Network Standard

Document No.
NS 169

Title:
Telecommunications Installations on Ausgrid HV Transmission Towers

Approved Date	27/03/2024	Revision		1	
Lifecycle Stage	Plan; Design; Construct	Internal Use	☒	External Use	☒
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Revision

No	Date	Description	Technical Approver	Authorised By
0	28/09/2004	Initial Issue	Keith Newland	Craig Moody
1	27/03/2024	Total re-write of the standard to align with new format requirements for Network Standards. Roadworks section was written as a functional specification. Removal of Training section.	Duminda Thenuwara	Murray Chandler

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Scope

This Network Standard applies to the attachment of new, and modification to existing third-party telecommunications installations on Ausgrid high voltage steel transmission towers.

Third-party carriers are subject to a Facilities Access Agreement with Ausgrid.

Refer to NS288 Installation of telecommunications antenna on Ausgrid poles.

Reference Documents

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

Ausgrid Documents

NS001 Glossary of Terms

NS156 Working Near or Around Underground Cables

NS165 Safety Requirements for Non-Electrical Work in and around Live Substations

Other Standards and Documents

AS/NZS 1768 Lightning protection

AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS/NZS 3010 Electrical installations – Generating sets

AS/NZS 7000 Overhead line design

AS 60529 Degrees of protection provided by enclosures (IP Code)

AS/CA S009 Installation requirements for customer cabling (Wiring Rules)

IEEE Std 837 IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

Service and Installation Rules of NSW

Clause	Standard Requirements

1 Selecting a Suitable Tower

1.1 A HV tower shall only be selected if there are no suitable poles available in the vicinity.

1.2 Ausgrid reserves the right to refuse access to critical towers following assessment of supporting power line criticality at the time of application.

2 Structural and Civil

2.1 The Telco must, as a minimum, carry out all works regarding a telecommunications installation under this Standard as if it is a "low-impact facility" under the Telecommunications (*Low-impact Facilities*) Determination 2018.

2.2 Telcos must:

- Engage Ausgrid to undertake a climbing inspection and a detailed structural assessment of the HV towers and their foundations.
- If required, engage Ausgrid to strengthen HV towers and their foundation[1].
- Design the telecommunications installation and do all things necessary to obtain Ausgrid's approval to commence installation work in accordance with this Network Standard.
- Supply and install their proposed telecommunications installation[1] in accordance with this Standard.
- Maintain, upgrade or create access tracks to HV towers for construction purposes.
- Prevent any environmental damage resulting from the construction activities.

2.3 Information Provided by Telcos

2.3.1 Telcos must:

- Supply to Ausgrid in pdf form, details of the telecommunication installation to be installed on the HV tower including the following:
  - details of proposed antenna (weights, sizes, wind loading characteristics, etc)
  - antenna attachment hardware
  - telecommunications
  - signage (size, weight)
  - feeder cable details
  - specification of proposed telecommunications installation works, including a draft Work Method Statement
  - any other information necessary to complete the installation.
- Supply to Ausgrid in pdf form, details of the remainder of the telecommunications installation to be installed at the HV tower site including the following:
  - details of proposed equipment cabin (e.g. location and design of cabinet/hut)
  - installation details of antennae and feeder cables on HV tower
  - details of proposed electricity supply arrangements
  - proposed cable routes and installation details
  - drawings and drawing lists

[1] All work on HV towers and their foundations must be carried out by Ausgrid as the Telco's contractor.

- specification of proposed telecommunications installation works, including a draft Work Method Statement
- any other information necessary to complete the installation
- other documents such as reports on the community consultation process, etc as described elsewhere in this Standard.

2.4 Detailed Investigation

2.4.1 HV Tower Assessment

2.4.1.1 Prior to commencement of any detailed design, the Telco will engage Ausgrid to conduct a detailed assessment of the HV tower by climbing the tower and examining and reporting any change from the original design. This inspection shall include the following:

- Assess the condition of all members, including measurement of any loss of section and recording the extent of damage against each member (using the member numbering system from the tower construction drawings and the forms available for this purpose as part of routine maintenance work).
- Record any damage or distortion of members including damage due to mechanical impact.
- Record any nuts and bolts found to need replacement.
- Record any areas of rust and their extent or loss of galvanising/onset of surface rust (to determine the need for painting or remedial works).
- Record any apparent movement, subsidence or damage to the foundations.
- If the tower has grillage foundations, then a test shall be made of the condition of the foundation. This may involve some excavation and inspection of the steelwork below ground level (For new antenna installations only. Not required for modification of existing antennas).
- During the site investigations, measurements shall be made of the tower footing electrical resistance, and a diagram prepared of the electrode configuration for the tower. A copy of this diagram and associated values shall also be forwarded to Shared Asset Coordinator.

2.4.2 HV Tower Structural Review

2.4.2.1 Following the assessment, Ausgrid will conduct a detailed structural review of the HV tower and the surrounding environment, including the following:

- The number and size of conductors, their tension and the load exerted by them on the tower.
- The effects of wind (the wind loading criteria for the tower will be determined by Ausgrid Network Reliability requirements).
- The effects of other loads, e.g. antennas.
- Any changes to the HV tower identified in the HV Tower Assessment report.

2.4.2.2 If drawings of tower foundations are not available, or if the tower has a grillage type foundation, it will be necessary for Ausgrid to undertake more detailed investigations into the integrity and adequacy of the foundations.

2.4.2.3 If drawings sufficiently accurate and detailed to describe and carry out a structural analysis of the HV tower:

- exist, then the Ausgrid Structural Engineer will confirm that the HV tower was constructed as specified by the drawings, including what variations apply; or
- do not exist or are insufficient, then Ausgrid will carry out additional inspections to confirm details of the HV tower.

2.4.2.4 Ausgrid will advise the Telco as soon as practical regarding any (actual or likely) inadequacy or significant structural damage regarding the HV tower that may impact on the proposed telecommunications installation.

2.4.2.5 The rotations of the antenna support points will be reported for a serviceability wind speed of 28 m/s.

2.4.3 Structural Design

2.4.3.1 A structural design check will be completed by Ausgrid to determine the effect of the additional loads resulting from the installation of the telecommunications installation and associated equipment.

