Part of Energy Queensland

Substation Standard

Standard for Substation Fire and Explosion Protection (STNW3035)

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Abstract: The aim of this document is to establish guidelines for substation fire and explosion detection and suppression systems within Energy Queensland, with the objective of providing safety to personnel, the general public and restricting the extent of damage to assets in the event of a substation fire.

Keywords: Fire, explosion, protection, standard, substation, SS-1-9.1

Standard for Substation Fire and Explosion Protection (STNW3035)

CONTENTS

FIGURES

TABLES

1 Overview

1.1 Purpose

This Standard defines the minimum design and maintenance requirements of fire and explosion systems for indoor and outdoor High Voltage (HV) installations.

This standard shall be used for selection of appropriate fire protection and detection systems (including design, installation, testing, operation and maintenance of such systems) for new substations and modification and/ or upgrade of existing substations.

1.2 Scope

This standard is applicable to both new substations and existing substations that will be/ are being modified or upgraded or undergo major refurbishment.

2 References

2.1 Legislation, Regulations, Rules, and Codes

Queensland Work Health and Safety Act, 2011 (Queensland Government)

Queensland Electricity Act, 1994 (Queensland Government)

Queensland Electrical Safety Regulation, 2013 (Queensland Government)

Queensland Electrical Safety Code of Practice 2020 – Works (Electrical Safety Office)

National Construction Code. (NCC) 2022 and its referenced standards

Building Act 1975 (Queensland Government)

Queensland Building Fire Safety Regulation 2008 (Queensland Government)

2.2 Controlled Documents

Standard for Substation Design Requirements – 20468486

Standard for Oil Containment - 3062359

2.3 Other Documents

Guide to Passive Fire Protection in Bulk & Zone Substation Basements, TSD0171

2.4 Other Sources

(AS2067:2016), Substations and high voltage installations exceeding 1 kV a.c

(AS 2118.1:2017), Automatic Fire Sprinklers – General Requirements.

(AS 2118.3:2010), Automatic Fire Sprinklers – Deluge.

(AS 2419:1-4), Fire Hydrant Installations.

(AS 2441:2005), Installation of fire hose reels.

(AS 2444:2001), Portable Fire Extinguishers and Fire Blankets – Selection and Location.

(AS 2676.1:2020), Installation and maintenance of batteries in buildings.

(AS 2941:2013), Fixed Fire Protection Installations – Pump Set Systems.

(AS/NZS 3000:2018), Electrical Installations.

(AS 3786:2023), Smoke alarms using scattered light, transmitted light or ionization (ISO 12239:2021, MOD)

(AS 3959:2018), Construction of buildings in bushfire prone areas

(AS 4072.1:2005), Components for Protection of Openings in Fire Resistance Separating, Elements – Services Penetrations and Control Joints.

(AS 4587:2020), Water Mist Fire Protection Systems.

(AS 4655:2005), Fire Safety Audit.

(AS/ISO 14520: all parts), Gaseous Fire Extinguishing Systems- Physical Properties and System Design.

(AS 61330:2005), High Voltage/Low Voltage Prefabricated Substations.

(AS/CA S009), Installation Requirements for Customer Cabling.

(Energy Networks Association [ENA] DOC 18-2015), Guideline for the Fire Protection of Electricity Substations

(NFPA 750:2018), Water Mist Fire Protection Systems.

(NFPA 850:2020), Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Convertor Stations.

3 Definitions and Abbreviations

3.1 Definitions

For the purposes of this standard, the following definitions apply.

Consequence Analysis	Analysis of the potential consequences associated with identified hazards in a substation, e.g., transformer fire or explosion and other effects - due to release of energy and hazardous materials.
Fire Door	A door set, single or multileaf, with a specified fire-resistance level to prevent the passage of fire past it.
Fire-resistance	The ability of an element of construction, component or structure, to fulfil for a stated period of time, the required structural adequacy, integrity thermal insulation or other expected duty, during exposure a standard fire-resistance test.
Fire-resistance level (FRL)	The fire-resistance for structural adequacy, integrity and insulation, expressed in that order, as required by the Building Code of Australia (BD/2). FRL is expressed in Minutes. Structural adequacy the ability to maintain stability and adequate load bearing capacity

	Integrity – the ability to resist the passage of flames and hot gases Insulation – the ability to maintain a temperature on the surface not exposed at below the limits specified. Internationally the code letters are designated R, E and I so that as an example FRL 180/120/60 is equivalent to REI 180/120/60
Fire-resistant partition/wall	A partition/wall, either load bearing or non-load bearing, capable of satisfying, for a stated period of time, the required structural adequacy, integrity, thermal insulation or other expected duty, when tested in accordance with AS 1530.4
Fire resistant surface	A surface has the ability to resist the passage of flame or hot gases. For example, a surface having a fire resistance of 120 minutes is expressed as FRL -/120/-.
Fire stop	A physical barrier designed to restrict the spread of a fire in cavities within and between elements of a building construction.
Fire retardant	A substance or a treatment, incorporated in or applied to a material, which suppresses or delays the combustion of that material under specified conditions.
Hazard	A condition or situation that has the potential to cause harm and/or damage. Hazards may be present in substation equipment (e.g., stored electrical or mechanical energy, combustible oil stored in transformers) or in the occupational environment (e.g., fuel in a vehicle).
Hazard Identification	A systematic approach for identifying hazards in order to prevent and reduce any adverse impact that could cause injury to personnel, damage or loss of property, environment and production, or become a liability.
Risk	Description of how likely harm could occur and the severity of the harm. The level of risk reflects: − the likelihood of the harm to occur − the potential consequences of the harm

3.2 Abbreviations

This list does not include well-known unambiguous abbreviations, or abbreviations defined at their first occurrence within the text.

ASD	Aspirated smoke detector
BCA	Building Code of Australia
CT	Current transformer
DFT	Dry film thickness
FFCP	Fire fan control panel

FIP	Fire indicator panel
HV	High voltage
IPL	Independent Protection Layer
ITP	Inspection & test plan
LCS	Local control station
MJC	Multiple jet control
NCC	National Construction Code
SA	Surge arrester
VT	Voltage transformer

4 Fire Risk Management

4.1 Fire and Explosion Risk Management Strategy

Fire and Explosion Risk Management Strategy for a HV substation shall be selected based on the categories as described below.

- Category 1:

− The installation complies with the mandatory requirements of AS 2067; and

− Consequence effects analysis indicates that the critical impairment threshold for fire and / or explosion events (as per industrial recognised guidance) are not expected to impact on onsite and offsite sensitive receptors (e.g., equipment, infrastructure, manned locations, etc) that could result in personnel fatality/ injury, asset damage, loss of supply, etc).

- Category 2:

− The installation does not comply with the mandatory requirements of AS 2067; and

− Consequence effects analysis indicates that the critical impairment threshold for fire and / or explosion events (as per industrial recognised guidance) are expected to impact on onsite and/ or offsite sensitive receptors (e.g., equipment, infrastructure, manned locations, etc) that could result in personnel fatality/ injury, asset damage, loss of supply, etc).

4.1.1 Category 1 Substation

HV substations meeting the Category 1 criteria are considered as risk associated with a fire and/ or explosion is reduced to so far as reasonably practicable (SFAIRP).

Consequence effect analysis should be conducted for Category 1 Substations to ensure fire and/ or explosion consequences are not expected to impact on onsite and offsite sensitive receptors.

4.1.2 Category 2 Substation

For HV substations that fall into Category 2, a fire risk assessment (FRA) shall be performed to demonstrate the risk associated with a fire and/ or explosion is reduced to so far as reasonably practicable (SFAIRP).

