

Snowy Technical Standards

SHL-ELE-156 (A)

**Annexure A - Switchrooms
General Low Voltage Electrical Requirements**

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This annexure forms part of the General Low Voltage Electrical Requirements Standard ([SHL-ELE-156](#)).

1. Scope

This Annexure sets out the requirements for switchrooms.

Switchrooms must be designed and constructed conforming to the General Electrical Requirements and this Annexure.

1.1. Applicable Standards

The design, manufacture and testing of equipment and components detailed in this annexure must comply with the requirements of all relevant Australian Standards or in the absence of appropriate Australian Standards, with relevant IEC, ISO or International Standard, together with the requirements of competent authorities having jurisdiction over all or part of the manufacture, installation or operation of the equipment, except where modified by this specification.

All works must comply with the requirements of the most recent releases of the regulations and standards noted in Snowy Standard [SHL-ELE-156](#). In the event of a conflict between different Codes, Standards or Regulations, the highest requirement must apply.

2. Safety Requirements

Switchrooms must be designed, manufactured and tested with the safety requirements detailed in the General Low Voltage Electrical Requirements ([SHL-ELE-156](#)). At a minimum, switchrooms must include the following safety features:

- Portable fire extinguishers
- Smoke detectors and alarms for remote monitoring and indication
- Safety escape luminaires with integral 2 hours battery backup and charger.
- Emergency and exit light with integral 2 hours battery backup and charger.
- Laminated Single Line Diagram (latest version) displayed in a prominent position.

3. Technical Requirements

3.1. Design Criteria

The equipment shall be designed for a minimum life duration of 20 years in the environment.

The design parameters, including specific equipment requirements are specified in this Annexure. The equipment must meet all the design criteria taking into account:

The design of the switchrooms must conform to the requirements of the National Construction Code NCC and AS 2067.

Floors must be designed for the following loads:

- Dead loads due to installed switchboards, assuming 100% utilisation of available board area.
- Live load of 5.0kPa across the full floor area.
- Rolling point loads imposed by installation of switchboards. Switchboards may be maneuvered into position by rollers.
- Site climatic, wind and seismic conditions as specified in the Site Specific Requirements

All product and equipment must be designed or selected so as to be readily available within Australia. Components must be standardised as much as possible

3.2. Classification of a Switchroom Building

The switch room shall be designed and rated according to the definition of a plant room per NCC Volume 1 and include the following:

- 2 hours fire rated, non-combustible walls, ceiling, floors and doors and include R2.5 insulation.
- Full compliance with C1.1 – Fire resistant construction.
- Full compliance with Switchroom Manufacturer’s specification, that the product performs as tested to AS 1530 series of standards.

3.3. Site Climatic Conditions

All switchroom components shall be selected and installed such that the equipment can operate at the full load rating at the worst climatic extreme detailed in the table below.

Condition	Detail	Value
Location	Southern NSW	-
	South Eastern SA	-
	Southern Victoria	-
Altitude	Above mean sea level	0-1000m ¹
Ambient Temperature (Dry bulb)	Minimum – Indoor	-5°C
	Minimum – Outdoor	-15°C
	Typical Maximum	35°C
	Extreme Maximum	40°C
Relative Humidity	Minimum	10%
	Maximum – Indoor Maximum – Outdoor	50% 100%

¹ The altitude of any Snowy Scheme installations above 1000m are detailed in the project specific documentation.

3.4. General

The switch room and equipment installed within the switch room shall be new and compliant with relevant Australian Standards for its operational duty. The switch room and its equipment shall be installed so that it maintains its operational rating when fully loaded and ambient temperature is at maximum.

Switchroom buildings must be dimensioned to suit:

- Internal MCCs, switchboards, equipment, etc, and required clearances dimensions
- Internal ceiling height of 3000mm
- Future equipment
- Cable access preferably is to be through penetrations in the building floor.

Switchrooms must be designed to minimise dust ingress. Internal walls and floors are to be insulated with R2.5 blankets to the wall cavities and the ceiling is to be insulated with R2.5 blankets to the ceiling cavities.

3.5. Fire Rating

The switch room must have a fire rating of at least two hours.

Where penetrations are made in the switch room walls, floors or ceiling, suitable permanent sealing methods must be used to maintain the fire rating (i.e. fire/smoke dampers, gland plates, sealants). Penetrations shall be designed to maintain the building fire rating. All proposed sealing methods must be approved by SHL. The finalised sealed penetration must be certified to verify that the work was undertaken in accordance with the manufacturer's requirements.

