PowerWater

NP041
Guidelines for Electrical Design Consultants

Disclaimer: Power and Water disclaims all liability for errors or omissions of any kind whatsoever (whether negligent or otherwise) for any damage or loss arising from the use or reliance upon the information contained in this document.

Further Information:

Electrical consultant must obtain written approval/confirmation from Power and Water on appropriate design approach prior to commencing any detailed design work.

For additional information or advice regarding this document, please contact the Manager Network Engineering on 08 8924 5191 or Manager Distribution Development on 08 8924 5729.

This document should be read in conjunction with the following documents:

- NP001 Design and Construction of Network Assets
- NP003 Power Networks Installation Rules
- NP007 Power Networks Service Rules
- NP010 Meter Manual
- NP021 Easement Guidelines
- NP027 Capture of Newly Installed Street Lighting
- Power and Water Standards Drawings

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2. Introduction

2.1 Application

The following guidelines to electrical designs are applicable only to those areas of the Northern Territory which are:

- serviced by existing electricity distribution networks under the direct control of Power and Water; or
- new electricity extensions to the existing distribution networks to be taken over by Power and Water.

2.2 Purpose

Guidelines NP041 have been prepared to provide general information for electrical consultants to be accredited and carry out competent design of electricity infrastructure, including land subdivisions where the infrastructure is to be provided and handed over to Power and Water for operations and maintenance.

Power and Water's various guidelines and construction standards are subject to regular review. Prior to submitting any design proposal, it is necessary that electrical consultants obtain the up-to-date version located on Power and Water's Web site (www.powerwater.com.au), Business, Power Networks Design and Construction Guidelines:

- NP001.1 Design and Construction of Network Assets - General Requirements
- NP001.2 General Specification for Underground Electrical Reticulation
- NP001.3 General Specification for Overhead Electrical Reticulation
- NP001.4 General Specification for Overhead Rural Residential Subdivisions
- NP001.5 General Specification for Overhead Commercial and Industrial Subdivisions
- NP001.6 General Specification for URD Subdivisions
- NP001.7 Reliability Criteria for Distribution Networks
- NP001.9 Conditions of Supply to Large Customers
- NP001.10 Documentation Requirements
- NP003 Installation Rules
- NP007 Service Rules
- NP010 Metering Manual
- NP021 Easement Guidelines
- NP027 Capture of Newly Installed Street Lighting
- NP041 Electrical Design Consultants
- Power and Water Standard Drawings

3. Further Information

The following pages provide details of the policy. If further information is required, please contact:

Manager Network Engineering

Power and Water Corporation

GPO Box 37471

Winnellie NT 0821

Fax (08) 8924 5121

Phone (08) 8924 5191

Or

Manager Distribution Development

Power and Water Corporation

GPO Box 37471

Winnellie NT 0821

Fax (08) 8924 5121

Phone (08) 8924 5729

4. Definitions

Act is the Electricity Reform Act 2000, and includes Regulations made under the Act.

Axe Handle Lot is a lot connected to a public road by a single narrow access way.

Basic Supply is 10kVA single phase for typical individual urban and rural residential and 25kVA three phase for rural living customers. In a high density urban residential, basic supply is based on the lot zoning (MD, MR or HR) and the area of the lot. In a general industrial or light industrial subdivision, the basic supply shall be 25kVA minimum three phase supply up to 50kVA or as advised for very large lot and specific development.

Battle Axe Lots are groups of at least two lots connected to public roads by narrow access ways, with the access ways located adjacent to each other.

Capacity means the rated demand applicable to a particular lot of land or customer, and refers to an average demand over a 15 minute period. Note that it does not refer to the calculated maximum demand under the *Wiring Rules*, which is generally higher than the average demand.

Controlled Activities are activities and developments within an electricity easement that are acceptable provided the conditions of use are agreed in writing by Power and Water beforehand.

Customer/Developer will usually be the same person. Generally the customer will be the person that owns the premises and will consume electricity. The developer is the person responsible for negotiating conditions of supply.

Design Certification
The electrical consultant shall certify all designs as complying with this Policy in the forms set out in Appendices B and C. The certifications shall be attached to the design drawings submitted to Power and Water for approval.

Design Officer is an appointed Power and Water's staff responsible in dealing with the electrical consultant for approving design extensions or augmentations to the network.

Electrical Consultant refers to the certified designer who carries out the subdivision or electrical infrastructure design on behalf of the Developer.

Electricity Easement is an encumbrance on private land that gives Power and Water the right to use and have access to the power assets installed on the land for the purpose of operations, maintenance or augmentation.

Electrical Safety Regulator is the person so appointed under the Act.

High Voltage (HV) refers to Power and Water's supply:

- at a nominal voltage of 11,000 volts or 22,000 volts three phase for distribution reticulation.
- at a nominal voltage of 66,000 volts or 132,000 volts three phase for transmission reticulation.

Large Customer refers to the owner of the premises where the power supply requirements necessitate the establishment of a substation(s) on a property.

Load Limiting Circuit Breaker is a circuit breaker, complying with the *Wiring Rules* and Clause 5.56 of the *Installation Rules*, that is used to limit the load of an installation to an agreed capacity in accordance with the Policy.

Low Voltage (LV) refers to supply at a nominal voltage of 230 volts a.c single phase line-to-neutral and 400 volts a.c three phase line-to-line with tolerance of +10% -6% at a frequency of 50 Hz refer to PWC Network Technical code and Planning Criteria.

Permitted Activities are activities and developments that may be carried out within an electricity easement without risk to personal safety or network integrity.

Point of Entry (POE) is the point where:

(1) for an underground service, the service crosses the property boundary (except where the pillar is located on the customer's property – see (f) below)
(2) for an overhead service, the service terminates (also called the "Point of Attachment" of POA)

Point of Supply is the point where Power and Water makes supply available. For low voltage supply, this is one of the following:

(a) A point of attachment of an overhead service on to a building or pole on which a metering panel is fitted.

(b) A point of attachment of an overhead service on to a pole forming part of unmetered aerial consumer's mains.

(c) A nominated point on a distribution substation located on the customer's lot.

(d) A point of connection of an underground service in fused pillar or metering panel, including underground services originating at an overhead line.

(e) A point of connection of an underground service in a pillar or junction box forming part of unmetered consumer's mains, located on the customer's lot.

(f) A point on a Power and Water pillar located on the customer's lot.

For high voltage supply, the point of supply will be as agreed between the customer and Power and Water, and will generally be at the terminals of a high voltage metering unit located on the customer's lot.

Prohibited Activities are activities and developments within an electricity easement that cannot be tolerated under any circumstances or at any time. If such activities or developments do occur Power and Water will require that they be discontinued or removed as appropriate.

Reticulation is any component of an electricity distribution system including the provision of adequate transformer capacity. An electricity distribution system comprises overhead or underground reticulation (underground cables, aerial conductors, switches, and transformers) up to 22,000 volts, owned by Power and Water, and generally located on a gazetted public road.

Road Owner means the appropriate Authority (Infrastructure Division, Department of Infrastructure, Planning and Logistic or Local Government Council) that has legal rights to control all activities on that road.

Rural Area refers to an area that is not an urban area (see below) and generally refers to lots predominantly larger than 0.4 hectares or outside major town centres (Darwin, Palmerston, Katherine, Tennant Creek, Alice Springs).

Service refers to the low voltage overhead or underground line running from a pole or pillar owned by the Authority, which crosses the property boundary of the lot, and runs to the *Point of Supply* located on the lot.

Serviced means that a low voltage supply is available on the lot.

Unserviced means that there is no low voltage supply installed on the lot.

Servicing Distance means:

(a) for an overhead service, a distance, not exceeding 40 metres, that permits a service to be run without exceeding the design tension, and while maintaining the required ground clearance as defined in the Standards Manual. Refer also to 5.25 of the *Installation Rules.*

(b) for an underground service in an underground area, a distance not exceeding 60 metres from the nearest pillar to the point of service.

(c) For an underground service in an overhead area, a distance not exceeding 60 metres from the nearest pole carrying low voltage mains to the point of service. Refer also to 5.26 of the *Installation Rules.*

Service and Installation Rules and General Conditions of Supply (the "Service Rules") should be read in conjunction with this Policy. They set out many of the conditions applicable to services and metering.

Urban Area generally refers to lots predominantly of up to 0.4 hectares or in major town centres (Darwin, Palmerston, Katherine, Tennant Creek, and Alice Springs) with power services and street lighting may be developed for residential, industrial or commercial purposes.

Wiring Rules is the Australian Standard AS/NZS 3000.

5. Accreditation

It is a requirement that subdivisions and new developments for large customers be designed by accredited electrical consultants at the Developer's cost. Power and Water will check and endorse design drawings for construction by the Developer.

Power and Water requires that electrical consultants are competent to design electrical assets that will be handed over to Power and Water. Electrical consultants must be accredited by Power and Water. A list of current accredited electrical consultants for subdivision development and electricity infrastructure will be provided to all developers for consideration upon request.