Fire risk assessment (FRA) shall include a fire safety study and a risk assessment. The scope of fire safety study shall include the following:

- Description of the facility
- Review of Legislation and Standards
- Hazard identification
- Consequence effect analysis
- Identification of fire prevention and control measures
- Documentation of recommended fire prevention, detection and protection measures.

4.2 General

Major fire and explosion consequences in a substation facility including electrical equipment containing flammable or combustible material hazards including, non-zone rated, or flameproof equipment enclosure and any building constructed from combustible materials with the potential for causing major incidents, with the following adverse consequences:

- Personnel injury or fatality due to radiant heat or explosion overpressure.
- Fire spread to structures and equipment in the vicinity of the fire - leading to structural collapse or damage to equipment.
- Fire spread to adjacent buildings leading to escalation of a fire event.
- Damage to equipment, structures and buildings due to explosion overpressure.
- Loss of supply to customers.

4.3 Fire and Explosion Risk Zones

A fire origin/source has a potential fire risk zone that extends in every direction from its perimeter. Refer to Table 6.1 of AS 2067 for considerations with regard to fire and explosion risk zones around outdoor transformers (see Appendix A – Extracts from AS2067-2016).

4.4 Fire and Explosion Sources Risk Assessment

Refer to Clause 6.7.1.3 of AS 2067 for categories of sources of fire and explosion hazard. A risk assessment for such hazards should be undertaken.

There are multiple heat energy sources (ignition sources) in HV installations, and all shall be considered. Heat sources include but are not limited to the following:

- Power transformers
- Oil filled instrument transformers
- Capacitors
- Circuit breakers and switchgear
- Oil filled cables
- Cable sheaths
- Air and pitch filled cable boxes

- Emergency diesel generators

Substations contain a number of features that represent particular fire risks:

- Substations are generally unattended.
- The equipment in substations operates at relatively high energy levels.
- Some substation equipment contains significant fuel loads. In particular oil filled transformers and reactors, and large cables galleries containing significant masses of combustible material.
- Cable ducts and conduits can act as paths for oil following a transformer failure.
- Unsealed ducts can convey burning oil into adjacent buildings.

4.5 Fire and Explosion Risk Management

The fire and explosion risk management measures shall comply with Clause 6.7.1.4 of AS 2067.

Treating of risk includes measures to reduce fire and explosion hazard and fire and explosion risk such as precautions and preventions. Precautions to fire explosion origins/sources may include:

(i) Electrical protection

(ii) Thermal protection

(iii) Pressure protection

(iv) Fire resistant materials

(v) Less flammable insulating fluid.

(vi) Switchgear with internal arc fault certification

(vii) Polymer housing (e.g., surge arresters)

(viii) Access restriction

Precautions to fire and explosion victims may include:

(i) Space separation from origin of fire or explosion

(ii) Flame propagation prevention

- Grading
- Liquid containment
- Fire barriers
- Extinguishing system

4.6 Independent Protection Layers (IPL)

Independent protection layer (IPL) is a device, system, or action that is capable of preventing a scenario from proceeding to the undesired consequence without being adversely affected by the initiating event or the action of any other protection layer associated with the scenario. These controls are used to determine the level of risk in the controlled state as part of a fire risk assessment (FRA).

The following Passive IPLs shall be considered in risk assessment:

- Spill containment or bunding - will reduce the frequency of widespread spills with severe consequences, such as spills from a ruptured transformer tank.
- Underground Drainage System, with remote impounding - will reduce the frequency of widespread spills with severe consequences, such as spills from a ruptured transformer tank.
- Fire rated barriers will reduce the frequency of escalation during a major fire event such as the failure of structures, equipment and buildings.
- Fireproofing - will reduce rate of heat input and provide additional time for depressurizing/ firefighting/ etc.
- Blast wall - will reduce the frequency of large consequences of an explosion by confining blast and protecting equipment/ buildings/ etc.
- Inherently safe design - if properly implemented can significantly reduce the frequency of consequences associated with a transformer fire scenario, such as sufficient spacing from a transformer to a building.

Active Fire Fighting System IPLs shall be considered in any risk assessment:

- Water Mist, Water Deluge, Water Spray Systems where automatically initiated,

Human IPLs involve the reliance on operators, or other staff, to take action to prevent an undesired consequence, in response to alarms or following a routine check of the system.

The effectiveness of humans in performing routine and emergency tasks has been the subject of several publications (Guidelines for Preventing Human Error in Process Safety; CCPS 1994b, and Swain 1983).

Overall, human performance is usually considered less reliable than engineering controls and great care should be taken when considering the effectiveness of human action as an IPL.

Management practices, procedures, and training may be considered as methods that would assist in establishing the PFD claimed for human action but should not be considered IPLs by themselves.

5 Considerations in design for Protection Against Fire

5.1 General

Generally, the measures of protection against fire and explosion fall into two categories:

- **Containment**, which aims at restricting the damage to one item of equipment or area of substation. Such precautions are usually passive. The use of non-flammable materials, physical spacing, oil containment, sealing of wall and floor opening, ducts, etc are all examples of passive systems (see Section 7).
- **Extinguishment** and Suppression, which aims at reducing the damage to the burning equipment and to reduce or eliminate any fire or smoke damage to other equipment. This includes portable and permanent fire suppression systems (see Section 8).

Substation fire and explosion protection shall follow the requirements summarised in ***Appendix B – Fire Protection Matrix***. The details surrounding the passive and active systems associated with fire protection are included in Sections 7 to 14 of this document.

In addition, the following considerations should also be given in the design and construction

5.2 Substation Site Considerations

When selecting the site for a proposed substation, consideration shall be given to:

- The possibility that a substation fire could escalate to neighbouring buildings or damage or ignite vegetation.
- The potential for a fire on a neighbouring property escalating to the substation.
- The availability of firewater for firefighting requirements.
- The availability of Fire Brigade Services in the event of fire.

5.2.1 Firebreak

Firebreaks to be provided in accordance with AS3959.

5.2.2 Vehicle Entrances

Two (2) vehicular entrances shall be provided, whenever possible, on opposite sides of the installation. A formed roadway to the second vehicular entrance is not necessary provided that the firebreak is graded so that it may be traversed by fire fighting vehicles under all but extreme weather conditions. (Refer to Section 7.3.1 of CIGRE WG A2.33 - Guide for Transformer Fire Safety Practices).

5.3 Outdoor HV Switchyards

5.3.1 General

In addition to the provision of safety clearances and space for equipment handling in outdoor HV switchyards (refer to Design Standard STNW 3013. Clearances in Air), which contributes toward providing adequate separation to prevent a fire spreading to other equipment, the following shall be considered:

- Transformer locations and separation (See Table A6.1 of AS 2067 reproduced in Appendix A – Extracts from AS2067-2016)
- The possibility of violent failure of oil filled post type CTs and VTs.
- Safe access for fire fighting
- Control of spilt oil – including bunding
- Possibility of fire propagation along cable trenches.

5.3.2 Provisions for Fire Fighting

5.3.2.1 Switchyard Layout

The switchyard layout shall provide adequate and safe access for the fire brigade, preferably from two directions at all times.

5.3.2.2 Hydrants

For Class 8 substation buildings, as required under Clause E1.3 of Volume 1 of the NCC, a fire hydrant system shall be provided or, if not able to be connected to town water supply, a minimum of one hour storage for firefighting.

The reduced capacity is in recognition of the inherent fire mitigation measures such as boundary separation, vegetation removal programs, and perimeter access road protection associated with remotely located Class 8 electricity network substations. Reduced firewater storage provision shall be assessed during risk assessment.

For Class 10a modular buildings – whilst a hydrant system may not be required under the NCC, consideration should be given to how a potential transformer or building fire would be put out.