3.6. Corrosion Proofing

All finished work must have corrosion protected surfaces or, alternatively, be fabricated using corrosion free materials.

3.7. Painting Specifications

For painting specification refer to [SHL-ELE-123 Protective Coatings](#).

3.8. Access and Egress

As a minimum, doors must be located at each end of the switch room to facilitate safe evacuation of personnel in case of a fire and at each end of the building if there are internal walls. For larger switchrooms additional evacuation doors may be required. Exceptions may apply as described in AS 3000: 2018 Section 2.10.2 (c) (iii).

The switch room door openings must be sized to allow the installation of switchgear.

External doors must:

- Provide a minimum 2 hour fire rating,
- Outwards openings to 180 degrees in the direction of egress,
- Key locks fitted to prevent unauthorised access (Locks must be keyed to the site standard)
- Three heavy gauge hinges per door leaf
- Internal panic bars used for emergency egress,
- Dust/weather seals to door frame

All doors must be fitted with automatic self-closing mechanisms. Facilities must also be provided to hold the doors in the open position. These door holding facilities must release the door to the closed position in the event of a fire.

Door frames and edging must be heavy duty aluminium or powder coated galvanised steel to a minimum thickness of 1.0 mm

At a minimum, egress path shall be provided such that the failure of any item of equipment will not prevent the unimpeded egress from the work area.

Access areas shall be adequately dimensioned for carrying out work, operating switchgear and transporting equipment and to enable work to be carried out safely. Space for evacuation shall be at least 600mm, even when removable parts or open doors, which are blocked in the direction of escape, intrude into the escape routes.

3.9. Steps and Landings

Where required, steps and landing must be included in the design for personnel and equipment access to all doors.

3.10. Light and Power

3.10.1. Internal Lighting

Consideration must be given to the use of LED fittings for internal lighting and is preferred by SHL. Light fittings may be twin 36W fluorescent batten type fittings with prismatic diffusers if an equivalent LED fitting cannot be sourced. Fittings must be minimum IP 56 rated. The illumination level inside each switch room and external landing must be not less than 400 lux. The number of light fittings must be calculated based upon a maintenance factor of 0.7 and lamp loss factor of 0.75. Lighting must be protected by 30mA earth leakage circuit breakers.

Emergency lighting with battery backup must also be provided. Emergency lighting must provide a minimum light level and duration as required by the NCC inside the building. Provision must be made in the lighting distribution board for facilities to test the emergency lights and earth leakage circuit breaker protective device..

Internal switch room lighting must be two-way switched. Switches must be mounted at each entrance and at the internal partition between interconnected rooms. Light switches must be installed at a height of 1350mm above floor level. Lights must be fed from a local light and power distribution switchboard located within the room

3.10.2. Network Socket Outlets

Two off flush mounted RJ-45 structured cabling outlets shall be provided for business laptop computer and IP telephone connections or as specified in the project documentation. Where a desk is specified the RJ-45 outlets shall be mounted on the wall above the top of the desk.

3.10.3. General Power Distribution

Double single phase socket outlets must be mounted at 5 metre intervals along the switch room building interior walls. These outlets must be rated 10 Amps at 250VAC. Socket outlets must be protected by 30mA earth leakage circuit breakers.

It is preferred that all switchroom wiring is contained within the wall cavities or within the floor structure. Where required, surface mounted conduit, tray or ducting is acceptable and must be in accordance with Annexure [D](#) – Low Voltage Cables and Cable Management Systems.

A light and power distribution board must be provided for the switchroom. The light and power board must comply with [Annexure M](#) – Lighting and Power.

3.10.4. Emergency Lighting

Emergency EXIT lights must be provided above all exits within the switch room and must be wall mounted.

Emergency escape lighting must be provided to provide illumination for safe egress of the switchroom. The quantity and types of emergency shall be determined in accordance with AS 2293.

As a minimum emergency light fittings must be located adjacent to each High Voltage and/or Low Voltage main incomer circuit breaker and the Fire Indicator Panel.

Emergency lighting must provide a minimum light level of 400 Lux inside the switchroom. Emergency lighting must provide a minimum hold up time of 90 minutes in accordance with AS 2293. Provision shall be made in the lighting distribution board for facilities to test the emergency lighting.