An electrical consultant wishing to become accredited may apply by submission of "Consultant Credentials" form (Refer Appendix A). The consultant will need to provide details of qualifications and experience in the appropriate area of expertise. The consultant may seek to be accredited for electrical design in:

Distribution Overhead Reticulation (up to 22kV)

- High Voltage & Low Voltage Overhead Lines (Bare Conductors)
- Aerial Bundle Conductor Low Voltage
- Pole Distribution Substations
- Rural Residential Subdivisions
- Industrial / Commercial Subdivisions
- Street Lighting Design

Distribution Underground Reticulation (up to 22kV)

- Package / Kiosk Substations and Switchgear
- Indoor Ground Level Substations
- Indoor Upper Level Substations
- Indoor Basement Level Substations
- High Voltage Switching / Intake Stations
- Urban Residential Subdivisions
- Industrial / Commercial Subdivisions
- Street Lighting Design

Design of Transmission Lines (66kV and above)

- Overhead Lines Design
- Underground Cable Design

CAD / Microstation Drawing Services

The application will be considered by the Manager Network Engineering. Where the quality of workmanship of a new electrical consultant is such as to require excessive checking, Power and Water will charge for the additional work at standard consultancy rates.

6. General Design Requirements

6.1 Design Intent Compliance

Prior to commencing any detailed design work, the electrical consultant must obtain a written approval/confirmation advice from Power and Water on the proposed design approach including high voltage and low voltage reticulation compliance matters to meet the current standards practice and network reliability requirements. Furthermore, any design proposal that deviates from Power and Water standard design practices, drawings and approved equipment the electrical consultant must provide all necessary supporting technical evidence in order to be considered for Power and Water approval assessment process.

For all street light scheme designs, the electrical consultant must in the first instance obtain approval from the respective road owner (local council or government agency or corporation entity) and this shall accompany the request for approval to Power and Water.

If detailed design drawings are submitted and the design intent has not been approved by Power and Water, the electrical consultant will be liable to any potential financial claim by the Developer and responsible to execute the required amendments to achieve compliance and for the design to be submitted for approval.

6.2 Power Networks Information

Power and Water will provide limited copies of A4 or A3 sized prints of available information from the Geographic Information System (GIS) on the existing electricity network upon request at no charge. Hard copy larger than A3 or digital copy in dgn format can be obtained by contacting the GIS officer and a charge will apply. The electrical consultant must check and verify on site the accuracy of the existing reticulation network prior to commencing the design work. Where the electrical consultant wishes to enter authorised sites (indoor substations, zone substations) or access high voltage switchgear (package substations or Ring Mains Units), contact the Design Officer to arrange the appointment. The GIS information provided is for indication only. Power and Water can not verify the accuracy of the information provided, and disclaims all liability for errors or omissions for any damage or loss arising from the use or reliance upon the information.

6.3 Existing Services

The electrical consultant must identify all existing services (electricity, water, sewerage, telecommunications, open drains, storm water drainage assets where appropriate) prior to carrying out the detailed design to avoid services clashing. Where the new design work can not be achieved in accordance with the standard power service allocation in a road reserve, the design consultant shall seek and obtain approval in writing from the Road Owner for any non-standard alignment. If during the construction phase, the designed power service is found in conflict with any existing services, the electrical consultant shall be responsible to submit a corrective plan to be approved by Power and Water and other applicable stakeholders.

6.4 Approved Road Crossing Methodology

The electrical consultant must obtain approval in writing from the Road Owner to open cut or under-road boring for electrical conduits in road crossings. The approved road crossing methodology shall be clearly stated in the design drawings for construction.

6.5 Sacred Sites

Power and Water and the electrical consultant are obliged to strictly comply with Sacred Sites legislation. It is incumbent on the electrical consultant to ensure that appropriate checks are made with the Aboriginal Areas Protection Authority (AAPA) in any new electricity infrastructure extension. A permit from AAPA must be obtained prior to the design drawings being signed off for construction. Failure to obtain AAPA clearance could result in prosecution to the electrical consultant and cause lengthy delays to the construction phase.

6.6 Environment and Heritage

Similarly, Power and Water is committed to ensuring that field activities have minimal impact on the environment, and that heritage values of an area are not negatively affected. The electrical consultant must obtain environmental assessment from the Environment Protection Authority, where route clearing or site demolition is required for new electricity infrastructure extension.

6.7 Electricity Easements and Rights of Way

Where any power asset is to be installed on private property, the electrical consultant must consider and ensure:

- 24 hour all weather access requirements are met for Power and Water's operations and maintenance purposes. A Right of Way to ensure legal access of appropriate heavy vehicles to the assets must be indicated in the design drawing for checking and approval;
- A Right of Way must not involve access through areas which may be deemed to be dangerous to personnel. This includes, but is not limited to, access through areas patrolled by guard dogs, operations involving vehicles or machinery or mechanical plant and equipment rooms;
- Easement and Right of Way shall not be located in areas where access may be obstructed by persons, vehicles, equipment, material storage areas, site usage, enclosed or partially enclosed car parks, loading docks, similar facilities or any other possible impediment;
- Safe working distances are met in accordance with the Electricity Reform (Safety and Technical) Regulations 2016, Northern Territory;
- Public safety under electrical fault conditions where significant step and touch potentials would be induced in nearby metallic structures (fences) or swimming pool to cause electric shock.

Typical electricity easements for specific power assets are:

- 1m x 1m for Underground Residential Distribution (URD) 3-5 slot fused pillar;
- 2m x 2m for 7 slot Fused Distribution pillar;
- 4m x 3.5m for Package Substation;
- 7m x 3m for Kiosk Substation;
- 3.5m x 2.5m for Ring Main Unit (RMU);
- 7.4m x 5m or 6.5m x 6.5m or 5m x 6.8m (depending on the customer's building layout) for One Transformer Indoor Substation;
- 10.7m x 5.3m or 10m x 6.6m or 7.9m x 6.8m (depending on the customer's building layout) for Two Transformer Indoor Substation;
- 15.2m x 5m or 12.5m x 7.2m or 11m x 7.5m (depending on the customer's building layout) for Three Transformer Indoor Substation;

- 3m wide for underground High Voltage or Low Voltage cable route;
- 8m wide for overhead Low Voltage power line;
- 10m wide for single circuit 11kV or 22kV power line;
- 25m to 35m wide for 66kV power line depending on construction type;
- 35m to 45m wide for 132kV power line depending on construction type.

In new subdivisions, Power and Water expects all underground and overhead power lines to be located on public roads, except for pillars, ring main units and substations. Lines crossing private property will only be considered for high voltage supply to individual battle-axe lots. The electrical consultant shall not design high voltage or low voltage reticulation across privately owned lots or public parks.

The electrical consultant must inform the Developer to comply with controlled, permitted and prohibited activities and developments within an electricity easement. Refer **NP021 Easement Guidelines** for full details.

6.8 Design Drawings

All design drawings shall be produced by Computer Aided Design Drafting (CADD) methods on Power and Water's drawing frames (A1 and A3 sized) for checking and construction approval by Power and Water. Contact the Design Officer or Network Engineering Drafting Services (08 8924 5833) to obtain an electronic copy of Power and Water's drawing frames if required. All design drawing prints originating from CADD files shall be clear and legible and shall be suitable for reduction to A3 size with all text at least 2mm high. Drawings which in opinion of Power and Water are of an inadequate standard shall be rejected. In particular, drawings that are not clear and legible at A3 size will be rejected.

- Drawing Title:

  Discipline, Region: POWER NETWORKS – DARWIN DISTRIBUTION

  Title Project, Lot, Stage: SUBDIVISION OF SECTION 1234, STAGE 1

  TIVENDALE ROAD, BERRIMAH, HUNDRED OF BAGOT

  Drawing Content: HIGH VOLTAGE RETICULATION

- Drawing Numbers: The electrical consultant shall advise Power and Water the required quantity of design drawings to be used in the project. A set of consecutive drawing numbers will be raised and provided to the electrical consultant.
- Electrical Consultant and Developer's Contact Details: All design drawings shall have both electrical consultant and developer's contact details, such as:

  Company Name

  Australian Business Number (ABN)

  Postal Address

  Phone Number

  Fax Number

  Contact Person

  Email Address (if available)

Power and Water requires uniform practices and drafting procedure to achieve an efficient and straight forward drawing management system. The electrical consultants must therefore

familiarise themselves with Standards Manual Volume 20 (Drawing Procedure, available on www.powerwater.com.au) in:

- Overview of Drawing Instructions;
- Standard Drawing Frames;
- Drawing Title Block Format – Work Instruction;
- Issuing Drawing Numbers – Work Instruction;
- Microstation Element Attributes and Symbology - Work Instruction;
- Acceptable AutoCAD File Format, Symbology and Settings;
- Drawing Amendment Notations;
- Transmission and Distribution – Electrical Layout Design Symbols;
- Electrical Standards Symbols - Work Instruction;
- High Voltage System Diagram Symbols;

6.8 Standards Drawings

The electrical consultants shall familiarise themselves with Power and Water's applicable standards drawings and Standards Bulletins which are periodically updated and issued by Strategic Asset Engineering Standards group. Standards drawings define the materials, set out the construction standard details and provide general design data for Power and Water overhead and underground distribution infrastructure. Standards Bulletins are issued to all registered electrical consultants, contractors, suppliers and Power and Water personnel for any amendment on the latest approved materials and practices.

