

# Transmission Substation Fences and Gates

## Design Standard (Technical Specification)

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Western Power’s Engineering & Design Function is responsible for this document

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## Revision Details

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0	August 2019	1	First Issue
1	April 2022	2	Review completed. No updates required.
2	March 2024	3	Standard Online Update

## 1. Introduction

This Technical Specification outlines the minimum requirements for the construction of fences and gates for Western Power Transmission Substations.

### 1.1. Purpose and Scope

The requirements outlined in this specification are intended to cover the material supply, fabrication, finish and construction of the following fence types and gates for Western Power Transmission Substations.

- Welded mesh fence
- Palisade fence
- Masonry wall
- Panel wall
- Chain link fence
- Boundary fence

In all matters, the requirements of this specification are relevant unless otherwise specifically stated elsewhere within the construction SoW of the project or shown on the drawings included in the project deliverables.

This specification applies to both 'Greenfield' and 'Brownfield' sites.

### 1.2. Acronyms

Acronym	Definition

### 1.3. Definitions

Terms and definitions used in this document

Term	Definition
AS	Australian Standard
AS/NZS	Australian/New Zealand Standard
Brownfield site	Site with existing or previous electrical assets
EDM	Enterprise Document Management
Greenfield site	New site with no previously installed electrical assets
NATA	National Association of Testing Authorities, Australia

SEQT	Safety, Environment, Quality and Training Function (Western Power)
SoW	Scope of Work

## 1.4. References

References which support implementation of this document

**Table 1.1 References**

Reference No.	Title

## 2. Supporting Documentation<sup>1</sup>

### 3. Compliance

#### 3.1. General<sup>2</sup>

All temporary works, shop drawings, materials, plant, equipment, workmanship, fabrication, and installations must comply with the latest revision of the Western Power technical documents such as Standards, Specifications, and relevant Australian Standards relating to the relevant component of the works unless otherwise noted in this specification or advised at the time of Tender.

There should not be any deviation from the provisions of the relevant standards and specifications without obtaining written approval from Western Power.

All work and materials must comply with higher-level Western Power technical documents, such as relevant Network Standards and Functional Specifications.

This Technical Specification should encompass all requirements of the relevant Australian Standards which are current at the time of issue. These relevant Australian Standards are listed in Table 3.1 below. A period will be set when the Technical Specification needs to be reviewed. If significant changes occur on an Australian Standard which affects safety, then an out of cycle review can be completed.

**Table 3.1: Standards and Guidelines**

Standard Number	Standard Title
AS 1110.1	ISO Metric Hexagon Bolts and Screws– Product grades A and B, Part 1: Bolts
AS 1112	ISO Metric Hexagon Nuts, Parts 1 and 2
AS/NZS 1163	Cold-formed structural Steel Hollow Sections
AS/NZS 1170	Structural Design Actions, Parts 0 - 3

<sup>1</sup> See Western Power Internal Document

<sup>2</sup> See Western Power Internal Document

Standard Number	Standard Title
AS 1170.4	Structural Design Actions – Earthquake actions in Australia
AS/NZS 1214	Hop dip galvanised coatings on threaded fasteners
AS/NZS 1252	High-strength steel fastener assemblies for structural engineering – Bolts, nuts and washers, Parts 1 and 2
AS 1275	Metric Screw Threads for Fasteners
AS 1397	Continuous hot-dip metallic coated steel sheet and strip - Coatings of zinc and zinc alloyed with aluminium and magnesium
AS/NZS 1554.1	Structural steel welding – Welding of steel structures
AS 1720	Timber structures (series)
BS 1722-10	Fences – Part 10: Specification for anti-intruder fences in chain link and welded mesh
BS 1722-12	Fences – Part 12: Steel palisade fences – Manufacturing and installation - Specification
BS 1722-14	Fences – Part 14: Specification for open mesh steel panel
AS 1725.1	Chain link fabric fencing - Security fences and gates - General requirements
AS 2159	Piling – Design and installation
AS 2067	Substations and high voltage installations exceeding 1 kV a.c.
AS 2082	Timber – Hardwood – Visually stress-graded for structural purposes
AS 2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2334	Steel nails – Metric Series
AS 2423	Coated steel wire fencing products for terrestrial, aquatic and general use
AS 2550	Cranes, hoists and winches – Safe use (series)
AS 3600	Concrete structures
AS/NZS 3678	Structural Steel – Hot-rolled plates, floorplates and slabs
AS/NZS 3679.1	Structural Steel – Hot-rolled bars and sections
AS 3700	Masonry structures
AS/NZS 3750	Paints for steel structures (series)
AS 3850.1	Prefabricated concrete elements – General requirements
AS 3850.2	Prefabricated concrete elements – Building construction
AS 4100	Steel structures
AS 4291	Mechanical properties of fasteners made of carbon steel and alloy
AS/NZS 4534	Zinc and zinc/aluminium alloy coatings on steel wire
AS/NZS 4600	Cold-formed steel structures
AS/NZS 4671	Steel reinforcing materials