2.4.3.2 The engineering drawings of the equipment cabin, the actual antenna support frames and connections shall be certified by a certified engineer.

2.4.3.3 If the reliability of the existing HV tower is likely to be affected by the proposed installation, then strengthening must be installed. Strengthening must not interfere with or degrade either the performance of the HV tower, or the ability to undertake maintenance or other work on the HV tower, its conductors and other equipment. All strengthening work shall be carried out with the HV tower's conductors being "live". In special circumstances, a limited power outage may be possible.

2.4.3.4 Any strengthening of the tower structure shall be designed by Ausgrid.

2.4.3.5 In analysing the structural design Ausgrid may need to prepare and review information that includes, but is not limited to, the following:

- the Inspection report (updated and revised if required)
- design calculations regarding the HV tower with telecommunications installation installed
- drawings and drawing lists regarding HV tower strengthening and telecommunications installation works
- specification of proposed HV tower strengthening works, including a draft Work Method Statement
- an amended PLS Tower model including the antennas with their support structures and any strengthening of the tower that is required

2.4.3.6 The report shall include displacement calculations when the work is conducted as a low impact project under the Telecommunications (Low-impact Facilities) Determination 2018.

2.5 Structural and Civil Specification

2.5.1 Structural and Civil Works

2.5.1.1 The Telco is prohibited from carrying out any work on or to HV towers or their foundations, except for the minor exceptions specified in this Network Standard (Carrying out audits by telco or their contractors will be allowed provided they have adequate qualifications to do the task).

2.5.1.2 Work on or to HV towers or their foundations includes the following:

- Attaching cables, cable ladder, cable labels, antennas and any other materials related to the telecommunications installation supplied and delivered to site by the Telco.
- The strengthening, modification and maintenance of the HV tower arising out of the telecommunications installation.
- Any work within the "zone of influence" (see below for a definition) of a HV tower footing.
- Any ongoing maintenance and modification to equipment or the HV tower arising out of the telecommunications installation.
- Modification to HV tower steel work and foundations.

2.5.1.3 All workmanship and materials supplied by the Telco must be in accordance with current standards issued by Standards Australia International Limited and the by-laws and ordinances of relevant government authorities.

2.5.1.4 The power, telecommunications, earth and telecommunications feeder cable routes must be set out by the Telco in accordance with the requirements of this Network Standard.

2.5.1.5 All equipment and cabling, both above and below ground, must be clearly marked by the Telco with the following information:

- ownership (i.e., the Telco)
- type of equipment
- location marker where applicable (e.g., underground cable markers to follow the run of underground cables).

2.5.1.6 Prior to commencing any excavation work, each Telco must employ a professional underground service locater to verify the exact location of existing services through all proposed construction areas and underground routes. Excavation in the vicinity of any underground services must be in accordance with the requirements of the owner of the service.

2.5.1.7 The requirements of NS156 shall apply when excavating in close proximity to Ausgrid's underground cables and NS165 when excavating inside Ausgrid substations.

2.5.1.8 If fixing to an existing structure, the Telco must repair any damage to the protective coatings, in accordance with the coating Manufacturer's specifications.

2.5.1.9 Where proprietary hardware is specified in drawings or other documents, the use and installation of that hardware must be in accordance with the manufacturer's specifications, unless noted otherwise.

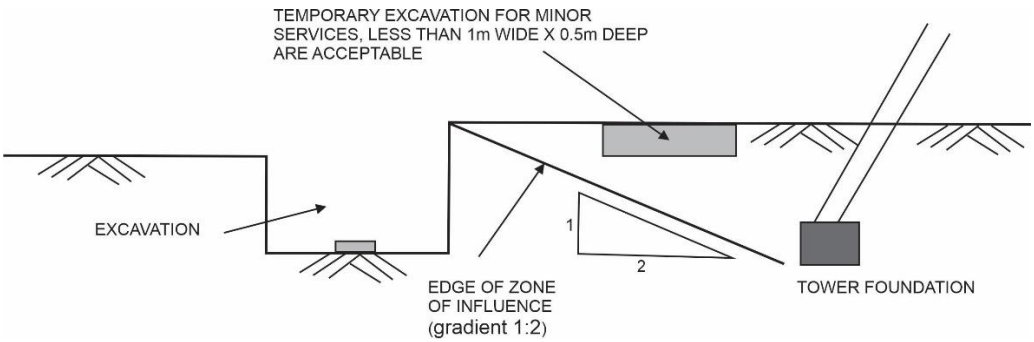

Figure 1: Zone of Influence

2.5.1.10 Excavations must not be performed adjacent to a footing, if the excavation is likely to encroach on the "zone of influence" of the footing, as shown in the above diagram.

2.5.1.11 Earthworks must not raise the level of the ground surrounding the tower legs or be constructed such that water collects around the tower legs.

2.5.1.12 The stability of the HV tower or any other Ausgrid asset must be maintained at all times during construction and maintenance operations by the Telco and its contractors. Temporary shoring or bracing must be used as necessary to keep the HV tower stable at all times, ensuring that no part of the HV tower becomes over stressed.

2.5.2 Design Constraints

2.5.2.1 Equipment mounted to HV towers must not protrude beyond the climbing corridor (which is typically 0.7 metres from the face of the tower but depends on the specific tower design and must be confirmed with Ausgrid on a case-by-case basis).

2.5.2.2 The telecommunications installation including its supporting steelwork must be designed and installed so that it does not restrict the climbing or rigging on an HV tower used for regular transmission line maintenance and construction procedures.

2.5.2.3 Holes must not be drilled in the HV tower metal work. No welding may be used on HV tower structural components except as detailed in Ausgrid's documentation.

2.5.2.4 Step bolts must not be removed as part of the works.

2.5.2.5 Cable clamps, if used on the HV tower climbing leg, are to be located just below the step bolts and on the inside of the HV tower leg.

2.5.2.6 Cable clamps (used to secure the telecommunications feeder cables to the support brackets) must be 316 grade stainless steel.

2.5.2.7 Signs erected on HV towers must be secured with epoxy glue or clamps (no drilling).

2.5.2.8 There shall be no more than two telecommunications installations permitted on each HV tower.

2.5.2.9 The Equipment Cabin must be constructed in accordance with the Building Code of Australia and the Australian Standards specified in this Network Standard.