Where a hydrant is required, water supply should be checked. If there is doubt about the adequacy and accessibility of the public hydrant, the mains should be extended to a hydrant on the site located close to the main entrance.

5.4 Switchgear, Control & Relay Buildings

Substation buildings may house protection and control systems, communications equipment and MV switchgear.

Electricity network substation buildings are generally deemed to be Class 8 buildings for the purposes of the NCC. However, some smaller facilities that utilise modular, transportable and temporary structures are able to be classified as Class 10a (ENA Doc 018-2015).

The Class 8 classification is generally used for stand-alone electricity substation buildings that are constructed using traditional building materials such as brick, masonry, structural steel and reinforced concrete. Class 8 also applies to those substations located within a larger “host” building, which may have a different purpose and NCC classification.

The Class 10a classification can be used for electricity substation buildings that have the following characteristics:

a) Construction using lightweight, shed like material (such as Colorbond, sandwich panels or prefabricated materials), or prefabricated transportable type buildings; and

b) Minor civil works for the foundation of buildings typically including a concrete slab, bored concrete piers or embedded steel piers. The civil works do not include cable pits and trenches unless they form part of the foundation.

Class 8 buildings as defined by the NCC shall comply with statutory regulations listed in Section 2. A Certificate of Compliance must be obtained and displayed in Class 8 buildings as required by Fire and Rescue Service Act. Further details on requirements are given in Section 7.2.

When buildings are not adequately spaced from mineral oil-filled transformers or reactors and barrier walls have not been constructed, then

- There shall be no windows facing the transformer/reactor.
- The doors shall be two (2) hour fire rated construction
- The internal walls, flooring, roof and eaves shall be constructed of an appropriately rated fire resistant material.

5.5 Oil Filled Transformers & Reactors

5.5.1 General

Transformers generally contain the largest quantity of combustible substance located in a substation. Therefore, special attention should be given to their location, transformer protection, and fire protection. Fires in oil-insulated transformers and reactors result principally from the breakdown of insulation. Arcing that follows an electrical breakdown can burn through the tank or vaporise the oil, thereby creating pressure sufficient to force off the cover or rupture the tank. A considerable amount of burning oil may be expelled over a large area, and an intense fire may follow.

Transformers that are involved in substantial fires are usually damaged beyond economical repair, so they generally do not require fire suppression when installed in outdoor enclosures. In the event of a transformer fire, fire brigade staff will enter the substation and apply a foam/water mixture to smother the fire, only after an Energy Queensland operator advises that it is electrically safe to do so.

5.5.2 Separation Distance

The layout of an outdoor installation shall be such that burning of an oil-filled transformer or reactor with a liquid volume of more than 100 litres will not cause a fire hazard to buildings, other transformers/reactors or objects. The minimum separation, in metres, should be maintained for various types of transformers as indicated by Table 6.1 of AS 2067-2016 and associated notes in Appendix A – Extracts from AS2067-2016.

For indoor transformers the minimum requirements for the installation shall be in accordance with Table 6.2 of AS 2067 and associated notes in Appendix A – Extracts from AS2067-2016.

If it is not possible to allow for adequate separation between transformers:

- fire barrier shall be provided.
- consideration of use of less combustible type K fluids such as synthetic ester oils to reduce allowable separation.

Fire protection clearances between a transformer and a building and requirements of fire-resistant surface are depicted in Figure 6.2 of AS 2067, which is reproduced in Appendix A. Note that distances G1 and G2 apply from the edges of the bund.

5.5.3 Oil Containment

Transformer fires are almost always associated with a rupture of the exterior tank of the transformer. This rupture, depending on its location on the tank and the size of the transformer, could allow a large amount of flaming liquid to be spread over a large portion of the substation yard. Also, even after the fire is extinguished, the transformer may still leak a sizable amount of combustible and environmentally damaging liquid over the yard. Therefore, special precautions should be taken to collect and contain the oil. For general guidance, see Standard for Oil Containment - 3062359 (STNW3036).

5.5.4 Cabling to Transformers

All conduits in transformer pits should be sealed to reduce the risk of either burning oil or burning cable insulation from spreading the fire.

5.5.5 Protection

Transformers shall be provided with fast-acting protective devices, which provide immediate automatic interruption in the event of failure. These are

- Pressure relief valves (PRV) with pressure safety margin above PRV Opening Pressure.
- Over current protection – relay.
- Earth fault protection.
- Differential protection.
- Buchholz Relay for gas surge/accumulation.
- OLTC Oil Surge relay.
- Rupture Discs of various types/design are in use as an alternative to PRV.
- Protection by over-fluxing relay.
- Over temperature protection.
- Duplicate Protection for large transformers; protection trip relays, circuit breaker trip coils & differential and earth fault and the current transformers supplying them.
- Current and Voltage Limiting Devices

5.5.6 Indoor Installations in Buildings Permanently Occupied by Persons

For HV installations located in public or residential building, special conditions imposed by Building Regulations shall be observed. In addition to the requirements for installation in industrial buildings, consideration should be given to the transformer insulating liquid being of type K, such as synthetic ester.

5.6 Switchgear

Arcing faults from switchgear have the potential to set fire to combustible materials. The selection of arc fault tested switchgear which vents away from the operator provides operator safety, as well as reducing the potential arc by-products emitted from the gear that may catch fire. Manufacturer's instructions regarding wall and roof spacing from the arc chute are to be followed – if there is insufficient roof or wall clearance vents shall be run from the arc chute to the outside of the building. Avoid installing cables or other combustible materials within 300mm of any arc vent chute openings on switchgear

5.7 Cables and Installation Practice

5.7.1 Control Cables

The control cables used in substation control buildings shall be of low smoke and flame retardant insulation. The precautions taken to minimise the risk shall be:

- To ensure that cable is properly rated and not overloaded
- Avoid undue congestion
- To seal all penetrations of walls or floors

Additional precautions for large or important substations include

- Spacing between cable trays, say from 450 mm to 600 mm apart.
- The segregation of control from power cables
- The use of enclosed trays.
- The application of commercially available ablative coatings which may be brushed or sprayed onto the cables

5.7.2 Power Cables

The basic precautions shall include passive IPL and inherently safe design measures

- To ensure that cable is properly rated and not overloaded
- Avoid undue congestion
- To space and support cables properly.
- To provide physical protection and support around any cable joints, and ensure cable joints do not lay directly on top of other cables

Further precautions for critical locations in large substation include

- The provision of separate chases for important circuits. The chases should be covered or filled with sand
- Cable sealing ends should be separated as far as possible.
- Coating cable sheaths with ablative coatings to prevent propagation of fire to other rooms.
- The provision of an automatic extinguishing system as a last resort in large substations (e.g., where the resultant loss of load may not be able to be picked up from adjacent substations).

5.7.3 Cable Installations

The most common types of cable installations found in substations are as follows.

5.7.3.1 Direct Burial

Where large runs of cables are installed in a common trench, design and install cable trench with suitable cable spacings and backfill material to prevent cables overheating and potential cable fire.

5.7.3.2 Permanent trenches

Trench systems consist of main runs that bring large groups of cables through the centres of equipment groups, with smaller trenches, short runs of conduit, or direct burial cable branching off to individual pieces of equipment. These trenches may also feed directly into the control and relay building. The trenches may be made of cast-in-place concrete, or precast materials.

Consideration shall be given to the installation of fire stops between the main trench and the smaller branch trenches and where they enter the control and relay buildings or other equipment. The use of combustible materials in the construction of these trenches and their covers should be avoided. Consideration shall be given to ventilating the trench system to prevent the build-up of combustible

gases from either natural or other sources. Trenches should be located in a manner that will prevent any combustible liquids, such as insulating oil, from entering the trench and possibly igniting the cables.