Standard Number	Standard Title
AS/NZS 4680	Hot-dip galvanised (zinc) coating on fabricated ferrous articles
AS/NZS 5131	Structural steelwork – Fabrication and erection
	National Code of Practice for Precast, Tilt-up and Concrete Elements in Building Construction

### 3.2. Acceptance Criteria

Compliance with the requirements of this specification for materials and construction of fences and gates shall be based on the minimum requirements and acceptance criteria set out in this specification, construction SoW of the project, construction drawings included in the project deliverables and relevant Australian and International Standards listed in Table 3.1.

### 3.3. Order of Precedence

Where this specification is inconsistent with another document making up the construction SoW of the project, the following order of precedence shall apply to determine which document prevails to the extent of inconsistency with, (a) being the highest precedence and (e) being the lowest:

- a) the specific terms and conditions of the construction SoW of the project
- b) the 'Policies and Guidelines' of the project
- c) any construction drawings included in the project deliverables
- d) any specific technical requirements stipulated to the project works
- e) this Technical Specification

### 3.4. Documentation and Traceability

Construction of structural steelwork for Western Power Transmission Substation fences and gates shall comply with the Technical Specification-Transmission Substation Structural Steelwork requirements.

## 4. Environmental Consideration<sup>3</sup>

Environmental issues associated with the construction of the substation fences and gates shall be identified and assessed throughout the construction period.

Project-specific environmental assessment provides information about the condition of the existing environment and identifies of any opportunities for environmental management and reduction of adverse environmental impacts

The contractor shall consult/liaise with the Western Power representative for any preidentified potential environmental issues that may arise during any stages of the construction of the substation fences and gates.

<sup>3</sup> See Western Power Internal Document



## 5. Materials

### 5.1. General

All materials used in the construction of the components for the fences and gates covered by this specification shall be as shown in the construction drawings.

Unless otherwise specified, materials used in the construction of the components for the fences and gates shall comply with the requirements specified in Table 5.1 below.

**Table 5.1: Fencing and gate materials**

Item No	Item	Material Specification
1	Welded mesh	Heavy weight welded mesh to AS 2423.
2	Wire for welded mesh	High tensile metallic coated wire. Wire diameter 4.0mm minimum. Tensile strength 450 – 700 MPa. Coating designation W10Z05A – hot-dip zinc / 5% aluminium, Class W10 to AS/NZS 4534 for coastal areas within 1.5km from the coastline and W10Z in other areas.
3	Wire for fence topping (welded mesh fence)	High tensile metallic coated wire. Wire diameter 2.8mm minimum. Tensile strength 450 – 700 MPa. Coating designation W10Z05A – hot-dip zinc / 5% aluminium, Class W10 to AS/NZS 4534 for coastal areas within 1.5km from the coastline and W10Z in other areas.
4	Barbed tape loops	High tensile galvanised wire to AS 2423. Wire diameter 2.5mm minimum.
5	Chain link fencing fabric	High tensile black PVC coated wire to AS 2423. Wire diameter 3.15mm minimum. Tensile strength 450 – 700 MPa. Base metallic coating not less than W02Z to AS/NZS 4534.
6	Bracing and support cables (chain link fence)	High tensile wires to AS 2423 twin twisted.
7	Pales (palisade fence)	Grade 400 to AS/NZS 3678. Thickness 3.0mm minimum. Hot-dip galvanised to AS/NZS 4680.
8	Fence posts, welded mesh support rails, canted post extension arms, mesh clamping bars, main gate post	Grade 300 to AS/NZS 3679.1. Hot-dip galvanised to AS/NZS 4680.
9	Steel hollow sections	Grade 350 to AS/NZS 1163. Hot-dip galvanised to AS/NZS 4680.
10	Fasteners - Bolts, Nuts and Washers	Property Class 8.8 to AS 4291.1 or Property Grade A to AS 1110.1 (bolts) and AS 1112.1 (nuts). <u>Bolt assembly:</u> Bolt assembly comprising bolts Property Class 8.8, nuts Property Class 8 and hardened washers to AS/NZS 1252.1. <u>Alternative bolt assembly:</u> Bolt assembly comprising bolts Property Class 8.8, nuts Property Class 8 and hardened washers to EN14399-3, System HR.

