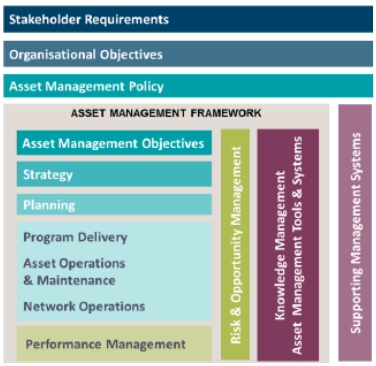
Transmission Substation Transportable Buildings

Design Standard (Technical Specification)



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Record of endorsement, approval, stakeholders, and notification list is provided in EDM# 53161262 appendix

RESPONSIBILITIES

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

CONTACT

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Revision Details

Version	Date	EDM Version	Description
0	January 2021	1	First Issue
1	March 2024	2	Standard Online Update

1. Introduction

This Technical Specification outlines the technical requirements for the design, construction, delivery, and installation of prefabricated transportable Switchroom and Relay room buildings for Western Power Transmission Substation projects.

1.1. Purpose and Scope

The requirements outlined in this specification are intended to cover the following areas associated with prefabricated transportable Switchroom and Relay room buildings:

- Design of transportable buildings for final-position, transport, storage and lifting stages
- Supply, fabricate, transport, store, delivery, and installation of transportable buildings

1.2. Acronyms

Acronym	Definition

1.3. Definitions

Terms and definitions used in this document

Term	Definition
AS	Australian Standard
CoC	Certificate of Completion
DS	Design Standard describes in detail a particular type of design. This is the "how" to implement a design with clear boundaries defined.
EDM	Enterprise Document Management
FRL	Fire Resistance Level as defined in the National Construction Code (NCC)
HMR	Hazard Management Register
HV	High Voltage
NATA	National Association of Testing Authorities, Australia
NCC	National Construction Code of Australia
SFAIRP	So Far As Is Reasonably Practicable
SiD	Safety in Design
SoW	Scope of Work

VESDA	Very Early Smoke Detection Apparatus

1.4. References

References which support implementation of this document

Table 1-1: References

Reference No.	Title

2. Supporting Documentation[1]

3. Compliance

3.1. General[2]

All temporary works, shop drawings, materials, plant, equipment, workmanship, fabrication, and installations must comply with the latest revision of 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 1163	Structural Steel Hollow Sections
AS 1170	Structural Design Actions, Parts 0-4
AS 1214	Hot-dip Galvanised coatings on threaded fasteners (ISO metric coarse thread series)
AS 1252	High Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering

[1] See Western Power Internal Document
[2] See Western Power Internal Document

Standard Number	Standard Title
AS 1554	Structural steel welding
AS 1657	Fixed platforms, walkways, stairways, and ladders- design, construction, and installation
AS 2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2550	Cranes, hoists, and winches – Safe use (series)
AS 3678	Structural Steel – Hot rolled plates, floor plates and slabs
AS 3679	Structural Steel – Hot rolled bars and sections
AS 3775	Chain sling for lifting purposes (series)
AS 4100	Steel Structures
AS 4291	Mechanical properties of fasteners made of carbon steel and alloy
AS 4600	Cold-formed steel structures
AS/NZS 5131	Structural steel works – Fabrication and erection
	National Code of Practice for Precast, Tilt-up and Concrete Elements in Building Construction
	National Transport Commission - Load Restrain Guide

3.2. Acceptance Criteria

Compliance with the requirements of this specification for design, materials, fabrication, construction, lifting and transport of transportable Switchroom and Relay room buildings shall be based on the minimum requirements and acceptance criteria set out in this specification, the construction SoW included in the project deliverables, and Australian and other relevant 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. Certification

The contractor shall submit test reports or certificates for all materials and manufactured components, including items supplied from overseas that are used in the design and fabrication of transportable Switchroom and Relay room buildings to the Western Power representative for acceptance. The documents

must state compliance with this specification and applicable Western Power technical documents, Australian Standards as described by these documents, and the project quality plan.

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.

4. Safety in Design[3]

The Safety in Design (SiD) process shall be adhered to in all design processes for designing the substation buildings. Any potential risks that may cause harm, affect the operation and maintenance of assets, or impact the environment or construction activities shall be identified during the design stages.