5.7.3.3 Underground Ducts/Conduits

Duct/Conduit systems may be made of various materials, with manholes or pull boxes located at reasonable pulling lengths. These manholes and pull boxes shall be located and constructed in a manner to prevent any flammable liquids from entering and possibly igniting the cables. Consideration shall be given to the installation of fire stops where the cables enter and leave manholes and pull boxes, and where the cables leave the conduit system.

5.7.3.4 Vertical Cable Runs

Fire stops or fire breaks, shall be installed in vertical cable runs since fire will more readily propagate vertically than horizontally.

5.7.3.5 Tunnel (Gallery) and Large Cable Basements

Fire protection requirements in cable tunnels and large cable basements shall follow the principles in Energy Queensland Technical Instruction TSD0171:

- Cables should be well spaced, minimum one cable diameter separation for crossing cables
- To stop spread of smoke and flames through building, install FRL -/120/120 fire stop on any penetrations from the cable basement or tunnel into the building.
- Where cables cannot be adequately spaced apart then application of an ablative coating to prevent fire propagation into the building shall be applied to the cables.

5.8 Surge Arresters

Surge arresters (SA) shall be properly sized and located to minimise the possibility of equipment fire and explosion initiated from surges or surge arrester failure. Energy Queensland adopts polymer SA to reduce the risk from explosion.

5.9 Power Capacitors

Power capacitor units located outdoors, which contain a combustible dielectric fluid, shall be a minimum of 3.0 m from any building not of fire-resistant construction or in a metallic housing. Capacitor units containing a flammable dielectric fluid located indoors shall be separated from adjacent areas by a one-hour fire-rated barrier.

6 Passive Fire Protection Measures

6.1 General

This section details passive fire protection systems appropriate for use in Energy Queensland substations.

6.2 Building Construction

6.2.1 Scope of Works

The construction requirements for the buildings and structures shall be in accordance with the Building Code of Australia [BCA] except where modified by this document.

6.2.2 Building Classification

Buildings and structures shall be classified in accordance with the BCA. Modular (transportable) switch rooms and control rooms are categorised as Class 10 buildings.

6.2.2.1 Switchgear Rooms

For Switchgear Rooms within buildings, provide construction for these rooms in accordance with the requirements of the NCC. Additional fire precautions may be required by Energy Queensland when using bulk oil circuit breakers than other types of switchgear.

Where a building incorporates a switchroom containing high voltage switchgear, the switchroom should be designed to relieve overpressures arising from switchgear malfunctions without structural damage and without causing harm to personnel from hot gas and molten metals.

- Doors and fittings shall be strong enough to prevent doors being blown out.
- Glazing or wired glass shall not be used.
- Sufficient space around and above the switchgear as recommended by the manufacturer shall be provided.
- Sufficient area of pressure relief vents shall be provided.

If the switchgear contains oil or compound, then additional fire precautions may be required – such as a yard hydrant system.

6.2.2.2 Control Rooms

The minimum fire requirements for a control room are that it shall be readily accessible in an emergency and that it shall be segregated from any major fire risk area

6.2.3 Construction of Modular Buildings

Unless otherwise noted there is no requirement for modular buildings to have a certified FRL. The building should be located and designed so that the largest credible fire (e.g., an oil-filled transformer, a circuit breaker, or neighbouring plant or storage facilities) will not involve or affect the operation of the equipment within the building or vice versa. Buildings should be constructed within Zone C as shown in Figure 6.2 of AS2067.

All fire doors shall have a two-hour fire rating and should be equipped with self-closing devices to maintain the fire rating of the wall.

6.2.4 Construction of Class 8 and Non-Modular Buildings

In addition to the requirements of modular buildings, in multi-story structures and fire-rated rooms, all floor and wall openings shall be sealed in a manner that will not reduce the fire rating of the floor and wall.

6.2.5 Segregation of Rooms

The extent of segregation depends on

- size of the building,
- Importance of the substation to the network or the consequences of a major fire
- The type of equipment housed.

The following are recommended for Class 8 buildings

- Cable basement shall be segregated from the switch and control rooms and all penetrations sealed with a minimum two-hour fire rated material.
- Roof spaces shall also be segregated to control the spread of fire or the collapse of the roof onto otherwise undamaged equipment.
- Segregation to comply with the requirements of the NCC.

6.2.5.1 Battery Rooms and Enclosures

In Class 8 buildings, where batteries are installed in standalone rooms or in associated enclosures within buildings, provide construction for these rooms in accordance with the requirements of the NCC.

The hydrogen gas given off from batteries that are located in confined areas can, at certain concentrations, become an explosion hazard. Refer to AS 60079-10-1 Classification of area – Explosive gas atmosphere. The level of hydrogen concentration should be calculated using manufacturer's guidelines.

Precautions such as ventilation should also be taken to assure that the hydrogen gas will not be present in a concentration sufficient to cause damage to nearby relay contacts.

6.2.6 Exits

Each control building, switchroom, cable basement, etc shall have a minimum of two (2) exits. These exits should be located at opposite ends of the building or each room to prevent the possibility of personnel being trapped by a fire. These doors should be open outward and be equipped with illuminated exit signs.

Panel and equipment arrangement should be designed so personnel can exit the equipment area from both ends. Accessibility and emergency exit facilities for switchboards/panels shall be in accordance with Clause 2.9 of AS 2067.

All doors opening to an exit way required to be fire isolated shall be fire resistant and self-closing and operate so that the exit way is not obstructed by doors in the fully open position.

6.2.7 Door Locks

Where fitted, panic hardware on all doors shall override any exterior lock or padlock to allow egress from the building. This feature is recommended because personnel may enter the building without first unlocking all of the exterior doors.

6.2.8 Furniture

The use of combustible materials with flame-spread, fuel-contributed, and smoke-developed should be avoided in the selection of desks, chairs, filing cabinets, storage boxes, display boards, building insulation, interior wall panels, mounting boards, etc.

Waste cans shall be self-closing to prevent fire and keep vermin out.

6.2.9 Storage

The storage of paper products, cleaning fluids, and other combustible materials in a control building should be minimized. Flammable liquids should be stored only in fire approved safety cans.

6.2.10 Ventilation

Large ducted ventilation systems shall shut down automatically during a fire and be equipped with an override device to allow for smoke removal when fire fighters deem it necessary. The fan override switch shall be located outside the fire hazard area, clearly marked, and easily accessible to fire fighters.

Automatic fire dampers shall be provided on large ducted ventilation systems.

6.2.11 Separation

Separation for substations shall consider requirements as follows:

- SafeWork Australia Code of Practice for
- Managing Risks of Hazardous Chemicals in the Workplace
- WorkSafe Queensland Segregation Tool for dangerous goods
- Other states' Dangerous Goods Regulations (as applicable) for:
    - Separation between buildings or areas where flammable materials are stored
    - Enclosures containing dangerous goods

For indoor substations, NCC requirements for:

- Fire compartments and segregation using fire rated construction or physical separation.
- Physical separation between components within substations to provide a good level of protection against propagation and spread of fire.

In rural or bushland settings the requirements of the Rural Fire Services should be considered to enable an adequate fire break to be maintained as per AS 3959.

6.2.12 Separation Distances

Separation distances between buildings shall follow the requirements of the BCA.

6.2.13 Compartmentation and Separation

6.2.13.1 Outdoor Transformers

Outdoor transformers are to be separated from all buildings, property lines and other transformers in accordance with the minimum requirements of the BCA, AS 3000 and AS 2067 Section 6.7 Protection against Fire and Explosions (see Appendix A – Extracts from AS2067-2016).