Item No	Item	Material Specification
11	Bricks	Clay bricks. Minimum characteristic unconfined compressive strength 15MPa to AS 3700.
12	Limestone blocks	Minimum block density 16kN/m <sup>3</sup> . Minimum compressive strength 4MPa.
13	Concrete blocks	Minimum block density 18kN/m <sup>3</sup> . Minimum compressive strength 5MPa.
14	Mortar for masonry works	Mortar class M3 (1c:1l:6s) to AS 3700.
15	Concrete	Cast in-situ: 32MPa Prefabricated: 40MPa
16	Steel reinforcing bars, wire, and fabric	Normal ductility to AS/NZS 4671.

## 5.2. Non Australian Steel / Materials

If any alternative steel and/or materials that are manufactured to a standard other than the appropriate Australian standards are offered, documented evidence that such steel and/or materials shall be entirely suitable for the intended application, design method, nominated design life and the environment where the structures will be located shall be provided.

The Contractor shall provide copies of the standard(s) or code with their offer and a table showing all the relevant properties of the relevant Australian standard steel/material and the proposed alternative steel/material for comparison and compliance to AS.

Acceptance of any such alternative steel/material shall be entirely at the discretion of the Western Power representative.

## 5.3. Certification

The contractor shall submit test reports or certificates of all materials and manufactured components, including items supplied from overseas that are used in the construction of fences and gates, stating compliance with the specification and applicable Western Power technical documents and or Australian standards together with such details and parameters required to be supplied by those documents and or project quality plan to the Western Power representative for acceptance.

Requirements for test reports or test certificates are provided in the relevant Australian Standards listed in Table 3.1. All such testing shall be carried out by an independent NATA-accredited laboratory approved by the Western Power representative.

# 6. Manufacture

## 6.1. General

All components for fences and gates covered by this specification shall be manufactured to the details shown in the construction drawings per the requirements of this specification and relevant Australian and international standards listed in Table 3.1.

All structural steelwork components, including fence and gate posts, post top extensions, gate frames and rails, etc., shall be fabricated to AS/NZS 5131 and hot-dip galvanised to AS/NZS 4680 before assembly.

Supply, fabrication, and surface finishing of all structural components for fences and gates shall be per the requirements of Technical Specification – Transmission Substation Structural Steelwork.

## 6.2. Welded mesh fence

The details of the welded mesh fencing, including dimensions, mesh configuration, and supporting members, shall be as shown in the construction drawings.

The wires used for the welded mesh shall be metallic coated unless otherwise specified. The wire coating designation shall be W10Z05A – hot-dip zinc/ 5% aluminium Class W10, to AS/NZS 4534 for coastal areas within 1.5km from of coastline and W10Z in other areas.

The mesh shall be manufactured by welding the longitudinal wires to the cross wires using the electric resistance welding process per AS 2423 to form the required configuration. It is recommended that the mesh be manufactured from metallic-coated wires instead of fabric metallic-coated after welding.

All other components, where not specified, and manufacture of welded mesh fencing shall be per BS 1722-10.

## 6.3. Palisade fence

The details of the palisade fencing, including dimensions, pale spacing, width, and supporting members shall, be as shown in the construction drawings.

