Ergon Energy Corporation Limited

Specification for Structure Foundation Construction

This material is made available on the basis that it may be necessary for a Registered Professional Engineer of Queensland (RPEQ) to undertake or oversee the engineering services to meet statutory obligations.

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Ergon Energy Queensland Pty Ltd ABN 11 121 177 802

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1. Purpose and Scope

This specification covers the construction of foundations for pole structures and steel towers. All costs and works associated with this Section of the Specification shall be included in the Schedule of Rates for Structure Foundations unless noted otherwise.

2. References

2.1 Ergon Energy controlled documents

Nil

2.2 Other sources

AS 2187 – Explosives- Storage, transport and use

3. Definitions, Acronyms, and Abbreviations

3.1 Acronyms and Abbreviations

The following acronyms appear in this standard:

AS Australian Standard

4. Security

Nil

5. Safety, Environmental and Ergonomic Considerations

As per Ergon Energy's Safety, Environmental & Ergonomic Policies.

6. General

The Contractor shall be responsible for the workmanship and all materials required for the installation and completion of all foundations as shown on the drawings.

Structure foundations shall be constructed in accordance with the nominated design drawings. These will typically be direct buried for concrete poles, whilst steel pole and lattice tower foundation will vary with the ground conditions. The design information shall indication the anticipated sub surface soil conditions, should the actual conditions vary from these during excavation, the designer should be notified immediately, to advise of any modification that may be required.

7. Foundation Installation Rates

The Structure Foundations Rates shall cover all costs and overhead necessary to supply, install and complete foundations for poles, including transport, excavation, covering, fencing, soil anchors, buried log anchors, formwork, timbering, pumping, dewatering, shoring, cement grouting, back filling, compaction, spoil disposal, clean up of site, and all other activities required to complete the foundations.

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Where in the opinion of the Superintendent the nature of the soil or any other condition will prevent the installation of the standard foundation, the foundation may be classed as a special foundation for which a design shall be provided by the Superintendent. Special foundations shall be installed by the Contractor at the scheduled rates for Miscellaneous Work. Man hours, equipment and all other items necessary to carry out these works, shall be allowed for in the Miscellaneous Works Schedule rates. The Superintendent may order additional depth of foundation up to one metre more than shown on the standard foundations. Such additional depth shall not constitute a special foundation but payment for the additional depth ordered shall be made at the appropriate rate in the Foundation Construction Schedule.

8. Foundation Setting Out

Pole positions, stay wire anchor and bollard positions shall be pegged by the Designer.

It is the responsibility of the Contractor to correctly identify pegs and to ensure that all structure pegs are in the correct position as detailed on the layout drawings supplied to the Contractor by the Designer.

The cost of any rectification work necessary due to failure to observe this requirement shall be borne by the Contractor.

9. Site Benching

Benching of pole sites shall be avoided by the Contractor where possible, and shall not take place without the written approval of the Superintendent. All costs of benching required by the Contractor shall be included in the rate for Construction Access.

If the Contractor considers that benching is essential at or near any particular pole site, he shall submit full details in writing to the Superintendent for approval, including the vertical and lateral extent of the bench, the proposed method of disposal of benched material, and any effects on the pole height, or foundation details which may result. Benches shall be constructed so as to prevent erosion and the accumulation of water on or near the bench. Adequate cut-off drains shall be installed to divert water flow away from the bench.

Any benched material left on site shall be spread evenly to a depth less than 1.0 m above natural ground surface level, shall be thoroughly compacted and slightly crowned to ensure even water run-off. All batter slopes shall be selected to remain stable in the long term under all weather conditions. In areas which the Superintendent considers prone to soil erosion, the Contractor shall set aside all top soil from the benched area and spread it evenly over the benched and filled area before completion of the Contract. Where deemed necessary the Contractor shall grass seed, fertilise and water the areas affected by earthworks. The species of grass seed and fertiliser requirements shall be nominated by the Superintendent. The entire area surrounding the bench shall be left clean and tidy.

10. Foundation Excavation

10.1 General

Bored foundations shall be excavated with boring machines equipped with associated augers suitable for cutting soils and soft rocks such as shales, friable sandstone and limestone.

