NP001.3
General Specification for Overhead Electrical Reticulation

This document is extracted from Network Policy NP 001, Design and Construction of Network Assets.

Other documents in this series include:

- NP001.1 Design and Construction of Network Assets – General Requirements
- NP001.2 General Specification for Underground 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
- NP001.8 Handover Documentation
- NP001.9 Electricity Supply to Large Customers
- NP001.10 Documentation Requirements

Further Information: For additional information or advice regarding this document, please contact the Manager Network Engineering on 08-89245191

General Specification for Overhead Electrical Reticulation

Power and Water's Standards Volume 1 sets out the standard arrangements for the installation of overhead lines and equipment. Refer also to Volume 2 for overhead/underground cable poles, Volume 3 (Street Lighting) and Volume 4 (ABC). Over time Power and Water may vary these arrangements, either permanently or on a trial basis.

Where a developer wishes to vary any standard arrangements, a formal application, setting out full details of the proposed variations, shall be submitted to the Manager Network Engineering, PO Box 37471, Winnellie, NT, 0821.

This document summarises, and should be read in conjunction with, the Electricity Supply Association of Australia publication C(b)1 "Guidelines for the Design and Maintenance of Overhead Distribution and Transmission Lines."

1 Scope

This document sets out the basic requirements for the design and installation of overhead distribution lines intended to be connected to Power and Water's network.

2 Safety

(a) Electrical Safety Manual and Work Health Regulations

New overhead lines that are separated from existing reticulation by a span are not treated as power lines in respect to Power and Water's *Electrical Safety Manual*.

However, it is a requirement that all construction work complies with the *Work Health (Occupational Health and Safety) Regulations*.

It should also be noted that, under the *Electrical Workers and Contractors Act*, the construction of overhead pole lines is classified as "electrical work", requiring compliance with the licensing provisions of that Act.

Where work is required to be carried out on overhead lines that have been, or can be, energised, then strict compliance with the *Electrical Safety Manual* and the *Regulations* will be enforced by Power and Water. In general, this requires compliance with the following:

Qualifications, Personal Clothing, Tools and Equipment

Description	Where required	Testing/Inspection
Safety Helmet	Working beneath line, within 600 mm live LV	Replace every 3 years, after any accident, or if damaged
Full length clothing	Working on pole with LV or HV circuits that may be energised	Replace when worn or torn
Safety boots	Working on pole with LV or HV circuits that may be energised	Replace when worn

Insulating gloves	Working on pole with live LV	Daily inspection and test for puncture. Replace when damaged.
Linesman's safety harness	Working on any pole	Daily inspection. Repair or replace as required.
Rescue kit, rescue line	Working on pole with live LV	Daily inspection. Repair or replace as required.
Ladders, ropes, pulleys, tool bags	Working on any pole, as required	Daily inspection. Repair or replace as required.
Qualified and licensed as overhead linesperson	Working on any pole carrying conductors capable of being energised	
Training in pole top rescue and resuscitation	Working on pole with LV or HV circuits that may be energised. One person on ground also to be trained.	Retraining at least every 12 months
Test lamps	Working on pole with LV	Daily inspection. Repair or replace as required.
LV earth sets	Working on pole with LV that is to be worked on dead	Daily inspection. Repair or replace as required.
Temporary Insulation	Working on pole with LV that may be energised	Daily inspection. Repair or replace as required.
First Aid Kit	Working on pole with LV or HV circuits that may be energised	Daily inspection. Replace as required.

Tools, equipment and clothing shall be to the relevant Australian Standard.
Ladders shall be insulating (either fibre reinforced timber or fibreglass).

