Prepared for
Powerlink Queensland
ABN: 82 078 849 233

AECOM

Appendix B

Detailed Project Description

June-2022

Genex Kidston Connection Project - Preliminary Documentation (2021/9060)

1.0 Transmission Line

1.1 Physical details of the transmission line

1.1.1 Structures and requirements

Aerial structures

Support structures are used to keep the high voltage conductors separate from each other, and clear of the ground and other obstacles. Requirements for minimum clearance between energised conductors and various types of obstacles are specified in the Electricity Safety Regulation 2013, which is part of the *Electrical Safety Act 2002*. The distance or span between structures and their height is determined by the topography, average temperatures, sensitive environmental areas, clearance requirements and structure loading limits.

Structures are fabricated in a range of heights to allow optimum height to be provided at each site. Typically, shorter structures are found on elevated areas such as hills, with taller structures in gullies, or where additional clearance is required over a mid–span obstacle such as a road.

Various designs of conventional self-supporting towers have been used in Queensland for over 50 years and are the standard form of support structure for high voltage construction observed throughout the state.

For self-supporting towers, individual components are fabricated from galvanised steel angle sections (members) and steel plate and are assembled onsite. Individual foundations support the four legs of the tower. Treatments can be applied to the galvanised surfaces of the towers and poles to reduce visual impact where necessary. For self-supporting poles, individual components are fabricated from galvanised steel plate and bolted or sleeved together onsite. A large single foundation supports the pole.

Structure duties

There are two specific duties of structures - suspension and tension.

Suspension structures

Suspension structures are used where the transmission line follows a straight line or has a very small deviation angle (up to 2 degrees). They are designed to carry the weight (vertical load) of the conductors and transverse (horizontal) load from wind on the conductors.

An outline of a typical self-supported double circuit suspension tower is shown in Figure 1-1. Features of the suspension structures are relatively light construction, with cross–arms on each side of the upper part of the structure (superstructure) and insulator strings supporting the conductors.

Tension structures

Tension structures, are characterised by a ‘heavier’ appearance due to the larger steel section sizes and conductors ‘terminated’ onto the cross–arms using insulators in a near horizontal orientation. Tension structures are designed to carry the weight (vertical load) of the conductors, and transverse (horizontal) load from wind on the conductors and conductor and earth wire tension loads. These structures are required at all changes in direction of the line greater than two degrees or where termination sites have been predetermined to facilitate line construction and operation. These structures are designed to withstand high longitudinal loading on the structure, which cannot be accommodated by the lighter suspension structures.

Tension structures are also used in conductor ‘uplift’ positions. Conductor uplift is a term used to describe the loading condition where in the absence of sufficient vertical loading the suspension insulator string will swing unacceptably close to the body of the tower under certain loading conditions, thus reducing electrical clearance. This situation can occur on a structure located at the base of a hill or steep terrain and is resolved by using a tension structure with its different insulation configuration even though the loading conditions would not normally require one at this location. Another use is for terminations at the end of the line.

A suite of structures may be designed for a particular project to cover a range of angle duties. For example, an intermediate type may be designed for angles up to 40 degrees and a 'heavy duty' type provided for angles up to 90 degrees and termination positions. An outline of a typical self-supporting double circuit tension tower is shown in Figure 1-1 and Figure 1-2.

