding Material General

TasNetworks Standard Construction Drawings and Appendix D detail requirements for bedding material in cable trenches. Any specific requirements for depth and location of sand bedding material shall be as specified in the Issue for Construction documentation. In general sand bedding material shall be nominally free of soluble salts, free of organic material (e.g. twigs, leaves, bark, wood, shells etc.) and of pebbles, stones and clay. Sand having such impurities may be rejected by TasNetworks.

Where the gradient of the trench is sloping, sand bag barriers shall be used at regular intervals to prevent the sand bedding from being washed away.

Where the trench has a rocky base and on steep trench gradients where washaway of bedding sand is likely to occur, sand/cement mix of 14:1 shall be used. When sand/cement mix is used, the Developer is not to add water once the sand/cement mix is installed in the trench. It must be compacted as delivered. If the trench bottom is rocky, a layer of sand cement mix shall be laid as a good and safe base for the cable to lie on.

17.4.3 Installation of Bedding Material

General requirements for installation of bedding material around conduits and cables are as follows:

- All conduits and cables shall be separated by compacted bedding material and spacers used to maintain separation between conduits and cables shall be removed prior to bedding material compaction. Bedding material shall be placed in layers not exceeding 100mm, packed under and around the sides to avoid the formation of air pockets beneath cables and conduits.
- To avoid conduit and cable movement during the installation and compaction of bedding material, conduit and cable ends, including conduit bends at each turret, cabinet or substation location and elsewhere shall be securely supported in position during placement and compaction of bedding material.
- Bedding material is to be finished at a level of 75mm minimum above conduits and cables unless shown otherwise in the Issue for Construction documentation.

17.4.4 Bedding Material-Special Considerations

In certain locations special considerations may need to be given to the type and extent of bedding material specified in order to improve the thermal properties of the installation (allow the cable to better dissipate heat). Instances where special considerations may apply may be where one or more major feeder cables occur in one trench or where cable design ratings are of specific concern. Such details will be contained within the Issue for Construction documentation.

17.4.5 Backfilling

Backfilling is to be completed as soon as practicable after the installation of foundations, conduits and earthing, notwithstanding the witnessing requirements in Section 12.2.

Preferably, the backfilling material will consist of the excavated material from the same location unless the original backfill consist of organic materials (leaves, twigs, weeds, bark; clay), large rocks greater than 50 mm, sharp objects or any other material that over time can indent, damage or penetrate the cable as the ground compacts or bears load. The original backfilling material shall also not be used for large traffic load areas. Backfill shall consist of granular material that can be sufficiently compacted to minimise landscape subsiding.

Notwithstanding the above backfilling requirements, the chosen backfill material shall not contribute to subsurface drainage so as to concentrate subsurface water with disruptive scouring effects along the cable trench.

Where excavated spoils are deemed to be unsuitable for use as backfill the Developer must ensure that imported fill does not pose a threat of introducing weeds that may not be already present in the surrounding environment. A local source of clean backfill should be considered in this regard.

Prior to installing backfill the Developer must ensure they have met the requirements of section 12 (witness points) and are aware of the requirements contained within the Electrical Works Specification regarding cable and conduit installation, polymeric cable cover and warning marker tape.

In addition the Developer must ensure that backfill used in Footpath trenches and Roadway trenches comply with local authority requirements.

Trenches and excavations in areas other than footpaths and roads (e.g. private property) shall be backfilled in loose layers **not exceeding** 150mm and compacted to achieve 95% of standard maximum dry density obtained in accordance with AS1289 E5.7.1. In areas such as car parks and internal roadways 98% of standard maximum dry density is required. Backfill material and compaction of car parks and internal roadways shall match the area prior to excavation.

17.4.6 Backfill in close proximity to proposed ground mounted assets

The Developer should be aware that specific requirements related to the specification of backfill used in close proximity to proposed positions of ground mounted assets may apply.

Ground mounted assets for underground subdivisions may include but not be limited to the following:

- Pits;
- Kiosk substations;
- Free-standing High Voltage switchgear;
- Termination poles;
- Turrets and Cabinets;
- Cable joints and nominated cable pulling pits; and
- Light poles.

Structural integrity - Backfill installed in close proximity to these locations shall consider the structural integrity of the proposed ground mounted asset foundations and be installed in

accordance with the Issue for Construction documentation and TasNetworks Standard Construction Drawings.

Turrets -When installing and compacting Backfill in close proximity to Turrets constructed of PVC or similar, care must be taken to ensure no buckling, warping or moving during the compaction and surface finishing process occurs. Where applicable, particular attention shall be made to ensure that backfill underneath has been sufficiently compacted prior to placement of the pits to avoid pit movement due to subsidence.

17.4.7 Backfill around subsurface cable joints

Where cable joints are installed as part of the project the Developer should be aware that specific requirements related to the specification of backfill used over the top of cable joints may apply. It is usual to have the entire cable jointing pit, apart from the very top layer, backfilled with bedding material. This requirement makes any later re-excavation easier to carry out. General requirements for cable pits can be found in TasNetworks' Standard Construction Drawings and any specific requirements will be detailed in the Issue for Construction documentation.