(b) Elevating Work Platforms must comply with the following:

Standard	Requirement
AS 2550.10 - 2006	1. Selection of appropriate type (Clause 3.1) 2. Emergency retrieval system (Clause 3.3) 3. Safe siting (Clause 4) 4. Requirement for Operational Instructions, and general operational requirements (Clause 5) 5. Requirements for working in the vicinity of overhead power lines (Clause 5.8) 6. Fall arrest/restraint devices to be worn (Clause 5.15) 7. EWP to generally be maintained, inspected and repaired in accordance with AS 2550.1 and AS1418.10 (Int) 8. EWP to be routinely inspected and maintained (Clause 6.2) 9. Periodic inspections (not exceeding 12 months) to be carried out (Clause 6.4.4) 10. Major inspection to be carried out after 10 years and then every 5 years (Clause 6.4.5) 11. Working records, including log books, to be kept (Clause 6.6) 12. Fibreglass booms to be inspected, maintained as required (Clause 6.7) 13. Fibreglass baskets to be inspected, maintained as required (Clause 6.8) It is the responsibility of the owner and operator to completely familiarise themselves with this standard

AS 1418.10 – (Int) - 2004	The unit shall be designed in accordance with Clause 1.5, in particular: 1. Design stress of FRP components shall not exceed 0.16 of ultimate strength 2. The structural integrity of FRP components to be confirmed by non-destructive testing at least every 2 years, or after impact or accidental loads 3. The hydraulic system shall be designed to arrest movement in the event of failure of hydraulic lines – check valves are not sufficient 4. Means of lowering the basket must be provided in the event of loss of power 5. Access to the platform shall comply with AS/NZ 1657 6. Safety harness anchorage to be provided In addition: 7. Electrical insulation shall be routinely tested (Clause M4) 8. Operating instruction plates shall be fitted (Clause 1.15) It is the responsibility of the owner and operator to familiarise themselves with this standard

Care shall be taken at all times by the operator of any EWP to ensure that the rated load of the unit is not exceeded.

(c) Cranes

Similarly, slew crane/borers and cranes shall comply with AS 1418.1 and AS 2550.1. It is the responsibility of owners and operators of this equipment to familiarise themselves with these standards.

(d) Licences

Appropriate licences must be held by all personnel operating EWPs, cranes, loaders, hoists and similar plant.

(e) Climbing a Pole in an Existing Line

No pole shall be climbed from the ground until an assessment has been made of the risks involved. Such an assessment shall include:

- the condition of the pole at ground line. Where there is no visible concrete above ground it may be necessary to remove soil around the pole base to check for rust
- sum up the job, including the safest position for the ladder, likely safety equipment required, any hazards likely to be encountered and the measures required
- set up warning signs as required to warn drivers and pedestrians of work aloft
- set out the emergency rescue kit at the base of the pole
- inspect safety equipment, belt, and other equipment to be used
- safely extend the ladder to the required position and angle
- inspect footings and adjust if necessary
- secure the foot of the ladder with a lashing rope to the pole
- climb the pole to the required position and secure harness strap to pole
- pass the ladder rope around the pole and secure
- fit hand line as required
- fit platform if employed, hauling it up on the hand line
- check the angle of the platform on the pole and if necessary adjust the length of the chain
- keep below live low voltage mains until covers have been fitted, using two insulating gloves

(f) Working on a Pole in an Existing Line

Personnel must comply with the *Electrical Safety Manual* when working on a pole in an existing line. This strictly requires the implementation of Access procedures. Personnel required to receive Access Permits must be trained as *Recipients in Charge*. Network Policy NP022 discusses accreditation of contractors to carry out work on existing lines.

(g) Ropes and Slings

Ropes and slings shall be stored and handled with care. They shall be inspected on a daily basis. Wire rope slings used with cranes or hoists shall be inspected at least annually by a qualified inspector. Wire rope slings with broken strands shall be discarded.

Synthetic and natural fibre ropes and slings shall be replaced when they show signs of significant wear.

Knots used in ropes shall be only those recognised for use in the industry for the intended purpose. Under no circumstances are the rated loads of ropes or slings to be exceeded.

(h) Working Adjacent to or Over Roadways

Work over or close to roadways, particularly where requiring partial closure of the road, shall be carried out only with the approval of the Department of Infrastructure, Planning and Environment (Road Development Division) or local Council, as appropriate. Any conditions imposed by such body shall be complied with. Closure of main roads may also require the involvement of the Police Force. Work within road reserves shall, in lieu of specific instructions from the appropriate authority, be carried out in accordance with AS 1742, "Manual of Uniform Traffic Control Devices". Warning signs shall be to AS 1743, Road Signs.