6.2.14 Fire Barriers

When separation distances are inadequate, some form of fire barrier to protect other substation equipment, control building, or neighbouring properties shall be installed. These barriers should be totally constructed of non-combustible materials such as concrete block, brick, sheet steel, reinforced concrete, etc with the fire rating of Fire Resistance Level [FRL] of not less than 120/120/120 in accordance with the requirements of the NCC, AS 3000 and AS 2067 Section 6.7 Protection Against Fire and Explosions

The height of the fire barriers shall be at least 0.3 m above the oil containing parts of the transformer including oil conservators, bushings, pressure relief vents, etc – unless otherwise determined by thermal radiation modelling and risk assessment.

The fire barriers should extend at least 0.6 m horizontally beyond the line of sight between all points on adjacent transformers. If the barrier is a part of a bund wall, the barrier length should be at least of the same length of that bund wall – unless otherwise determined by thermal radiation modelling and risk assessment. Refer to Figure 1 of AS 2067 given in Appendix A.

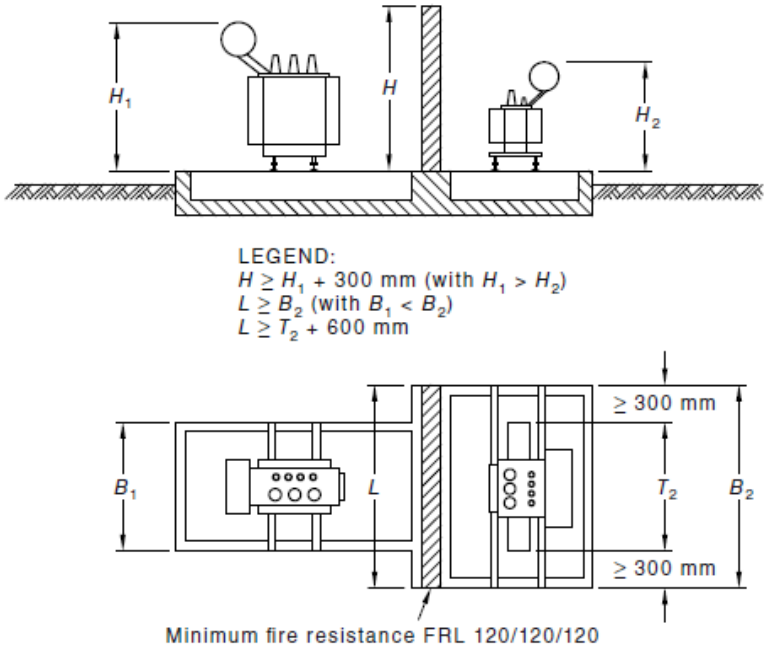


FIGURE 6.1 SEPARATING WALLS BETWEEN TRANSFORMERS

Figure 1: Separating Walls Between Transformers

Removable fire barriers should be considered when space is needed for equipment maintenance or replacement.

6.2.14.1 Transformer Rooms in Buildings

If transformers cannot be located outdoors, provide construction for transformer rooms within buildings having a Fire Resistance Level [FRL] of not less than 120/120/120 in accordance with the requirements of the BCA, AS 3000 and AS 2067 Section 6.7 Protection Against Fire and Explosions.

The performance requirements of the building structure itself may need to be considered especially where substations are located in commercial buildings.

In this case, the structural designer should consider the risk of a potential progressive collapse of the entire structure itself due to fire and explosion. Where necessary, suitable mitigation measures should be employed including additional redundancy of key structural members.

For basement, vault or underground, surface and high-level substations NFPA Chapter 3 requires a higher fire resistance due to the potential risk of collapse of the entire building.

6.3 Fire Sealing of Services Penetrations

All services penetrations shall have a system or materials used to maintain the fire resistance of the fire separation element where the services pass through the element.

6.3.1 Standards

Service penetration fire sealing systems: To BCA C 3.15. **Exception** – For control and auxiliary cables that penetrate the FRL rated walls of fire compartments in a Class 8 building, the requirement is:

- Commercial Firestop Pillows, trimmed with Firestop Putty, are installed, removed and reinstalled, (as required for progressive cabling), to fill the balance of the penetrations by the attending Substation tradesperson.
- No certification, and no periodic audit-inspection certification.

6.3.2 Certification

General: Submit evidence of compliance, in conformance with the recommendations of AS4072.1 Appendix B complete with drawings detailing location and type of approved fire rating detail used for each service penetration.

6.4 Fire Retardant Coatings

For existing substations where determined to be necessary by Energy Queensland, provide a water based ablative coating suitable for application on power cables located in cable chambers for the purpose of reducing flame spread along all vertical and horizontal cabling.

The coating shall be toxic free and environmentally friendly fire resistant specifically designed for cables. The coating shall not affect the current carrying capacity of the electrical cables. The coating shall remain flexible and water resistant when dry.

The installation shall be installed according to the manufacturer's requirements by a certified installer and shall allow the cables to operate within design temperature limits.

All coatings and systems shall have been tested in accordance with Factory Mutual Global 3971 Approval Standard or equivalent. Cables shall be coated to provide a minimum dry film thickness [DFT] of 1.6 mm for the continuous length of the cabling and fire stopped at walls and sleeves to stop the spread of fire.

6.5 Bunding

Every indoor and outdoor high voltage installation containing equipment with a liquid dielectric such as transformer insulation oil shall have provision for containing the total volume of any possible leakage.

Containment of any possible leakage of combustible or flammable liquids shall comply with the requirements of AS 1940, AS 2067 and applicable Environmental Protection Legislation.

7 Fire Suppression Systems

7.1 General

7.1.1 Applications

Fire suppression systems shall be provided in accordance with the requirements of AS 2118, AS/ISO 14520, AS 2419, AS 2444, AS 2941 and AS 4587.

7.1.2 Personnel Safety

Suppression systems adopted for use on fires involving electrical equipment shall not increase the risk of electrocution to personnel involved in fighting the fire. Water based systems shall only be used within the fire area once all electrical systems have been isolated and made safe by Energy Queensland staff. Electrical hazards and associated risk to personnel while fighting fire shall be considered as part of Hazard Identification.

7.2 Fire Hydrant Systems

7.2.1 Application

Fire hydrant systems shall be provided to each substation only where required in accordance with the National Construction Code of Australia and AS 2419.1.

7.2.2 Street Fire Hydrants

Street hydrants may be used to provide coverage, where applicable.

A fire risk assessment shall identify the location and capability of all fire hydrant to be used during firefighting. This includes the range, discharge density and residual pressure of the hydrant involved.

A Fire Protection Matrix shall be developed and referred to when deciding on active and suppression firefighting measures. This matrix will be based on the requirements of the National Construction Code of Australia and AS 2419.1, and where applicable, the results of a fire risk analysis.

7.2.3 On Site Fire Hydrant System

A fire risk assessment shall identify the location and capability of all fire hydrants to be used during firefighting. This includes the range, discharge density and residual pressure of the hydrant involved.

A Fire Protection Matrix shall be developed and referred to when deciding on active and suppression firefighting measures.

The basis for determining firewater storage requirements shall be reviewed in a fire risk assessment. This matrix will be based on the requirements of the National Construction Code of Australia and AS 2419.1, and where applicable, the results of a fire risk analysis.

7.3 Fire Extinguishers

7.3.1 Application

Fire extinguishers shall be provided as one of the first response aids at each substation area where required in accordance with the Building Code of Australia, AS 2067 and AS 2444.

7.4 Fire Hose Reels

7.4.1 Application

Fire hose reels shall be provided as one of the first response aids at each substation area where required in accordance with the Building Code of Australia and AS. 2441.