17.4.8 Backfill- Road Crossings

Requirements for road crossings will be detailed in the Issue for Construction documentation and TasNetworks Standard Construction Drawings. In general a well graded gravel (natural or FCR) compacted in accordance with local council requirements for road ways is acceptable.

The Developer should note that the local road Authority may call for compaction testing of the selected back fill material to confirm suitability.

At the ends of conduit installed underneath roadways it is necessary to secure the FCR backfill and ensure subsidence of the FCR does not occur. To secure the FCR, bags filled with FCR/cement mix (20:1) are to be packed tightly around the ends of the conduit.

17.4.9 Backfilling Around Unterminated Cable Ends – Awaiting TasNetworks

In some cases it may be prudent for the protection of cables and security reason for unterminated cable ends to be temporarily buried (service turret, cabinet, pole and substation sites). In such cases the Developer shall backfill around cable ends with cable bedding sand and appropriately seal cables using a heat shrink cap prior to burial.

17.4.10 Reinstatement of Surfaces

Permanent reinstatement of surfaces shall be carried out as soon as practical after backfilling, the surface level and finish shall match as near as possible the surface prior to excavation and be to the satisfaction of the local authority, owner and TasNetworks as applicable.

Additionally the reinstatement of concrete driveways and slabs shall include the drilling and doweling of adjoining concrete surfaces where practical during the reinstatement work.

Ground surface settlement that occurs following completion of the Works shall be made good prior to the end of the Defects Period (refer Section 22).

The Developer should make necessary efforts to ensure ground mounted Assets are suitably marked and protected during this process to avoid damage.

17.5 Conduit/Cable Markers

Whilst the As Built documentation will capture the locations and depth of the installed electrical infrastructure, TasNetworks may require Conduit/Cable Markers to be installed above ground. These markers must be installed in accordance with Issue for Construction documentation and TasNetworks Standard Construction Drawings. Locating the markers must be considered prior to backfilling.

17.5.1 Kerb Markers and Markers in paved areas

The location of all electrical conduit road crossings, which have been installed through directional boring, shall be clearly marked with “DANGER – Under Ground Electricity Cable in Vicinity” markers (as per TasNetworks approved signage design). These must be securely fixed using approved adhesives or fixings positioned vertically centrally above the Electrical services conduit centre, on the curbing at either side of the road.

17.5.2 Above Ground Cable Markers

Signage may be necessary to show the location of buried electrical services in other areas (not defined in 17.5.1). This will be as signage indicating “DANGER Underground Electricity Cables in Vicinity” (as per TasNetworks approved signage design), which must be mounted appropriately on posts or approved suitable infrastructure (fences, walls etc.) securely fixed using approved adhesives or fixings in accordance with the Issue for Construction Documentation.

17.6 Concrete Work

17.6.1 General

Concrete work shall comply with the requirements of AS 3600. The latest version of each standard at the time of installation shall apply.

17.6.2 Preparation and Placement

Concrete shall be prepared and placed in accordance with section 17 of AS 3600.

17.6.3 Cement

All cement shall be Portland Cement Type GP and shall conform to the requirements of AS 3972.

17.6.4 Aggregates

Aggregates shall conform to the requirements of AS 2758 Part 1. The nominal maximum size of aggregate for reinforced concrete shall be 20mm.

17.6.5 Water

Water used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, and organic matter of other deleterious substances.

17.6.6 Reinforcement

Reinforcement shall comply with section 17.2 of AS 3600 and AS/NZS 4671. Reinforcement stored on site shall be suitably protected from the weather and suitably supported clear of the ground.

Reinforcement shall be accurately placed in position to the tolerance set out in section 17.5.3 of AS 3600 and secured against displacement by tying with annealed wire of not less than 1.5mm diameter at all intersections of bars and laps of fabric. Reinforcement shall be supported from formwork or ground surfaces by approved concrete, metal or other chairs, spacers or ties to provide the cover specified on the drawings.

17.6.7 Formwork

Formwork shall comply with the requirements of section 17.6 of AS 3600.

Formwork shall be designed and constructed to prevent any movement or distortion during the placement and compaction of concrete. All formwork shall be positioned and supported to the tolerance set out in section 17.5.2 of AS 3600. Forms shall be close to prevent leakage of concrete. Any movement observed in the formwork during placing of concrete, resulting in formwork being pushed out of position, or out of plumb, or collapsing in any way shall result in rejection of the work. All rectification and restoration works shall be carried out at no cost to TasNetworks.

17.6.8 Surface Finishes

The surface finish of formwork shall be in accordance with AS 3610.1 unless otherwise specified.

The following surface finishes are required:

- For footings and concrete surfaces below ground level Class 5;
- For exposed concrete surfaces Class 3; and
- For internal concrete surfaces in pits Class 3 .

Surfaces specified as Class 3 finish shall be true and free from stone pockets, depressions, voids, projections beyond the surface, and other large blemishes. Imperfections shall be filled with mortar or tooled and smoothed away as required to produce an even, sound surface. All exposed corners shall have a 45° arris and a minimum of 20mm wide.

Unformed concrete surfaces on floors, slabs, etc. shall be finished in accordance with section 17.1.4 of AS 3600 so that dense uniform and even surfaces true to line, levels and section is obtained with a minimum of working of the surface.