Standards drawings are classified under:

- Volume 1 Overhead Line Manual;
- Volume 2 Underground Manual;
- Volume 3 Street Lighting Manual;
- Volume 4 Aerial Bundled Cable Manual.

Details of all standards drawings are available on www.powerwater.com.au .

The electrical consultant shall not specify non-standard materials or practices in any design project without obtaining prior approval in writing from the Standards Engineer.

Suggestion, information, or any other queries, relating to the Standards drawings, new materials or practices should be directed to:

Standards Engineer

Network Engineering, Standards group

Power and Water Corporation

PO Box 37471

Winnellie Northern Territory 0821

Phone: 08 8924 5563 – Fax: 08 8924 5121

6.10 Standards Approved Items and Manufacturers

All purchased materials/equipment to construct electrical reticulation shall be in accordance with PWC's relevant standards/technical requirements and from a PWC authorised manufacturer, The electrical consultants shall familiarise themselves with PWC's approved items and communicate is requirement to both the developer and contractors.

Any non-standard materials/equipment used without obtaining prior approval in writing from Power Networks. The works can be rejected and replaced by the approved standard item at the developers cost before the power clearance can be issued.

6.11 Reliability Criteria for Distribution Networks

Power and Water's reliability philosophy at distribution level is based on a modified 'n-1' criteria. This means that, in the event of any single failure of equipment, supply should be quickly restored – either by switching around the fault (ie. connecting to nearest substation or distribution pillar as advised), or by the use of a suitable generator.

Urban Areas:

All high voltage reticulation in urban extensions are to be looped or tied so that individual faults may be switched around. Under special circumstances where providing a high voltage loop is considered impractical, one individual substation may be allowed to be on a radial feed that can be supplied by a single mobile generator.

Rural Areas:

Where possible, high voltage supply in a rural extension is to be looped and switched around by installation of Gas Break Switch (GBS). Power and Water shall check and advise the requirement with the electrical consultant when receiving the design master plan concept.

For more details, refer guidelines NP001.7 Reliability Criteria for Distribution Networks available on www.powerwater.com.au .

6.12 High Voltage Master Plan

Prior to commencing any detailed overhead or underground power design for land subdivisions or specific development in stages where a number of substations are to be installed, the electrical consultant must prepare an estimate of overall maximum demand required and submit a High Voltage Master Plan to Power and Water for assessment.

Where stages are to be built over a number of years the Master Plan must consider how supply (including during contingencies) will be met during development where practically feasible.

The electrical consultant must consult Power and Water to ascertain:

- Locations of existing and future high voltage connection points to meet the guidelines NP001.7 Reliability Criteria for Distribution Networks;
- Spare available capacity of existing distribution networks in the area for immediate or short term high voltage supply;
- Power headwork by the Developer to be carried out in order to meet the anticipated overall maximum demand of the subdivision;
- High voltage cable / conductor sizes for internal reticulation and backbone feeder where applicable;
- High voltage switchgear at suitable locations for networks switching operations under normal and contingency conditions;

- After Diversified Maximum Demand (ADMD) kVA per residential lot to be applied for calculating low voltage drop not exceeding 4% in radial sections;
- Agreed kVA anticipated demands by Power and Water for lots with high density residential, community use, specific industrial and commercial developments.
- Power services to current stage developments shall not be supplied from future stages.

Design drawings submitted by the electrical consultant for checking and construction approval shall be rejected if Power and Water has not previously agreed on the proposed High Voltage Master Plan and approved electrical design intent.

6.13 Low Voltage Calculation Program

Each circuit of low voltage reticulation originating from a substation shall be designed such that the maximum permissible voltage drop under normal operation condition must not exceed 4% with the agreed ADMD loads correctly applied as per NP001.1 Design and Construction of Network Assets – General Requirements.

Power and Water has developed a Low Voltage Calculation program specifically for overhead and underground subdivisions. The accredited electrical consultant may be trained and obtain the program free of charge upon request. To arrange, contact the Design Officer or Manager Distribution Development.

6.14 Flood Zones in Coastal Areas and River Valleys

The electrical consultant must not design critical power assets (substations, Ring Main Units, low voltage pillars) that could be prone to damage by flood water. All critical power assets must be installed at suitable locations that are identified with 1% Annual Exceedence Probability (AEP) zone or less, previously referred to as a 1:100 year flood. The AEP terminology better informs designers of the probability of a flood of a certain size to occur in a period of a year. The 1 in 100 year flood terminology has been abandoned as it often gave a false perception that a flood of that size could only be expected every 100 years.

6.15 Charges

- Where the overall supply to a subdivision requires minor augmentation work on the existing reticulation, Power and Water will provide the actual charge to carry out the design and installation for the Developer.
- Where the overall supply to a small or medium subdivision requires high voltage and/or low voltage extension from the existing reticulation, the Developer shall be responsible for the design and installation of the electrical reticulation by engaging accredited electrical consultant and contractor. Power and Water will carry out drawing approval, auditing contractor's installation, final connection work, testing and commissioning at the Developer's cost.
- Where the overall supply to a large subdivision exceeds the existing reticulation's spare capacity, the Developer shall:
    - be responsible for the cost of design and installation of high voltage and / or low voltage reticulation; and
    - be advised by Power and Water of the cost of providing adequate network capacity to the subdivision's maximum demand requirement.
- Customers who have an exceptionally large load increment on the electricity distribution system may require major reinforcement of the electricity system. Under such

circumstances, the customer's contribution towards the capital costs for augmentation and reinforcement works will be subject to individual negotiation in accordance with the Capital Contribution Policy. Generally, such customers will be Contestable within the meaning of the *Electricity Networks (Third Party Access) Act* and *Code.*

6.15 Detailed Electrical Design Compliance

After receiving a written approval/confirmation advice from Power and Water on the proposed design intent, electrical consultant shall design the reticulation extension and customer's installation (where required by the Developer) as directed by Power and Water with reference on:

- Network Policy NP001.1 **General Requirements**
- Network Policy NP001.2 **General Specification for Underground Electrical Reticulation**
- Network Policy NP001.3 **General Specification for Overhead Electrical Reticulation**
- Network Policy NP001.4 **General Specification for Overhead Rural Residential Subdivisions**
- Network Policy NP001.5 **General Specification for Overhead Commercial and Industrial Subdivisions**
- Network Policy NP001.6 **General Specification for URD Subdivisions**
- Network Policy NP001.7 **Reliability Criteria for Distribution Networks**
- Network Policy NP001.9 **Conditions of Supply to Large Customers**
- Network Policy NP001.10 **Documentation Requirements**
- Network Policy NP003 **Installation Rules**
- Network Policy NP007 **Service Rules**
- Network Policy NP010 **Meter Manual**
- Network Policy NP021 **Easement Guidelines**
- Network Policy NP027 **Capture of Newly Installed Street Lighting**
- Network Policy NP041 **Guidelines for Electrical Design Consultants**
- Relevant distributed Standards Bulletins, emailed update advice on electrical design requirement changes.

The electrical consultant shall certify all electrical designs as complying with relevant Network Policies and as directed from time to time as appropriate. The certifications shall be attached to the design drawings submitted to Power and Water for endorsement. Refer Network Policy NP001.10 Documentation Requirements for details of design submission by the electrical consultant for checking and construction endorsement.

6.17 "As Constructed" Drawings

On completion of the works, the contractor may provide "marked up" drawings showing any changes made from the original design plan, to the electrical consultant for preparing "As Constructed" drawings. The following "As Constructed" drawing requirements shall be submitted to Power and Water:

- One A1 sized of paper prints of all project drawings indicating appropriate "As Constructed" amendment;
- One A3 sized of paper prints of all project drawings indicating appropriate "As Constructed" amendment;

- Electronic copy (CD-ROM or DVD disks) of all project drawings formatted as Microstation "*.dgn" files. Submitted "as constructed" drawings in *.dgn" format, shall have all its reference files packaged into one single file.

"As Constructed" drawings must have correct land title lot numbers and road names. "As Constructed" drawings which in the opinion of Power and Water are of an inadequate standard shall be rejected. In particular, any information in "As Constructed" drawings that is not clear and legible in A3 print will be rejected.

The scale of the "As Constructed" drawings shall be at least 1:1000 for new large area subdivisions and 1:500 for any upgrades and additions to existing infrastructures.

Copies of all required formats of "As Constructed" drawing shall be submitted to Power and Water Project Manager prior to final contractor handover inspection work to be arranged. Only when "As Constructed" drawings are checked and accepted as correct, the final connection work by Power and Water will then be scheduled to proceed.