Unless otherwise specified, all pales shall be 100mm wide x 3mm thick and produced from steel sheet Grade 400 to AS/NZS 3678. Pales shall be curved or straight with single or multiple spikes at the top, as shown in the drawings. The finished pales shall have no visible twist or warp. It is recommended that holes shall be provided in the pales during fabrication to facilitate the fixing of barbed tape. Pales shall be hot dip galvanised to AS/NZS 4680 unless specified otherwise. Additional paint coating shall be provided where specified on the construction drawings.

Provision shall be made for thermal expansion by providing slotted holes at the rail-to-post connection as shown in the drawings.

All other components, where not specified, and manufacture of palisade fencing shall be per BS 1722-12.

## 6.4. Chain link fence

The details of the chain link fencing, including dimensions, fabric size and configuration, and supporting members, shall be as shown in the construction drawings.

Unless otherwise specified, the chain link fence shall be heavy-duty Type 1-R-L/B-T rail-less 3 barbed top security fencing with cranked top to AS 1725.1.

The wires used for the chain link fabric shall be 3.15mm in diameter and black PVC coated to AS 2423 unless otherwise specified. PVC coating shall be applied over galvanised fabric mesh. The base metallic coating shall not be less than W02Z to AS/NZS 4534. The chain link fabric mesh size (pitch) shall be 50mm x 50mm and shall have barbed selvages at the top and bottom.

All other components, where not specified, and manufacture of chain link fencing shall be per AS 1725.1.

## 6.5. Panel wall

The details of the panel wall fencing including dimensions, wall material type, and supporting members, shall be as shown in the construction drawings.

Prefabricated concrete panels shall be manufactured accurately to the dimensions shown on the drawings per the requirements of AS 3610.1, AS 3850.2, National Code of Practice – Precast, Tilt-up and Concrete Elements in Building Construction and Technical Specification – Transmission Substation Concrete.

Proprietary Autoclaved Aerated Concrete (AAC) panels, where nominated, shall be from approved manufacturer. Material certificates and test reports for the AAC panels shall be submitted to the Western Power Representative for acceptance before the commencement of work.

## 6.6. Gates

### 6.6.1. General

The details of vehicle entry and personnel gates, including dimensions, in-fill material and supporting members, shall be as shown in the construction drawings.

The gate shall have the same quality and degree of security as the adjacent fencing. The top and bottom rails of the gate shall be at the same level as the fence rails.

Unless otherwise specified, the gate in-fill shall be the same as for the adjacent fencing. The clear distance between any vertical framing of the gates and adjacent posts shall not be greater than the clear distance between the in-fill mesh spacing.

Double leaf gates shall be capable of being opened through 180 degrees inward unless otherwise specified.

### 6.6.2. Locking Arrangement<sup>4</sup>

Double gates shall be fitted with a sliding horizontal locking bar, secured to a locking plate welded to the gate frame at approximately mid-height (but not exceeding 1.5 m) to ensure that the locking bar passes through both of the meeting stiles so that the two gate leaves are firmly held in the shut position. For single gates, the locking bar shall shoot into a socket on the gate post. Locking bar guides welded to the stile shall be an integral part of the stile.

Locking bars shall be holed to receive a padlock, or the locking plate shall be prepared for alternative locking devices if these are specified. A box is to be provided around the padlock to prevent cutting of the hasp.

The personnel gate is to be secured with a deadlock, allowing locking/unlocking inside and outside the substation. The lock is to be keyed to suit the Western Power Master key system for substations. Active access control with a swipe card reader and electric mortice lock shall also be provided for personnel access gates.

Refer to Register - Substation Design Drawing Register - EXTERNAL Version for standard locking system for gates. The locking system shown in Western Power standard drawings is the intellectual property of 'Southern Wire P/L' and shall not be fabricated or provided by others. Other suitable alternative locking mechanisms may be used subject to approval by the Western Power representative.

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<sup>4</sup> See Western Power Internal Document

### 6.6.3. Hinges<sup>5</sup>

Hinges shall be provided such that it is impossible to remove the gates by lifting them at the hinges when they are in the shut and locked position. The hinges shall be provided with a simple and easily applied system of adjustment for the correction of sag, settlement or misalignment during installation and service.