The surface of outdoor slabs provided around Kiosk substations and similar shall be finally broom finished to avoid slippery conditions in adverse weather.

17.7 Horizontal Directional Drilling

17.7.1 General

The accuracy of property boundary pegs and finished surface levels shall be established by the Contractor before drilling and installation of conduit, and the required clearance to other services shall be maintained. Conduit incorrectly located relative to final boundary locations and finished surface will be rejected and rectification shall be at no cost to TasNetworks.

Cover to the top of conduit shall be not less than:

- The minimum depth required by the controlling road authority for any conduit installed under a roadway;
- The minimum depth required by the Council authority for cable installed in other locations; and
- Regardless of conduit diameter the top of conduit shall in no case be less than 600mm for LV and 900mm for HV below the finished road or ground surface.
- Additional depth below ground may be necessary to avoid heaving of the surface. Note the above requirement applies only to conduit installed in conjunction with Horizontal Directional Drilling and not to orange electrical PVC conduit that is installed together with orange warning tape via open trenching.
- A tracking system shall be used to ensure the bore follows the required installation profile and achieves required clearances to underground obstructions in addition to ensuring the minimum depth of cover is maintained.
- Care shall be taken to ensure conduit is not damaged during installation.
- Ends shall be cleanly and squarely cut and temporarily plugged to the satisfaction of the Liaison Officer.
- Joints where movement may occur during cable installation, (e.g. transition joints close to bends) shall be provided with a cast concrete collar to ensure movement does not occur.
- Where new works adjoin existing works and specific requirements are not detailed on the Issue for Construction Documentation TasNetworks' Liaison Officer shall be consulted to ascertain TasNetworks requirements.
- If conduit has been improperly installed, jointed, or damaged, the Contractor is required to return to site and reinstall at no cost to TasNetworks.
- After installation, all conduits shall be cleaned of all dirt and foreign matter and an unused 6mm synthetic draw cord or a 2mm galvanised steel draw wire shall be installed. If during cable installation the conduit is found not to be clean, or the draw cord improperly installed or jointed, the Contractor may be required to return and rectify at no cost to TasNetworks.

17.7.2 Bore Log

A bore log shall accompany the As Constructed Plan to confirm depth and alignment along each bore. The log shall be neat and legible, presented in tabular form. Information provided shall include for each bore, as a minimum:

- Project name and location;
- Contractor details;
- Date;
- bore No;
- Size and No. of conduits installed;
- Depth below finished surface level to the top of the bore at approximately 3 m spacing;
- Alignment with property boundary; and
- Other information considered necessary by either the Contractor or Liaison Officer.

17.8 Public Lighting

Public Light column foundations shall be constructed in accordance with TasNetworks Standard Construction Drawings, the Issue for Construction documentation and the following requirements:

- Lighting column locations shall be pegged (marked) as per the Issue for Construction documentation, prior to the installation of underground cables and associated electrical infrastructure, to ensure the columns are installed in the correct location;
- Issue for Construction documentation shall specify the foundation type required and foundation locations and shall consider the location of existing underground surface services (refer section 14);
- Tolerances on the location of the foundations shall be in accordance with the Issue for Construction documentation and Council requirements; and
- Erecting of light columns must consider the details provided in TasNetworks Standard Construction Drawings and where electrical supply cables have been installed prior to light pole installation care must be taken to apply protections as necessary to ensure cabling is not damaged during the erecting process.

17.9 LV Turret and Cabinets

17.9.1 General

All turrets and cabinets shall be located where shown on the Issue for Construction documentation and installed as detailed in TasNetworks Standard Construction Drawings. Care must be taken to ensure that no damage occurs to the cabinets or turrets during the installation process including cracks in turrets, and scratches or dents in cabinets which can lead to rust.

17.9.2 Turret Bases

The turret base shall be installed horizontal with the aid of a spirit level such that the top of the base is 75 - 100mm above the final ground level or the ground level shall coincide with the ground line mark on the turret base (if it is marked).

Where a turret is installed in sloping ground, then the soil on the higher side shall be contained by concrete blocks or similar. The minimum buried depth shall be on the lower side of the turret.

Where turret bases are located in situations that may result in movement, the base shall be anchored at each corner by 10mm diameter round reinforcing rods driven into the ground sufficiently to ensure no movement of the base will occur.

Compaction of backfill prior to placement of turrets and must also be considered in accordance with Section 17.4.6.

Alignment of these assets must consider their footprint alignment with roads, footpaths and boundaries.

17.9.3 Cabinet Bases

Cabinet base frames shall be installed horizontal with the aid of a spirit level such that the base front plate is approximately 75mm (50 %) buried. There must be no gaps between the ground and base frame plates in order to prevent rodent access.

A concrete footing nominally 250mm thick shall be installed around the bottom of the base frame to secure it in place.

Compaction of backfill prior to placement of cabinets must also be considered in accordance with Section 17.4.6.

Alignment of these assets must consider their footprint alignment with roads, footpaths and boundaries.

17.9.4 Turret Covers and Cabinets

Turret covers and cabinets must be positioned on the bases and firmly secured by tightening the fixing bolts into the bases.

17.10 Kiosk Substations

17.10.1 General

Kiosk substations are self-contained transportable units designed for installation on stable, level, well drained foundations. Installation requirements will be clearly set out in the Issue for Construction documentation.