2.5.3 Detailed Structural and Civil Design

2.5.3.1 The typical detailed structural and civil design work regarding the HV tower, including the design, fabrication, supply and delivery to site of additional galvanised steel members for HV tower strengthening (including all nuts, bolts, and washers),will be carried out by Ausgrid.

2.5.4 Roadworks

2.5.4.1 All roadworks shall meet the following functional specification:

- Allow for 100 tonne crane, 46m EWP, turning radius for both
- Provide 20 x 20 m Crane and/or EWP pad to facilitate installation works, with minimum 100kPa bearing capacity
- Provide all weather access to the site for 4WD light vehicle
- Allow for all temporary and permanent environmental controls as per Landcom blue book
- Comply with National Parks and/or environmental approvals for selected base and finish materials
- Not impede the flow of water, and have any water diversions or controls lined with a suitably durable material and or energy dissipater

2.5.4.2 Any roadworks undertaken by the Telco must be as follows:

- all topsoil and all other organic material removed
- exposed subgrade to be proof rolled to an in situ density not less than 98% standard dry density at optimum moisture content in accordance with AS1289
- sub-base material can be geogrids, geofabs or crushed sandstone material, free from stones larger than 75mm and any organic or other deleterious matter
- sub-base material must be placed in layers not exceeding 200 mm loose thickness and compacted uniformly to 95% modified maximum dry density compaction in accordance with AS1289
- base course must be 100mm crushed rock (DGB20), compacted to 100% modified maximum dry density in accordance with AS1289. The top surface of the base course must be trimmed and compacted to the cross falls shown on the drawing.

- provide surface and subsoil drainage to minimise erosion and to drain the track subgrade

2.5.4.3 Existing roads and tracks shall be made good on completion of the construction work, including disposal of all waste material in accordance with local council and EPA requirements.

2.5.5 WHS Signs

2.5.5.1 The Telco must supply Ausgrid with warning signs for Ausgrid to install on the HV Tower. The signs shall warn of the presence or hazards of proximity to radio frequency radiation, including information regarding the owner of the telecommunications installation. All signs must satisfy all relevant legislation, standards, and industry codes.

2.5.6 Prevention of Access to HV Towers

2.5.6.1 The Telco must ensure that the telecommunications installation, including the Equipment Cabin, cable ladders and other hardware must not facilitate unauthorised climbing onto the HV tower. The completed installation must comply with Energy Networks Association (ENA) Doc 015-2006.

2.5.6.2 In the design proposal, the Telco must explicitly indicate where it proposes to modify existing, or install new, anti-climbing devices on HV towers to ensure compliance with this section.

3 Electrical Installation

3.1 General

3.1.1 The erection of telecommunications installations on HV towers is an uncommon arrangement, not expressly covered under AS/NZS 3000, and accordingly is deemed an “Alternative Arrangement” under AS/NZS 3000 (Clause 1.9.4).

3.1.2 Telecommunications installations at HV towers must comply with:

- this Network Standard
- Clause 1.9.4 of AS/NZS 3000
- the relevant provisions of the Service and Installation Rules of NSW regarding the installation of the service main, consumers mains, metering and main switchboard (at the meter location).

3.1.3 Connection application must be made in accordance with Ausgrid’s connection application process.

3.1.4 All Telcos must comply with Clause 2.5.1 of this Network Standard, and accordingly are strictly prohibited from carrying out any work on or to HV towers or their foundations.

3.1.5 All Telcos must engage an ASP/Level 3 who must:

- Be accredited as a Chartered Member of Engineer's Australia (CPEng) or Registered Professional Engineer (RPEng) status or equivalent.
- Supervise, check and endorse all work carried out by the engineer’s partners, employees, contractors and agents.
- Supply signed certificates for the design and construction of the electrical works of the installation of the telecommunications equipment, affirming that each is fit and safe for its intended use, and with annual maintenance, or any other maintenance specified by the ASP/Level 3, is likely to remain fit and safe for its intended use for the next 15 years.

3.1.6 The ASP/Level 3 must design and verify as correct the electrical design of the Telco’s telecommunications installation before any on-site work commences, during installation (particularly regarding the installation of the underground submains and earthing system) and at the completion of all electrical works before “go-live”.

3.2 Scope of Electrical Installation Work by First Telco

3.2.1 As part of a telecommunications installation at a HV tower the First Telco must supply and install:

- Service mains from the agreed point of common coupling to the connection point as defined in the Service and Installation Rules of New South Wales. Note: Estimate the expected load of future installations to avoid any further upgrades.
- Consumer mains from the connection point to an approved main switchboard installed at least 20 metres from the HV tower. Note: The 20 m separation is necessary to prevent any earth potential rise (EPR) issues, associated with the HV tower, affecting the LV network MEN system at the main switchboard.
- Service Protection Device/s, Meters (as per meter providers requirements) and associated equipment in the main switchboard.
- An approved meter provider shall supply and install the meters.
- Equipment Cabin at the base of the HV tower
- Underground submains run from the main switchboard to an isolating transformer at the Equipment Cabin.
- An Isolation Panel mounted on the outside of the Equipment Cabin.
- Submains run from the isolating transformer to the Isolation Panel and from the Isolation Panel to the First Telco's distribution board located in the Equipment Cabin (mounting location subject to the First Telco's requirements).
- Final subcircuits run from the distribution board to the First Telco's telecommunications equipment and electrical installation.
- A manual transfer switch (in the Equipment Cabin / Isolation Panel), permitting electrical power to be sourced from either mains or generator supply (if the Telco chooses to have a generator backup option) to be in accordance with AS/NZS 3010.
- A complete earthing system for the Equipment Cabin, joined to the HV tower earthing system.

3.2.2 Subject to the First Telco's requirements, the telecommunications installation may include:

- Within the Equipment Cabin:
  - air-conditioning unit(s) and an air-conditioning control panel
  - security system components and a security control panel
  - a battery backup unit.
- A portable generator unit used to supply temporary power to the Telco's telecommunications installation, installed outside the Equipment Cabin.