7.5 Fixed Spray Water Sprinkler Systems

7.5.1 Applications

For outdoor substation applications where physical separation/installation of fire rated construction cannot achieve effective fire segregation from adjacent property, fixed automatic water spray sprinkler suppression systems are to be provided in accordance with Building Code of Australia and AS 2118.

Where applicable water spray/deluge systems shall be used for the fire protection of the following:

- Combustible liquids associated with externally mounted transformers/radiators.
- Electrical hazards including outside yard oil switches.

A Fire Protection Matrix shall be developed and referred to when deciding on active and suppressing firefighting measures.

7.5.2 System

Water spray deluge systems where required shall incorporate automatic deluge valve assemblies and open spray nozzles with pipework arrays to direct water onto the surfaces of external transformers and bulk oil equipment.

Water spray deluge systems shall be provided to deluge with open sprayers in accordance with AS 2118.3. All nozzles shall be provided with plastic caps. Nozzles subject to mechanical damage shall be protected with listed guards.

Water spray piping in outdoor locations and where exposed to corrosive conditions shall be galvanised steel. Water spray piping in indoor locations shall be painted black steel.

The systems shall be operated automatically from heat actuation devices incorporating pilot sprinklers and multiple jet controls [MJC].

The water sprays shall be arranged in accordance with AS 2118.3 to impact the surfaces of a transformer and bulk oil equipment or store to provide both cooling to the components but also form an emulsified water and oil mixture unable to ignite or burn.

The water spray systems shall provide complete water spray impingement on all exposed exterior surfaces of the equipment.

Where there is insufficient space to install water spray nozzles beneath transformers water shall be introduced from the sides by horizontal nozzles.

Manual release controls for deluge systems shall be provided at the control valve assemblies and at other locations deemed necessary.

Deluge systems shall include a tell-tale drain downstream of the deluge valve at the 1st low point to indicate the deluge valve is passing. Hydraulic calculations shall allow for the tell tail drain discharge amount.

A Fire Protection Matrix shall be developed and referred to when deciding on active and suppressing firefighting measures.

7.5.3 System Activation

Water spray systems shall be activated automatically with fusible links or bulbs, in accordance with AS 2118.

Water spray suppression system shall be monitored with flow switches to signal activation to the QFES network (only where required) and Energy Queensland SCADA system via the FIP

7.6 Water Mist Systems

7.6.1 Applications

Provide water mist systems for protection of internal transformers in accordance with the requirements of AS 4587 and AS 2067. The requirement for a water mist system shall be determined in a fire risk assessment.

A Fire Protection Matrix shall be developed and referred to when deciding on active and suppressing firefighting measures. Design of water mist systems in accordance with NFPA 750 shall be to the approval of the Building Certifier.

7.6.2 Performance Requirements

Description: Water Mist fire-extinguishing system shall be an engineered system for total flooding of the hazard area.

Design Criteria:

Application parameters shall include compartment variables such as height, volume, ventilation and obstructions. The fire hazard type and configuration shall also be evaluated.

The level of performance shall be described in the design. Control, suppression or extinguishment shall be selected.

Pipe sizing shall be determined by hydraulic calculations.

For transformer protection particular attention shall be given to ensuring adequate spray coverage and fire detection for:

- Main transformer body.
- Conservator oil tank end sections and oil level gauges.
- Oil filled tap chargers.
- Oil coolers.
- Underside of transformer body.
- Flame trap and bund area.
- Any cable trays above the bund area.

Minimum electrical clearances for high voltage equipment shall be observed in accordance with the requirements of Energy Queensland and AS 2067.

7.6.3 Piping and Fittings

Piping, valves, and discharge nozzles: Comply with types and standards listed in AS 4587 for charging pressure of system.

All piping shall be stainless steel [Type 304L or Type 316] or copper tube.

All fittings used on piping shall be equivalent to wrought copper or stainless steel.

Installation of water mist system pipework and nozzles in each of the transformer bays shall be coordinated with other services trades and shall be arranged to avoid the conductor phase to earth clearance zones.

7.6.4 Hangers and Supports

Hangers and supports shall be designed and installed in accordance with AS 2118.

7.6.5 Nozzles

Nozzles shall be listed individually or as part of a pre-engineered system.

Provide blow-off caps where nozzles are subject to clogging by external or foreign materials. Nozzles shall be labelled to identify manufacturer, type and size of orifice.

Spare nozzles shall be provided.

Provide open water mist nozzles and dry pipes after control valves.

7.6.6 Valves

All valves shall be listed SSL/UL/FM for their intended use.

All gaskets, O-rings, sealants and other valve components shall be constructed of materials that are compatible with the gas and water additive contained in the water.

7.6.7 Strainers and Filters

Provide system strainer downstream of each water supply system, water supply tank, pump, pipe section, fitting, valve or other piping component.

Strainer shall be sized for continuous operation at the required minimum flow and pressure. Provide spare pipeline and individual nozzle strainers.

7.6.8 Detection, Actuation and Control Systems

Control of the water mist system shall be automatic with the facility for manual override. Automatic control shall conform to the requirements of AS 1670. Control and indicating equipment shall conform to the requirements of AS 1603 and the additional requirements outlined in AS 4587 including reliable power supply, audible and visual fault indication, system discharge indicator and a maintenance isolate switch at the FIP for each of the protected zones.

Provide devices for the operation of the water-mist releasing devices or valves, discharge controls, and shutdown equipment.

Provide dual automatic detection (aspirated smoke detection [ASD] system and point type analogue addressable photoelectric smoke detectors) for operation of the water-mist system including localised control panels and wiring back to the FIP as recommended by the manufacturer of the water mist system.

Ensure IP rating of the detection, actuation and control systems enclosures and equipment suits the operating environment they are installed in and is in accordance with AS 1939 requirements.

Provide deluge control valves and associated equipment for each zone protected by the system.

Provide an emergency electrical manual release device for the operation of each zone protected by the system [adjacent door leading to protected zone].

Provide automatic releasing control equipment in accordance with AS 4587.

All audible alarms and visual warning devices, as outlined in AS 4587, shall be provided. This shall include visual and audible indication for both alert and evacuate states.

7.6.9 Pumps and Pump Controllers

Firewater pumps shall be designed and installed in accordance with AS 2941. Pumps shall be sized to meet the required system water flow rate at the minimum system pressure. Such flow and pressure requirements shall be determined by hydraulic calculations.

Pumps shall start automatically and shall supply water to the water mist system until manually shut down. Water pressure levels at site shall meet the minimum pressure requirements for the pump.

7.7 Clean Agent Systems

7.7.1 Application

Provide gaseous clean agent systems in accordance with the requirements of AS 14520 to the following areas:

- Cable Chamber Rooms (where required)
- Other locations as identified on a site-specific fire risk assessment.

The gaseous agents shall be selected from the following:

- HFC – 227 ea.
- IG 55.
- IG 541.

The designer will carry out a life safety/cost benefit analysis for submission to Energy Queensland to determine the system solution. In addition, the CO2 gas may be considered where systems are already installed in existing substations.

7.7.2 Performance Requirements

Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling, and below the raised floor.

Delegated Design: Design the system for Class A, B, and C fires as appropriate for areas being protected, and include 10% safety factor. Use clean agent as indicated and in concentration suitable for normally occupied areas.

System Operating Sequence: System shall be double knock, aspirated smoke detection [ASD] system and analogue addressable point type photoelectric smoke detectors reporting to a fully programmable microprocessor-based control panel programmed to operate as follows:

Alarm Level 1

The ASD system will activate a local alarm at the FIP and occupant warning sounders, alert signal. This alarm will not activate the gas suppression system or contact the fire brigade. Alarm can only be cancelled at the FIP by inspecting staff if on site.