The construction shall be fully compliant with the design detailed in the Issue for Construction documentation. If a variance from the design may be required the Contractor shall obtain prior approval from the Liaison Officer.

Care must be taken when installing the substation on the foundation to ensure that no damage is done to any part of the unit. Scratches and dents to the kiosk enclosure must be avoided as these will lead to rust and premature failure of the enclosure. All lifting must be done in accordance with the manufacturer's instructions.

Other cases may arise where treatment alternative to that mentioned below is desirable to achieve optimal installation, such details will need to be discussed with the Liaison Officer.

Modification of existing fences, trees and shrubs etc. is sometimes required and should be carried out with suitable reinstatement as necessary. Such modifications where not detailed in the Issue for Construction documentation must be discussed with the Liaison Officer.

Planting of additional trees and shrubs to enhance appearance can be carried out but should be located such that TasNetworks bears no responsibility for their ongoing maintenance.

17.10.2 Installation Coordination

The Civil Contractor shall liaise with the Electrical Contractor and Liaison Officer to:

- Ensure all earthing (and conduits where required) is installed during foundation construction; and
- Return to complete site finish after installation of cables and backfilling of cable pits and in accordance with applicable construction drawings prior to commissioning of electrical works.

17.10.3 Normal Installation

Site conditions which define a "Normal installation" are instances where the ground is stable, flat or moderately sloping with no other services underneath the proposed location of the substation.

Excavation should be designed so that finished ground level is 40mm below the top of the concrete base of a kiosk substation.

In this way reasonable overall height of installation is achieved and clearance is provided for operation and maintenance and removal of Kiosk substation lifting gear.

An exception to this rule is the case where an existing or proposed structure, e.g. footpath or kerb is in such close proximity to the substation that it will form an obstruction to operation and maintenance etc. unless additional clearance above ground is provided.

Having set out the substation and an adequate period of time has elapsed for consolidation of fill, a suitable surround is constructed to the edges of the substation using concrete, stone spalls, paving slabs or bricks set in concrete; or asphalt to blend in with site considerations. In some instances re-grassing of an area may suffice. Such information will be detailed on the Issue for Construction documentation and TasNetworks Standard drawings.

The width of the surround is determined by the proximity of fences and footpaths, kerbs, etc. but should not normally exceed approximately 1 m.

It is preferable to extend the surround to the edges of fences and footpaths, etc. where practicable to minimise growth of unsightly weeds etc. or alternatively to limit the width to provide a suitable mowing strip.

The thickness of the surround should not be less than 100mm to prevent cracking and where necessary steel reinforcing or trowelled joints should be used.

The surround should be installed so that lifting gear for Kiosk Substation is unrestricted, suitable fall is provided for natural drainage away from the substation and flush finish is provided to footpaths, kerbs etc. After installation of the surround, ground in the vicinity should be graded back to natural ground level and the disturbed ground reinstated.

It is important to note that depending on the substations design the finished ground surface directly around the substation may be specified based on the earth system performance requirements, or operational and maintenance requirements. Care should be taken to install the final surface layer in strict accordance with the Issue for Construction documentation.

17.10.4 Special Foundation Installation

Site conditions which may deem that a “Special Foundation” is required are instances where the ground is unstable or other assets are installed beneath the substation location.

The Designer shall design a foundation suitable for the site conditions. The design shall be part of the Issue for Construction documentation.

17.10.5 Retaining Walls, Batters and Drainage Installation

Site Conditions: Where steeply sloping or unstable ground cannot be avoided, or where non-TasNetworks services are located adjacent to a substation excavation, a retaining wall and/or batter may be required to prevent ground movement. Drainage may also be necessary to manage water flows at the site and prevent erosion or water entering the kiosk.

Designed details of the type of retaining wall, batter or drainage required, shall be included with the Issue for Construction documentation.

17.10.6 Retaining Walls, Batters and Drainage Installation

Special consideration for sites that are exposed to road traffic or manoeuvring vehicles (e.g. car park) will be detailed within the Issue for Construction documentation.

18. Clean up on Completion

On completion of work the Developer shall restore all work sites to a clean, weed free and safe condition. All excess material and waste shall be disposed of at an approved refuse site as applicable at no cost to TasNetworks.

19. As-Built Documentation

As-Built documentation must be signed off by the Developer's Project Manager and submitted to TasNetworks upon completion of the works.

As a minimum the As-Built documentation is to include (but is not limited to):

- Drafted and certified versions of the Issue for Construction drawings incorporating all variations. These drawings are to be a true reflection of the as installed network.
- Certificate of Completion – Electrical Works
- Certificate of Completion – Civil Works
- URD Test certificates (as appropriate):
 - High voltage cables – UD-C-TC-001
 - Kiosks - UD-PC-TC-002
 - Kiosk earthing system - UD-PC-TC-002 (developed by the Designer)
 - HV and LV switchgear – UD-C-TC-003
 - Cable tests - UD-PC-TC-004
 - Turrets, cabinets and streetlights - UD-C-TC-005
 - Toptronic testing for turrets, cabinets and streetlights – UD -E-TC-006
- Factory Acceptance Test (FAT) certificates and reports
- Deed of Materials Compliance
- Title Search showing easements

Developers shall submit all necessary information to enable correct asset records to be maintained as presently exists or as may be redefined by TasNetworks from time to time for work undertaken. This will allow TasNetworks plans and mapping to be updated on completion of the work.