3.11. Earthing

The building shall be supplied with a tinned copper earth bar, wall mounted and installed within the room to facilitate earth connection to all switchroom electrical equipment. Where the building contains both an LV and HV switchroom, a separate earth bar in each switch room shall be provided.

The earth bar shall be sized and pre-drilled to facilitate the termination of all earthing conductors plus additional 10% spare terminations. Only one earth conductor shall be terminated at each connection point onto the earth bar.

Note – A continuous 25x3mm earth strap within the switch room for equipotential bonding shall be provided for power station switchrooms.

3.12. Cables and Cable Ladders

Interconnecting power and control/signal cables between equipment within the switch room must be routed via gland plates through the baseframe structure on cable ladder or on cable ladder installed within the switch room space routed above the equipment.

A system of cable ladder must be installed within the baseframe of the switchroom. These ladders must be located adjacent to the gland plate and must not obscure access to any gland plate from directly under the switchroom.

Cable ladder installed within the switch room must be coordinated with top entry cable entry to equipment and switchroom services such as lighting, fire detection and ducts associated with the air conditioning and ventilation system.

Cable entry via cable trenches are an acceptable entry method for ground floor switchrooms. Cable trenches shall be designed to support the load of any equipment installed above the trench.

Cables must enter and exit the equipment located within the switch room by bottom entry through gland plates. Gland plates must be bolted to the underside of the floor joists in an approved manner. All gland plates must be complete with a welded earth stud and bolted flexible earth conductor connected to the earth bar within the

electrical equipment above the gland plate. Each gland plate must include a complete all-round gasketed edge to seal the switchroom against dust.

All LV cabling must be in accordance with the [Annexure D](#) – Low Voltage Cables and Cable Management Systems.

3.13. Air Conditioning and Ventilation

The switch room building should be fully air conditioned or provided with a suitable means of mechanical ventilation. Where the switch room is not fully air conditioned, heat load calculations must be undertaken to demonstrate that the internal room temperature will not exceed 25°C with the installed electrical equipment operating at 100% load. All switch room air conditioners shall be installed with N+1 redundant refrigerated closed circuit split system reverse cycle HVAC units.

The switch room heat load calculations must determine the maximum heat load of the switch room and include an additional 20% safety margin for future expansion/ growth.

Where mechanical ventilation is utilised, combined fire and smoke dampers must be installed in all ductwork entering the switchroom. The combined fire and smoke dampers must maintain the switch room fire rating and comply with AS 1682. Appropriate filters must be provided with a mechanical ventilation to prevent the ingress of dust.

Air conditioners shall not be installed above switchboards, electrical enclosures or electrical equipment, unless there is no feasible alternative location and the location is approved by SHL. In this instance, the air conditioner shall be provided with an external drip tray draining to a safe location.

The air conditioning system must be designed to maintain the internal room temperature at 25°C with the installed electrical equipment operating at 100% load and the worst site outside air conditions. The system must be capable of maintaining the internal temperature with a single air conditioning unit offline (faulted, isolated for maintenance, etc). The air conditioning system shall retain temperature settings and automatically resume operation after power supply interruption.

A room temperature transmitter shall be provided in each switch room and wired to a local PLC I/O card. The temperature transmitter shall provide a 4-20mA signal for monitoring from the local PLC control system. A high temperature warning shall be configured in the PLC system.

The condensate drain from the air conditioning units shall be connected to the site drainage system.

Air conditioners/ducts must be located internally to facilitate adequate air movement / turnover, and to target high heat generating equipment, e.g. VSDs. Condensers must be suitable for outdoor installation and operation, and located so as not to interfere with cables and cable supports under the switchroom. A lockable local isolator must be fitted adjacent to each compressor for isolation of the electrical supply.

Air conditioning equipment must be automatically shut down by the fire system.

3.14. Fire Detection and Suppression System

3.14.1. Design

Switchrooms must have fire detection and suppression systems designed by suitably qualified engineers.

3.14.2. Fire Indicator Panel

The fire detection system must be a microprocessor based with a Fire Indication Panel (FIP). The FIP must be

provided in a metal wall mounted cubicle complete with battery backup and LED indicators and controls. As a minimum the indicators must include Power On, Charger High/Low and Battery Fail. Manual controls must be provided for battery test, reset and lamp test.

Mimic Panels

The fire detection system must interface with the control system to provide indication and status of the switch room fire detection system. If interfacing with the existing panel is not practical, the panel must be upgraded or a new separate panel must be installed in the site control room.