- A level 1 alarm signal is sent from the FIP to inform Energy Queensland, via the SCADA control panel, of the detection status. An Energy Queensland staff member must investigate to confirm the fire or false alarm and to manually cancel the alarm.
- The level 1 alarm will continue until the alarm is cancelled at the FIP. If the alarm is cancelled the system will be brought back to normal status.
- If the ASD system remains in alarm for sixty [60] seconds after the alarm cancel function is activated, the level 1 alarm will be re-activated.
- During the level 1 alarm the building occupants also have the opportunity to cancel/terminate the alarming sequence via the dedicated red ‘gas discharge abort’ push buttons.

Alarm Level 2

When the system detects an increased amount of smoke via both the ASD and a point detection system, the level 2 alarm is initiated, [only after level alarm has been operating and/or has not been cancelled].

- The local alarm at the buildings FIP continues, evacuate signal so that occupants can proceed to evacuate the room.
- Commence auto shutdown of HVAC equipment and closure of all associated fire dampers.
- The ‘DO NOT ENTER’ sign illuminates at the entry to the gas suppressed area.
- Both the flashing light and the ‘EVACUATE’ signage illuminate within the room.
- A level 2 alarm signal is sent from the FIP to inform Energy Queensland of the detection status. A staff member must investigate to confirm the fire or false alarm so as to manually cancel the alarm.
- The local fire authority is called automatically via ASE where connected to the QFES network.
- The gas suppression system will activate sixty [60] seconds after the level 2 alarm has been initiated [actual delay time between stage 2 and 3 to be confirmed/approved by Energy Queensland].
- The level 2 alarm will continue for sixty [60] seconds after which time the level 3 alarm sequence will commence unless the alarm is cancelled at the FIP, in which case the system will be brought back to normal status.
- The building occupants and/or Energy Queensland staff have the opportunity to cancel/terminate the level 2 alarming sequence via the dedicated red ‘gas suppression discharge abort’ push buttons.

Alarm Level 3

- The gas suppression system activates sixty [60] seconds after the level 2 alarm has been initiated [and has not been manually cancelled].

- The building occupant warning system continues to operate.
- The 'DO NOT ENTER' sign continues to illuminate at the entry to the control room.
- Both the flashing light and the 'EVACUATE' signage illuminate at all exits from the protected room.
- A level 3 alarm signal is also sent from the FIP to inform Energy Queensland of the detection status.
- The level 3 alarm will continue after the gas suppression has completely discharged, until the alarm is cancelled at the associated system, in which case the system will be brought back to normal status.
- The building occupants only have the opportunity to cancel/terminate the level 3 alarming sequence after the gas system has discharged completely.

All of the above sequencing can be manually cancelled by staff via a start/stop station

The stage 2 alarm sequence can also be manually cancelled by staff via a start/stop station

Following a discharge or by activation of the low pressure switch the "SYSTEM INOPERATIVE" sign shall activate indicating that the discharge is complete, and the gas cylinders require refilling.

- Install gas bottles and associated equipment in locations to allow for adequate maintenance access and provide appropriate dangerous goods signage.
- Coordinate with mechanical services contractor to provide motorised fire/smoke dampers to all ventilation openings, ductwork entering/leaving the room and interconnections with the FIP and shutdown all mechanical ventilation equipment serving the room.
- Areas to be protected with gas suppression systems shall be adequately sealed and leak tested in accordance with AS 14520. All doors shall be fitted with seals and door closers.
- Areas to be protected with gas suppression systems where required shall be fitted with pressure relief vents.

7.7.3 Piping Materials

Piping, valves, and discharge nozzles: Comply with types and standards listed in AS 14520 suitable for clean agent type and gas charging pressure of system.

7.7.4 Mechanical Manual Release

The clean agent cylinder configuration shall have a mechanical manual actuator for manual release and discharging to the risk area/s located adjacent the bottle storage area. The mechanical release shall be housed within a box with a hinged Perspex cover so as to avoid accidental release. Provide also engraved signage with text no less than 10 mm high to identify the manual gas discharge release.

Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid or install valve and separate pressure relief device.

Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

7.7.5 Discharge Nozzles

Discharge nozzles shall be used to disperse the gas. The nozzle used shall be provided with pipe threads that correspond with the nozzle size. The nozzles shall be FM approved and UL listed.

7.7.6 Control Panels

Description: AS or FM Approved: including equipment and features required for testing, supervising, and operating fire-extinguishing system.

7.7.7 Local Control Station [LCS]

LCS shall be provided at the exit doors of the protected room comprising an abort switch [inhibit] and manual discharge switch. Operation of the abort switch shall send a system abort indication to the FIP when a fire condition exists. A separate 'fault' indication shall result if the abort switch is operated when no alarm condition exists. Fault signal shall be transmitted to Energy Queensland via the SCADA. Audible alarm indications shall change when the abort switch is operated as an audible acknowledgement that the control panel has received the abort signal.

Operation of the manual discharge switch shall initiate the time delay and activate the audible and visual signage in accordance with AS 14520.

7.7.8 Audible and Visual Alarm Devices

'DO NOT ENTER' and "EVACUATE AREA' signs and flashing warning devices shall be installed to all protected room entry/exit doors and shall incorporate audible alarms in accordance with AS 14520.

7.7.9 Gas Purge

Gas shall be purged after a Stage 3 discharge by operation of mechanical ventilation system if installed, or as directed by Energy Queensland.

Mechanical ventilation system shall purge the gas to atmosphere in accordance with AS 1668 2 operating at a minimum of six [6] air changes per hour.

A keyed switch located next to the entry door outside the protected room shall turn on the supply and extract fans serving the fire- affected room/s to purge the gas.

7.8 Water Supply

7.8.1 Scope of Work

Water supplies for fire suppression systems shall be adequate for meeting the system demands in accordance with the requirements of Building Code of Australia, AS 2118, AS 2419 and AS 4587.

The basis for determining firewater storage requirements shall be reviewed in a fire risk assessment.

7.8.2 Standards

AS 2118 – Automatic Fire Sprinkler systems.

AS 2419 – Fire Hydrant Installations.

AS 2941 – Fixed Fire Protection Installations – Pump-Set Systems.

AS 4587 - Water Mist Fire Protection Systems.

7.8.3 General Requirements for Fire Pumps

Type: Diesel driven pumps to AS 2941– Use of electric driven pumps shall not be considered.

Description: Factory-assembled and -tested fire pump and driver unit.

Fire protection pumps shall be centrifugal unless otherwise stated in the manufacturer's requirements.

Materials used in the construction of the pump shall be suitable for the quality of water supply. Pumps as a minimum shall be constructed with cast iron casing, bronze impellors and stainless-steel shafts.

Provide direct coupled diesel pump mounted on a mild steel base frame, complete with controls, starting system, water cooled cooling system, fuel system and tank and exhaust system.

Cooling system: Closed primary system with engine driven pump and heat exchanger cooled by open secondary cooling water drawn from the fire water supply.

Include manual shut-off valve, flushing type strainer, automatic thermostatically controlled electric valve and pressure gauge upstream of the heat exchanger.

Wastewater outlet: Provide a wastewater line connected to drain one size larger than the inlet piping, without valves, from the heat exchanger to a visible open tundish.

Flexible piping connections: Provide black steel pipe diesel exhaust system from the engine to discharge externally to atmosphere. Include flexible connection at exhaust manifold, residential muffler, catalytic converter, fully insulated complete with galvanised steel sheathing.

Adequate ventilation shall be provided for cooling of engines and motors in accordance with manufacturer's recommendations.