Adequate notification shall be given for the Developers surveyors as to the timing of cabling so as the trench is open at adequate points to ensure the integrity of the data capture. If these conditions are not met then part or all may need to be re-excavated at the expense of the Developer (as per the original conditions) or suitable location equipment utilised to confirm the accuracy of the As-Built record. TasNetworks' Liaison Officer will specify the requirements. Any easement registered must ensure that TasNetworks' assets are contained within the designated easement.

As-built data shall be submitted on completion of the works and be comprised of the following (any/all of the conditions below may be altered after consultation with TasNetworks):

- A geospatial survey of as-constructed works that captures:
 - Location, alignment and depth of all kiosks, turrets, cabinets, joints, pits, conduits and cables (including start and end points of any road-crossings, major bends, change in directions).
 - Installation method (e.g. open-trench, bore) for all cable and conduit sections.
 - Material, size(s) & formation for all conduit sections (including which conduit the cable is contained in if applicable).
 - Pit and lid material and size.
 - Pit end-face diagrams showing conduit formation and cable position.
 - Cable trench and road crossing cross section
 - Sizes, types, voltages and the origin and/or destination of jointed cables
 - The size, type and voltage of all new cables.
 - Additional permanent structures located at the discretion of the surveyor and or TasNetworks to help strengthen TasNetworks' databases. This for example may be in the form of property boundaries (in relation to easements) or other significant structures or features.
- Photographs;
- Bore logs (if applicable); and
- Other relevant information.

The supplied as-built data shall comply with the following criteria:

- Spatially referenced to the Map Grid of Australia (MGA 94);
- Supplied in both MicroStation (DGN) and PDF file format; and
- Accuracy of 100mm in relation to existing survey marks.

The process for submission of As-Built records shall be as follows:

- The Developer shall deliver the required test certificates, completion certificates, marked up and signed versions of the Issue for Construction documentation and the Deed of Materials Compliance to the Liaison Officer prior to energisation.
- Within two weeks of completion of works the Developer shall engage a surveyor to undertake the geospatial survey of as-constructed works (cables and conduits are required to be surveyed when the trenches are open).
- At the time of survey, the Developer will provide the Surveyor with a marked-up copy of the construction drawing (or similar) that contains the required asset information, including surveyed locations of underground infrastructure installed as part of the project
- The Surveyor will update the survey DGN file with the additional asset information and send a finalised version to Developer and Liaison Officer (both DGN file and a PDF version).
- Developer shall submit the DGN and PDF files, along with any other relevant information (i.e. photos, test results etc.) to the Liaison Officer.

- If changes are required the Developer shall mark up the survey as required and resubmit to the Surveyor to update.

20. Certificate of Completion

The Certificate of Completion - Electrical Works and Certificate of Completion – Civil Works (Appendix A - Certificate of Completion – Electrical Works), shall be provided to the Liaison Officer by the Developer stating that all works have been carried out in accordance with this specification, Issue for Construction documentation, TasNetworks Standard Construction Drawings and any other relevant TasNetworks requirements as specified by TasNetworks.

TasNetworks shall carry out a final inspection only after receipt of the Certificate of Completion (Electrical and Civil) and associated As-built documentation. Electricity supply to the Project shall be withheld if all works and documentation have not been completed in accordance with the Certificate of Completion.

Any infrastructure found missing or damaged prior to TasNetworks signing the Certificate of Acceptance shall be repaired at no cost to TasNetworks.

21. Faults Found During Cable Installation

Should faults be identified on existing underground infrastructure during the installation of underground cable and accessories, which occurred due to the installation works, the Developer is liable for such rectification and/or additional costs. Electricity supply to the Project may be withheld until any outstanding costs are reimbursed by the Developer.

22. Defects Liability

Unless specifically directed otherwise in writing by TasNetworks, faults found during the defects liability period shall be rectified by TasNetworks and all costs shall be recovered from the Developer.

Should TasNetworks direct the Developer in writing to undertake rectification of defects such rectification shall be undertaken at a time and in a manner directed, at no cost to TasNetworks.

Refer to the Connection Contract for further details in relation to the defects liability period.

Appendix A - Certificate of Completion – Electrical Works

PROJECT NAME:

PROJECT No:.....

LOCATION:.....

AS-BUILT DOCUMENTATION NO:

I/We.....

being the Developer/Developer’s Representative for the above Project, hereby certify that electricity reticulation detailed on the Issue for Construction documentation and associated works schedules have been completed, including the following:

- i. Cables, columns, substations, turrets, cabinets, earthing and other equipment have been installed in accordance with this specification and as shown on the As-built documentation attached and signed by the Project Manager.
- ii. Cables, columns, etc. have been installed in alignments approved by the appropriate local authority.
- iii. Kerb markers have been installed to mark accurately the location of road crossings conduits and Public Lighting conduits, also warning sign posts/plaques (if required) have been installed.
- iv. Statutory requirements have been complied with in respect to clearances of overhead lines and cover over underground cables.
- v. All High Voltage and Low Voltage cable terminations, connections, joints, and associated earthing have been completed in accordance with the manufacturer’s installation instructions, this specification and as directed by the Liaison Officer.
- vi. Public Lighting has been installed in accordance with requirements of the Construction Issue Plan, AS/NZS 1158, and applicable authority.
- vii. Earthing tests have been conducted and results are detailed as per the UD Electrical Testing Specification and Designer’s requirements.