7 Overhead Line Design

Overhead power line extensions are accepted by Power and Water for:

- Rural subdivisions;
- Extensions in Minor Centres (outside major town centres such as Darwin, Palmerston, Katherine, Tennant Creek and Alice Springs);
- Areas where the local Council or Road Authority or Development Consent Authority has granted permissions or approvals;
- Industrial subdivisions;
- Commercial subdivisions where the supplying distribution network is overhead and require small loads of less than 300kVA.

Where a Road Owner requires specific underground supply to any of the above typical overhead line subdivisions, Power and Water would support it. The electrical consultant shall be responsible for obtaining written approvals from relevant Road Owner prior to commencing work on an overhead line design.

7.1 Overhead Design Documentation

In subdivisions, the electrical consultant shall submit a design report with details of:

- Allocated kVA per lot (basic supply) or specific maximum demand depending on the approved lot zoning by the Development Consent Authority (DCA) or known development application in the subdivision process;
- Voltage drop calculations with After Diversity Maximum Demand loads.
- Maximum Design Tension: 500 Pa at 20 Celsius degrees (Darwin), at 15 Celsius degrees (Katherine) and 5 Celsius degrees (Tennant Creek and Alice Springs);
- Calculation of forces on poles;
- Calculation of minimum Ground Clearances on poles at 65 Celsius degrees to satisfy Road Authority for road crossings and on road reserve;
- Selection of suitable poles. D type poles should be employed to avoid the use of guys for cost effective maintenance management.

7.2 Overhead Design Drawings

One set of A1 and one set of A3 sized drawings are to be submitted for checking and approval, and shall contain the following:

- Project title, drawing number, electrical consultant and developer's details as per **Clause 6.8**;
- Locality map;
- Subdivision cadastral layout;
- Legends and Notes;
- Pole location and alignment;
- Tension, Sag, Conductor and Pole Schedules;
- High Voltage / Low Voltage / Street Lighting (if required) Reticulation;
- High Voltage Phasing Labelling (as per Standards Bulletin No. S12-062);

- Low Voltage Load Balancing Proposal indicating phase allocation to each lot (Red, White or Blue phase) on both the single line diagram and subdivision cadastral layout;
- Existing and New High Voltage Schematic Diagrams;
- Earthing Installation Requirements for Substations, Gas Break Switches, Recloser, Sectionaliser, Smart Fuses;
- Works by Developer's Contractor;
- Works by Power and Water (Final Connection, Testing & Commissioning of all new substations and high voltage switchgear, any required Augmentation work on existing overhead power line);
- Developer Notes;
- Basic supply to each lot, anticipated or specific maximum demand for lot with known proposed development application in the subdivision process;
- Location of driveways (where known);
- Stakeholder responsible for submission of "As Constructed" documentations to Power and Water. Refer Section 10, NP020 Guidelines for Developers of Subdivisions and Electricity Infrastructure on www.powerwater.com.au.

7.3 Pole Transformer Selections

The electrical consultant shall select suitable overhead transformer sizes from:

11kV / 240 V Transformer:

- 16kVA.

11kV / 433 V Transformers:

- 25kVA;
- 63kVA;
- 100kVA;
- 200kVA;
- 315kVA;
- 500kVA.

22kV / 240 V Transformer:

- 16kVA.

22kV / 433V Transformers:

- 25kVA;
- 63kVA;
- 100kVA;
- 200kVA;
- 315kVA;
- 500kVA.

Transformer sizes will be determined based on:

- Basic supply for each lot depending on its zoning approved by Development Consent Authority; or
- Specific maximum demand for lot with known development application in the subdivision process.

7.4 Overhead Subdivision Design Principles

Overhead electrical reticulation extensions (11kV or 22kV) as per Standards Manual Volume 1 shall be required in:

- any subdivision within 50km of Darwin or required by Development Consent Authority / local Council;
- subdivisions less than eight hectares unless they are too far from the existing distribution network to be economically connected (i.e. more than a few kilometres);
- subdivision with lots larger than eight hectares where the surrounding area is reticulated.

Axe-handled and battle-axe-handled lots are not recommended in new subdivisions as they present significant problems in installing customer's internal reticulation to meet an acceptable voltage drop.

Where a developer wishes to proceed with axe-handled or battle-axed lots, the following electrical design is required:

- Establishment of a suitable substation at the front boundary of each axe-handled (single) lot;
- Extension of high voltage power line and establishment of a suitable substation at the end of the "handles" of battle axed lots or axe-handled lot with access length greater than 200 metres. A 10 wide electricity easement covering the full length of reticulation and establishment of a sealed road pavement capable of taking the weight of a 15-ton service vehicle for Power and Water to carry out operations and maintenance the power line within the axe/battle handled access are required.

The electrical consultant shall select suitable transformer size to provide the basic power supply to each of the newly created lots in the subdivision as follows:

- 10kVA single phase for rural residential lot; or
- 25kVA three phase for other rural zoned lot; or
- Minimum 25kVA three phase for industrial zoned lot with area of 1667sqm or less; or
- 15kVA three phase per 1000sqm for industrial zoned lot, subject to maximum 50kVA (area of 3333sqm or slightly more); or
- Minimum of 50kVA three phase for typical horticultural lot; or
- Agreed kVA by Power and Water for specific horticultural or industrial development or very large lot; or
- Anticipated power maximum demand figure based on AS-3000 for commercial lot.

Where only basic supply for each newly created lot in subdivision process, provisions for readily available high voltage reticulation and future substation establishment with minimal interruptions must be designed and constructed in the subdivision stage.

The electrical consultant must consult Power and Water to confirm suitable overhead conductors in the design. Typical high voltage overhead conductors are:

- Hydrogen (7/4.50 AAAC) conductor for residential subdivisions. Where the overhead power line extension of the subdivision will be part of the major distribution feeders or within 3km of an existing or future designated zone substation, Neon (19/3.75 AAAC) will be required;
- Fluorine (7/3.00 AAAC) conductor is accepted for one single substation on a radial feed and not within 3km of an existing or future designated zone substation;
- Neon (19/3.75 AAAC) conductor for all industrial / commercial subdivisions.

Typical low voltage overhead conductors are:

- 4 core 95 and 150sqmm Aerial Bundled Conductors (ABC) for all rural residential subdivisions;
- Neon (19/3.75 AAAC) conductor for all industrial subdivisions. If street lighting is required, Fluorine (7/3.00 AAAC) conductor can be used.

Minimum aerial earth conductor will be Fluorine (7/3.00 AAAC). 3/2.75 steel conductor will not be used as aerial earth conductor in distribution overhead power line.

Pole earthing requirement is a standard practice on all poles as per Power and Water's Standard Drawing S1-2-3-19 Pole Earthing Method as follows:

- Standard Type A Pole Earthing shall be Option 2 where the use of an auger to drill minimum diameter hole to a depth of 3m is applied.
- Type A Pole Earthing shall be used on every 5th pole in Urban Industrial (11kV) areas and every 3rd pole in Rural (22kV) Areas.
- Pole with special mounted arrangement such as transformer, Gas Break Switch (GBS), HV Metering Unit, Capacitor Banks, HV or LV cable termination etc. shall be installed with specific earthing requirement to meet local earth / CMEN earth values.
- Type B Pole Earthing shall be applied to the rest of the other poles.
- In summary, a pole shall have one earthing installation of either Type B or Type A Option 2 or specific earthing requirement.
- A clear reference to Pole Earthing Method drawing S1-2-3-19 with the General Earthing notes shall be included in the Pole Schedule with a new column titled Earthing in which each pole's earthing requirement is specified.

The electrical consultant must not design an overhead power line extension using non-standard conductor without obtaining prior approval in writing from the Strategic Asset Engineering Standards group.

Where power supplied to subdivision of large lots (8 hectares or more), low voltage reticulation may be waived by installation of a suitable overhead substation at the common lot boundaries. Appropriate low voltage ABC termination blocks must be installed on LV cross-arm at the transformer pole.

High voltage switchgear (Gas Break Switch or Sectionaliser) shall be installed in the subdivision at suitable location for networks switching operations under normal and contingency conditions. Power and Water shall advise of such requirement.

The electrical consultant must check on-site and ensure that substation and high voltage switchgear poles selected such that 24 hr all weather safe access for operations and maintenance purposes shall be met.

For extremely long overhead HV designs (>60km), transposition of conductors should be considered. In structures where conductor phasing does not follow the standard configuration (Red White Blue from road side), the electrical consultant shall indicate actual conductor phasing on design drawings by consulting with the Design Officer. Design shall indicate phase labelling on all poles structures with non-standard configurations.

The electrical consultant shall be responsible to assess the soil condition and specify appropriate earthing installations to achieve satisfactory Common Multiple Earth Neutral (CMEN) and local earth values for:

- Pole substation : 1 Ohm CMEN and 30 Ohm max local earth;
- Gas Break Switch : 30 Ohms max local or combined earth;
- Sectionaliser : 30 Ohms max local or combined earth;
- Voltage Regulator : 30 Ohms max local or combined earth;
- Recloser : 30 Ohms max local or combined earth.