3.3 Scope of Co-location with Other Telcos

3.3.1 If a second Telco wants to co-locate its telecommunications installation at an HV tower that already has the telecommunications installation of another Telco installed (or Ausgrid has granted written approval for another Telco to attach its installation), then the second Telco is responsible for the installation of all of its own equipment as discussed in Clause 3.2 with the exception that only one set of consumers mains and one metering panel is allowed at any site. Therefore, the second Telco must upgrade or replace the existing consumers mains and meter panel and enclosure so that there is one common meter housing for both of the Telcos' meters.

3.3.2 Telcos with a telecommunications installation at a particular HV tower, or written approval from Ausgrid for an installation at that HV tower, must liaise with Ausgrid to confirm and co-ordinate submains and equipment location for any telecommunications installations proposed by another Telco.

3.4 Installation of Consumer Mains by First Telco

3.4.1 Ausgrid will extend the existing low voltage supply to an agreed connection point located adjacent to[2] the property boundary. The connection point must be at least 20 metres from the HV tower and associated metalwork (including buried metalwork). From the connection point, the First Telco must install their consumer's mains to the meter panel. Refer below for details regarding meter panel installation.

3.4.2 Where it is likely that another Telco may choose to co-locate its equipment at the HV tower, it may be prudent for the First Telco to install consumers mains with sufficient capacity to supply both Telcos, to minimise future disruptions to supply.

3.5 Meter Panel for Single Telecommunications Installation

3.5.1 The First Telco must supply and install a new metering panel to suit the number of phases required by its telecommunications installation.

3.5.2 For an overhead low voltage network, the panel must be mounted within a pole mounted weather-proof enclosure located adjacent to the property boundary in accordance with Section 4 of the Service and Installation Rules of NSW complete with a padlock keyed to Ausgrid's requirements.

3.5.3 For an underground LV network area, the panel may be mounted on a steel pole in a weather-proof enclosure, or in a suitable weather-proof box mounted on the ground in accordance with Section 4 of the Service and Installation Rules of NSW. The First Telco must liaise with Ausgrid to determine a final mounting location. Service fuses, main switches and neutral links must be installed in the panel in accordance with the Service and Installation Rules of NSW.

3.5.4 Where Ausgrid knows that another Telco may choose to co-locate its equipment at the HV tower, Ausgrid will advise the First Telco to install a meter panel with sufficient space to also accommodate the other Telco's equipment, to minimise future disruptions to supply.

3.6 Meter Panel for Co-location with Another Telco

3.6.1 If a second Telco wants to co-locate its telecommunications installation at a HV tower that already has the telecommunications installation of another Telco installed (or Ausgrid has already granted written approval for another Telco to attach its installation), then the second Telco must upgrade or replace the existing meter panel so that there is a new grouped metering panel in accordance with Section 4 of the Service and Installation Rules of NSW for all of the Telcos' meters.

3.6.2 The panel must be mounted within a pole or ground mounted weather-proof enclosure located adjacent to the property boundary in accordance with the Service and Installation Rules of NSW, as nominated on accompanying drawings and must include two (2) padlocks one for each Telco keyed to Ausgrid requirements. The second Telco must liaise with Ausgrid to determine the final location and mounting method.

3.7 Submains from the Meter Panel

3.7.1 Each Telco must run an underground low voltage submain from the meter panel to the isolation transformer at its Equipment Cabin. The Telco must liaise with Ausgrid to confirm and co-ordinate submains installation arrangements. The Telco must notify Ausgrid of the rating of the LV supply required, which must be a three phase supply with no neutral conductor.

3.7.2 The cable shall have no metallic sheathing to provide an inadvertent earth return path.

3.7.3 Submains shall be installed outside the transmission line easement and only cross the transmission line easement perpendicular to the transmission line to enter the Equipment Cabin.

[2] If the connection point is in the verge of a roadway, then before any work commences the *First Telco* must obtain local council approval. If the connection point is on private property, then the lease or easement, etc covering the *telecommunications installation* must also cover the sub mains.

3.7.4 With the Equipment Cabin located inside the base of the HV tower, the final approach of the submains to the Equipment Cabin must be at right angles to the face of the HV tower and towards the centre-line of that tower. This arrangement is intended to avoid contact with any existing buried counterpoise earthing conductors possibly radiating out from the HV tower legs

3.7.5 Submains cables must be double insulated and installed underground in HD UPVC conduit for the entire length, glued at all joints to prevent the ingress of moisture. The insulation level achieved by this cable and conduit combination must be maintained from the meter panel to the terminals on the primary side of the isolation transformer in the Equipment Cabin.

3.8 Supply System Characteristics

3.8.1 The electrical supply system characteristics (at Ausgrid's distribution centre busbar) shall be as follows:

- 400/230 volts, three phase, four wire, 50 Hertz.
- Maximum prospective fault level 10kA in residential areas or 30kA in commercial/industrial areas unless noted otherwise on the drawings or as nominated by Ausgrid.

3.8.2 The MEN (Multiple Earthed Neutral) system of earthing must not apply beyond the meter panel to prevent earth potential rises associated with the HV tower being impressed on Ausgrid's LV network. However, the design and construction of the local earthing system for the telecommunications installation must be in accordance with the principles of a MEN system.

3.8.3 The earthing system for the secondary side (i.e., load side) of the isolating transformer (housed in the Equipment Cabin) must be segregated from the MEN system of the low voltage network. The earth connection of the telecommunications installation at the HV tower site must be connected in common to the star point of the isolating transformer secondary. The star point of the isolating transformer secondary must be connected to the earth mat for the telecommunications installation, and the base of the HV tower, as described below.

3.8.4 All equipment supplied and used in the telecommunication installation must be rated for a working voltage of 400/230 volts, 50 Hertz, AC.

3.9 Isolation Panel

3.9.1 Each Telco must supply and install an Isolation Panel that contains isolation switches such that when the switches are in the OFF position, all AC and DC power (including the generator supply if provided) to the Telco's transmitter equipment and the antenna installations on the HV tower is dead, and no antenna mounted on the HV tower can emit any form of output.