All projects are required to have a SiD Hazard Management Register (HMR) and these risks shall be registered in the HMR and eliminated or minimised so far as is reasonably practicable (SFAIRP).

5. Transportable Building Design

5.1. General Requirements[4]

Building layout shall be designed for the ultimate arrangement per the DS- Substation Buildings.

The designer shall read the building template drawings alongside this document. The template drawings shall be the base of any project-specific building design.

Transportable buildings must be elevated from the finished surface level using concrete pedestals to have a 1.8 m headroom clearance for maintenance access.

5.2. Loading Criteria

5.2.1. General

Transportable Switchroom and Relay room buildings shall be designed to withstand all applicable loads during lifting, transport, and storage, and installation into the final position. The loading criteria which have been specified in DS-Transmission Substation Buildings shall be adhered in design of transportable Switchroom/Relay room buildings.

5.2.2. Load Combinations

The load combinations shall be per DS- Substation Buildings.

5.3. Design Criteria

5.3.1. General[5]

The transportable Switchroom and Relay room buildings shall be designed based on the building layout to current limit state design requirements.

Transportable buildings shall be designed to ultimate and serviceability limit state conditions stated in Section 5.3.2 and Section 5.3.3.

[3] See Western Power Internal Document
[4] See Western Power Internal Document
[5] See Western Power Internal Document

5.3.2. Ultimate limit states

This corresponds to the maximum load-carrying resistance of a structure or section of a structure and shall be considered for stability and strength limit state conditions stated in Section 5.3.2.1 and Section 5.3.2.2.

5.3.2.1. Stability limit state

The structure as a whole or any part shall be designed to prevent instability due to overturning, uplift and sliding.

5.3.2.2. Strength limit state

The structures, including all members, connections and holding down bolts, shall be designed to this state, with consideration of the limit state of collapse, it shall be confirmed that:

$$R_d \geq E_d$$

Where,

R_d = design capacity

E_d = design action effect

The following, but not limited to, actions shall be checked and satisfied where applicable:

- Bending
- Shear
- Punching shear
- Axial forces

5.3.3. Serviceability limit states

This corresponds to conditions beyond which the structure cannot perform adequately for normal use under expected actions.

The designer needs to consider all the factors that may deteriorate the structural adequacy of the structure over the intended design life of the structure and incorporate appropriate measures to mitigate any adverse effects. Such factors may include, but not limited to, the following:

- Deflection

  The base frame of the Switchroom and Relay room buildings shall be designed to limit the deflection to no more than 1mm for each span with all equipment installed under all support conditions such as lifting, transport, storage, and final position.
- Corrosion
- Creep

5.3.4. Structural Design

The building and all elements shall be designed to withstand all applicable permanent and lateral loads during the stages of lifting, transport, storage, installation, and final position as part of the permanent structure.

The prefabricated building must have designated lifting and jacking points and withstand the forces expected during transportation, storage, and installation.

5.3.4.1. Building stability

The building shall be designed so that it is not prone to progressive collapse following a substation fire. Structural redundancy, such as bracing, shall be incorporated into the structural system to ensure the building is robust enough.

All load paths shall be considered and determined before commencing the detailed design.

5.3.4.2. Structural system

Flooring system:

The transportable building shall have a robust steel perimeter base frame, as the fully loaded building is to be supported by its longitudinal perimeter members.

The base-frame design must assume supports will only be provided at the longitudinal building extremities.

The building base-frame shall be designed with hot-rolled open sections with bolted connections, including longitudinal and transverse beams and floor joists, to allow hot-dip galvanising. It shall be designed for all possible support conditions, including lifting with a crane, jacking and skating, and final position.

Cold-formed and hollow sections shall not be used in the floor structure.

Floor penetrations shall be designed based on the equipment layout and required cable entries.

Equipment shall be secured to the floor structure using holding-down bolts. The building design and drawings must note any restrictions on floor loading and equipment securing.

Access platforms and stairs shall be designed per architectural drawings.

The platform gratings and handrails shall be designed of fibre-reinforced plastic material.

The base frame must be hot-dipped galvanised; painting treatment is not acceptable.

Wall system:

The transportable building shall be designed as a fully fitted steel stud frame type per all relevant Australian Standards.

Wall penetrations shall be designed for switchboard arc ducts and cable entries.