As the Road Owner is expected to own street lighting assets from January 2018, the electrical consultant is required to seek a clear approval advice on specific street lighting requirements on any subdivision work from relevant local government (Council/Shire/Township) or Department of Infrastructure, Planning & Logistic (Infrastructure Division) or Corporation Entity before commencing any concept design. Only when approval is granted, Power and Water's current overhead or underground supplied street lighting design can be used to avoid a difficult situation that the Road Owner could reject the ownership of newly installed street light assets.

8 Underground Subdivision Design

Electricity extensions in new urban areas shall be underground in major town centres (Darwin, Palmerston, Katherine, Tennant Creek and Alice Springs) as per Power and Water's Standards Manual Volume 2. Axe handled and battle axe handled lots are not permitted in urban subdivisions.

Where required by the Road Owner, underground reticulation can also apply to rural residential or industrial subdivision. It is the electrical consultant's responsibility to obtain a written advice from the relevant Road Onwer on the preferred electricity networks in any subdivision design.

8.1 Underground Design Documentation

In urban subdivisions, the electrical consultant shall submit a design report with details of:

- Allocated kVA per lot (basic supply) depending on the approved lot zoning by the Development Consent Authority (DCA). 10kVA single phase for single dwelling lots (zoned **SD** or specific **MD** for one unit only). 22VA per sqm three phase for duplex or unit lots (zoned **MD** multiple dwelling residential or equivalent) with a standard service cable provided for up to three duplex / units. A fused distribution pillar without service cables will be required for intended for more than three duplex / units. 55VA per sqm three phase for maximum four storey flats (zoned **MR** medium density residential or equivalent) with a fused distribution pillar. 88VA per sqm three phase with a fused distribution pillar and provision for a future substation location for maximum eight storey flats (zoned **HR** high density residential or equivalent). 15kVA three phase for **Urban-Rural** lots, a fused pillar on lot or on common side property boundary between each 2 lot.
- Where the power requirements of the subdivided lots are unknown at the time of the development (eg zoned **CB** Central Business, **FD** Future Development, **SU** Specific Use or the like), then Power and Water shall require the Developer to provide a legal serving agreement and appropriate bank guarantee for potential land buyer of each lot to develop specific infrastructure.
- Anticipated maximum demand based on Australian Standards-3000 or equivalent estimation of specific proposed development in the subdivision application process (eg. Educational Schools / Sports establishment, **CP** Community Purposes, **DV** Development, **SU** Specific Use, Shops, Residential Units, Townhouses, **C** Commercial and Residential High Rise Building developments);
- Suitable locations for critical power assets (substations, Ring Main Units, distribution pillars) on 1% Annual Exceedence Probability (AEP) zone or less.
- Voltage drop calculations with After Diversity Maximum Demand loads (4.5kVA or 7kVA per single residential lot), calculated kVA per zoned **MD**, **MR**, **HR** lot or specific development load. Refer to NP001.1 General Requirements for application of ADMD loads in voltage drop calculation.

8.2 Underground Subdivision Design Drawings

One set of A1 and one set of A3 sized drawings are to be submitted for checking and approval, and shall contain the following:

- Project title, drawing number, electrical consultant and developer's details as per **Clause 6.8**;
- Locality map;

- Subdivision cadastral layout, scale 1:1000 at A1 sized drawing;
- Legends and Notes;
- Works by Developer's Contractor;
- Works by Power and Water at Developers' cost (Final Connection, Testing & Commissioning of all new substations, high voltage switchgear and cables, low voltage cables, distribution pillars, street lights and any required augmentation work on existing underground distribution networks);
- Developer Notes;
- Basic supply to each residential zoned lot, anticipated or specific maximum demand for lot with known proposed development in the subdivision application process;
- Low Voltage Load Balancing Proposal indicating phase allocation to each lot (Red, White or Blue phase) on both the single line diagram and subdivision cadastral layout;
- Diagram showing allocation for all services (power, communication, sewer, water, street lighting, storm water)
- Typical cable trench details (with and without Telstra/NBN pit);
- Sand pit locations for cable turning requirements;
- Six (6) electrical design drawings are required for a typical urban subdivision: High Voltage Reticulation, Low Voltage Reticulation, Street Lighting Reticulation where applicable, Conduit Layout, Master Services Plan, Single Line Diagrams (High Voltage & Low Voltage) & Construction Notes;
- For small urban subdivisions with a few lots, three (3) electrical design drawings may be accepted: High Voltage & Low Voltage, Street Lighting Reticulation where applicable & Conduit Layout, Single Line Diagram & Construction Notes;
- Existing and New High Voltage Schematic Diagrams;
- Specific Earthing Installation Requirements for Indoor Substation, Combined Package Substation and Ring Main Unit, Intake Station and Switching Station;
- Party responsible for submission of "As Constructed" documentations to Power and Water. Refer Section 10, NP020 Guidelines for Developers of Subdivisions and Electricity Infrastructure on www.powerwater.com.au;

8.3 Substation and High Voltage Switchgear Selections

Where the potential maximum demand is greater than 200kVA, a customer substation shall be required. Between 100kVA and 200kVA, a decision on whether a customer substation shall be advised by Power and Water depending on a number of factors, such as the number and size of substations in the area, distance between them, security and capacity of the low voltage network. The electrical consultant shall select the following suitable substations and underground high voltage switchgear for appropriate applications:

11kV / 433V Transformers:

- 315kVA Package (only with pre-approval by Power and Water);
- 500kVA Package;
- 750kVA Package;
- 1000kVA Package;
- 500kVA Kiosk;
- 750kVA Kiosk;
- 1000kVA Kiosk;

- 500kVA Indoor Oil Type;
- 750kVA Indoor Oil Type;
- 1000kVA Indoor Oil Type;
- 1500kVA Indoor Oil Type;
- 1000kVA Indoor Dry Type;
- 1500kVA Indoor Dry Type;

11kV Switchgear:

- Dreicher SF6 (non-extendable) Ring Main Units (RMU) is the standard HV switchgear fitted inside the package substation MK2 and MK3, this RMU can also come in an outdoor enclosure installation for 11-22kV, 35-400sqmm cables;

- Schneider SF6 RM6 (non-extendable) Ring Main Units with outdoor enclosure, stand-alone installation for 11-22kV, 240-400sqmm cables;

- Schneider SF6 SM6 (extendable) Switchgear (630A Isolator, Circuit Breaker, HV Metering Unit) for High Voltage Switching/Intake Station;

PWC approval will need to be obtained for the use of distribution RMU switchgears within 1km of an existing or future designated zone substation due to high fault level encountered.

22kV / 433V Transformers:

- 315kVA Package (only with pre-approval by Power and Water);
- 500kVA Package;
- 750kVA Package;
- 1000kVA Package;
- 300kVA Kiosk;
- 500kVA Kiosk;
- 750kVA Kiosk;
- 1000kVA Kiosk.

22kV Switchgear:

- Schneider SF6 RM6 (non-extendable) Ring Main Units with outdoor enclosure, stand alone installation for all cable termination up to 300sqmm;

- Dreicher SF6 (non-extendable) Ring Main Units (RMU) is the standard HV switchgear fitted inside the package substation MKII, this RMU can also come in an outdoor enclosure installation for 11-22kV, 35-400sqmm cables;

- Schneider SF6 SM6 (extendable) Switchgear (630A Isolator, Circuit Breaker, HV Metering Unit) for HV Switching/Intake Station.

8.4 High Voltage Distribution and Low Voltage Cable Selections

Only selected cables and manufacturer approved by Power and Water's Strategic Asset Engineering Standards group may be used in underground distribution extension. Paper lead mineral insulated non-draining (MIND) 11kV and 22kV cables shall not be used in new installations. Power and Water generally uses single-core cables for ease of installation. Details of approved manufacturers and technical cable information are available on the internet www.powerwater.com.au

Typical underground cables should be used are:

- 11kV radial feeder with single substation and cannot be further extended in future: 95sqmm, Aluminium single core cable;
- 11kV distribution feeder: 240sqmm, Aluminium, single core cable;
- 11kV express (backbone) feeder: 400sqmm, Aluminium, single core cable. Where required for higher current carrying capacity, 300sqmm, Copper, three core cable will be allowed;
- 22kV feeder: 240sqmm, Aluminium, single core cable;
- 415V distribution cable: 240sqmm, Aluminium, single core cable;
- 415V / 240V service cable: 25sqmm, Copper, single core cable;
- 415V / 240V street lighting cable: 25sqmm, Copper, single core cable.