The Contractor shall make excavations for foundations of the type and dimensions chosen for each pole, and shall keep the Superintendent advised of his excavation programme to enable inspection

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of every excavation by the Superintendent as the work proceeds. If the Contractor excavates the pole foundation hole by more than 100 mm over the specified depth, he shall at his cost backfill the hole with concrete to the specified depth. Payments for foundations shall be made on the basis of the pole types at the appropriate prices in the Schedule of Rates. The Principal shall not be liable for any extra cost because a foundation type is varied during excavation, except where the Superintendent directs that a special foundation of a type not specified be installed.

The excavation of foundations shall be carried out with minimum disturbance to the adjoining ground surface. All excavated material shall be kept clear of the excavation and care shall be exercised to prevent spoil falling into the excavation. Any such spoil shall be removed from the excavation by the Contractor.

10.2 Caissons

Where in the opinion of the Superintendent the nature of the soil (eg soft clay, loose sand, excessive pore water pressure) is not self supporting, caissons may be used to prevent the collapse of the soil. The Superintendent shall determine the length of caisson required for each foundation. The approval to install caissons by the superintendent does not predispose that foundation to be classed as a special and the payment for installation of a normal foundation shall still apply unless otherwise directed by the Superintendent.

The contractor is to determine the type of caisson, e.g. removable or sacrificial and the material e.g. steel or concrete. The caisson installation rate is to be based on one metre lengths and include all necessary equipment, items and labour required to carry out these works, e.g. caisson, driving, vibrating, welding, removal, backfill and compaction outside the caisson and pumping.

10.3 Special Foundations

Where in the opinion of the Superintendent the nature of the ground so requires (e.g. soft soil, surface water or seepage), the contractor may be directed to install a special foundation. This will typically be in the form of breast logs or concrete beams installed in the direction of the line on each side of the pole. Alternatively the Superintendent may specify “turtle backs of stabilised backfill or gravels to raise the height of lateral support to the pole. Other special foundation types may also be used where appropriate; Payment shall be made in accordance with the relevant item in the “Miscellaneous Work” Schedule of Rates.
If for any reason, the finished ground surface level around a pole foundation is below the adjoining ground surface level, this depression shall be adequately drained by the Contractor to prevent the accumulation of water around the foundation. The cost of these measures and all other costs associated with foundation excavation shall be allowed for in the rates for supply and installation of each type of foundation except as specified hereunder for rock excavation.

11. Tower Foundations

The Contractor shall excavate soil and/or rock, fix tower steel and reinforcement, place concrete in foundations and backfill around foundations in accordance with this Section and the Drawings.

11.1 Setting out of Foundations

The Designer shall supply the Contractor with the tower centre and centreline location pegs and required heights of “K” points in relation to the tower centre peg. The Contractor shall set out the foundations using a recognised method to ensure correct alignment of the tower steelwork when erected without the forcing of members during erection.

The tower stubs and legs shall be aligned and located within the following tolerances or such tighter tolerances as the Contractor deems necessary.

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- The maximum permissible tolerance on rotation of the tower leg stub about its longitudinal axis shall be ±2 degrees.
- The maximum permissible tolerance on the slope or rake of the tower leg stub shall be ±1 degree.
- The maximum permissible tolerance on the horizontal distance (including diagonal distance) between any appropriate correspondence points on any two tower leg stubs on any one tower shall be ±10 mm.
- The maximum permissible tolerance on the levels of appropriate corresponding points on any two legs of any one tower shall be ±5 mm.

11.2 Choice of Foundation Type

The contractor shall construct the tower foundation design supplied by the Designer, unless alternative designs have been approved by the Superintendent.

Where the Superintendent determines that ground conditions do not meet the Designers design criteria, the Superintendent may direct that special foundations be installed.

Payment for foundations shall be at the scheduled rate for the type of foundations installed. Payment for special foundations shall be in accordance with Clause 14 below.

11.3 Foundation Excavation

All excavations shall be carried out with minimum disturbance to the adjoining ground surface. All excavated material shall be kept clear of and shall be prevented from falling into the excavation. When a backhoe is used for excavating, the machine shall be positioned on the tower base diagonal to achieve least disturbance at the face nearest the tower centre.