Supported overhead horizontal cable ladders from the wall/ceiling shall be installed below the ceiling and designed to support cables, including future installations. The wall or ceiling-mounted supports must be designed accordingly.

Vertical cable ladders shall be installed above each main floor for secondary cable entry.

The building shall incorporate support rails for cable ladders and wall-mounted electrical equipment capable of carrying the applicable loads.

Roof/Ceiling system:

The roof of the Switchroom/Relay room building shall be designed as per architectural drawings. Any gaps shall be sealed to prevent rainwater from blowing back at overhangs and barge capping. The ceiling shall be horizontal rather than following the slope of the roof.

An appropriate restraint system shall be designed to allow safe roof access for maintenance activities where required in compliance with Code of Practice-Prevention of Falls at Workplaces requirements and AS 1891. Layout of the access and anchorage point shall be provided on the design drawings.

5.4. Lifting, Transport and Final-position Design

The contractor shall design the transportable buildings, fitted with all building services, and required electrical equipment, according to the building layouts to withstand all applicable loads per this document for lifting, transport, storage, and final position conditions.

The contractor shall design the building so it can be lifted by a crane or jack and skating system.

5.5. Installation design

The contractor shall design the installation process, including, but not limited to, the following:

- Temporary storage of the building in the factory
- Lifting design and rigging configuration
- Transport
- Crane size and mobility
- Lifting layout, including the possible crane position, truck location and all site restrictions
- Safe work method statement
- Temporary bracing design and layout, if required
- Construction sequence

The contractor shall ensure that building stability is not compromised during manufacturing, storage, transportation, and installation.

The contractor shall submit a lifting plan per Technical Specification-Transmission Substation Lifting Requirements.

5.6. Building Services

Building services shall be designed per DS-Substation Buildings.

5.7. Fire Protection

Fire protection shall be designed per DS-Substation Buildings.

5.8. Amenities

Relay room amenities shall be designed per DS-Substation Building.

5.9. Battery room

Battery room design shall be per DS-Substation Building.

5.10. Sealing[6]

Cable sealing shall be designed per DS-Substation Building.

Roxtec sealing system shall be used for sealing the secondary cables entry to ensure the cable entry cut-out is weather and vermin protected. The size and quantity of the cables and any possible future needs shall be considered in the Roxtec sealing system design.

The contractor shall design sealing system for HV cables entering the Switchroom building through the floor to prevent dust and vermin ingression.

5.11. Earthing

The Switchroom/Relay room building earthing design shall in accordance with DS-Earthing Design-Transmission Substations.

5.12. Building Signage and Labelling

Building signage and labelling shall be designed per DS-Substation Building.

5.13. Project Deliverables

The following, but not limited to, calculation and drawings for transportable buildings shall be provided which shall become Western Power intellectual property (IP).

5.13.1. Calculation and Reports

- Building holding down design including holding down bolts calculation in accordance with DS-Substation Foundation and Structures.
- Structure analysis and calculation including the major and minor structural elements, base frame, beam to column connection, bracing connections, splices, and weld design.
- Digital files of the structure analysis software.
- Structural design report
- All required serviceability checks
- Lifting design including the following:
    a. lifting/jacking points
    b. lifting method statement
    c. lifting bracket details
    d. Centre of gravity
    e. Rigging plans
- Transport plan method statement
- Jacking and skating method
- HVAC design report
- Vesda design report
- HMR

[6] See Western Power Internal Document

5.13.2. Drawings

Drawings shall be submitted in digital format per DS-Computer Aided Design.

- General building arrangement and setting out details
- Building layout, elevations, and sections
- Floor plans and details including openings and setting out dimensions
- Roof plans and details including sealing and flashings
- Ceiling plans and details
- Cladding details
- Wall and door details
- Steel shop drawings
- Cable ladder support details layout and details
- Light and power arrangement and details
- A/C details
- VESDA system details
- Earthing details

6. Building Fabrication and Supply

6.1. General

All structural steelwork for the Western Power transportable Switchroom/Relay room building shall be fabricated as shown on the construction drawings, per Technical Specification-Transmission Substation Structural Steelworks requirements and AS/NZS 5131.

6.2. Material

The construction materials shall comply with Western Power fire resistance requirements, design life and aesthetics as specified by Western Power.