8.5 Underground Subdivision Design Principles

- The electrical consultant must consult with the developer on specific area of work that can be fully installed in one construction stage in any design submission.
- Package substation which is a primary source of low voltage supply to a specific number of lots shall be installed in the same stage as the lot land release stage. Low voltage emergency link from another source of supply shall not be used for servicing newly created lots in any land release stage.
- A minimum of 5.5m vertical clearance is required between the top of a package substation and any building encroachment on a 4.0m x 3.5m electricity easement.
- High voltage cables must be installed in 150mm orange heavy duty conduit. A 70sqmm copper earth conductor shall be installed direct buried along all high voltage cable route.
- No high voltage through joints are permitted in new installations except in exceptional circumstances (cable run exceeds typical cable drum size) and with prior approval of Power and Water. No low voltage joints are permissible in new installations.
- High voltage and low voltage distribution reticulation must not be installed across any privately owned property.
- On specific case by case basis with prior written approval from local government, high voltage or low voltage distribution reticulation may be considered to be installed across open space (recreation park) by Power and Water.
- Locations of cable joint or turning pits shall be readily accessible. Under no circumstances may joint or turning pits be installed under carriageways, driveways or the like where repair crews could be endangered by vehicles.

  The electrical consultant must obtain Power and Water's approval on suitable locations for any substation or high voltage switchgear proposal to ensure 24 hr all weather safe access for operations and maintenance purposes is met. Unsuitable locations for substation or high voltage switchgear will not be accepted for connection by Power and Water.
- High voltage underground cable extension from an overhead line pole must not be greater than the critical length associated with ferroresonance phenomenon. Refer to standard drawings S2-4-2-9 and 10 for data on the critical lengths of cable with reference to different transformer sizes.
- Low voltage servicing (One-Pillar-per-Two-Lots) design shall be applied in all new design submissions in subdivision land releases as follows:
  - 240sqmm distribution cables originated from package substation connect to Main distribution pillars.
  - 240sqmm distribution cables shall be used to connect Main distribution pillar on each MD lot for multiple dwellings/units/townhouses.

- 4 x 25sqmm service cables originated from a Main distribution pillar connect to maximum of two Sub-Main distribution pillars for SD lots or specific MD lots for single residential only.
- 4 x 25sqmm service cables cannot be used to connect two consecutive Sub-Main distribution pillars on the same path.
- 4 x 25sqmm service cables cannot be used to connect to any Sub-Main distribution pillar over 60m away from the Main distribution pillar.
- Main or Sub-Main distribution pillar is centrally installed between the boundary of two adjacent lots so that the required electricity easement on each lot shall be limited to 0.5m x 1.0m.
- Main or Sub-Main distribution pillar for power service shall be right on one of the two corners on the property lot and water/sewer services are on the other corner.
- Where water or sewer service is requested to be located on both sides of a property lot, it shall be at least 0.5m horizontal clearance separation from the required electricity easement of the Main or Sub-Main distribution pillar installed on between the boundary of two adjacent lots or completely on one lot.
- Where there is one lot left on the design, electricity easement shall be 1.0m x 1.0m.
- 22m of 25sqmm service cables inside each lot shall not be required to install by the Developer. Appropriate length of single or multi-phase 25sqmm service cables shall be installed by the land owner's licensed electrician from the distribution pillar to the house's switchboard location.

- Basic low voltage supply requirement is subject to lot zoning or anticipated/specific maximum demand of the proposed development in the subdivision application as stated in Section 8.1.
- If power service is required to be provided to a Park or Open Space lot, it will be treated like another SD lot in the electrical design consideration.
- Low voltage reticulation systems for single residential subdivisions shall be designed for a diversified demand of 4.5 kVA per lot typically or 7 kVA per lot for high valued suburb. The 4.5 kVA or 7 kVA figure shall be applied only for calculating voltage drop in radial sections in accordance with Table 1, NP001.1 Design and Construction of Network Assets – General Requirements.
- Selected substation location shall not have any single circuit of 240sqmm low voltage cables to the first distribution pillar with maximum distance more than 250 metres.
- Only single circuit of 4 x 240sqmm low voltage cables are to be used for all voltage drop calculation within 4% maximum allowance.
- Double circuits of 8 x 240sqmm low voltage cables could only be considered for design approval on a case by case basis at Power and Water's discretion for the following cases:
    - Voltage drop at the farthest end load is slightly over 4%;
    - Voltage drop 4% compliance to meet specific load (commercial or multi-dwellings) of the property adjacent to the substation location.
- Case of UG Residential Subdivision in UG Reticulated Area:
    - In any package substation with 3 or more LV circuits being used, at least 3 LV circuits need to be linked with Open Point distribution pillars.
    - In any newly installed substation, at least 1 circuit must be linked to another distribution pillar from a different substation. The linked distribution pillar from a different substation can be a future substation in the next stage or an existing substation in previous stages.
    - On any spur LV circuit, there shall not be more than 20 lots being serviced.

- Where the linked distribution pillar from a different substation which is out of the current subdivision area, the consultant must consult with Power Networks for specific consideration to meet the LV link design requirement prior to commencing the detailed electrical design.

- Case of single package substation in OH Reticulated Area:
  - One LV circuit to be linked back to a suitable HV/LV pole or LV pole shall be required.
  - Where there is no available LV reticulation in the nearby OH networks, this requirement shall be reviewed by Power Networks for determination.
- Consecutive distribution pillars on the same side of a road shall be connected to the same low voltage circuit from a substation.
- The electrical consultant must indicate a proposed phase connection (Red, White or Blue) to each lot with single or multi-phase power service for load balancing purposes. This shall be indicated on both the single line diagram and subdivision cadastral layout.
- A 70sqmm copper earth conductor shall be installed direct buried with every low voltage cable route. Where the common trench having both high voltage and low voltage cables, a single 70sqmm copper earth conductor will be installed.
- Street Lighting Design Advice:
  - Street light point of supply is taken from 80A or 100A fuse on 160A base inside LV compartment of the installed package substation. This is the street light isolation point by Power and Water and Road Owner shall own, operate and maintain all electrical assets for street lighting after the isolation point.

  - Appropriate street light cable run from the installed package substation to a suitable location of a street light standalone box / distribution pillar.

  - Street light standalone box/distribution pillar details including street light control module (time switch or PE cells), incoming and outgoing LV circuit to each individual street light. No electricity meters are required inside the street light standalone box/distribution pillar and Power and Water's specific Distribution Pillar number can be used in the current transitional period.

  - Power and Water's current standard street light installations can be used if approved by Road Owner.

  - Approval for the use of PE cells or timer switch in new street lighting installations in Darwin, Palmerston or Katherine area is to be sought from the Road Owner.

  - The electrical consult must provide written approval by the appropriate Road Owner for any street lighting design drawing submission.

- All electrical works on existing assets and final connection shall be carried out by Power and Water. The contractor may carry out new electrical works or be authorised to work on isolated power assets where allowed. Isolated assets mean existing assets that are disconnected by Power and Water from all possible sources of electricity supply by means which will prevent unintentional energisation of the apparatus.

- The electrical consultant shall be responsible to assess the soil condition and specify appropriate earthing installations to achieve satisfactory Common Multiple Earth Neutral (CMEN) and local earth values for:
    - Package substation : 1 Ohm CMEN and 30 Ohms local earth;
    - Kiosk substation : 1 Ohm CMEN and 30 Ohms local earth;
    - Indoor substation : 1 Ohm CMEN and 30 Ohms local earth;
    - Ring Main Unit (Stand alone) : 30 Ohms local or combined earth;
    - Cable Termination pole : 30 Ohms local or combined earth.

9 Indoor Substation Designs

Establishment of an indoor substation is used instead of a typical package substation in:

- Highly valued Central Business District (CBD) areas; or
- Maximum demand of a proposed development is more than 1,000kVA; or
- Proposed shopping / commercial centre or specific establishment with high risk of public safety (school; recreation centre; etc.) or
- Requirement for multiple transformer installation for greater security of power supply; or
- Substation to be installed in above or below ground level in a building.

The electrical consultant shall have adequate indoor substation design experience and sufficient knowledge of utilising Power and Water's available indoor substation standard drawings, suitable high voltage and low voltage switchgear and appropriate power cables prior to preparing detailed design drawings for any development project that requires establishment of an indoor substation.

Indoor substation design drawing submission shall include:

- Locality plan and site plan layouts of indoor substation building on the property lot.
- Civil and structural details of indoor substation building.
- High voltage and low voltage switchgear layouts including lighting and general purpose power layout inside the indoor substation building.
- High voltage cable pit and conduit layout.
- Low voltage cable ladder and conduit layout.
- Earthing installation layout including all earth and neutral connection details for high voltage cables, individual transformer, high voltage switchgear, lighting and power switchboard, consumer's low voltage cables.
- Details of high voltage and low voltage switchgear installations.
- Details of high voltage and low voltage switchgear protection settings.
- Details of high voltage and low voltage cable installations from street supply area into the indoor substation location including customer's low voltage cables connecting to the load side of circuit breaker(s). The electrical consultant must check and verify on site the accuracy of the existing reticulation network prior to commencing the detailed design work. Where the electrical consultant wishes to enter or inspect authorised sites (nearby indoor substations or package substations or Ring Mains Units), contact Power and Water's Design Officer to arrange a suitable appointment.
- Existing and New High Voltage Schematic Diagrams (11kV or 22kV Supply Feeder).
- Low voltage and high voltage Single Line Diagram of the indoor substation including all relevant power cable lengths.
- Scope of Works by the Developer including construction of the indoor substation building, civil works, building certification approval, "As Constructed" handover documents, survey plans showing new electricity easement requirements for land title registration.
- Scope of Works by the Developer's electrical contractor.
- Scope of Works by Power and Water at the Developer's cost for final connection works and associated distribution network upgrade works if applicable.