3.9.2 The Isolation Panel shall be as follows:

- Lockable, supplied with locks or padlocks keyed to Ausgrid's requirements.
- Vandal proof.
- Weatherproof (rated IP66 in accordance with AS 60529).
- Mounted on the outer wall of the Telco's Equipment Cabin.
- Complete with isolation switches and voltmeters to enable an operator standing at the face of the Isolation Panel to isolate all electrical conductors emanating from the Isolation Panel and confirm isolation with reference to voltmeters[3].
- Complete with a single line diagram showing incoming and outgoing circuits to the Isolation Panel and all equipment within it.
- Complies with the requirements specified in Figures 2 or 3.
- Prominent signage is to be installed on, or immediately adjacent to the isolation panel as shown below:

[3] Isolation and metering of the dc circuitry only (not ac) may be requested by *Telco*. This may be acceptable, provided dc only isolation guarantees that no antenna on the installation is active.

This panel isolates equipment associated with this cabin only.
Equipment supplied from separate cabins will require separate isolation.

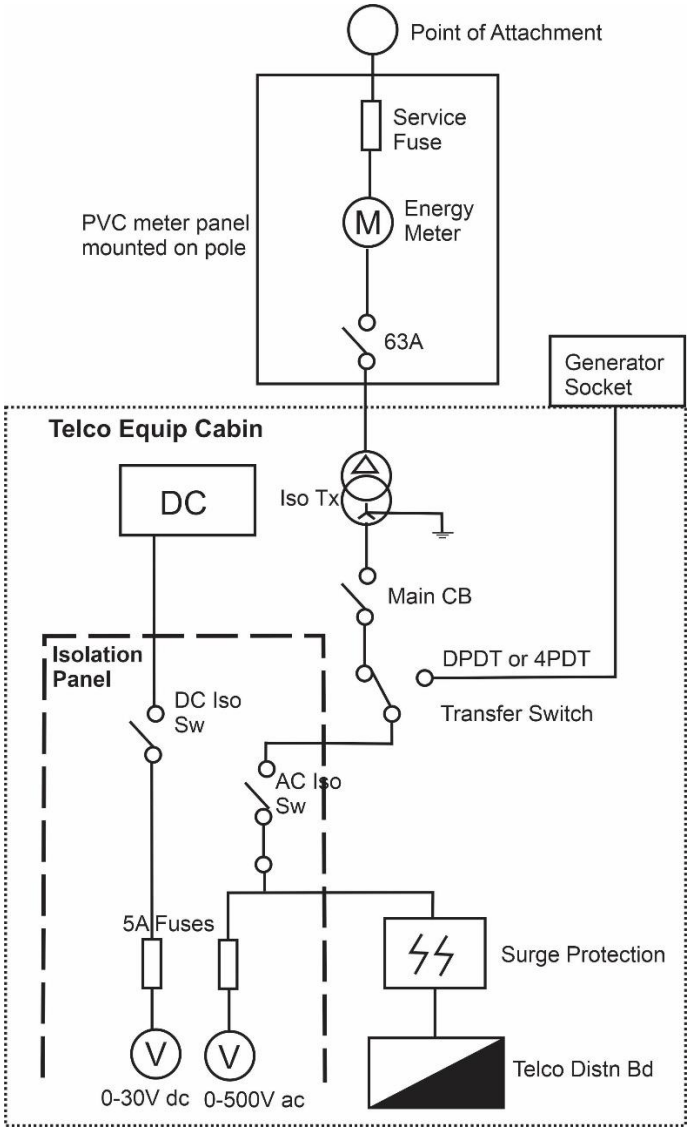

Figure 2: Single Line Diagram – Separate ac Isolation Switch

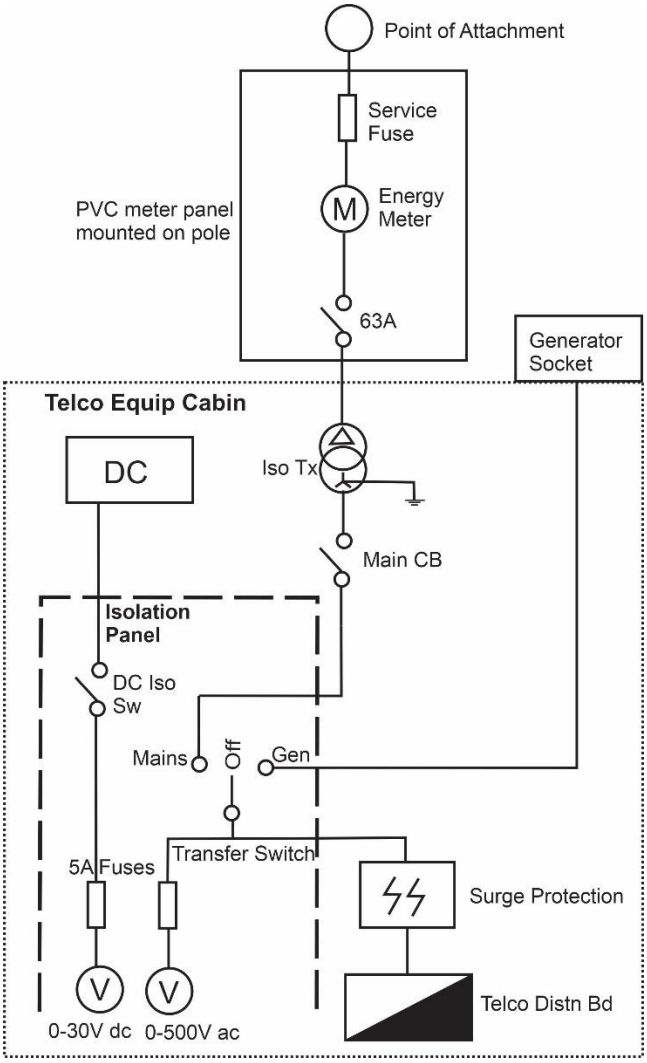

Figure 3: Single Line Diagram – Combined transfer/ac Isolation Switch

3.10 Generator Supply

3.10.1 If the Telco chooses to have a generator backup option, the Telco shall supply and install an appropriately rated 5 pin IP56 rated male power socket mounted on the outside of the Telco's Equipment Cabin so that the Telco's telecommunications installation may be powered from a portable generating unit when required.

3.10.2 Any mobile generator unit that the Telco uses must be installed in accordance with the relevant requirements of AS/NZS 3000, AS/NZS 3010, and Section 8 of the Service and Installation Rules of NSW.