The bottom hinge shall be attached to the gate frame and post.

Hinges are to be purpose fabricated-items. Pivot plates to receive the hinge pins are located at the top and bottom of the gates, and the bodies of the hinges are bolted to the gate posts. The hinges are to incorporate bronze disks to reduce friction. The fixed parts of the hinges are to be bolted to the gate posts, with two 3 mm shims installed between the hinges and the posts during initial construction to allow for future adjustment.

Refer to Register - Substation Design Drawing Register - EXTERNAL Version for standard hinge details for gates. Gate hinge details shown in Western Power standard drawings are the intellectual property of 'Southern Wire P/L' and shall not be fabricated or provided by others. Other suitable alternative hinge details may be used subject to approval by the Western Power representative.

## 7. Construction

### 7.1. General

All components for fences and gates covered by this specification shall be constructed to the details shown in the construction drawings per the requirements of this specification and relevant Australian and international standards listed in Table 3.1.

All prefabricated fence and gate components shall be stored and stacked in a manner to provide adequate structural support and minimise any warping and dimensional changes.

Standard and industry-approved equipment shall be used for the construction works and shall be maintained in a safe operating condition throughout the works.

Special consideration shall be given to the site conditions, such as maintaining safe electrical clearances, site limitations, street access, delivery sequence, transport requirements, inclement weather, and overhead obstructions for the entire duration of all works associated with the fences and gate construction.

### 7.2. Line and Level

All posts shall be vertical. Horizontal displacement shall not be greater than the height of the post divided by 240. The fence shall be so installed that on completion, it is truly on the line of the boundaries set out in the construction drawings. The top of the fence shall be even and follow approximately the profile of the ground or levels indicated in the construction drawings. Unless otherwise agreed with the Western Power representative, the installation of the fence shall not include cutting or filling of the ground to vary the levels.

The bottom of the fence in-fill shall be not more than 50mm above mean ground level or anti-tunnelling slab level. Similarly, the bottom of the closed gates shall be not more than 50mm above the concrete sill level.

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<sup>5</sup> See Western Power Internal Document

### 7.3. Surveying

A survey of the site along the proposed fence alignment shall be carried out to verify all existing benchmarks and the setting-out information provided in the relevant construction drawings, including existing topography and features.

### 7.4. Underground services

An underground services survey shall be carried out using ground penetrating radar (GPR) and/or potholing before the fence construction to locate and identify existing underground services along the proposed fence alignment. Consultation and approval shall be sought from relevant authorities. Services commonly looked at, but not limited to, are gas mains, water mains, telecommunication cables and HV electrical cables.

### 7.5. Setting-out

The contractor shall set out the fence alignment and position of the gates per the construction drawings. All relevant setting-out details shall be submitted to the Western Power representative for verification and approval before the commencement of any construction activities.

### 7.6. Welded mesh fence

The manufactured components of the welded mesh fencing and gates shall be assembled to the details shown in the construction drawings and generally per the requirements of BS 1722-10.

Mesh supporting rails are to be attached to the posts using 8 mm cup head square neck bolts and shear head security nuts. The bolts are to be installed with the heads on the outside of the fence.

The mesh is to be secured to the inside face of the outer flange of the posts and to the fence rails using clamping bars or clips using 8 mm cup head square neck bolts and nuts, with the heads of the bolts on the outside of the fence. One longitudinal wire must be on the outer side of each bolt where the mesh is attached to the posts and rails. Shear nuts are to be used on alternate bolts, and conventional hexagon head nuts on the remainder. The same method is to be used for securing the welded mesh panels to the frames of personnel and vehicle access gates.

Pivot plates to receive the hinge pins are to be welded to the top and bottom of the vertical sections of the gate frames adjacent to the gate posts. The fixed parts of the hinges are to be bolted to the gate posts, with two 3mm shims installed between the hinges and the posts during initial construction to allow for future adjustment.