(i) Stringing during Storms

No stringing work is to be carried out when there is an electrical storm within 10 km of the line being strung.

3 General

(a) Drawings

Drawings shall be provided for every overhead line project. The standards required are set out in the publication *NP 001.10 Documentation Requirements*.

(b) Phasing

Phasing shall generally follow Power and Water's standard phasing. Phasing must be determined at the time of design.

(c) Lines on Roadways

No line may be constructed on a road controlled by the Department of Infrastructure, Planning and Environment without the permission of the Department.

Poles on high-speed roads shall not be placed in locations that may cause hazard to motorists. Locations near intersections should be discussed with the authority concerned.

(d) Railways

Designers shall familiarise themselves with the route of existing and any proposed railway, and shall ensure that line crossings are constructed to the standard required by the railway authority. Refer to Network Policy NP 018.

(e) Other Services

New lines on existing roads may impact upon telephone, water, sewerage, cable TV, drainage and other systems. It is the responsibility of the designer to ensure that adequate consultation is carried out with the relevant authorities.

(f) Alignment

Pole lines shall be constructed at the standard alignments shown in the S2-4-1 series of drawings in Volume 2 of the Standards Manual.

When designing lines in rural residential subdivisions, no bare conductor shall be closer than 1500 mm to a property boundary. This will require siting of the line on the inside of the curve in curved roads, or use of offset construction.

(g) Low Voltage ABC

Power and Water uses 4 core 95 mm^2 ABC in certain circumstances. This is the preferred conductor for overhead residential areas because of the reduction in tree clearing afforded. Consequently, no new bare low voltage conductor will be accepted in urban residential suburbs. However, ABC is basically unsuitable for industrial subdivisions because of the small size and higher losses.

In rural subdivisions the limitation on span length significantly increases the number of poles required, so bare conductor is more economical and may be used.

(h) Bare Conductors

Power and Water uses the following types:

1. 3/2.75 steel (previously SC/GZ, but now SC/AC) to AS 1222.2
2. ACSR/GZ but moving to ACSR/AC to AS 3607
3. AAAC/1120 to AS 1531

Aluminium conductors shall be fully greased.

The conductor size is based on a number of factors, including voltage drop, fault rating and losses.

In urban areas, fault rating usually dictates the high voltage conductor size. Within 3 km of a zone substation in Darwin, the minimum size is 100 mm^2 aluminium. This may be up to 200 mm^2 immediately outside an 11 kV zone substation.

In rural areas, it is often possible to use small conductors such as 3/2.75 steel (SC/AC) or 3/4/2.50 ACSR. However, the high losses in these conductors restrict the economic load range that they can be used for. They should not be used in areas where significant future load growth is expected. They may also need protection by fusing if close to a present or future zone substation (because of fault level – refer HB C(b)1).

Consequently, designers must confirm the conductor size before proceeding with detailed design of any extension.

For low voltage lines, voltage drop is the main determinant of size.
Aerial conductors are subject to "aeolian" vibration, requiring the use of vibration protection at higher stringing tensions. The requirements for vibration protection are set out in HB C(b)1 and the Standards Manual.

(i) Stringing Tension

The designer shall calculate the ruling or basic span (known as the "Mean Equivalent Span" or "MES") on each run between strain points. Using the appropriate stringing chart, the MES shall be used to tabulate the sag in each span over a range of temperatures sufficient for construction purposes. Refer to S1-4-1-14.

The designer shall calculate tensions at the minimum temperature shown on the appropriate chart, and shall check that under maximum wind conditions the maximum tension in the conductor does not exceed 70% of its UTS.

(j) Uplift

The designer shall check for uplift at each intermediate span. No uplift is acceptable for any intermediate construction at the minimum temperature shown on the appropriate stringing chart.