11.4 Rock Anchor Foundations

The Contractor shall construct the rock anchor foundations such that:

- Blasting does not fracture the rock below the concrete cap;
- Excavation shall be deepened through any friable rock;
- Holes for rock anchors are air blasted clean before insertion of resin capsules and bars;
- Resin or cement water grout completely fills any voids and provides an approved construction joint between each anchor bar and concrete cap;
- Anchor bars and resin capsules are stored and used in accordance with approved resin manufacturer's recommendations. Capsules whose shelf life has been exceeded shall not be used.

11.5 Column Extensions

Column extensions shall be provided in accordance with the tower schedules. Column extensions refer to those columns above 600 mm to a maximum height of 1300 mm. Payment for column extensions shall be included in the standard foundation rates.

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12. Rock and Soil Variations

The Contractor shall make good, at his own expense and to the approval of the Superintendent, any excavation in which excessive depth, overbreak or disturbance to adjacent in situ soil or rock has occurred.

The following methods shall be used for determining whether the excavation shall be paid for as rock or not:-

(i) Material, which in the opinion of the Superintendent, could reasonably be excavated by the use of an appropriately fitted powered rock auger, or hand tools such as picks, shovels or hand bars, shall not be considered to be rock even though the Contractor may choose to excavate it by use of pneumatic tools or explosives.

(ii) Material which in the opinion of the Superintendent could not reasonably be removed by use of the rock auger or hand tools but which must be removed by pneumatic tools or by the use of explosives or which must be broken up by such means before removal, shall be considered to be rock.

The tendered rates for the specified soil type foundations shall include all costs of soil and rock excavation and the specified cement stabilised backfill. Where a special foundation or additional soil excavation is required by the Superintendent, payment for the soil and rock excavation and backfill involved will be at the appropriate Miscellaneous Works Schedule rates.

Where the Superintendent requires additional rock excavation or a special foundation involving rock excavation, payment of rock excavation and backfill involved shall be based on the volume of rock excavated within the dimensions of the specified foundations and shall be made at the appropriate Schedule rates.

The volume of excavation shall be obtained by multiplying the plan area shown on the drawings by the required depth of excavation, measured from the undisturbed ground level at the centre of the excavation.

13. Use of Explosives

Rock may be excavated with the use of explosives, subject to the Superintendent's approval. The Superintendent will not approve the use of explosives where there is adjacent infrastructure. The Superintendent may also withhold approval if he considers the number and sequence of charges or safety procedures inadequate or that adjacent structures of transmission lines would be liable to damage.

Without limiting the Contractors obligations under the Contract generally:

(a) When explosives are used, the Contractor shall obtain the necessary license from the appropriate authority and shall conform to all Government regulations, the S.A.A Explosive Code AS 2187 Parts 1, 2 and instructions relation to transport, storage, handling and the use of explosives.
(b) Blasting shall be carried out strictly in accordance with the regulations and/or requirements of local or other authorities having jurisdiction in the matter. Adequate safety precautions shall be observed at all times to ensure that there is not possible danger during blasting operations to property, livestock, members of the public or any adjacent existing transmission line. Blasting mats shall be used where deemed necessary or at the discretion of the Superintendent.

Detonation of charges shall be by means of cordtex, detonators and safety fuse.

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Electrical detonators shall not be used unless approved by the Superintendent.

To minimise the effect of the shock wave on adjacent, installations, appropriate time delay relays shall be inserted between the charges if more than one charge is to be used in a blast.

All proper precautions shall be taken to prevent the disturbance of rock surrounding the excavation.

Where blasting results in the need to remove material in excess of that shown on the drawings, payment will not be made for the removal of such excess material. In all cases, the fractured rock or other materials shall be trimmed, cut out or undercut and the voids made good with other materials by the Contractor at its own expense and to the satisfaction of the Superintendent.

No blasting shall be permitted within 100m of Substations.

14. Dewatering and Shoring

Where foundations are constructed in accordance with the drawings, no extra payment shall be made for routine dewatering or shoring which may be required during excavation to maintain the specified dimensions for construction or safety reasons.