3.10.3 The wiring from the above power socket must be terminated onto a two position (i.e., 'Mains' and 'Generator'), manual transfer switch. The transfer switch must:

- switch all phases and neutral, between mains and generator supply
- have its mains supply served from the main circuit breaker mounted in the Equipment Cabin, with the main circuit breaker served from the load side of the isolating transformer
- be installed inside the Equipment Cabin or in the Isolation Panel, except if it serves as the AC isolation switch, then it must be installed in the Isolation Panel and must be a three position switch with an OFF position as well as the Mains and Generator positions as shown in Figure 3.
- must be lockable, supplied with a padlock keyed to Ausgrid's requirements.

3.10.4 The electrical design of the installation must ensure that when both the AC and DC isolation switches are in the OFF position, all power (including the generator supply) to transmitter equipment and the antenna installations on the HV tower is dead, and no antenna mounted on the HV tower can emit any form of output.

3.10.5 Safety and operating signs must be erected near the male power socket on the outside of the Equipment Cabin warning of the presence of the isolating transformer and the possible touch potential hazards.

3.10.6 Safety hazards may arise due to the presence of a motor generator set close to the HV tower. The Telco must include protection of tower from fire damage in their risk assessment strategy.

3.11 Isolation Transformer

3.11.1 Each Telco must supply and install a low voltage isolation transformer with the following characteristics:

- For three phase supply: 400/400V-230V, load rating to suit, enclosed type power isolation transformer, delta - star connected complete with inter winding earthed screens.
- Power frequency withstand of no less than 28 kV for 60 seconds and lightning withstand of no less than 70kV for a standard 1.2/50 µS waveform between primary and secondary transformer windings, and between each winding and earth.
- Fully insulated active and neutral (where applicable) terminals on both the primary and secondary sides.
- Mounted in accordance with manufacturer's recommendations.
- All connections specified and configured to maintain required insulation levels.
- The isolation transformer's enclosure must be:
  - louvre ventilated indoor type with ingress protection rating of IP40
  - powder coat finished
  - bonded to the common earth system of the HV tower and Equipment Cabin (not Ausgrid LV network MEN system) (i.e., in common with the star point of the isolating transformer secondary).

3.12 Protection and Control of Low Voltage Installation – Main Circuit Breaker

3.12.1 Control and protection must be provided on the load side of the isolation transformer by the main circuit breaker, mounted in the Telco's Equipment Cabin.

3.13 Mains Supply Isolation

3.13.1 The Telco shall supply and install an 'AC isolation switch' within the 'Isolation Panel' enclosure on the Equipment Cabin external wall (refer to Clause 3.10). This 'AC isolation switch' shall be a suitably rated switch on the load side of the manual transfer switch, or the transfer switch itself (in which case, the manual transfer switch must have an OFF position - see Figures 2 and 3). A voltmeter shall be installed to confirm AC power isolation.

3.13.2 The electrical design of the installation must ensure that when both the AC and DC isolation switches are in the OFF position, all power (including the generator supply if provided) to transmitter equipment and the antenna installations on the HV tower is dead, and no antennae mounted on the HV tower can emit any form of output.

3.14 Battery Backup Supply Isolation

3.14.1 If the Telco includes a Battery Backup as part of its telecommunications installation, then the Battery Backup unit must be installed in the Telco's Equipment Cabin and include the following:

- DC isolation switch, within the Isolation Panel, that isolates all conductors run from the battery backup unit
- appropriate labelling adjacent to the DC isolation switch

- a voltmeter mounted on the Isolation Panel that must confirm DC power isolation as indicated in Figures 2 or 3 as appropriate
- suitably rated and insulated conductors, fuses, and other wiring to suit Figures 2 or 3 as appropriate.

3.14.2 Telcos must mount their equipment such that the DC isolation switch is adjacent to the AC isolation switch within the Isolation Panel, and ensure all equipment and wiring is suitably segregated.

3.14.3 The electrical design of the installation must ensure that when both the AC and DC isolation switches are in the OFF position, all power to transmitter equipment and the antenna installations on the HV tower is dead, and no antennas mounted on the HV tower can emit any form of output.

3.15 Distribution Board

3.15.1 An Equipment Cabin distribution board must be supplied and installed by each Telco.

3.16 Security System and Air Conditioning Control

3.16.1 The Telco may supply and install in its Equipment Cabin:

- air-conditioning panel (control, monitoring, etc), air conditioning units and associated control wiring
- security control panel and security control and monitoring system components and wiring.

3.17 Cable Ladders External to Equipment Cabin

3.17.1 All cable tray and ladder must be installed so that it is electrically continuous and bonded to the lightning protection earthing system, and provided with screw fixed proprietary covers.

3.17.2 The distance between fixings must not exceed the manufacturer's recommendations.

3.17.3 All fixings must be hot dip galvanised.

3.17.4 Fixings used for the attachment of cable tray/ladder to HV towers and building structures must be hot dip galvanised metal thread screws, bolts or another method approved by Ausgrid.

3.18 Testing and Commissioning

3.18.1 The Telco must ensure that the installation is compliant with all of Ausgrid's requirements and that test results and certificates are supplied to Ausgrid for approval prior to the submission of the Certificate of Compliance for Electrical Work (CCEW).

3.18.2 Test and inspection results that the Telco must supply include:

- visual inspection for compliance with isolation bonding and installation requirements
- insulation resistance (AS/NZS 3000)
- earthing system continuity
- HV tower potential rise, touch and step voltages at critical points of the installation (unless high impedance layer method is used). The Telco will employ a specialist company approved by Ausgrid to carry out these tests at the completion of the works.

3.18.3 Telco appointed ASP shall apply for electrical connection via Ausgrid website. Telco shall provide compliant test certificates.

3.18.4 The Telco must provide all necessary instruments and plant for carrying out all tests during and on completion of the works.

3.19 Underground Cable Markers

3.19.1 The Contractor must provide cable markers and orange electric marker tape to all underground cabling. Cable markers must be provided at each change of direction of underground cabling and at intervals not exceeding 25m on straight runs. Cable makers will consist of a prefabricated concrete pad with engraved stainless steel or brass plate.