(k) Mid-Span Separation

Power and Water uses the methodology set out in HB C(b)1 for calculation of mid-span separation. This factor limits the span length permitted for any type of construction.

Permissible span length for LV reticulation tends to be shorter than HV because of closer spacing of conductors. These span lengths are shown in Standards Bulletin S1-010.

However, the maximum span lengths shown in S1-010 may be exceeded if mid-span spacers are fitted to the line. See section (v) below.

(l) Joints in Overhead Conductors

There are two types of line splice acceptable to Power and Water, namely preformed and compression.

Preformed splices may be used on rural projects where at least 15% nominal Every Day Tension is used. Splices with a minimum strength of 80% of the conductor UTS shall be used. Compression splices shall be used in all other cases. Note that preformed splices do not perform satisfactorily at urban stringing tensions, as a minimum tension of 8% UTS is required to properly bed them in. Only one splice may be used per span, (refer 5(i)).

Taps off mains conductors may be made using approved forged parallel groove clamps; bimetallic PG clamps are required for copper-aluminium joints. Non-tension joints may also be made using compression fittings. Tap joints shall always be arranged so that the copper components are below aluminium – i.e., rain cannot run from copper parts to aluminium parts, as this causes accelerated

corrosion.

For conductors above 110 mm^2, a minimum of 2 PG clamps shall be used per connection.

Low current taps, such as for substation live line clamps, may be made using approved "bail" clamps or similar.

Connection of conductors into HV or LV switchgear shall employ bimetallic compression lugs or stalk lugs. Direct connection of aluminium conductors into "U-bolt" connectors may only be used for conductors smaller than 100 mm^2, and in accordance with the manufacturer's recommendations.

Acceptable types of clamps and lugs are listed in the Standards Manual. No other type will be accepted without prior approval of Power and Water.

(m) Ground Clearances

Lines shall be designed for the ground clearances shown in the S1-4-1 series of drawings, plus an allowance for survey error and stretch of 150 mm.

The maximum design temperature shall be 65^0C except as follows:

- main high voltage feeders shall be designed for 75^0C
- low voltage in industrial/commercial subdivisions shall be designed for 90^0C
- designated low voltage tie lines in residential subdivisions shall be designed for 90^0C.

When in doubt about what is a main feeder or tie line, Power and Water should be consulted.

(n) High Voltage Insulators

Due to on-going problems with birds and fruit bats, particularly the *Pteropus Alecto* or "Black" fruit bat, it is necessary to use insulators having a large overall length. An approved 500 mm post insulator is to be used for all 11 and 22 kV extensions.

Approved silicone insulators are to be used for terminations. These are much less prone to lightning damage than porcelain. A list of approved insulators is available from the Network Standards Officer; no new insulator may be used without prior approval.

(o) Crossarms

High voltage crossarms on new constructions shall be approved bolt-on fibreglass where shown in the Standards manual. When adding to or replacing crossarms on an existing pole, the construction shall be changed to bolt-on fibreglass.

(p) Poles

Poles shall be selected from the range shown in the Standards Manual. If a contractor wishes to employ any other type of pole, prior approval of Power and Water must be obtained. A detailed design drawing shall be submitted for each type of pole proposed. Power and Water may require structural checking by a qualified Engineer, and/or field testing, and, if approved, the pole may become a standard design.

All welding shall be carried out by qualified welders experienced in this type of fabrication. Generally welding shall comply with AS 1554.1. The surface of all welds shall be smooth and free of sharp contour changes. All burrs and sharp edges shall be removed.

A general specification for fabricated poles is included in the Standards Manual (S1-1 series). Power and Water may reject poles that are bent or twisted.

Steel may be either 250 or 350 grade to AS 3678 and 3679.

Note that Power and Water will not accept timber poles. Spun concrete poles may be used with the prior approval of Power and Water, and may be subject to conditions.

(q) Guys

Ground guys may be of the Power Installed Screw Anchor (PISA) or direct-buried types. In solid rock, drilled/grouted or similar methods may be employed with the approval of Power and Water. PISAs may only be installed by personnel with demonstrated competence in their installation.