3.14.3. Detectors

The switch room must be provided with either a combination of ionisation smoke detectors and thermal detection per room and a VESDA or approved equivalent fire detection sniffer system installed in the switchroom, within the LV MCC tiers and all other electrical panels including any VSD panels.

The VESDA must be of a type design, manufactured and tested to comply with AS 1603.

Two spare volt free fire alarm contacts must be provided.

On fire detection, the systems will:

- Trip incoming power to at MCC main circuit breaker;
- Shutdown air conditioning units;
- Release hold on open doors;
- Activate a local strobe mounted above the switch room door;
- Activate a local siren mounted above the switch room door; and
- Activate the suppression system.

Certificates of Conformity detailing the compliance with the standard must be provided. Certificates of Conformity must be issued by an accredited testing authority

Sampling Pipework

The response time for the least favourable sampling point in the system must not exceed 90 seconds and the system must be balanced so that the volume of air drawn from the last sampling point must not be less than 60% of the volume from the first sampling point.

Drawings of the pipework design showing the proposed layout and supporting calculation showing response times and balance details of each sampling point must be provided.

All piping must be supplied and installed in accordance with AS 2032. The main sampling pipes must be grey/white of the PVC electrical type to AS 2053.2 of 25mm nominal diameter and must be identified as fire detection sampling pipe at intervals not exceeding 600 mm for the entire length.

All sampling pipes must be coloured red or have visible red markers at least 2 mm side, longitudinally along the pipe length.

All changes of direction must be made with long radius bends and tees. Proprietary branching pieces are acceptable.

The far end of each trunk or branch pipe must be fitted with an end cap and drilled with a hole or holes appropriately sized to achieve the performance as specified and as calculated by the system design.

All joints must be airtight and made by using solvent cement, except at the point of entry to the detector enclosure.

All pipework must be supported at not less than 2000mm centres.

Each sampling point must be identified with appropriate labelling. The number of sampling points and the distance of the sampling points from the ceiling or roof structure must comply with AS 1670.1

3.14.4. Fire Suppression System

The fire suppression system must be of FM200 type or an approved equivalent. The gas bottles must be stored under the switchroom or adjacent to the switchroom exterior walls. As a minimum the fire suppression system must include:

- A combined break glass and gas isolate station at each door internal to the room,
- An "Extinguishing System Inoperative" illuminated sign internal and external to the room,
- A "Fire Alarm Evacuate Area" illuminated sign internal to the room,
- A "Do Not Enter Gas Discharged" illuminated sign external to the room,
- A break glass at each access door external to the building to extinguish the "Do Not Enter Gas Discharged" illuminated sign

3.14.5. Manual Call Points

The switch room must be fitted with manual call points mounted on the wall at positions inside and outside of all personnel exit doors. Manual call points must be red and complete with a weatherproof kit. All manual call points must comply with AS 1603.5.

3.14.6. Magnetic Door Holders

Each switch room access door must be fitted with a keyed lock and a magnetic lock fitted to the door head. In the case where the switch room includes a separate HV and LV room the personnel access doors leading into these rooms must each be fitted with the specified magnetic locks and standard passage lock. A card reader must be fitted to the external wall adjacent to the door. A reed switch must be fitted to the door jam to sense when the door is closed.

A local control box must be wall recessed inside the switch room adjacent to the door. All three components must be wired to the control box and a 25mm conduit c/w draw wire must be installed within the switch room fabric between the control box and the nearest cable gland plate.

The magnetic lock must be fail safe, i.e. when power fails, the lock releases.

All keyed locks must be keyed alike, a minimum of Six (6) copies of the key must be supplied to the Principal prior to the first delivery. The keyed locks must be used for construction access.

3.14.7. Power Supplies and Batteries

The system must be powered from a self-contained regulated 24V DC supply located within each detector or controller assembly. The batteries must be of the sealed type with a design life of five years and must be sized to:

- Maintain the complete system continually for a minimum of twenty-four hours
- Maintain the complete system, including all ancillary warning devices in full alarm condition for at least two hours after the twenty-four hour period.

3.14.8. Fire Cabling

Fire rated cabling must be used for connection of fire detection and suppression systems. Refer to [Annexure D](#) – Low Voltage Cables and Cable Management Systems for specific requirements for fire cables.