3.20 Underground Services

3.20.1 Underground conduits must be laid on a clean, fine particles sand bed and covered with a minimum 100 mm thick layer of sand and covered by a heavy duty orange PVC cable protection strip, at least 200mm wide and 5mm thick and laid a minimum of 75mm above the conduit prior to backfilling with clean fill. Backfilled trenches must be compacted and original surface reinstated or made good to the approval of Ausgrid. The PVC cover strip may be replaced with a lighter plastic marker tape if the conduits are installed beneath concrete or asphalt paving.

3.21 Telecommunications Conduit

3.21.1 Connection to the external telephone network must be by means of a suitable insulated or isolating system approved by Ausgrid for each telecommunications installation, e.g., fibre optic cable. Where optical fibre is used, it should be at least 10 metres long.

3.21.2 If the telecommunications conduit and submains are installed in a common underground trench, then a minimum separation between conduits in accordance with AS/NZS 3000 and AS/CA S009:2020 must be maintained.

3.21.3 All such conduit installations must be suitable for future drawing through of fibre optic cabling.

4 Safety and Lightning Protection Earthing System

4.1 General

4.1.1 Each Telco must supply and install:

- a complete safety and lightning protection earthing system which is compliant with AS/NZS 7000 and AS/NZS 1768.
- all necessary upgrades and repairs of the existing lightning protection earthing system of the HV Tower as a result of a new telecommunications installation supplied by the Telco.

4.1.2 Safety and lightning protection earthing systems must be consistent with the following design principles:

- The Equipment Cabin must be installed within the base of the HV tower.
- Each Telco must undertake a risk analysis of each location proposed to erect new or additional telecommunications installations or antenna on HV towers. This analysis must consider the risk of electrical shock to:
  - any person in the vicinity of the HV tower's base
  - any person who uses electricity in the vicinity of the HV tower supplied from the same network distributor as the Telco telecommunications installation.

4.1.3 As a minimum, the risk assessment must consider:

- step and touch potential rises around the HV tower under fault conditions
- transferred potential hazards arising from the connection of power and telecommunications circuits related to the telecommunications installation
- and, for each of the above, take into account the effect of:
  - the prospective fault level at the HV tower
  - the footing resistance of the HV tower
  - the presence of overhead earth wires.

4.2 Equipment Cabin Electrical Bonding

4.2.1 For equipment cabins constructed from concrete/concrete block, the following minimum requirements for equipotential bonding, shielding and current dissipation shall be followed:

- Reinforcing bars and mesh in both the floor and roof slabs must be solid, bonded together by welding at each cross-over around the perimeter. Wire ties must be installed at each other cross-over.

- At least two starter bars and the associated vertical reinforcing rods in each of the block walls must be welded together and bonded (by welding or brazing) to both the roof and floor slab reinforcing mesh. Refer to Ausgrid's drawings 236804 sheet 1, 236805 sheets 1 and 2, 236806 sheets 1 and 2. Wire ties must be installed at each other cross-over.
- Two copper earth straps (25 x 3 mm or 70 mm^2 cable) must be brazed onto the floor reinforcing and brought up 200 mm above the finished floor level and adjacent to the walls inside the cabin for bolting to the cabin's "common earth bar". These straps must be insulated with PVC to prevent corrosion at the concrete/air interface. They will be located in accessible positions (near diagonal corners) and clear of equipment and racks set against the walls.

4.2.2 For equipment cabins constructed of materials other than concrete/concrete blocks (e.g., demountable or steel frame and cladding) all electrically conductive frame and cladding components of the cabin must be bonded together and connected to the cabin's "common earth bar" via two copper earth straps (25 x 3 mm or 70 mm^2 cable). These straps must originate in accessible positions, near diagonal corners of the building, and clear of equipment and racks set against the walls.

4.2.3 The following shall apply for all equipment cabin construction types:

- A copper earth bar (50 x 6 mm) must be installed on the wall inside the cabin, approximately 150 mm above floor level. This is the "common earth bar", mounted off the wall where necessary to permit the easy connection of earth tails run from adjacent equipment. The common earth bar may be set flush with the wall, where required, so that it does not interfere with wall-mounted equipment racks.
- Equipment in the cabin (other than telecommunications circuits) requiring an earth must:
  - be bonded to the common earth bar by a connection that is either crimped and bolted or brazed
  - use its own dedicated cable to connect to the earth bar, except for equipment in close proximity to each other, which may share a common bond to the common earth bar if interference is not expected
  - use earthing cables that are as short as possible.
- A separate earth bar must be provided for telecommunications equipment. This bar will be installed on insulating mountings and connected to the "common earth bar" at a single point.

4.3 External Earthing for Equipotential Bonding and Gradient Control

The safety and lightning protection earthing system is required to comply with AS/NZS 1768 and step and touch voltages as stated in AS/NZS 7000. The HV tower site is classified as a 'special location' by Ausgrid due to the likely frequency of access by utility staff, Telco staff and the public.

4.3.1 Equipotential Bonding

4.3.1.1 The HV tower leg carrying the coaxial cable earthing conductor and the diagonally opposite leg must be bonded to the "cabin/tower earth grid" by insulated 70 mm^2 stranded copper conductor.

4.3.1.2 Two earth bonding cables ("main" and "back-up") shall be installed to connect the "common earth bar" to the buried "cabin/tower earth grid". The cables shall consist of insulated 70 mm^2 stranded copper conductor. In the equipment cabin they shall be connected to the "common earth bar" near diagonally opposite corners of the building. The cables shall be installed in diverse routes and connected to the cabin/tower earth grid at diverse locations.

4.3.1.3 The main and back-up earth bonding cables connecting the "common earth bar" to the buried "cabin/tower earth grid" must be run in glued PVC conduit to prevent ingress of moisture.

4.3.1.4 All conduits must be buried at a minimum depth of 600 mm and covered by a heavy duty orange PVC cable protection strip, at least 200 mm wide and 5 mm thick and laid a minimum of 75 mm above the conduit. The PVC cover strip may be replaced with a lighter plastic marker tape if the conduits are installed beneath concrete or asphalt paving.

4.3.1.5 The ends of all conduits exposed to the weather or buried in the ground must be sealed with either polystyrene/plastic plugs or expanding foam fill to prevent the ingress of moisture.

4.3.1.6 PVC insulated 70 mm^2 stranded copper earth bonding conductors must be used for connections between the telecommunications feeder cable earth bars and the HV tower legs.