The works shown on the As-built documentation are ready for commissioning.

Note the Project Manager shall sign and date the As-built documentation.

Dated thisday of20

(Developer/Developer’s Representative Name)

(Developer/Developer’s Representative to Sign)

(Company Name)

- Attachments:
- 1 As-built documentation CIRCULATION
 - 2 Test Certificates - Project File
 - 3 Cable Location Log
 - 4 Deed of Materials Compliance Form

Appendix B - Certificate of Completion – Civil Works

PROJECT NAME:.....

PROJECT No:.....

LOCATION:.....

ISSUE FOR CONSTRUCTION DOCUMENTATION NO:
.....Revision.....

I/We

of.....

being the Developer/Developer’s Representative for the above project do hereby certify that TasNetworks requirements as per the Issue for Construction documentation, TasNetworks Standard Construction Drawings and URD Civil Works specification have been completed, including the following (strike-out items that aren’t applicable):

- (i) All trenching, Horizontal Directional Drilling (where applicable), supply and laying of conduits and back filling, including the installation of draw cords/wires, and conduit caps, has been completed.
- (ii) Construction of road lighting (Public Lighting) and cabinet foundations including hold down bolts and conduits has been completed and are installed in the locations shown on the Issue for Construction documentation. Associated service pits are installed (where required).
- (iii) Preparation of Kiosk substation sites has been completed as per the Issue for Construction documentation.
- (iv) Final footpath levels have been established and real property survey pegging is complete.
- (vi) Surfaces have been reinstated in accordance with this specification and the Issue for Construction documentation.

Note: The Site Manager shall certify the As Built documentation (sign and date).

Dated thisday of.....20.....

(Developer/Developer’s Representative Name)

(Developer/Developer’s Representative to Sign)

(Company Name)

Appendix C - Applicable Standards and Codes

These standards/guides listed below are common standards to be used by the contractor for the purposes of distribution construction related work. This list is not exhaustive and number references to standards within this document are for the convenience of the service provider. The current standards at the time of the project shall be used.

C.1 Standards

| Subject | Standard |
|--|--------------|
| Electric cables – polymeric insulated – For working voltages 1.9/3.3(3.6) kV up to and including 19/33(36) kV | AS 1429.1 |
| Substations and high voltage installations exceeding 1 kV a.c. | AS 2067 |
| Electric cables – polymeric insulated – For working voltages 19/33(36) kV up to and including 87/150(170) kV | AS 1429.2 |
| Insulation coordination - (phase-to-earth and phase-to-phase above 1 kV) - Application Guide | AS 1824.2 |
| Electric cables - Twisted pair for control and protection circuits | AS 2373 |
| High Voltage switchgear and control gear - Dimensional standardization | AS 62271.301 |
| Underground marking tape – Non-detectable | AS 2648 |
| Electrical installations (known as the Australian Wiring Rules) | AS 3000 |
| Electrical installations-Selection of cables | AS 3008.1 |
| Approval and test specifications - Electric cables - Thermoplastic insulated for working voltages up to and including 0.6/1 kV | AS 3147 |
| Cable protection covers | AS 4702 |
| Conduits and fittings for electrical installations | AS 2053.1 |
| Earth potential rise-protection of telecommunication network users, personnel and plant | AS/NZS 3835 |
| Safe working on or near low voltage electrical installations and equipment | AS 4836 |
| Electrical hazards on metallic pipelines | AS/NZS 4853 |
| Overhead electrical line design, part 1: Detailed procedure | AS/NZS 7000 |
| Lighting for roads and public spaces | AS 1158 |
| ENA EG1 Substation Earthing Guide | ENA - EG1 |
| ENA EG0 Power System Earthing Guide | ENA – EG0 |
| The storage and handling of flammable and combustible liquids | AS 1940 |
| Concrete structures | AS 3600 |
| General purpose and blended cements | AS 3972 |
| Aggregates and rock for engineering purposes-Concrete aggregates | AS 2758.1 |
| Testing and Inspection Guidelines. | AS3017 |
| Quality management systems – Requirements. | AS/ISO 9001 |