Only for cases of special foundation work, the cost of dewatering and shoring shall be payable at the rates for timbering and pumping. The use of caissons shall be in accordance with clause 10.2.

15. Protection of Works

Open excavations for foundations, when left unattended, shall be fenced off on all sides with a continuous fence. Alternatively bored excavations may be adequately covered when left unattended. The cost of all such precautions to make the workplace safe and secure shall be included in the Schedule rates for “Structure Foundations”.

16. Concreting of Foundations

Concreting of foundations shall be carried out in accordance with the drawings and this Specification. Placement of concrete shall not commence until the excavation has been inspected and approved by the Superintendent and shall proceed in his presence.

16.1 Poles

A pad of concrete or a precast biscuit where shown on the drawings shall be placed beneath concrete pole butts prior to pole erection and concrete placement.

16.2 Towers

The Contractor shall place and align stubs, cleats, reinforcing steel and tower bases and shall support them at all stages of construction**.**

Concrete required for the foundation shall be placed in one pour, and shall be placed in the foundation within 48 hours of the completion of excavation.

17. Backfilling

Backfilling shall be carried out within 48 hours of the completion of excavation of the foundation and shall proceed only after foundations have been inspected by the Superintendent and the structures erected and plumbed. Backfill shall be placed and compacted until the level is such that

after any long term settlement the final level of the backfilled area is higher than the surrounding natural ground level.

Any surplus backfill shall be spread around the pole. The finished surface of the backfill shall be left even and tidy to the satisfaction of the Superintendent, without depressions which could hold water and so that the water is directed away from the pole.

Where imported backfill material has been used, surplus spoil after completion of the foundation shall be spread neatly over the site (or disposed of at the Schedule rates if so directed by the Superintendent). Cement stabilised backfill shall be placed within 2 hours of the cement being added to the backfill.

17.1 Concrete Pole and Stay Anchorage Backfilling

17.1.1 Concrete Backfill or Cement Grout

Concrete backfill or cement grout shall be as specified on the drawings in accordance with the Specification for Concrete Work.

17.1.2 Stabilised Soil Backfill

Unless otherwise directed by the Superintendent and where nominated on the drawings the Contractor shall backfill the poles with the excavated material stabilised with cement in the ratio of 1 part of cement to 8 parts fill (by volume).

The stabilised backfill shall be thoroughly mixed in an above ground rotary mixer or by equivalent means as approved by the Superintendent. Water shall be added to the mixture in the mixer or as a continuous spray as the backfill is fed into the excavation. The quantity of water added shall vary according to the soil types encountered but shall be sufficient to provide a moist and pliable material for optimal compaction of the backfill and for hydration of the cement.

The backfill shall be placed in layers not exceeding 200 mm thick and thoroughly compacted using approved compaction equipment.

The finished surface of backfill shall be left smooth and shaped to create a watershed from the pole surface.

17.1.3 Stabilised Sand Backfill

The Superintendent may direct that stabilised sand be used as backfill. The backfill shall then be mixed in the ratio of 1 part of cement to 8 parts sand (by volume).

It shall be thoroughly mixed with the cement and water in an above ground rotary mixer to give a slump of between 50 and 80 mm.

Stabilised sand shall then be placed using concrete vibrators.

The finished surface of the stabilised sand shall be trowelled smooth to create a water shed from the pole surface.

The Superintendent may specify the use of imported sand for backfilling if he considers the excavated soils, or soils within 200 metres of the pole site, are unsuitable for stabilisation. In such circumstances the Contractor will be reimbursed for the importation of sand at the appropriate rates in the Schedule for Miscellaneous Works.

18. Installation of Staywire Anchors

18.1 General

The Contractor shall install the type of staywire anchor to suit the ground conditions at each site. The type of anchor installed shall be chosen by the Contractor in consultation with the Superintendent. Where there is disagreement the opinion of the Superintendent shall prevail. Payment for staywire anchors shall be made at the rate included in the "Structure Foundations" schedule. This rate shall apply for all types of staywire anchors. No additional payment shall be made if the type of anchor is changed to another standard type during construction.