All materials used for building construction shall be free from Asbestos or Asbestos-related products.

Timber building material shall not be used in construction of the building due to the risk of fire ignition during a fire.

Combustible material shall not be used in construction.

6.3. Flooring System

The floor shall consist of compressed fibre cement (CFC) sheets of a minimum thickness of 20 mm, fixed per manufacturer's instructions. All edges of the CFC sheets must be supported by sub-floor steelwork and joints between sheets must be fully sealed with epoxy or mastic (fixed sheets) or compressible foam strips (removable panels 'R' behind switchgear) to form a weatherproof floor. All joints must be sanded flush.

The floor must be finished with 2 mm Armalon grey homogeneous vinyl, professionally installed with seam-welded joints, extending 100 mm up the wall with 25 mm coving at the joint between floor and wall.

6.4. Wall

All gaps shall be sealed as required to prevent the blowback of rainwater into the building.

The walls shall have the following general specifications:

- The interior and exterior linings of the wall are to be finished with pre-painted zincalume steel
- The external wall profile must run vertically with a male/female vertical edge connection that must be sealed to prevent the ingress of dust and vermin
- The internal wall profile must run vertically with a male/female vertical edge connection
- Flashing shall be provided around the arc duct opening and all doors

6.5. Doors

The doors shall have seals all around, effectively preventing rain and dust penetration. The door furniture shall be Lockwood satin chrome. Western Power will supply door cylinders and keys only for installation by the Contractor. The door furniture and finishing shall be per the drawings provided by Western Power.

6.6. Roof

The roof is to be clad externally with a pre-painted steel Custom Orb profile. The roof sheets are to be dressed at the end using filler foam and installed per the manufacturer's instructions. Due to transport restrictions , there will be no eaves on the buildings, but a small overhang may be included in the design to keep out rainwater.

The roof will have the following general specifications:

- Gutters and down-pipes are required
- The internal ceiling profile shall be the same as the internal walls
- All external flashings will be fabricated from matching Colourbond flashing

6.7. Electrical works

All electrical works shall comply with AS3000.The cabling shall be run under the floor or through the walls/roof space to minimise the conduits in the building.

The Contractor shall terminate cables in the building in an eighteen (18) way 415 volt AC MCB distribution board, which will have spare MCBs for Western Power purposes.

A commercial-grade metal distribution board is to be provided with door and escutcheons in PC steel.

The Contractor shall include an emergency light test function.

The installation of a three-phase power supply to each distribution board will be carried out by others on site.

The Contractor shall label each pole per AS3000, and labels shall be supplied for each electrical device (e.g., GPO's, air conditioners, light switches) identifying the circuit.

Electrical requirements shall include the following:

- Internal lights

- 100W weatherproof bulkhead light over external doors
- 2-way switching of room lighting
- Lockable isolation switches shall be provided for air conditioners
- General purpose double outlets (GPO's)
- Three phase 20 Amp outlets in each building

7. Transport and Cranage

7.1. General

The Contractor shall be responsible for all requirements, including approvals, inductions, and resources required to transport the Switchroom/Relay room building to the Destination and locate them on the footings.

The Contractor is responsible for satisfying themself regarding the adequacy of the roads to access and available space within the Destinations to allow the completion of the delivery and placement activities.

The Contractor shall arrange the following:

- Written contact with Western Power's Representative to confirm the proposed delivery arrangements at least seven calendar (7) days before the proposed delivery and unloading for Western Power review
- Protection from damage to all fittings and building components during the loading, transportation and unloading activity
- Attendance of any personnel at any induction courses required for access to and working on site
- All cranage, slings, spreader beams, shackles, and qualified riggers for loading the building(s) at the construction/storage site and unloading at the Destination as described above
- All licenses and permits necessary for the loading, transport, delivery, and placement of the building(s), including the personnel and mechanical plant involved in the activity
- Compliance with transport conditions of all appropriate authorities, including restrictions for specific times or days and protection of all service authorities and private assets affected by the delivery process
- All attendance by police or private transport escorts and backup services as required for transport
- Any temporary storage, and security from damage for the buildings during and after delivery until they are placed satisfactorily on the foundations
- Transport, delivery to the Destination, unloading and installation of all associated specified equipment including air conditioning units

Appendix A: Approval Record and Document Control[7]

[7] See Western Power Internal Document