The top threads at the end of the bolts are to be burred over after installation to prevent easy removal of the nuts. The length of the bolts is to be such that the nuts could be loosened, and two extra 3 mm shims installed, if required in the future, in addition to the two shims installed during initial construction.

The fence and gate topping wires, to which the barbed tape loops are attached, are to be tensioned to 1.0 to 1.2kN unless otherwise specified.

Barbed tape loops are to be positioned centrally across the three tensioned topping wires, and each loop is to overlap the adjacent loop by half its diameter. The loops are to be attached to the topping wires using crimped clips.

To reduce the final amount of deflection in the fence rails, during the installation of the welded mesh fences, the bottom horizontal rail shall be supported so that, after propping, tightening of the bolts,

aligning, and plumbing to the fence and before placing concrete to posts surround, there is a slight upward camber. The temporary props to the bottom rail shall be removed only after the concrete has been set.

### **7.7. Palisade fence**

The manufactured components of the palisade fencing, and gates shall be assembled to the details shown in the construction drawings and generally per the requirements of BS 1722-12.

Finished pales should be straight with no visible twist or warp.

Pale supporting rails are to be attached to the posts using 12 mm cup head square neck bolts and shear nuts. Shear head nuts, which leave a smooth dome-shaped nut after the hexagon part has been sheared off, shall be used. A thread-locking compound is to be applied to the threads of the bolts to minimise the possibility of the nuts becoming loose.

The bottom rails are also to be attached to intermediate supports, consisting of 16 mm diameter x 350 mm long galvanised bolts, the head ends of which are cast into the anti-tunnelling slab.

Pales are to be attached to the rails and gate frames using 8 mm diameter swaged pins and collar fixings with the head of the pins on the outside of the fence. The pins are to have a head shaped to fit the profile of the pales and are to have a minimal projection to minimise the possibility of tampering.

Pivot plates to receive the hinge pins are to be welded to the top and bottom of the vertical sections of the gate frames adjacent to the gate posts. The fixed parts of the hinges are to be bolted to the gate posts, with two 3mm shims installed between the hinges and the posts during initial construction to allow for future adjustment.

The top threads at the end of the bolts are to be burred over after installation to prevent easy removal of the nuts. The length of the bolts is to be such that the nuts could be loosened, and two extra 3 mm shims installed, if required in the future, in addition to the two shims installed during initial construction.

All threaded bolts used for attachment of fittings on fences and gates shall be sized correctly for clamp-on fittings and securely tightened with nuts fitted inside the fence.

To reduce the final amount of deflection in the fence rails, during the installation of the palisade fences, the bottom horizontal rail shall be supported so that, after propping, tightening of the bolts, aligning, and plumbing to the fence and before placing concrete to posts surround, there is a slight upward camber. The temporary props to the bottom rail shall be removed only after the concrete has been set.

### **7.8. Chain link fence**

The manufactured components of the chain link fencing and gates shall be assembled and installed to the details shown in the construction drawings and per the requirements of AS 1725.1.

### **7.9. Panel wall**

Prefabricated concrete wall panel shall be installed to the details shown in the construction drawings and per the requirements of AS 3610.1, AS 3850.2, National Code of Practice – Precast, Tilt-up and Concrete Elements in Building Construction and Technical Specification – Transmission Substation Concrete.

Proprietary Autoclaved Aerated Concrete (AAC) panels, where nominated, shall be installed strictly per the manufacturer's written instructions. The proposed installation methodology shall be submitted to the Western Power Representative for acceptance before the commencement of work.

### **7.10. Masonry wall**

The masonry wall where nominated shall be constructed to the details shown on the construction drawings and per the requirements of AS 3700.

Bricks and masonry blocks shall be from approved manufacturers and shall comply with the design requirements.

Unless otherwise specified, the minimum density and compressive strength of the masonry units shall be as shown in Table 5.1 of this specification. The mortar used in masonry construction shall be minimum class M3 (1cement:1lime:6sand) to AS 3700.

### **7.11. Boundary fence**

Details of the boundary fencing, including fence type, dimensions and supporting members, shall be as shown in the construction drawings.

Boundary fences, where nominated, shall be constructed to the details shown on the construction drawings and per the requirements of the relevant AS and local government authorities.