| | |
|---|---------------|
| Quality systems Model for quality assurance in production, installation and servicing. | AS/ISO 9002 |
| Identification of the contents of pipes, conduits and ducts | AS 1345 |
| Classification of Subsurface Utility Information (SUI) | AS 5488 |
| Methods of testing concrete - Determination of properties related to the consistency of concrete - Slump test | AS 1012.3.1 |
| ISO metric hexagon bolts and screws – Produce Grade C – bolts | AS 1111 |
| Structural design suite | AS/NZS 1170 |
| Hot-dip galvanised coatings on threaded fasteners (ISO metric coarse thread series) | AS 1214 |
| Methods of testing soils for engineering purposes | AS 1289 |
| Specification and supply of concrete | AS 1379 |
| Demolition of structures | AS 2601 |
| National plumbing and drainage code | AS 3500 |
| Formwork for concrete | AS 3610 |
| Design for installation of buried concrete pipes | AS 3725 |
| Concrete structures retaining liquids | AS/NZS 3735 |
| Access covers and grates | AS 3996 |
| Precast concrete pipes (pressure and non-pressure) | AS 4058 |
| Steel Structures | AS 4100 |
| Fibre reinforced concrete pipes and fittings | AS 4139 |
| Earth Retaining Structures | AS 4678 |
| High strength steel bolts with associated nuts and washers for structural engineering | AS/NZS 1252 |
| PVC pipes and fittings for storm and surface water applications | AS/NZS 1254 |
| Structural steel welding – welding of reinforcing steel | AS/NZS 1554.3 |
| Hot-dip galvanised steel bolts with associated nuts and washers for tower construction | AS/NZS 1559 |
| Steel reinforcing materials | AS/NZS 4671 |

C.2 Codes

| Subject | Code |
|---|--------------------|
| National guidelines for prevention of unauthorised access to electricity infrastructure | ENA-DOC 015 |
| Building Code of Australia | BCA |
| Sewerage Code of Australia | WSA 02 |
| Codes of practice | Work Safe Tasmania |

C.3 International Codes

| Subject | Code |
|---|-------|
| IEC Standard Degrees of protection provided by enclosures (IP code) | 60529 |

C.4 Others

Environmental Protection Authority Requirements

C.5 Department of State Growth

| Ref | Subject | Revision |
|------------|---|----------------|
| G3 | Traffic Management (PDF) (WORD) | June 2013 |
| G4 | Compaction Assessment (PDF) | March 1995 |
| G5 | Descriptive Terms in Geomechanics (PDF) | June 1997 |
| G6 | Production of Aggregates and Rock Products (PDF) (WORD) Explanatory Notes (PDF) (WORD) | July 2014 |
| G7 | Asphalt Production (PDF) | June 2012 |
| G8 | Construction survey (PDF) | September 2010 |
| G9 | Product Quality (PDF) | June 2012 |
| G10 | Construction Environmental Management Plan (PDF) | June 2012 |
| R21 | Clearing and Grubbing (PDF) | March 2009 |
| R22 | Earthworks (PDF) | June 2012 |
| R23 | Subgrade Zone (PDF) (WORD) | June 2013 |
| R24 | Geotextiles (PDF) (WORD) | July 2014 |
| R31 | Open Drains and Channels, (PDF) | June 2004 |
| R32 | Drainage: Culverts, Pipelines and Related Structures (PDF) (WORD) | July 2014 |

| | | |
|-------------|---|-------------------------------------|
| R33 | Subsurface Drainage (PDF) (WORD) | July 2014 |
| R34 | Drainage and Kerb Maintenance, (PDF) | November 2010 |
| R35 | Waterway Clearing and Scour Repair (PDF) | November 2010 |
| R36 | Kerb and Gutter (PDF) | June 2004 |
| R40 | Pavement Base and Subbase (PDF) (WORD) Form R40.1 Nomination of Materials Form (PDF) (WORD) Explanatory Notes (PDF) (WORD) | July 2014 July 2014 July 2014 |
| R42 | Insitu Stabilisation with Cementitious Materials (PDF) | March 1995 |
| R50 | Guide Notes for Bituminous Surfacing Specifications (PDF) | June 2011 |
| R51 | Sprayed Bituminous Surfacing (PDF) | June 2011 |
| R55 | Asphalt Placement (PDF) Explanatory Notes (PDF) | June 2011 |
| R57 | Bituminous Slurry Surfacing (PDF) | March 1995 |
| R61 | Road Safety Barrier Systems, (PDF) Road Safety Barrier Design Guide - Part A (PDF) Road Safety Barrier Design Guide - Part B (PDF) Road Safety Barrier Design Guide - Appendices (PDF) | October 2009 |
| R64 | Pavement Marking (PDF) Pavement Marking (WORD) | July 2013 |
| R70 | Landscaping (PDF) | February 2005 |
| R80 | Miscellaneous Concrete Slabs (PDF) | June 2004 |
| R81 | Minor Concrete Structures (PDF) | August 2003 |
| R91 | Property Accesses (PDF) | June 2004 |
| R92 | Underground Service Facilities (PDF) | June 2004 |
| R101 | Emergency Management (PDF) | November 2010 |

Appendix D – Specifications for Cables

D.1 Cable Jointing Record

| | | |
|---|-----------------------------|----|
| Date: | | |
| Location: | | |
| Joint Number: | | |
| Joint Type (Tick Relevant): | HV | LV |
| Jointers Name: | | |
| Cable 1 Type: | Cable 1 Destination: | |
| Cable 2 Type: | Cable 2 Destination: | |
| Other Information: | | |
| Jointer to complete: <i>I confirm that the joint has been completed as per the manufacturer's installation instructions</i> Name: _____ Signature: _____ Date: _____ | | |

D.2 Specification for Cable Trench Backfilling Material and Cable Bedding Sand

The supply of backfilling material and bedding sand shall be in accordance with the following quality and tests and inspection requirements.