Near zone substations Power and Water may require concrete-encasement of the guy rod to prevent electrolytic corrosion.

Pedestrian guards are to be used in urban situations, and in semi-urban rural areas. Refer to S1-2-1-9.

(r) Galvanising

All ferrous items other than poles shall be hot dip galvanised to AS/NZ 4680. Coating shall be not less than 600 g/m^2.

(s) Bolts

Bolts shall comply with AS/NZ 1559. All bolted connections shall use heavy duty galvanised spring washers.

(t) Overhead Earth Wire

In most locations within the NT soil resistivity is very high. Consequently, the "CMEN" system of earthing has been adopted.

This involves the connection of every pole to the low voltage neutral, or if there is no LV, to an earth wire carried with the line.

This takes advantage of the multiple earth connections provided by the poles in the line, and makes achievement of 1 ohm at substations possible.

Consequently, except as otherwise advised by Power and Water, an overhead earth wire (OHEW) shall be run with every high voltage line that does not have LV attached. Details of earthing are shown in the S1-2-3 series of drawings.

(u) Switchgear

Power and Water may require the installation of Air Break Switches (ABSs), Gas Break Switches (GBSs) links, sectionalisers, fuses or the like in any high voltage extension.

(v) Low Voltage Spacers

These shall be used on every bare low voltage line in rural areas, where the span length exceeds 60m. They shall be so installed that no unsupported span length exceeds 60m.

4 Strength Requirements

The 1991 edition of HB C(b)1 used as the basis of wind loading a wind pressure of 500 Pa on smooth round conductors. Other nominal wind pressures applied to structures. This differed from transmission line designs that typically used wind speeds and pressures derived from AS/NZ 1170.2.

The difference in philosophy related to the relative importance and risk exposure of the two types of line. Distribution lines are typically surrounded closely by trees and buildings, while transmission lines are usually more exposed. Transmission lines are also more important, and so are designed to survive cyclones.

The 1999 edition of HB C(b)1 (and subsequently the 2004 edition) introduced wind loading criteria based on probability criteria, and actual wind speeds. The effect of this is to significantly increase, in some cases, the wind forces that overhead lines must be designed for. AS/NZ 1170.2 is referred to in HB C(b)1 as the source for information on basic wind speeds and probability.

The Territory is an area classified in AS/NZ 1170.2 as subject to tropical cyclones. In Region C (within 50 km of the coast) the regional 1:100 year wind speed is 56 m/s. Region B (between 50 and 100 km from the coast) has a regional 1:100 wind speed of 48 m/s, while further inland Region A applies (41 m/s). Ultimate limit state winds speed is 73 m/s for Region C.

These Regions are further divided into Terrain and Height Categories. Terrain Category 1 relates to areas where there is no shielding from winds. Category 2 applies in rolling timbered countryside, while Category 3 is for built-up areas. Most distribution lines are erected in Category 3 areas, except for rural lines (Category 2).

HB C(b)1 discarded the concept of a nominal wind force + safety factor. Instead, it carries over the concept of "limit state" design from AS/NZ 1170.2. This says that, because the wind events are extremely rare, you do not need a conventional safety factor at all. Instead, a "material variability" factor is included. This means that, under the calculated wind loads, the total stresses imposed are not to exceed 90% of the nominal strength of the structure.

HB C(b)1 introduces a "basic" conductor wind pressure of 900 Pa, as the minimum to be used. This equates to the exact equivalent of the previous HB C(b)1, since 500 Pa with a safety factor of 2 (giving failure load at 1000 Pa) is equivalent to 900 Pa loading a structure to 90% of its failure load. The basic design wind pressures become 900 Pa on conductors and 2160 Pa on fabricated or USC poles.