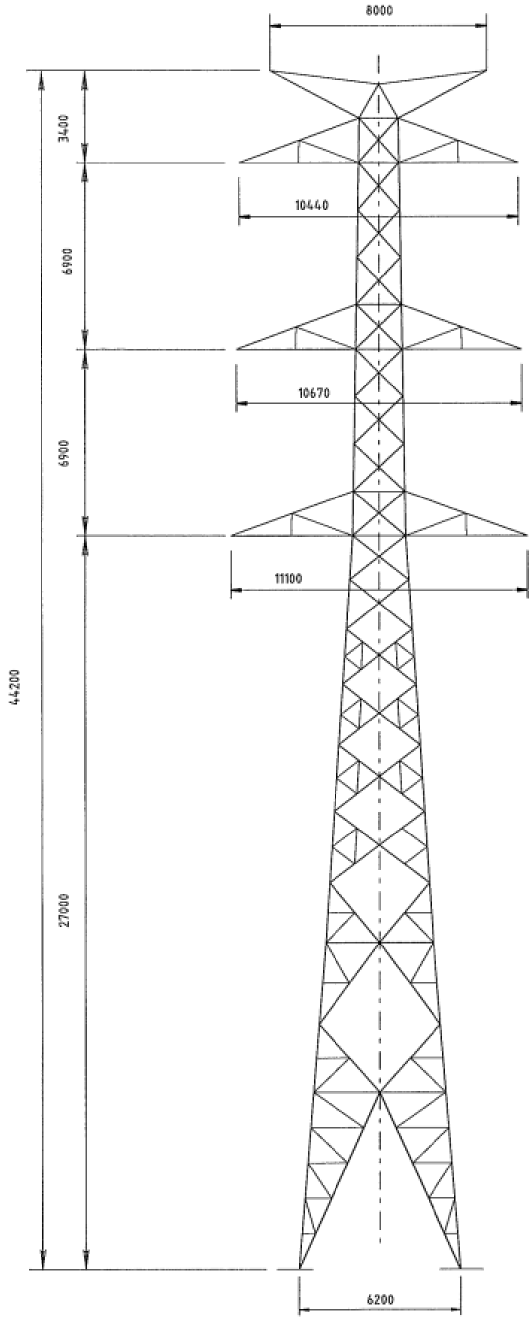


Figure 1-1 Outline of a typical suspension structure

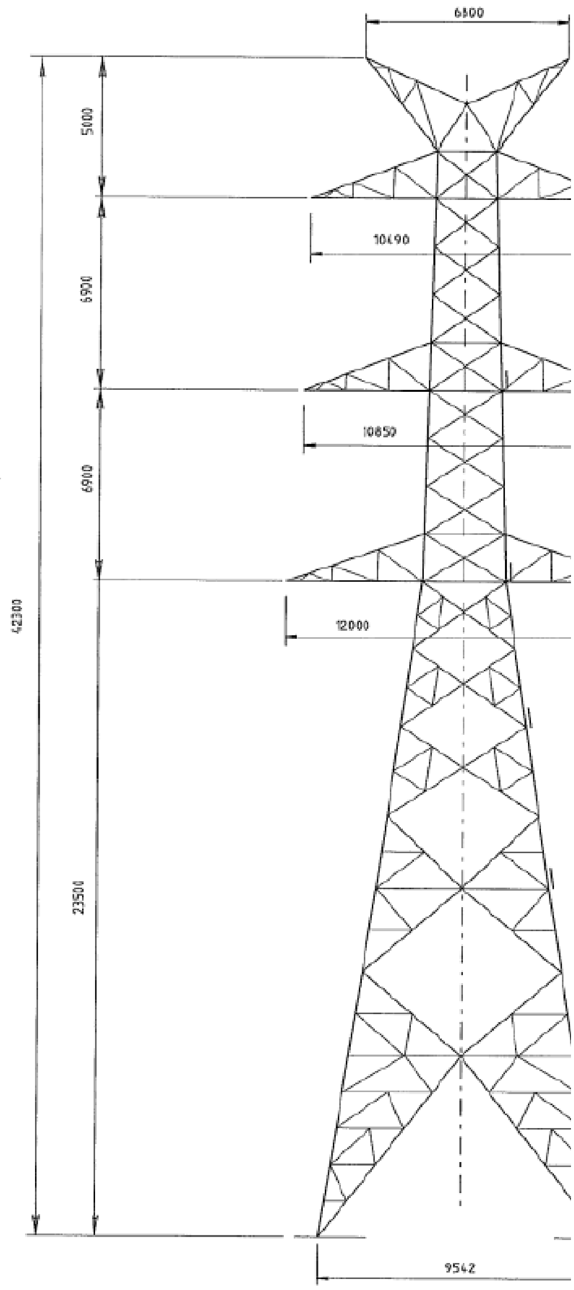


Figure 1-2 Outline of a typical 275 kV tension tower

Conductors, earth wires, insulators and fittings

Conductors

For single circuit configuration, each structure will support six individual conductors, configured as three twin conductors per phase and two smaller diameter earth wires with fibre optic cables within.

Earth wires

Overhead earth wires provide protection to the conductors from direct lightning strikes to safely dissipate earth fault currents and are also used as a support for optical fibre cables for communication purposes.

Insulators and fittings

Insulators are used to provide a mechanical connection between conductors and structures and to provide electrical insulation between the high voltage electricity and the (earthed) structure. The length of insulators in a string is determined by line voltage, clearance requirements and environmental (e.g. pollution) considerations. For this Project, insulators will be discs made of glass.

Special galvanised steel or aluminium fittings connect both the line end of the insulator to the conductors and the tower end to the structure. A typical insulator string is shown in Figure 1-3.