D.2.1 Backfilling Gravel

The gravel shall be free of vegetable matter such as twigs, leaves, wood etc and pebbles, stones and lumps of clay. It is to be of a tightly binding nature and the particles are to be tough and durable. The gravel shall be natural material derived from the disintegration or crushing of Permian mudstone or shaly limestone and shall consist of particles evenly graded in accordance with the table below. Other properties shall be in accordance with those indicated in the table.

| Test | Preferred Value | Maximum Permissible Variation | Remarks |
|--------------------------|-----------------|-------------------------------|--|
| Thermal Resistivity | Min 1.2 °C.m/W | +10% | - |
| Particle Distribution | Sieve mm | Percentage passing | AS1289.3.6.1 Sieve |
| | 4.75 mm | 100% | Variation within range stated will be permitted at TasNetworks' discretion |
| | 2.36 mm | 80-100% | |
| | 1.18 mm | 50-80% | |
| | 600 um | 30-60% | |
| | 300 um | 20-45% | |
| | 75 um | 10-25% | |
| Soluble Salts | Min 0 | +0.5% | - |
| Organic content | Min 0 | +1.0% | Oil material only |
| Acidity (pH) | 7.0 | + or – 1.0 | - |
| Fine Fraction | <425 mm | | AS 1289.3.6.1 |
| Liquid Limit | Max 25% | | AS 1289.3.1.1 |
| Plasticity Index | Max 4% | +2.0% | AS 1289.3.3.1 |
| Dry Compression Strength | Min 1350 kPA | - | If applicable |
| Hardness | Loss 50% | - | Los Angeles Test |

D.2.2 Sand

The sand shall be nominally free of soluble salts, free of organic material (eg twigs, leaves, bark, wood, shells etc) and of pebbles, stones and clay. Sand having such impurities may not be accepted by TasNetworks at which point the Developer is liable for any costs relating to the removal of unacceptable sand and the purchase and installation of sand to this specification.

The sand shall be graded with the particle distribution from approximately 0.05mm to 2mm, but consideration will be given to a similar sand having additional particles up to 5mm making no more than ten percent of the total by weight. Where the bedding sand appears to fall outside this range a particle size distribution test may be requested of the Developer by TasNetworks to prove its suitability using sieves in accordance with to AS 1289.

| Test | Preferred Value | Maximum Permissible Variation | Remarks |
|-----------------------|-----------------|-------------------------------|---|
| Thermal Resistivity | Min 1.2 °C.m/W | +10% | - |
| Particle Distribution | Sieve mm | Percentage passing | AS1289.3.6.1 Sieve |
| | 5 mm | 100% | Variation within range stated will be permitted at TasNetworks' discretion |
| | 2 mm | 90-100% | |
| | 0.05 mm | 0-5% | |
| Soluble Salts | Min 0 | +0.5% | - |
| Organic content | Min 0 | +1.0% | Value will refer to oily material. Sand is to be nominally free of solid organic material |
| Acidity (pH) | 7.0 | +0.5 | - |

If offered, sandy loam may be considered as an alternative.

D.3 Fine Crushed Rock

The FCR shall be free from organic matter, lumps or balls of clay, excessive amounts of mica or secondary minerals or other adverse constituents. It shall be uniformly well-mixed and not segregated. The ratio of fines to the major particles shall be as per the Table below. The largest size shall be 20mm.

| Test | Value | | Remarks |
|---------------------------------|----------------|--------------------|--|
| Soaked Cube strength unconfined | Min. 1.5 (MPa) | | AS 1141.52 |
| Coarse Aggregate | | | |
| Wet Strength | Min. 100 (kN) | | AS 1141.22 |
| Wet/Dry strength | Min. 35% | | AS 1141.22 |
| Flakiness Index | Max. 35 | | AS 1141.15 |
| Fine Fraction | <425 mm | | AS 1289.3.6.1 |
| Liquid Limit | Max 25% | | AS 1289.3.1.1 |
| Plasticity Index | Max 4% | | AS 1289.3.3.1 |
| Percentage Passing | Sieve, mm | Percentage passing | AS1289.3.6.1 Sieve |
| | 19 | 100 | Variation within range stated will be permitted at TasNetworks' discretion |
| | 9.5 | 80 | |
| | 4.75 | 65 | |
| | 2.36 | 49 | |
| | 0.425 | 21 | |
| | 0.075 | 10 | |

D.4 General

Spot tests of gravel/sand delivered by the Contractor may be made from time to time with the view of maintaining an acceptable standard of quality. Spot check test results will be the initially accepted values. If they do so vary, then TasNetworks may reject the gravel/sand in question and the Contractor shall remove it from the point of delivery.

The decision to accept variation in the above requirements will be at the discretion of TasNetworks.

Appendix E – Deed of Materials Compliance

PROJECT NAME:

PROJECT No:

LOCATION:

I/We(Please Print)

of

Declare that:

1. The Materials used by the Developer in the installation, construction and commissioning of the Electrical and Civil Works are those specified in the Issue for Construction documentation; and
2. The Developer certifies and warrants to TasNetworks that the Materials comply with the TasNetworks Design Standards, Construction Specifications and Standard Construction Drawings and TasNetworks Materials and Assemblies document.

Developer Sign-off:

_____ Date: _____

(Developer to Sign)

Dated thisday of20