9.1 Indoor Substation Building

- The location of the indoor substation building must satisfy specific compliance and obtain a written approval by the relevant authorities such as NT Fire and Rescure Services (NTFRS) for fire escape egress and evacuation corridor not along the substation building, Development Consent Authority (DCA) for Active Street Frontage and Provision for Services requirements.
- The indoor substation building shall be constructed to the relevant building code National Construction Code of Australia (NCC) and shall be certified by a registered building certifier prior to handover to Power and Water.
- No other services can pass through the indoor substation building footprint such as water, sewer, stormwater, telecommunications etc.
- The indoor substation building and the customer's Main Switch room can be free standing or form an integral part of the premises. The indoor substation building needs to be located next to the customer's Main Switch room as unmetered customer's low voltage cables will not be permitted exceeding fifteen (15) metres to minimise electricity losses incurred by Power and Water. In exceptional cases where unmetered customer's low voltage cables could not be installed within fifteen meters from the Point of Supply in the indoor substation, the electrical consultant shall prepare a detailed submission seeking Power and Water approval based on:
    - Selection of a suitable low voltage cable size to meet a maximum voltage drop of 0.5% on full load current;
    - Appropriate installation method of the selected low voltage cables to be suitably connected to a low voltage circuit breaker inside the indoor substation building.
- Unhindered 24hr all weather direct access to a proposed indoor substation location for heavy vehicles (up to 25 ton crane and 5 ton transformer in weights) and safe personnel entry/exit access for construction, operations and maintenance works in both normal and emergency situations shall be met to Power and Water's satisfaction. Access through areas that are considered dangerous/hazardous or cumbersome to Power and Water's operations and maintenance personnel is not acceptable.
- It is essential that the immediate area around the indoor substation building is level and the maximum allowable slope of the access road / driveway to the indoor substation building is 1:10. Access route to the indoor substation building shall be in a minimum width of 4 metres and 7 metres wide at the front area of the indoor substation and shall not be obstructed by parking vehicles, equipment storage place, site usage or any other impediments. If there is any plan to have a hangover above the indoor substation building, it must be at least 4 metres in height. Any access passage through a building from an indoor substation to such an area must be fire rated construction.
- The indoor substation building must not have any structural column or any other services to be installed inside.
- Entry & egress from the indoor substation via any secure areas of other buildings will not be accepted.
- Entry to the indoor substation from the street will be via doors or gates fitted with a standard 1-13 lock supplied by Power and Water.
- Cable pulling eyes and unistrut channel "cast ins" cable duct covers are required to be included in "T" pits in relevant Standards drawing.
- High voltage and low voltage cable route from the property boundary to the indoor substation shall be the shortest distance from the nearest public road with only one 90 degree bend permitted.
- The power cable route shall be direct and clear of other services.
- Where power cables are to be installed within basements or underground car parks, the cables shall be installed within the ceiling soffit for protection.

- Power cables installed with less than 3m height clearance shall be suitably protected in steel conduits or covered by an accessible top hat section of not less than 4mm in thickness.
- Where the electrical consultant chooses to utilize enclosed cable risers or such, clear access to the riser must be maintained at all times and storage of other items within the riser will not be permitted.
- All power cables installed on cable tray or unistrut channel shall be fastened with appropriate cable clamps approved by Power and Water.
- The indoor substation earth grid shall be installed into natural ground directly below the substation chamber floor or within the lowest basement directly below the substation and connected to the substation via 2 x 37mmdia galvanised pipes.
- Suitable steel connection boxes shall be installed for access and at all change of direction of the earth conduits to the indoor substation. Change of direction of the earth conduits shall be kept to the minimum.
- The lowest basement earth grid shall be clearly identifiable by signage installed into the floor above the earth grid.
- High voltage switchgear earth bar of 25mm x 6mm Cu is to be installed into the "T" pit with sufficient pre-drilled holes for each required switch. The earth bar shall be direct connected to the combined neutral /earth bar by a 70sqmm Cu conductor.

9.2 Indoor Substation Size

Based on AS-3000 maximum demand calculation figure and verified information on existing electricity networks in the area, the electrical consultant shall make appropriate assessments in deciding correct orientation and suitable size of the proposed indoor substation building satisfying the following:

- Installed single or multiple transformers with adequate capacity to satisfy the proposed development overall maximum demand figure and/or being capable of accommodating any planned future extension with minimal electricity supply interruption. A single transformer building must not exceed 1,000kVA in installed capacity and satisfy the agreed reliability level of power supply between the Customer and Power and Water.

- Where the indoor substation building is to have multiple transformers, the number of transformer selected must be the same size and capable of supplying the whole load in the event of loss of one transformer by the use of Power and Water's currently available mobile generator to meet N-1 reliability supply criteria requirement.

- Where the point of power supply is from multiple transformers, the customer's Main Switchboard must have suitable bus-tie(s) with the inclusion of a Castell or Kirk trapped key interlocking system. The trapped key interlocking system shall have a sequence of operations that are either trapped or released in a predetermined order so that a bus-tie can only be closed if one supply source fails.

- There are 3 different layout options for each one, two or three transformer indoor substation arrangement. Standards drawings only show indicative minimum dimensions for the indoor substation building only. Exact indoor substation building dimensions shall be correctly determined by the electrical consultant's specific design to ensure a safe minimum of 1000mm clear opening provided from any structure to high voltage and voltage switchgear and a minimum of 900mm between each power switchgear.

9.3 Indoor Substation Type

The electrical consultant shall consider the appropriate type of indoor substation to provide the required electricity point of supply and internal electrical installations in the early planning stage of the development with the Developer and their architect in order to meet both commercial objectives and relevant regulatory compliance.

Power and Water currently has standards on ground level and upper (first) level indoor substations for one, two or three transformer arrangement.

9.3. 1 Ground Level Indoor Substation

- Standard oil type transformer(s) shall be installed in ground level indoor substation.
- Indoor substation building shall be minimum height of 3 metres.
- Power and Water has various detailed options and standards drawings applicable to ground level indoor substation building for selection and construction.
- Provision must be made within the substation building to contain any oil spillage (in the event of a transformer tank failure). Spillage from transformers shall be designed to be contained within the substation building for 110% of oil volume as per the current Australian Standard 1940 – The Storage and Handling of Flamable and Combustiable Liquids.

9.3. 2 Upper Level Indoor Substation

- This is a preferred option for any commercial/residential development proposal that is expected to meet the Development Consent Authority's "active frontage" requirement to the Public Realm in the Central Business District (CBD) areas of Darwin, Palmerston and Alice Springs in the Northern Territory.
- Special dry type (containing no oil or other liquid) transformer(s) shall be installed in upper level indoor substation. Order for dry type transformer(s) could take up to ten (10) months for delivery compared to typically three (3) months in the case of oil type transformer.
- Indoor substation building shall be minimum height of 4 metres.
- The standard size of ordered dry type transformer is 1000kVA and it is significantly more expensive than standard oil type transformer.
- Appropriate transformer lifting beam and lifting hoist details where required shall be designed to Power and Water's satisfaction.
- Where any lifting equipment is required for the indoor substation, it shall be approved by Power and Water.
- For more technical details of first level indoor substation design compliance, refer Design Standards for Upper Level Substation Chambers published by the Strategic Asset Engineering Standards group.

Notes on Second or Higher Level Indoor Substation Proposals:

- There are no higher level indoor substation standards designs and the electrical consultant shall provide all appropriate technical details to be satisfactorily accepted by Power and Water.
- A separate high voltage switching station building shall be provided by the Developer within one floor of street access level.
- The high voltage rising mains and associated earthing, signalling, protection and control cables between the switching station and the upper level indoor substation are to be contained in an approved separate, locked, fire isolated riser shaft incorporating fire barriers between floors and with provision for access at each floor for the installation and subsequent maintenance of cables.

- Special arrangements for personnel access under normal and emergency conditions and specially designed, permanent lifting facilities are necessary and the Developer/Body Corporate is responsible for providing and maintaining such facilities and for the whole lifting operation involved in installing and removing heavy equipment.