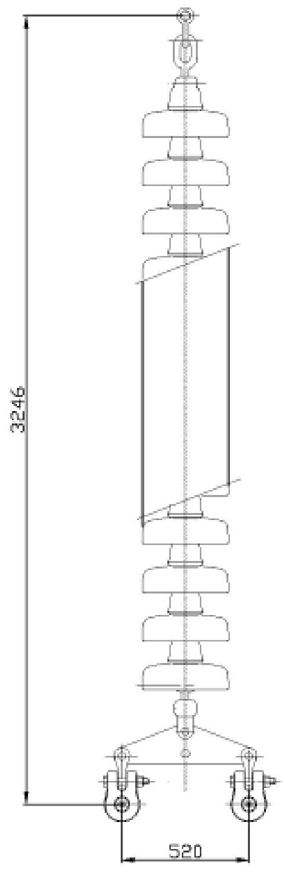


Figure 1-3 Typical insulator string

Telecommunications

Telecommunications infrastructure will include dual communication paths via 48 core Optical Ground Wire (OPGW).

1.2 Easement and access

1.2.1 Easement

For the vast majority of cases, Powerlink Queensland transmission lines are constructed on easements. An easement is a registered interest in a parcel of land providing Powerlink Queensland with a right of way allowing the transmission line to be built, operated and maintained on part of a property with ownership of the land remaining with the landholder. Restrictions are placed on activities permitted on an easement to maintain public safety and ensure the line can operate reliably. Compensation is paid to directly affected landholders in accordance with the heads of compensation in the *Acquisition of Land Act 1967.*

Easement width is determined by the size and type of line, and the need to maintain safe electrical clearance between the high voltage conductors and any object or structure adjacent to the line under all conditions. This includes safe electrical clearance to vegetation in and adjacent to the easement.

For a 275kV transmission line, a 60 m wide easement will be acquired.

1.2.2 Access tracks

Heavy vehicle access to the transmission line is required during construction and for ongoing operation and maintenance. In steeper terrain or where creeks or gullies intersect the easement, tracks may need to detour off the easement. Where access is generally available from adjacent public roads, limited access track construction to the structure site is normally all that is required for both construction and maintenance activities. In all cases, maximum use is made of existing public and privately owned roads and tracks.

Where the proposed transmission line is co-located with the existing Ergon 66 kV and 132 kV lines, existing Ergon access tracks will be upgraded where necessary to facilitate construction and maintenance activities. The location of access tracks on each property will be confirmed closer to the construction phase in consultation with each landholder.

1.3 Construction

Construction of a transmission line involves a series of field activities which are broadly grouped as follows:

- site set out
- flora and fauna surveys
- mobilisation
- installation of gates, grids, cleandown bays and access tracks
- vegetation clearing
- tower site benching
- foundation installation
- structure assembly and erection
- conductor and earth wire stringing
- site rehabilitation
- demobilisation.

1.3.1 Site set out

Following cadastral survey of the transmission line easement, the location of the transmission line within the easement is then set out. Structure sites are marked and orientated using design information. Structure locations are based on the technical characteristics of the structures and conductors, topographical constraints, landholder requirements and environmental considerations.

Approved clearing areas will be identified and marked prior to vegetation clearing.

1.3.2 Flora and fauna surveys

A pre-construction weed survey will be undertaken prior to construction activities commencing and a post-construction weed survey will be undertaken after the first wet season once construction is finalised. The surveys will occur along the easement and access tracks and will identify weeds of national significance, restricted and invasive matters and regionally declared weed species.

Pre-clearance habitat surveys will be undertaken immediately prior to clearing to identify any active breeding places and where possible relocate fauna to an undisturbed location.

1.3.3 Vegetation clearing

The amount of vegetation clearing required is dependent on terrain, vegetation type and significance, and landholder requirements (where feasible). The aim is to clear vegetation sufficient to meet Powerlink Queensland’s safety, reliability and operational requirements for the transmission line.

In non–sensitive areas, the most effective and efficient clearing method for large scale clearing is by bulldozer, often fitted with a ‘stick rake’ or ‘tree spear’ to push over larger trees or use of a mega-mulcher. Timber of commercial value may be recovered just prior to clearing. Depending on land use, landholder requirements, environmental constraints and maintenance requirements, cleared vegetation may be dealt with in the following ways:

- chipped or mulched on site and used for easement revegetation
- stacked and windrowed - any stacked and windrowed vegetation must be placed in a manner which does not concentrate overland flow or create erosion
- stacked and burnt - any burning of cleared vegetation may only occur in accordance with a permit from the Fire Brigade and so as not to create any additional hazard to the surrounding environment or transmission line.

In sensitive areas, such as steep or erosion prone terrain, near watercourses or other environmentally sensitive areas, alternative methods of clearing such as hand clearing (chainsaw) or the use of a fella-buncher (or excavator with cutting attachment) may be appropriate. These techniques are more labour intensive and time consuming than other mechanical means but achieve the desired clearing outcome.

In steep terrain or environmentally sensitive areas, trees may be cut above ground level, felled along the contour and allowed to decompose naturally or mulched. In areas where hand clearing is required stump heights will be discussed and agreed with the landholder.