Terrain Category 3 reduces wind forces to less than the "basic" value. Consequently, no change to the previous design basis is necessary except for Region C, Category 1 and 2 areas. The following basic wind pressures are to be used in these areas:

Region C Wind Forces

Description	Terrain Category 1	Terrain Category 2
Conductors	1560 Pa	1190 Pa

Steel Poles	3700 Pa	2850 Pa
Round Poles	2400 Pa	1800 Pa

Further, if the line is further than 25 km from the coast, (i.e., halfway between Regions C and B), then the wind pressure for Terrain Category 2 areas may be reduced to 900 Pa.

Note that with the above wind loads, stresses in structures are not to exceed 90% of stress corresponding to failure.

5 Construction

(a) Notification

Power and Water shall be notified at least 7 days in advance of the Contractor's intention to commence construction. At this time the contractor shall provide a schedule of the work, including expected times for pole erection, stringing, and earth installation.

The schedule shall list witness points for design completion (pole locations), foundation pouring, and earthing installation.

(b) Pole Foundations

Drawing S1-4-1-16 provides details of foundations for the range of poles in use.

As shown, it is not always necessary to use full-depth concrete as backfill. When using foundations other than full-depth concrete, earth used for backfill (between the bottom and surface layers of concrete) must be adequately rammed in layers not exceeding 200 mm, preferably using a hydraulic or pneumatic rammer.

Pole foundations shall be finished above ground, with the surface sloping away from the pole to prevent pooling of water. This requires careful finishing inside a fabricated pole. A foundation capable of pooling water will be rejected and shall be re-finished.

Poles shall be safely supported for at least 12 hours after pouring concrete, and lines shall not be strung until at least 48 hours after pouring. Pole holes shall be covered over or adequately fenced off when the site is unattended.

(c) Guys

PISAs shall be installed in accordance with the manufacturer's recommendations. This generally requires the achievement of a specified installing torque. A verifiable means of measuring the applied torque shall be employed. Where a pressure gauge on the auger motor is used for torque indication, this shall be calibrated to the satisfaction of Power and Water, and may be audited.

In soft ground, it may be necessary to use guy rod extensions to reach the required torque.

Direct-buried guys shall be prepared by cutting a slot for the guy rod at the specified angle. Note that failure to do this results over time in the guy rod pulling itself through the ground, leading to slackening of the conductors and loss of ground clearance. Concrete used to encase the bedplate shall contact only undisturbed soil, and shall be allowed to set for at least 48 hours before tensioning the line.

(d) Concrete

Generally concrete shall be 20 MPa and should be from an approved supplier.

Where concrete is not supplied mixed from an approved supplier, the following applies:

- Cement shall be Type GP Portland Cement, except in mangrove swamps, where Type SR Sulphate Resisting Cement shall be used
- Cement shall comply with AS/NZ 3972
- Aggregates shall comply with AS/NZ 2758. and AS/NZ 1141 – "Aggregates for Concrete (Excluding Lightweight Aggregates)"
- Cement shall be thoroughly dry and free of lumps, caking and watermarks
- Water shall generally be fit for human consumption
- Admixtures shall not be used without the prior approval of Power and Water
- Concrete shall have a slump of approximately 80 mm at time of placement
- Mixing shall use an efficient power driven batch mixer, and shall be used for a period of not less than 2 minutes after all materials and water have been placed in the mixer

Concrete shall be placed in the morning if daytime temperatures are likely to exceed 32^0C.

(e) Conductors

Care must be taken in handling conductors to ensure a reasonable service life.

Conductors shall not be allowed to contact salt water. Similarly, conductors shall not be dragged across hard or stony ground, or over obstacles such as fences.

(f) Paying out Conductors

The normal methods are:

- fixing the end of the conductor at the first pole, and with the conductor drum mounted on a truck or trailer, driving the vehicle along the line route, paying out the conductor as it goes. The conductor is immediately lifted onto rollers at each pole. On stony ground the conductor is to be kept under sufficient tension to prevent it from contacting the ground – this requires braking of the drum.
- pulling through a draw wire on the crossarm rollers, and then tension stringing the conductors.

On very soft/grassy or sandy ground with no rocks, it may be acceptable to pull the conductor out along the ground from a stationary drum. The onus is on the construction supervisor to demonstrate to Power and Water that this method will not damage the conductor.