9.3. 3 Basement Level Indoor Substation

There are no basement indoor substation standards designs by Power and Water. The electrical consultant must have prior proven experience in basement level indoor substation designs in similar climatic conditions in the Northern Territory and provide detailed technical solutions addressing the following design concerns to the satisfaction of Power and Water prior to considering this type of indoor substation proposal:

1. The proposed basement indoor substation building location shall be no lower than first basement floor.
2. Unhindered 24hr safe access including vehicle parking arrangement to operations staff in normal and emergency situations.
3. Unobstructed 24hr all weather access by heavy vehicle operations in normal and emergency situations to carry out routine / specific maintenance or repair, replacement work.
4. Simple and safe work approach on how to remove / reinstall a transformer / high voltage switchgear asset from inside the basement indoor substation building out to ground level ready for picking up by a suitable crane.
5. Appropriate ventilation method to dissipate heat releases by substation equipment under normal operating conditions to provide adequate natural air circulation between the basement substation building and open air.
6. Appropriate substation walls to be constructed to reduce humidity level and water condensation inside the basement indoor substation building.
7. Natural air ventilation method to prevent vehicle fume or smoke entering the basement indoor substation building where it is located in the same area for car parking spaces.
8. Appropriate fire alarm strategy and communication protocol to both Power and Water and Building Management Body Corporate in the event of fire or equipment explosion inside the basement substation building.
9. Appropriate risk assessment and preventative method employed in the event of flood water entering the basement indoor substation building.

10 Design Checking and Endorsement

The electrical consultant shall submit an appropriate design report, relevant A1 and A3 hard copies of design drawings and design compliance certificate(s) to Power and Water for checking and endorsement. They can be hand delivered to Manager Transmission and Distribution Design (Overhead) or Manager Distribution Development (Underground), Power and Water Corporation, Ben Hammond Complex, Illiffe Street, Stuart Park or posted to Power and Water Corporation, PO Box 41741 Winnellie NT 0821.

An overhead or underground Design Officer will be assigned to carry out the electrical compliance checking. Depending on a number of current design drawings received and other projects workload, the Design Officer should return the design drawings with specific comments back to the electrical consultant typically within 2 to 3 weeks. Power and Water shall make best possible effort to carry out design checking with comments returned no more than 4 weeks. The electrical consultant must adequately address all comments or issues raised in the marked-up drawings and re-submit copy of A1 and A3 amended drawings for endorsement. If the electrical consultant resubmits amended design drawings without adequately addressing the issue raised, Power and Water shall reject the submission.

Where the quality of the design submission of the electrical consultant is such as to require several marked-up times or various changes made in the design approach, Power and Water shall charge for the additional work at standard consultancy rates.

Endorsement in principle may be issued if requested by the electrical consultant or developer after Power and Water satisfies itself with the proposed design methodology, master plan, layout of reticulation with approximate sizes and details of staging of the development.

Where the developer is providing street lighting as part of a subdivision or a road owner is providing new or modified street lighting as part of roadwork, approval of a specific street lighting category and appropriate type street light installation requirements must be sought from the road owner. Endorsement by Power and Water of a street lighting drawing refers only to the suitable point of supply and compliance with Power and Water's Standards Manual if applicable.

All design drawings endorsed by Power and Water are valid for construction for 12 months from the date signed. Should this period be exceeded prior to commencement of the construction work or any significant changes made, the developer shall re-engage the electrical consultant to revise the design and re-submit drawings for endorsement in accordance with current standards.

Power and Water endorsement of design drawings becomes null and void if significant changes are made to the development. Changes such as reduction or addition of scope of works, building size or other load changes, number or zoning of lots, route variations, etc., require re-submission of the affected drawings. Similarly, at construction stage, if site conditions require a change in the design, the drawings must be immediately amended by the electrical consultant at the Developer's cost to reflect the change. Submission of design changes must be made in a timely manner to provide Power and Water staff sufficient time (at least one to two weeks) to consider and endorse the changes.

The design endorsement must not be construed as Power and Water accepting responsibility for the technical adequacy of the design. This responsibility rests solely with the developer's consulting engineer.

PowerWater

Network Engineering, Power Networks

APPENDIX A

CONSULTANT CREDENTIALS

COMPANY'S NAME: .....

DATE:..... REVISION DATE: .....

GENERAL INFORMATION

NAME OF COMPANY: .....

.....

A.C.N (Australian Company Number) .....

NAME(S) OF DIRECTORS .....

.....

.....

.....

COMPANY ADDRESS .....

.....

POSTAL ADDRESS .....

.....

CONTACTS .....(W)

.....(M)

.....(FAX)

.....(email)

.....(email)

.....(email)

QUALIFIED STAFF

NAME: .....

QUALIFICATION .....

DESIGN EXPERIENCE

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NAME: .....

QUALIFICATION .....

DESIGN EXPERIENCE

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NAME: .....

QUALIFICATION .....

DESIGN EXPERIENCE

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NAME: .....

QUALIFICATION .....

DESIGN EXPERIENCE

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COMPANY'S CAPABILITY PROFILE

TYPE OF DESIGN WORK	YES/NO
DISTRIBUTION OVERHEAD RETICULATION (UP TO 22kV)	
• High Voltage & Low Voltage OVERHEAD LINES (bare conductors)	.....
• Aerial Bundle Conductor (ABC) Low Voltage	.....
• Pole Distribution Substations	.....
• Rural Residential Subdivision Design	.....
• Industrial / Commercial Subdivision Design	.....
• Street Lighting Design	.....
DISTRIBUTION UNDERGROUND RETICULATION (UP TO 22kV)	
• Package / Kiosk Substations and Switchgear	.....
• Indoor Ground Level Substation Design	.....
• Indoor Upper Level Substation Design	.....
• Indoor Basement Level Substation Design	.....
• High Voltage Switching / Intake Station Design	.....
• Urban Residential Subdivision Design	.....
• Industrial / Commercial Subdivision Design	.....
• High Voltage / Low Voltage Extension Design	.....
• Street Lighting Design	.....
DESIGN OF TRANSMISSION LINES (66kV and ABOVE)	
• Overhead Line Design	.....
• Underground Cable Design	.....
CAD, Microstation DRAWING SERVICES	.....
OTHERS, PLEASE SPECIFY	

.....

Notes:

All stated claims by the electrical consultant in specific design experience must be able to submit its own actual design drawings to Power and Water for accreditation process assessment.

LIST OF FIVE DESIGN CONTRACTS (Most Relevant to Claimed Electrical Design Capability)

PERIOD	**PRINCIPAL'S NAME & DESCRIPTION OF DESIGN WORK**
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LIST OF FIVE DESIGN CONTRACTS (Most Relevant to Claimed Electrical Design Capability)

PERIOD **PRINCIPAL'S NAME & DESCRIPTION OF DESIGN WORK (cont.)**

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REFEREES/QUALIFICATION/ACCREDITATION

LIST/SUBMIT A COPY OF INFORMATION RELEVANT TO THIS APPLICATION, SUCH AS DESIGN ACCREDITATION WITH OTHER ELECTRICITY SUPPLY ORGANISATIONS / PRIVATE DEVELOPERS, DESIGN QUALIFICATION, EXPERIENCE ON CLAIMED CAPABILITY.

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REFEREE'S NAME: .....

POSITION/ORGANISATION: .....

CONTACT PHONE: .....

RELATED ELECTRICAL DESIGN WORK:

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REFEREE'S NAME: .....

POSITION/ORGANISATION: .....

CONTACT PHONE: .....

RELATED ELECTRICAL DESIGN WORK:

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REFEREE'S NAME: .....

POSITION/ORGANISATION: .....

CONTACT PHONE: .....

RELATED ELECTRICAL DESIGN WORK:

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CERTIFICATION

I CERTIFY ON BEHALF OF THE COMPANY THAT THE INFORMATION PROVIDED ABOVE IS TRUE AND CORRECT. I ACKNOWLEDGE THAT PROVISION OF INCORRECT INFORMATION WILL CAUSE IMMEDIATE CANCELLATION OF ACCREDITATION. I ALSO UNDERTAKE TO NOTIFY POWER AND WATER WITHIN 7 DAYS OF ANY CHANGE TO THE STATUS OF QUALIFIED STAFF.

SIGNATURE: .....

PRINT NAME: .....

POSITION: .....

DATE: .....

Power & Water OFFICE USE ONLY

COMMENTS

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Manager Network Engineering

Date:

FORWARD CORRESPONDENCE TO:

POWER AND WATER CORPORATION

PO BOX 37471

WINNELLIE NT 0821

OR Fax: 08 8924 5121

PowerWater

Network Engineering, Power Networks

Appendix B **CERTIFICATE OF ELECTRICAL DESIGN COMPLIANCE**

PROJECT TITLE: .....

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SUBURB: ..... CITY/TOWN/HUNDRED: .....

DRAWING TITLE	**DRAWING NUMBER**
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.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

I / We certify that:

- The design complies with Power and Water's standard design requirements;
- Voltage drop and pole strength complies – (where applicable - calculations attached);
- The accuracy of the existing network has been checked on site and the design verified;
- All existing services have been identified where practicable.

Signature: ..... Date: ..... / ..... / .....

Name of Designer: .....

Consulting Firm: .....

Contact Phone: .....Fax: .....

Note that, if incorrect information is provided with a design, and this results in Network Engineering having to make site visits or carry out excessive checking, the design consultant will be required to bear the cost. If there are any queries, please contact the Manager Distribution Development on (08) 8924 5729.