4.3.1.7 Terminations will be made with a tinned copper single hole crimp lug and secured with an M12 (minimum) stainless steel bolt and nut. No penetrations, welding or other intrusive action on the HV tower structure shall be performed. Where approval has been obtained to drill a hole through galvanised steelwork on the HV tower, the bare metal inside and around each hole must be coated with a zinc-rich paint (such as “Galmet”, or “Durazinc” epoxy), to replace the lost galvanising, before the insertion of a bolt. Care must be taken to ensure that excessive zinc-rich paint is not applied so that the electrical connection is not affected. The finished connections must also be painted with the zinc-rich paint over the lug, bolt and nut to prevent corrosion.

4.3.1.8 Any anti-climbing devices (including barbed wire) on the cabin roof must have two separate earth bonds to the equipment cabin frame or concrete reinforcing "cage". For cabins of concrete/concrete block construction the earth bonds shall be through mounting bolts for the anti-climbing device supports being welded to the roof reinforcing and cast in the concrete slab. Stainless steel M20 bolts will be used for protection against corrosion. For cabins of demountable or other construction types the earth bond shall be via two 70mm2 stranded copper conductors connected between the anti-climbing device and the conductive cabin frame near diagonally opposite corners of the building.

4.3.2 Voltage Gradient Control

4.3.2.1 If a substantial earthing system already exists around the base of the HV tower, it may not be necessary to establish an additional earth grid for the Equipment Cabin provided that the installation is compliant with the requirements of AS/NZS 7000 regarding safe prospective touch potentials, and if this applies the Telco may supply and install a connection from the "common earth bar" to the existing system.

4.3.2.2 However, if there is not an adequate existing earth system for the HV tower complying with AS/NZS 7000, other than that provided by the concrete encased footings, then the Telco must supply and install with the Equipment Cabin its own earth grid bonded to the HV tower steelwork. The new “cabin/tower earth grid” must be constructed of 25 x 3 mm copper strip and buried at 400 mm below finished ground level.

4.3.2.3 Copper earthing conductors must not be used if there is direct buried HV tower steelwork or galvanised steel earthing conductors unless a maintainable cathodic protection system is also installed to prevent corrosion of the steelwork. The Telco is responsible for ongoing maintenance of the cathodic protection system.

4.3.2.4 The “cabin/tower earth grid” must consist of two separate buried earth conductor strips. One strip must encircle the base of the HV tower including the generator pad and be laid 1 to 1.5 metres out from the HV tower legs unless approved otherwise by Ausgrid and noted on the drawings. The other strip must encircle the cabin and be laid 0.5 to 1 metre inside the HV tower legs. A vertical earthing electrode must be installed adjacent to each HV tower leg and bonded to the copper strips using an approved method to IEEE 837 Standard for Qualifying Permanent Connections Used in Substation Grounding[4]. These electrodes must be either:

- 15 mm diameter stainless steel rods; or
- 25 x 3 mm copper straps or 70 mm^2 stranded cables dropped in a continuous vertical length into a predrilled hole and filled with a non-corrosive bentonite slurry
- Counterpoise conductors with vertical earth electrodes if these are already installed as the HV tower earthing system.

4.3.2.5 The length of the earth electrodes must be determined from on-site soil resistivity tests and must provide a sufficiently low grid impedance for protection of the installation and must not be less than 2.4 m.

4.3.2.6 The connections between bonding conductors and the driven electrodes or the upper end of the strip-type electrodes must be easily accessible and enclosed in inspection pits. Within each pit the

[4] For example, “cad welding” or certain crimp connections (test reports required).

end of each bonding conductor must be formed into a loop (approximately 75 mm) to allow for the connection of equipment for testing of the electrode. If bonding to a driven electrode rod then suitable C-crimps or a U-bolt type clamp must be used to attach the flat strip to the round rod. If U-bolts are used, then the connection must be kept clear of the soil.

4.3.2.7 Earth conductor joints in the ground will be installed in covered pits where noted on the drawings to allow for the periodic inspection, testing and easy replacement of earth conductors if necessary.

4.3.3 Alternative to Voltage Gradient Control

4.3.3.1 As an alternative to the above voltage gradient control measures, the earthing system may be supplemented by a combination of equipotential bonding and high impedance layers. The following is an acceptable arrangement to comply with this option:

- Concrete equipotential layers (100 mm minimum thickness) – touch voltage
- High resistance asphalt layer (50 mm minimum compacted hot mix) – step voltage

This approach is to be undertaken for a radial distance of 1.5 metres around:

- HV tower legs
- any equipment cabins
- portable generator pads.

4.3.3.2 The Telco must be responsible for maintaining all voltage control measures in good condition.

4.3.4 Telecommunication Equipment Earthing

4.3.4.1 A coaxial cable earth bar must be installed below the gland plate on the Equipment Cabin external wall. The telecommunications cable gland plate (if metal) will also be bonded to this earth bar. This earth bar must have its own separate PVC insulated (70 mm^2) copper earth bonding cable connected directly to the "cabin/tower earth grid" and mechanically, protected by galvanised steel conduit fixed to the Equipment Cabin wall. Below ground it will be protected against long-term corrosion by glued PVC conduit. The connection onto the earth grid will be either “cad-welded” or an approved crimp that is accessible in an inspection pit.

4.3.4.2 On the HV tower another coaxial cable (tinned copper) earth bar will be positioned near the top of the conduit bends where the conduits swing away from the leg towards the cabin in order to keep the earth tails as short as possible. The conduits will be bonded to the earth bar. This bar is to be fixed to the HV tower leg and must have a separate 70 mm^2 insulated copper earthing cable connected directly to the earthing point at the bottom of the HV tower leg. This cable will be installed in galvanised steel conduit mounted on the HV tower steelwork to minimise risk of damage due to impact.

4.3.4.3 The isolation transformer enclosure must be bonded to the earthing system of the distribution board.

4.3.4.4 The earthing system design (relevant to the scope of the Telco’s work under this Network Standard) must be provided to Ausgrid, and Ausgrid may require the Telco to confirm the touch and step voltage levels by a test method approved by Ausgrid at the completion of construction. Any testing must be at the Telco’s expense.