Care must be taken to avoid kinks in the conductor. In the event that a kink develops, the conductor shall be cut and spliced.

Note that rollers must be used in every case for stringing bare conductors and ABC.

(g) Tensioning Conductors

Tensioning may be measured using direct observation, a dynamometer, or wave timing.

- Direct observation requires the use of sight boards mounted at each end of the span.
- A dynamometer may be placed in series with the conductor. This is difficult to achieve in practice, and is not popular.
- By striking the conductor at a support, and using a stop watch to record the time taken for the resulting wave to complete three complete return trips, the sag can be calculated from the formula:

$$S = t^2/29.3$$

Where t = the time for 3 complete return trips
and S = the sag in metres

For example, if the time recorded is 9.0 seconds, then $S = 9^2/29.3 = 2.76$ m.

Care shall be taken when tensioning conductors that the pole and crossarm are not twisted excessively.

(h) Allowance for Stretch

All conductors bed in and creep over their life. To avoid loss of minimum ground clearance, it is necessary to tension conductors to a higher tension than the nominal design tension.

On a stringing chart this is reflected in selecting a tension corresponding to a lower temperature. For example, on a day when the temperature is 30^0C, Drg S1-3-1-3 for Cherry conductor shows a nominal tension of 5.45 kN and 3.6 m sag for a 200 m span. The 20^0C curve for the same span shows a tension of 6.0 kN and a sag of 3.3 m.

If, instead of pulling the conductor up to 5.45 kN, you pull it up to 6.0 kN, you are "over-tensioning the conductor by 10^0C".

It is normal practice in the Northern Territory to make 10^0C allowance for stretch. However, Power and Water may specify in particular cases that additional measures be taken, such as pulling the conductors up as much as 40% over the nominal tension and holding that tension for a period of several hours. This practice eliminates stretch resulting from bedding in, so that only allowance for creep need be made.

(i) Jointing

Aluminium conductors shall be prepared by wire brushing and greasing in all cases. Wire brushes used for cleaning copper conductors shall not be used for cleaning aluminium.

Splices in conductors or earth wires shall not be closer than 8 m from an intermediate pole or 30 m from a termination. No more than one joint is permitted in any one span. No joints are permissible in railway crossing spans (refer Network Policy NP 018).

(j) Insulators

Care shall be taken with porcelain insulators to ensure that they are not chipped or damaged. All insulators shall be wiped clean prior to energising the line.

(k) Line Clearing

New lines shall be cleared to the specification shown in S1-4-1-4.

Where lines are being constructed on an existing road under the control of a Government Department or Council, approval from the relevant body must be obtained prior to carrying out the clearing. The site shall be cleared to the satisfaction of the road authority.

(l) Use of Explosives

Blasting of holes may only be carried out by licensed personnel, and only if approval of the relevant Council and/or road authority has been given.

Blasting shall be carried out in strict compliance with the *Dangerous Goods Act* and *Regulations*, and the *Work Health (Occupational Health and Safety) Regulations*. No blasting is permitted within 100 m of zone substations or power stations.

(m) Site Cleanup

Construction sites shall be left clean and tidy on completion of the work. This requires:

- removal of all surplus material
- removal or clean disposal of excavated earth, cleaning the ground around each pole and stay hole
- disposal of tree loppings to the satisfaction of the road authority
- repair drains, driveways, fences, etc., to the satisfaction of the owner

(n) Testing and Commissioning

All new lines must be phased out, and earthing tests conducted (with acceptable results), before they may be energised. The results of all tests shall be recorded on an approved schedule and forwarded to Power and Water prior to energising.

(o) "As Constructed" Drawings

Shall be provided within 14 days of completion of the line.

(p) Construction Program

The contractor is required to submit an Electrical Installation Program as per NP001.1 before commencement of construction. It shall be submitted to the Project Officer in Darwin (PO Box 37471 Winnellie 0821, Fax 89245121). For centres other than Darwin the Manager Distribution Development will determine the auditing process and notify Regional staff accordingly.