3.15. Lightning Protection

The switch room lightning protection system must provide protection against lightning strikes in accordance with AS 1768.

A lightning system assessment report in accordance with AS 1768 shall be provided. If the results of the assessment indicate that lightning protection is required, the lightning protection solution must be in accordance with AS 1768. A detailed lightning protection design shall be provided, including design calculations, schematics and equipment schedule.

Buildings, structures and plants must be protected against lightning strikes by air termination and must be bonded to earth by down conductors. Vertical air terminations must consist of a single copper rod in accordance with AS 1768. Removable test links must be installed in every down conductor.

Earth rods must be housed in inspection pads clearly labelled 'Lightning Protection Earth'.

The lightning protection system is bonded to all services as described in AS 1768.

3.16. Safety Equipment

Portable wall mounted fire extinguishers must be provided inside the switchroom and any other internal rooms. The fire extinguishers must be located adjacent to each access door. Each fire extinguisher must be a 9kg dry type suitable for electrical fires and have operating instructions on the cylinder.

An AS 4836 compliant switchboard Low Voltage Rescue kit must be installed on an inside wall adjacent to the entrances to the switch room. Above the LV switchboard recovery kit is to be a sign showing the location and the correct operation of the kit.

A dedicated storage cabinet within the switch room should be considered to house Arc Flash PPE.

3.17. Flooring

Generally, internal floors shall be constructed from CFC sheet screw fastened to supporting joints. Switch Room access flooring (false flooring) is an acceptable alternative and must be approved by SHL. Access floors and landings shall be designed to allow for future removal and installation of the demountable equipment on site. All flooring shall be designed to withstand loading from lifting, transport, in-service conditions and removal/ installation of equipment in situ.

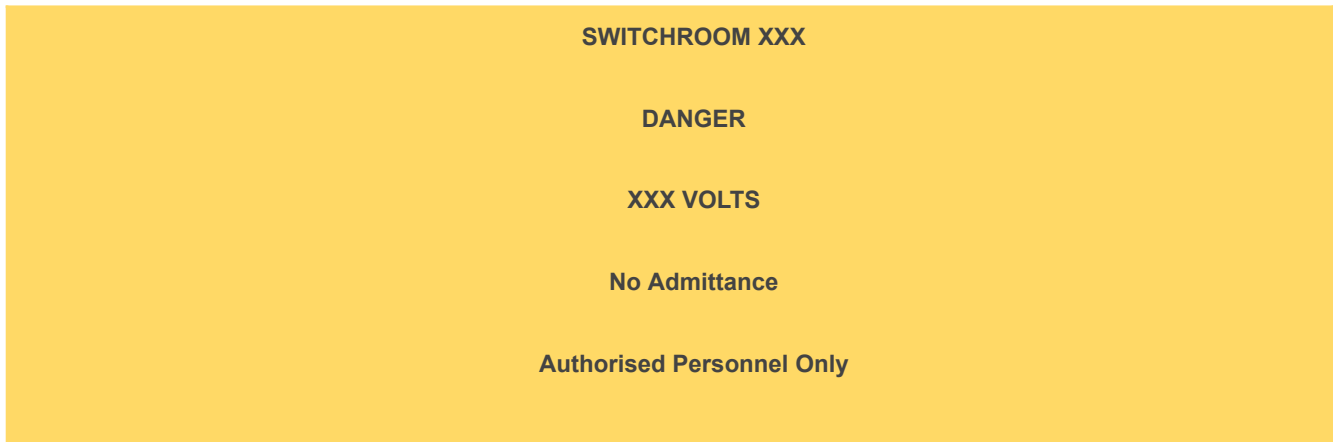
The switch room floor shall have a maximum tolerance of $\pm 1\text{mm/metre}$ in all directions across the switch room with a maximum deflection of $\pm 3\text{mm}$ over the entire length and width of the switchroom.

Cable openings for switchgear and switchboards cable entries shall have removable panels fitted. The panels shall be made from the same material as the flooring and covered with the same coating material as the floor.

3.18. Signs/Notices

All switch room building doors must have labels fitted to indicate that the building is a restricted area. All signs and notices shall meet the requirements of AS 3000 and AS 2067.

Danger signs, in accordance with AS 3000 and the requirements given in AS 1319, must be fitted to each door providing access into the switch room including internal doors. All switch room building doors shall have labels fitted to indicate that the building is a restricted area. Each sign must read similar to:



In addition to operating instructions on portable fire extinguisher cylinders, labels providing appropriate operating instructions must also be fixed to the wall adjacent to these units. Labels to be provided in accordance with AS2444.