Chemical treatment may also be used for selective treatment of incompatible vegetation while minimising ground disturbance. The method may be through stump injection, cut stump or overall spray technique and is mostly suitable for regrowth vegetation.

Clearing for the Project is carried out in accordance with the requirements specified in the Environmental Management Plans. The proposed clearing for the transmission line varies across the easement as a result of an extensive impact minimisation process undertaken for the Project. The following clearing areas are used within the easement:

- Full Width Clearing – where vegetation is required to be removed across the easement corridor (60 metres wide)
- Draw Wire Path Clearing – where vegetation is required to be removed in the centre of the corridor (21 metres wide)
- Tower pad sites – require a 30 x 30 metre pad to be cleared.

1.3.4 Foundation installation

Geotechnical assessments are undertaken prior to construction to determine the appropriate foundation type for each structure. Bored foundations are often used, and are shown on Figure 3-6. Alternative foundation types (i.e. mass concrete, micro-piles, mini-piles) are used in situations where ground conditions are not suitable for bored foundations.

The choice of foundation type is dependent on the specific nature of the soil and rock and takes into account soil/concrete friction strength, flooding water levels, soil bearing capacity, construction constraints, rock levels, and soil properties.

Construction of tower foundations usually consists of the following steps:

- setting out
- excavation/boring
- leg stub/base set up
- placement of reinforcing steel/concreting
- concreting of excavated foundations
- installation of earthing.

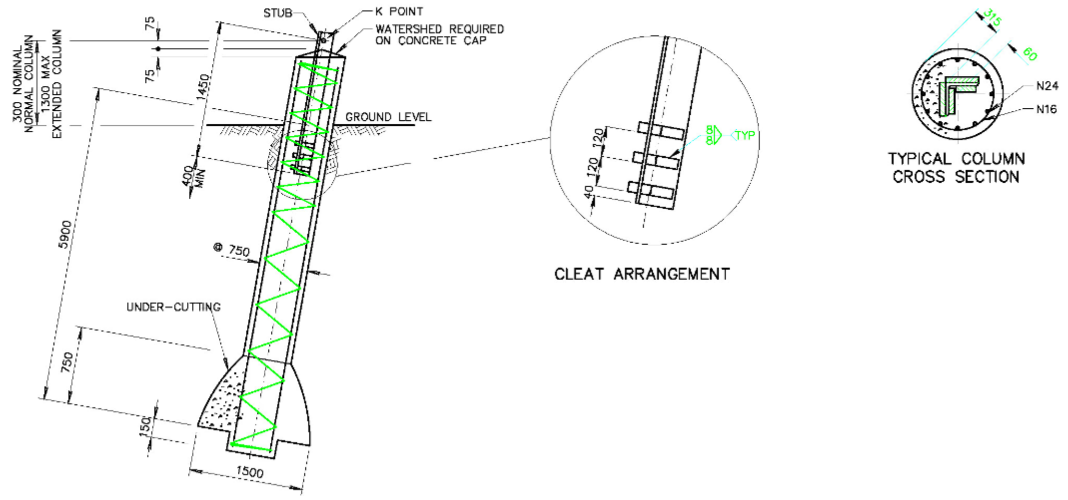
Setting out involves the placement of temporary pegs on site to mark the location of the excavation. Dimensions of foundations are determined by structure type and height and soil conditions at the site.

Excavation of bored foundations may be by truck mounted auger, backhoe or track mounted excavator. The excavation is bored at the same inclination as the structure leg. In unstable ground conditions, the excavation may be stabilised by the insertion of a steel ‘liner’ in a bored foundation and shoring or timbering for a mass concrete foundation. Although dependent upon the geology of the surrounding soil, foundations are typically excavated to approximately 8–12 m.

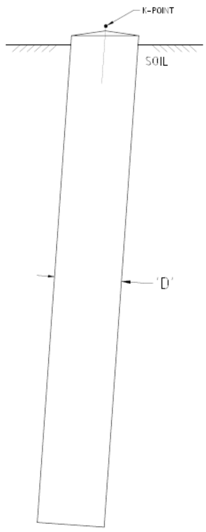
Micro or mini piles involve small diameter 50-300 mm diameter drilled holes which are designed to have a centrally placed steel reinforming member. Subject to ground conditions, the foundation design and the size of the drilling equipment being used, a range of piles, from 3-12 are drilled per leg. These small and grouped piles are then bonded and tied back into a pile cap and/or column forming a tower leg foundation. Micro or mini pile foundations are the preferred foundation for difficult drilling conditions including hard rock, saturated and collapsing soils.