18.2 Inclined Soil - Cement Grouted Anchors

The cement grouted anchors shall be installed using 3 to 1 sand to cement grout to the approval of the Superintendent. The grout column shall be continuously vibrated during placement using mechanical high speed vibrators held against the anchor tendon. The anchor bars shall be centrally located in the anchor holes with concrete or plastic spacers and aligned to within ±2 degrees of the staywire inclination.
These inclined anchors require thorough inspections to ensure the soil conditions are adequate, the presence of non-cohesive soil or saturated soil significantly reduces the capacity of the anchor. The excavations must be approved by the Superintendent.

The grout column shall be raised a minimum of 300 mm above the surrounding soil level and sloped to shed water.

Cover to soil or rock shall be 50 mm or greater. Stay anchor bars not so aligned shall be replaced or rectified to the Superintendent's satisfaction.

The grout shall be allowed to cure for a minimum of fourteen (14) days before any load is applied.

18.3 Mass Concrete Anchors

Mass Concrete Anchors shall be installed in accordance with this Specification and the drawings.

The front of the excavation shall form a vertical face. The anchor bars shall be centrally located in the anchor holes with concrete or plastic spacers and aligned to within ±2 degrees of the staywire inclination.
Unless otherwise noted on the drawings soil shall be reinstated above the concrete with the finished surface of the backfill shall be left even and tidy to the satisfaction of the Superintendent, without depressions which could hold water and so that the water is directed away from the stay.

18.4 Corrosion Protection

Stay anchor rods shall be galvanised and protected by concrete or grout cover. Stay anchor rods shall be placed within PVC pipes and grouted such that no part of the anchor rod is in contact with the soil. Threads and nuts shall be positioned sufficiently clear of the ground to the approval of the Superintendent.
All PVC pipe and grout shall be supplied by the Contractor. The cost of these materials shall be allowed for in the rates for supply and installation of Stay wire Anchors.

Backfilling shall be such as not to damage the corrosion protection.

18.5 Anchor Testing

The Contractor shall supply on site a suitable portable anchor testing device capable of loading an anchor rod and anchor axially in uplift to its required limit state load capability as shown on the drawings. The anchor testing device shall include an accurate reading of the uplift load being

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applied, and this load indication device shall be calibrated accurately by the Contractor in the presence of the Superintendent, prior to field use. The testing device shall be subject to approval by the Superintendent prior to use. The geometry of the testing device shall be such that the full anchor - soil interaction the device does not provide restraint to the soil under load.

The Contractor shall load test those anchors nominated by the Superintendent. Such load tests may be limit state load tests on separately installed anchors to prove the design limit state strength capability of the anchor, or proof load tests on working anchors to 50% of their design limit state strength capability to check their correct installation.

For both limit state and proof load tests the maximum load shall be held for two minutes. For proof load tests, each anchor tested shall be loaded twice and the displacement of the anchor rod shall be accurately checked before and after the second loading. If the permanent displacement of the anchor rod after the second proof loading exceed 5 mm, or as otherwise nominated by the Superintendent, that anchor may be rejected by the Superintendent, and shall be replaced by a properly installed anchor at the Contractor's expense.

All costs associated with the above anchor testing shall be included in the rate for anchor testing in the Schedule of Miscellaneous Works.

19. Erosion Protection for Foundations and Access Works

The Contractor shall, if directed to do so by the Superintendent, carry out works to prevent the erosion of the soil of any foundation of any pole, such as the provisions of :-

(i) Beds of rip rap bound with wire netting,

(ii) Concrete aprons,

(iii) Grassing, including topsoiling, fertilising, seeding and watering, or

(iv) Cut off drains (sloping sites)

Such precautions shall generally be required for loose soils adjacent to foundations in areas prone to flooding or gullying.

Additional payments for any such work shall be made in accordance with the rates set out in the Schedule of Rates for Miscellaneous Works, provided that such work is not necessary because of over excavation, removal of surface vegetation, benching and access works by the Contractor.

20. Structural Concrete

Where structural concrete is required, it shall comply with the requirements in the Specification for Concrete Work.

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