Proprietary boundary fencing materials shall be installed strictly per the manufacturer's written instructions. Material certificates, test reports and the proposed installation methodology shall be submitted to the Western Power Representative for acceptance before the commencement of work.

### **7.12. Temporary fence**

Temporary fencing, where specified/required, shall be constructed to maintain the site security during the construction. Standard chain link fence shall be used for temporary fencing as per details shown on the construction drawings. The manufacture and construction of temporary chain link fence shall be per Sections 6.4 and 7.8 of this specification. Temporary fences shall be removed upon completion of the construction works.

### **7.13. Vehicle barriers**

Vehicle/safety barriers, where nominated, shall be installed according to the details shown on the construction drawings.

Approved proprietary products may also be considered. Proprietary vehicle/safety barriers shall be installed strictly per the manufacturer's written instructions. Material certificates, test reports and the proposed installation methodology shall be submitted to the Western Power Representative for acceptance before the commencement of work.

### **7.14. Foundations and Concrete slabs**

#### **7.14.1. General**

The concrete used in the construction of the fence and gate footings and concrete slabs shall be per the construction drawings and Technical Specification – Transmission Substation Concrete.

Unless otherwise specified, concrete shall be 32MPa for the gate sills and other concrete elements, including post footings and anti-tunnelling slab.



### 7.14.2. Excavation and backfilling

Excavation for the post footings and concrete slabs shall be carried out according to the details shown on the drawings. Footing depths shown on the drawings shall be maintained at the shallowest part of an excavation if on sloping ground. Where required, all open excavations shall be suitably fenced and or adequately covered for personnel safety.

Suitable backfill shall be placed around the footings and compacted to the levels shown on the drawings. Care shall be taken to avoid damage to the concrete footings when depositing the backfill material. The compaction plant shall be selected depending on the type of material to be compacted and the difficulty in accessing areas within the excavation. See Technical Specification – Earthworks, Roads, and Drainage for more information.

### 7.14.3. Post footings

Posts for fences and gates shall be set in concrete, as shown on the construction drawings. After the installation of posts or stays, the complete excavation shall be filled with concrete and well compacted as the filling proceeds.

The posts are to be supported in a vertical position at the correct location and depth until the concrete has been set sufficiently to provide adequate support. The concrete for fence post footing is to be allowed to cure for a minimum of 7 days before the fence in-fills are installed. Gate post footings are to cure for a minimum of 14 days before the gates are fitted.

### 7.14.4. Anti-tunnelling slab

Anti-tunnelling slabs are to be installed as per the details shown on the construction drawings.

100 mm wide drainage gaps are to be provided in the slabs where nominated on the drawings. Where drainage gaps are not required, alternate control or expansion joints shall be installed in the slab between the fence posts.

### 7.14.5. Gate sills

Concrete sills are to be installed below the main and personnel gates, as shown on the construction drawings. The width of the sill is to match that of the anti-tunnelling slab below the fence unless otherwise specified. The drop bolt keeper for the main gate drop bolts is to be incorporated into the sill. Grooved drop bolt keepers shall also be installed to hold the main gates open at the angles required, as shown on the drawings.

## 7.15. Fence earthing

Fence and gate earthing shall be as per relevant earthing detail drawings.

Provision shall be made in the anti-tunnelling slab/post footings for earthing of the fence and gates as shown in the drawings. Unless otherwise specified, one 40 mm diameter flexible PVC conduit shall be installed in the anti-tunnelling slab/post footings to allow for the installation of earthing conductors. These are required at alternate in-line fence posts, corner fence posts and gate posts.

The conduits are to extend 50 mm from the top and side of the concrete. The below-ground ends shall emerge from the concrete on the outside of the fence at a depth of 500 mm below the finished ground level. The conduit bending radius within the concrete shall be 120 mm minimum.

The ends of the tubes are to be plugged or capped during construction to prevent ingress of concrete or other material.

### **7.16. Signage**

The signage and labelling for the substation fences and gates shall be provided as per the details shown on the construction drawings.

# Appendix A: Approval Record and Document Control<sup>6</sup>

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<sup>6</sup> See Western Power Internal Document