Leg stub setup is the process of placing an extension of the tower leg (the ‘stub’) in the correct position and inclination within the excavation, in preparation for concreting in place. A temporary jig or template is used to hold the stub firmly in place in the correct horizontal and vertical alignment and is removed after concreting. Reinforcing steel is required in tower foundations, with the amount varying with tower and foundation type. Temporary formwork is also used for the foundation column above ground (bored foundations) and above the base (mass concrete foundations). Concrete is placed in accordance with normal construction procedures and formwork removed after an appropriate curing time.

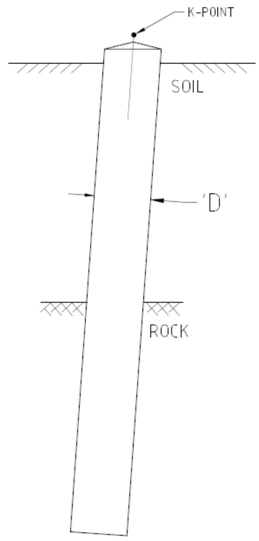
Backfilling of mass concrete foundations is completed using the excavated material if suitable, or imported fill. Surplus material is spread evenly about the site or removed, depending on quantity and suitability.



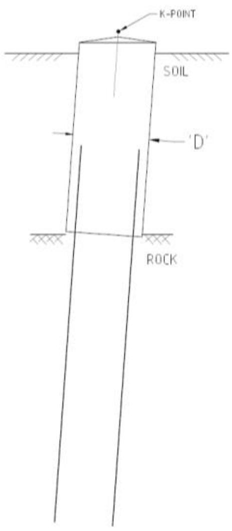
Bored undercut foundation



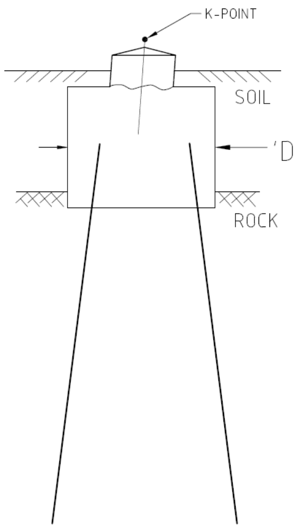
Bored straight side



Bored rock socket (low to hard strength rock)



Bored rock anchor (medium to hard strength rock)



Bored rock anchor (medium to hard strength rock)

Figure 1-4 Typical bored foundation types

1.3.5 Structure assembly and erection

The term 'structure assembly and erection' refers to a sequence of activities from delivery to site, preassembly, erection, tightening and inspection of tower components of each structure.

Steel for lattice towers is fabricated, galvanised, sorted and bundled ready for delivery at a contractor's facility off site and transported to the final location in two or more pieces, typically by semi–trailer. Preassembly of the tower is usually carried out adjacent to its final site and involves assembly of a number of sections, which will allow convenient erection at the following stage.

Where practical, bolts holding the members together are tightened at this stage. Larger or heavy towers may require the use of a small mobile crane at this stage to move members and sections about the site. A large mobile crane (Plate 1-1) is used to erect the tower in sections with a work crew installing and tightening all bolts, and checking that the structure is complete.

Plate 1-1 Transmission conductor drums and mobile crane utilised in structure erection

1.3.6 Conductor and earth wire stringing

Conductor and earth wire stringing is usually carried out in sections of varying length of up to 10 km between termination structures, depending on constraints, terrain, and access. Existing infrastructure such as buildings, roads and fences may require hurdling which is a method that adopts a protective barrier to prevent contact and potential damage. Additionally existing distribution and powerlines which intersect the Preferred Alignment may require other electrical entity works to facilitate stringing. This may include but is not limited to:

- Undergrounding sections existing distribution powerlines
- supply of additional generation to impacted powerlines
- network outages
- live line hurdling which involves the installation of a portable undercrossing protective barrier.

The conductor and earth wire stringing process requires the use of specialised equipment, and is briefly described as follows.

- A powerful winch (puller) is set up at one end of the stringing section, and a braking device (tensioner) at the other. These designated ‘brake and winch’ sites are typically 50 m x 50 m and predominately on easement. In some instances off easement brake and winch sites may be required due to topographical constraints and constructability requirements. These brake and winch sites are generally cleared and stripped of the topsoil layer, which is stockpiled separately and used for rehabilitation of the site at completion of stringing.
- Specially designed pulleys (stringing sheaves) are fixed at each conductor and earth wire attachment point on each structure in the section (Plate 1-2).
- Multiple high strength, non–rotating steel winch ropes are threaded continuously through the corresponding sheave on each structure between the winch and the tensioner. This is often facilitated by threading light polypropylene ropes through the sheaves as they are installed. These ropes are used to pull the winch rope through the sheaves at each structure without the requirement for a worker to climb the structure.
- For each stringing section, for each conductor and earth wire individual winch ropes will be runout.
- The conductors (electrical cables) are then pulled out under tension through the stringing sheaves on each structure and through to the winch. The tension in the winch ropes is continuously monitored to avoid over tensioning. Workers carry out visual checks through the stringing section to ensure that the conductor run out proceeds smoothly and wires remain clear of all obstructions.
- At the completion of the run out of all conductors and earth wires, they are attached to structures or temporary anchorages.
- Conductor and earth wire tensions are adjusted to give the design sag (i.e. the correct ground clearance).
- Conductors are clamped in final positions at the end of insulator strings at each suspension structure, and terminated on insulator strings at each tension structure.
- Conductor spacers are installed between the twin-conductors (sometimes from a helicopter).
- Earth wires are clamped or terminated as required at each structure earth wire peak.
- Equipment is repositioned and the above process is repeated for subsequent stringing sections.