Resuscitation signs, explaining treatment in case of persons suffering an electric shock, must be mounted at each end of the switchroom. Above the switchboard recovery kit must be a sign showing the location and the correct operation of the kit.

Illuminated Exit signs must be installed above each access door.

3.19. Miscellaneous

All switchrooms must include a cabinet to store current drawings. All cabinets and other fittings must be constructed from non-combustible materials.

3.20. Specific Requirements for Battery Rooms

Switchrooms specifically designed for the installation of batteries must also meet the requirements of AS 2676 and [Annexure J](#) – DC supplies.

3.21. Specific Requirements for Transportable Switchrooms

Transportable switchrooms must:

- be dimensioned to suit road transport to site
- be weatherproof, prefabricated constructions suitable for transporting to site and mounting on a structural steel frame.
- be transported to site complete, with preinstalled MCC, switchboards, and equipment wherever possible

3.21.1. Construction

Wall and Ceilings

Transportable switchroom wall and ceiling panels must have exterior and interior metal skins with a minimum core insulation thickness of 50mm. All metal skins must be:

- At least 0.5mm thick
- Fixed at centres not less than 200mm
- Must be earthed
- The internal metal skins must be Colorbond steel, in white.
- Wall and ceiling cavities must be insulated to provide a minimum thermal performance rating of not less than R2.5

The roof shall be of similar constructions to the walls including two hours fire rating. Falls shall be in accordance with the cladding manufacturer's recommendations.

Stormwater

The roof shall include gutters and downpipes finished ground level for connection on site to the site stormwater drainage system.

Exterior Walls and Roof

The external metal skins must be Colorbond steel coloured to the following:

- Sides: Mist Green;
- Roof: Birch Grey;
- Trim: Caulfield Green.
- The transportable switchroom roof must be pitched and guttered with access awning to doorways.
- External doors must be constructed with a high-density foam core sandwiched between Colorbond metal sheeting of 0.5mm minimum thickness

Switchroom Base

The base of the transportable switchroom building must have a perimeter frame constructed on parallel steel beams with floor joists spaced no more than 1000 mm apart. Where the floor is supporting heavy switchgear panels, steel joists must be spaced to match the edge of each panel. If the base is too large to handle, it may be fabricated in pieces and bolted together after galvanising.

Cable penetrations through the floor must be clear of obstructions. The penetrations must be located and dimensioned to suit the installed equipment, and to accommodate future extensions to the switchgear and switchboards.

The steel support frame for the building, including the ceiling supports, must be effectively earthed to the base frame. A 19mm x 50mm galvanised threaded steel stud must be welded to each end of the base support structure for site earthing. The studs must be fitted with two galvanised flat and one galvanised spring washer and two galvanised nuts.

Flooring

The wearing floor surface must be compressed fibrous cement board with a minimum thickness of 18mm and must be coated with a wear resistant 2 mm thick seam welded industrial vinyl. The vinyl must cover all floor surfaces including the first 100mm from the floor of all of the interior walls.

Switch Room access flooring (false flooring) is an acceptable alternative and must be approved by SHL. Access flooring and landings shall be designed to allow for future removal and installation of the demountable equipment on site.

Foundations

The switch room building must be mounted on a steel structure designed to carry the full weight of the switch room with all switchboards and switchgear mounted.

3.21.2. External Lighting

Entrances to the transportable switchrooms must be fitted with external weatherproof fluorescent or LED luminaires mounted above the doorways, maintenance access to external fixtures and fitting must not require the use of a ladder unless approved by the SHL.

External lighting must be individually switched with a switch inside each door.

3.22. Documentation

At a minimum, the following documentation shall be provided with the design and installation of the switchroom:

- Design report and accompanying certifying documents
- Shop drawings
- Floor plan
- AS 1768 lightning protection report, schematics and equipment schedule
- Elevation drawings
- Section drawings
- Fire services layout drawing
- Lighting layout drawing
- HVAC layout drawing
- Floor structural design drawings
- Floor supports, staircase and access platform structural design drawing
- Equipment General Arrangement (internal and external)
- Cable schedule for building services
- Equipment list for mechanical and electrical items
- Label list including label text and text size, overall dimensions, colour material and fixing method.
- O&M manuals.