A variation of the above process uses a helicopter to undertake the direct run-out of conductor and/or earth wire (Plate 1-2). It is quite similar to the above process but differs in that no steel winch rope is used.

Plate 1-2 Stringing sheaves and helicopter stringing

1.3.7 Road crossings

Where transmission lines cross road reserves, approval will be sought from the relevant road authority under Section 102 of the *Electricity Act 1994*.

1.3.8 Watercourse crossings

Where possible, structures will be located 50 m from watercourses. Where the transmission line crosses watercourses, previously cleared tracks for existing crossings will be preferentially used to minimise new watercourse crossings. Where new crossings are required, the construction methodology will be dependent upon the size of the watercourse, however are generally developed in line with accepted development requirements for operational work that is constructing or raising waterway barrier works.

The construction of bed-level crossings typically involves the excavation of the crossing bed to an appropriate depth to provide a stable base. The excavation is then lined with a heavy duty geo-fabric, and filled with aggregate using a combination of rock sizes up to150 mm to lock the rock into place. In some instances where it is not practical to undertake excavation works due to unfavourable soil properties, alternative solutions may be required which may include, but are not limited to:

- installation of bog mats
- installation of geomaterials.

1.3.9 Laydown areas

Laydown and staging area requirements will be determined by the Project contractor. It is anticipated that laydown areas will also include temporary concrete batching pad sites. Standalone laydowns will be kept to a minimum and where possible be located in previously disturbed sites away from sensitive areas.

1.3.10 Site reinstatement

Reinstatement will be undertaken progressively during construction, where practicable, and Powerlink Queensland will ensure that all disturbed areas impacted from construction are reinstated at the end of the Project. The short-term goal of reinstatement is the stabilisation of soils to provide a suitable matrix for vegetation establishment to aid in preventing erosion. Reinstatement also includes the replacement of topography, topsoil, and fences where disturbed.

1.4 Operation and maintenance

1.4.1 Operation

After completion of construction and commissioning of the transmission line, the amount of activity on site decreases substantially. During operation, normal practice is for maintenance staff to carry out scheduled inspections of the line, easement and access tracks every two to four years depending on the risk of vegetation growth.

These inspections (patrols) are either by vehicle or helicopter. Additional inspections may be required to perform such activities as emergency repairs.

1.4.2 Maintenance

1.4.2.1 Structures, conductors and fittings

Structures, conductors and fittings are inspected for any signs of unusual wear, corrosion or damage. Transmission lines are designed for a 50 year in-service life and are very reliable under most conditions. Maintenance staff normally conduct a detailed visual inspection about once every two to three years.

Provision may be made for some structure and conductor maintenance tasks to be carried out from a helicopter, with the line either energised or de–energised. Typically, insulators are replaced every 25 years with the majority of the remaining equipment designed to last the life of the line.

1.4.2.2 Easements

Inspection of the easements is carried out on each scheduled line patrol, with the main aim being to record the type, density and height of vegetation regrowth. Additional matters of interest include new under–crossings (e.g. distribution powerlines) or other activity or construction within the easement, which may affect operation or maintenance of the line.

Powerlink Queensland’s policy is for the landholder to be contacted prior to any vegetation control work on a property and the landholder’s agreement obtained regarding the treatment method to be employed. This is particularly important if herbicides are involved for withholding periods for meat production.

Easement vegetation management is important to ensure the safe operation of the transmission line. Vegetation management is undertaken in accordance with Powerlink Queensland’s standards and procedures.

Three techniques for vegetation management are employed:

- mechanical
- hand clearing
- chemical (herbicides).

The technique adopted for each area takes into account a number of issues such as landholder requirements, type of regrowth, terrain and the local environmental conditions. Mechanical clearing is usually by a tractor driven slasher or similar vehicle, and is suitable for shrubs and smaller trees. It is limited to relatively flat and accessible terrain due to the type of vehicle used.

Hand clearing is labour intensive but allows the vegetation clearing to be quite selective and ensures that disturbance to non-target species is minimised. Hand clearing can be employed in areas where vehicle access is not available. Lopping of larger trees is also an option near urban or in visually sensitive areas.

Chemical treatment may also be used for selective treatment of incompatible vegetation while minimising ground disturbance. The method may be through stump injection, cut stump or overall spray technique and is mostly suitable for regrowth vegetation.

1.4.2.3 Access tracks

Maintenance of access tracks is required to ensure that vehicle access to structure sites is available for inspections and structure maintenance. Techniques employed should be appropriate for the area. For example, a grader may be required in hilly terrain where some reshaping of drainage is necessary, but a slasher could be preferred in open grasslands.

The work should minimise disturbance to natural groundcover, thus reducing erosion potential and subsequent maintenance requirements. Maintenance of access provided by others is undertaken in consultation with the appropriate authority.

1.5 Decommissioning

Typically a transmission line has a 50 year operational life and after this time may:

- be replaced with a transmission line designed for the revised environmental constraints and electrical system requirements at the time
- if the line were no longer required, be dismantled and the easements may be surrendered to the property owner.

At the time when the transmission line is decommissioned, it will be de–energised, dismantled and removed.

Prior to decommissioning of the transmission line, a Decommissioning Management Plan which provides detail regarding the proposed decommissioning works, environmental risks associated with decommissioning and management and mitigation measures will be prepared. This plan will utilise environmental management strategies, practices and technologies current at the time of decommissioning to comply with regulatory provisions and to appropriately manage environmental issues which may be associated with decommissioning of the transmission line.

2.0 Switching Station

2.1 Physical details of the switching station

A typical switching station layout and structures are shown in Plate 2-1.

Plate 2-1 Typical substation layout

2.1.1 Aerial structures

Aerial structures comprise of galvanised tubular steel acting as:

- strain beams for terminating the transmission line conductors
- poles for supporting aerial earth wires over the switching station.

2.1.2 Gantry structures

Gantry structures are of steel construction and are used to support high voltage conductors throughout the switching station that interconnect sections of electrical equipment. Requirements for minimum clearance between energised conductors and various types of obstacles are specified by the Electricity Safety Regulation 2013. The distance between structures and their height is determined by the equipment layout and these clearance requirements.

2.1.3 Support structures

Support structures are used to maintain ground clearance to the various items of electrical equipment. Support structures at the switching station will be of conventional fabricated steel and tubular steel construction.

2.1.4 Busbars

Busbars act as high capacity connectors between pieces of equipment. They are made of tubular aluminium.

2.1.5 Buildings

The proposed switching station will contain the following buildings:

- an air–conditioned combined demountable control/communications building
- an air–conditioned demountable amenities building
- a storage shed on a concrete slab.

The proposed switching station will include a site office building which is likely to include office space, a kitchenette and ablutions facilities. Reticulated water supply is not available at the proposed switching station location and is not proposed to be extended to the site. Rainwater tank(s) will be provided at the switching station site for general use excluding drinking water. Water tanks will be enclosed and provided with first flush devices in order to improve quality of rainwater caught and stored on site for use.

2.1.6 Electrical equipment

Electrical equipment is grouped into:

- primary plant involved in the transformation, switching and isolation of high voltage electricity
- secondary systems associated with the protection, metering and control of the primary plant
- communication systems linking the automated control and signalling equipment in the switching station to remote control facilities as well as voice and data communications facilities.

2.1.7 Helipad

A helipad will be required at the Guybal Munjan Switching Station. The helipad will include the following.

- Helipad will be construct in a 30meter diameter alongside the access road to the Guybal Munjan Switching Station.
- Helipad will have an additional 20 meter fire break buffer around the helipad to allow Helicopters to land during bush fires.

2.1.8 Fire Break

Fire Break will be constructed 30 meters wide along the Powerlink boundary Fence.

2.2 Construction

Construction of the proposed switching station will involve a series of field activities including:

- a detailed site survey to allow detailed structure and switching station design
- vegetation clearing
- earthworks and levelling for the switching station platform and access road
- site fencing
- installation of a site drainage system
- installation of a switching station cable trench and conduit system
- installation of the switching station earthing mat
- installation of the switching station structure and building foundations
- buildings, structure and electrical equipment erection
- conductor and earth wire stringing
- site rehabilitation.

2.2.1 Vegetation clearing

The area affected by the construction of the built elements of the switching station must be fully cleared.

2.2.2 Earthworks

A level surface is required for the construction of the switching station, therefore the initial stage of construction is earthworks, usually by a cut and fill process to bench the pad, the extent of which will depend on the site profile. Earthworks for the site comprises compacted fill approximately 1 m above surrounding ground level. Fill may be required to be imported to meet specification requirements.

2.2.3 Platform surfacing

A 100 mm thick platform road base surface will be laid as part of initial earthworks. This will extend up to 3 m outside the future compound fence alignment all around the site, excluding the future roads. A final 100 mm thick platform of additional road base surfacing finish covering the same area will be laid after completion of civil works. A further 100 mm thick gravel surface will be placed within the compound after completion of civil works.

If space permits, excavated spoil material is to be mounded with the available mulch onsite and used as a planting bund for landscaping around the periphery of the site. Surplus clean fill material will be removed from site and appropriately disposed.

2.2.4 Site access

Road works will comprise:

- the access road to and within the switching station
- parking around the switching station buildings.

Access to the switching station site will be from the nearest road.

2.2.5 Cable ducts

Underground cable trenching within the switching station includes cable trenches, cable pits and conduits as required for multicore cables.

2.2.6 Site fencing

The switching station will be surrounded by a 2.4 m high chain wire security fence, topped with several strands of barbed wire. Gates will be provided and locked to allow entry by authorised vehicles and personnel.

2.2.7 Civil works

This phase of the work involves the installation of the switching station security fencing, drainage, roads, cable trenches, switching station earthing and installation of structure foundations. The switching station copper electrical earthing mat will be installed across the site at a depth of approximately 600 mm. The disturbed soil will then be compacted and covered to prevent erosion.

Drainage work consists of the installation of all drains, pits and culverts necessary to control the flow of stormwater from the site. All roads into the switching station compound and equipment area will be either gravelled or bitumen sealed to prevent erosion.

It is expected that structure foundations will be one of two main types, broadly described as bored and excavated. Bored concrete foundations are used in most situations whilst excavated foundations are used where pad type footings are required.

Isolated concrete plinths and foundations will then be constructed to support the site infrastructure. Concrete for foundations will be supplied from the nearest commercial batching plant and poured in accordance with normal construction procedures. Formwork will be removed after an appropriate curing time. Other foundation requirements such as those for the control and communications buildings are normally completed at this time.

2.2.8 Structure and building erection

The steel for the lattice and tubular structures will be fabricated, galvanised, sorted and bundled ready for delivery at a factory or workshop off site. Pre–assembly of the structures will be carried out on site and will involve assembly of the individual members into a number of sections, which will allow convenient erection by a mobile crane.

The demountable control building and amenities building will both be of a transportable prefabricated building design with ‘colorbond’ walls and roofing. They will be delivered complete to site and installed on their foundations using a mobile crane. The storage shed will typically be galvanised metal walls and roofing.

2.2.9 Erection of landing beams, gantry structures, conductors and busbars

Once all strain beams, gantry and support structures have been erected, the busbars and high voltage electrical equipment will be placed in position and all electrical connections made. Cables that carry the control and protection signals to the control equipment located in the bay buildings will be laid and all connections made. Conductors are strung between the high–level gantries and connections made to the high voltage equipment. The final connection to be made is that of the incoming transmission lines.

2.3 Operation and maintenance

After the completion of construction and commissioning of the switching station, the amount of activity on site will decrease substantially as the switching station is designed to be monitored and controlled remotely. For safety and security reasons, only authorised personnel are permitted access to switching station compounds. Regular security checks will also be carried out. Remotely controlled operational cameras will be installed as remote video monitoring of the switching station enables a quick response to issues.

Facilities exist for manual and emergency site control, should this be necessary. Maintenance staff will carry out routine inspections of the switching station and detailed maintenance of all plant and equipment at regular intervals. Additional inspections may be required as a result of equipment failure, damage, modifications and upgrades.

During the routine inspections, the switching station and items of plant will be inspected for signs of unusual wear, corrosion or damage. Faults and defects will be reported to maintenance staff who will rectify any problems identified.

Switching station equipment is designed with a service life in excess of 40 years with refurbishment scheduled every 15 years and is very reliable under most conditions. Apart from the detailed visual inspections that maintenance staff undertake, routine maintenance will be carried out periodically depending on the type and make of the item of plant concerned.

Vegetation regrowth control within the switching station compound and under the incoming power supply transmission lines will be undertaken to maintain electrical safety clearances between the conductors and vegetation.

2.4 Decommissioning

The design life of the switching station is typically around 40 years. However, after that time it would be reasonable to expect that replacement or refurbishment work would occur to bring the equipment to the required level of performance and reliability. When the switching station is considered no longer necessary, it would be removed and remediation works undertaken.

Prior to decommissioning of the switching station, a Decommissioning Management Plan which provides detail regarding the proposed decommissioning works, environmental risks associated with decommissioning and management and mitigation measures will be prepared. This plan will utilise environmental management strategies, practices and technologies current at the time of decommissioning to comply with regulatory provisions and to appropriately manage environmental issues which may be associated with decommissioning of the switching station.