Compression – Ignition Drivers:

Each compression ignition driver shall be of the compression ignition, air cooled mechanical injection type, and shall comply with AS 2491. Drivers shall be directly coupled to the pump by means of a flexible coupling adequate to transmit full power of the engine, whilst maintaining axial alignment. Each drive shall be provided with a pressurised lubrication system comprising a direct engine driven pump, filter and distribution system. Each compression driver shall have an independent fuel system comprising pipework reticulation system and fuel storage tank.

Starting systems shall be battery powered unless specified otherwise and incorporate two [2] batteries with automatic and manual start operation from the battery start and a manual start operation from the control battery.

Compression ignition fire pump drives shall operate reliably for at least 2,000 hours or five [5] years of operating time between overhauls.

8 Fire Detection and Alarm System

8.1 General

8.1.1 Application

Automatic detection and alarm systems shall be provided in accordance with the requirements of the Building Code of Australia, AS 1670.1 and AS 7240.13.

For Class 10 buildings, where a Fire Indicating Panel to AS4428 is not required, alarms from fire detectors shall be fed back to Energy Queensland's SCADA system as a substation alarm.

Automatic fire detection systems shall be installed in accordance with requirements of Appendix B - Fire Matrix.

8.2 Control and Indicating Equipment

8.2.1 Standards

- General to AS 7240.2.
- Alarm investigation facility [AIF] To AS 4428.10.
- Alarm signalling equipment [AIS] To AS 4428.6.
- Power supply units: To AS 4428.5.
- Fire indicator panel [FIP] To AS 4428.3.
- Main evacuation control panel [MECP] To AS 4428.4.

8.2.2 Fire Indicator Panels [FIP]

The FIP shall be provided as follows:

- To AS 1603 and AS 1670 and to regulatory authority approval.
- ActivFire Register listed.
- IP rating of enclosure to suit environment and in accordance with AS 1939.
- Provide 316 stainless steel enclosures in corrosive environments.
- Enclosed in a surface mounted metal cubicle type enclosure with hinged door complete with glass viewing window.
- Microprocessor based configured as a fully analogue addressable system.
- Capable of proving an interface via a communication loop between the fire indicator panel and the mechanical services switchboard to shut down the A/C in fire alarm conditions.
- Provided with "Walk –test" feature that allows one person to perform easy and accurate system testing.
- Provided with a feature that allows the front panel to display all sensors that need cleaning as well as the ones that do not.

- A provision for each addressable loop to have a minimum of 20% spare device capacity and spare loop capacity for future expansion.
- The FIP shall be provided with an alphanumeric display with all events [including date and time] being permanently recorded and retrievable.
- Provide a facility to automatically test detectors in-situ with a delayed alarm and command capability.
- Provide the following features on the FIP:
- Easy expansion with addressable loop and conventional zone cards.
- Individually addressable detectors.
- On -site programmable for a wide variety of applications.
- Supports conventional detector inputs and analogue addressable loops.
- 127 devices per loop [minimum].
- Wide range of addressable devices – detectors, sounder bases, input/output modules, 4- 20 mA analogue input.
- Fully addressable and compatible with misting control equipment.
- Fully addressable and compatible with fire extinguishing systems and associated equipment detailed in this document.
- Four operator access levels.
- Programmable for single and dual detection method of operation, generation of pre-alarm and alarm signals and provision of suitable interface to localised control panels of the misting sprinkler systems.
- Programmable alarm verification, output logic control, alarm thresholds, network operation and annunciation.
- Provide isolation facility to enable testing without transmission of alarm signals to the fire brigade (when connected to the QFES network)
- Provide isolation facility to enable muting of audible alarm when field crews are carrying out works on the system. In addition, provide local muting function adjacent each local gas suppression isolation point.
- Low level links to SCADA system.
- Fault alarms to SCADA systems to Energy Queensland to initiate an immediate technical visit.
- Alarm signals to Fire Brigade (when connected to the QFES network) and SCADA.
- 19-inch compatible cabinet range.
- Activfire Register listed to AS 1603.4 and AS 4428.1.

The system shall be capable of being programmed in the field via a portable laptop personal computer and download for program editing. It shall be possible for the system to be stored for program editing. It shall be possible for the system to be stored on a CD/DVD and all programming shall be multi-level password protected. All programmed information shall be stored in non –volatile memory after downloading into the panel. The system shall continue to operate during reprogramming. During programming upload or download the system shall retain the capability for alarm reporting.

Primary power for the FIP shall be obtained from the mains supply in accordance with AS 3000 and AS 1670.

Provide sealed electrolyte high quality, long life [10-year design life] batteries as the secondary power supply for the FIP as required. The battery supply shall be calculated to operate its load as defined in AS 1603.4 Clause 2.8. Batteries shall be sized to compensate for deterioration and aging during the battery life cycle.

When calculating battery and battery charger capacity it shall be assumed that the number of devices to be supplied equals the number of devices fitted plus the number of requested spare devices i.e. power supply capacity shall be sufficient to supply the board when all spare alarm capacity is utilised. Battery calculations shall be submitted to justify the battery size. Batteries should be housed in the control cabinet.

Provide battery charging circuitry for each standby battery bank in the system low voltage power supply or a separate circuit. The charger shall be housed in the FIP or the battery cabinet.

Provide an approved block plan drawing for every floor to a scale of 1:500 showing areas of the building provided with fire detection and auxiliary devices as described and labelled at the LCD display of the FIP. Room names shown on the plan shall match that on the LCD display on the FIP. Show areas protected with multipoint aspirated smoke detection systems, water mist systems and the gaseous fire extinguishing systems.

Provide a single line diagram showing interface links from the FIP to each of the relevant control panels associated with the multipoint aspirated smoke detection systems, water mist systems and the gaseous fire extinguishing systems. Indicate on this drawing the conditions required for pre-alarm [single detector] and alarm dual detector operational.

8.2.3 Smoke Alarms

Photoelectric sensing to AS3786:2023. NO and NC relay contacts for signalling to SCADA.

8.2.4 Detectors

8.2.4.1 Standards

- Heat detectors: To AS 7240.5.
- Analogue addressable point type smoke detectors: To AS 1603.2.
- Multi-point aspirated smoke detectors [ASD]: To AS 1603.8.
- Remote Indicators: To AS 1603.15.
- Visual warning devices: To AS 1603.11.
- Sounders To AS 1670.4 and AS 60849

8.2.4.2 Multi Point Aspirating Smoke Detection

General: All flow calculation shall be carried out for all flow calculations for balancing the system and pipe layout within the protected area. A Registered Professional Engineer Queensland shall check and certify these calculations as a sufficient design for the intended risk.

The aspirated smoke detection [ASD] pipework is to be labelled with 'ASD FIRE DETECTION SYSTEM- DO NOT PAINT' printed along its length.

Standards: AS 1603.8 and AS 1670.1 – 2004 Section 5.2. Interfacing: Interface with FIP.

8.3 Manual Call Points

Provide manual call points to the substation in accordance with the requirements of the Building Code of Australia, AS 1603.5, AS 7240.11 and AS1670.1.

8.3.1 External Alarm Indication

Provide external alarm indicators where specified herein and in accordance with Building Code of Australia, AS 1603.11 and AS 1670.1.

8.3.2 Power Supply

Surge protection: Ensure that normal operation is maintained and that voltage surges in the power source do not damage the control and indicating equipment.

Sealed batteries: Cycle the batteries before practical protection so that 100% or greater of nominal capacity is available at practical completion

8.4 Fire Alarm Monitoring

8.4.1 General

Standard: To AS 7240.21.

Connection: Connect the installation to the monitoring service provider.

Provide connections and equipment to the local Energy Queensland communications network [SCADA], mechanical services systems, security alarm systems, Energy Queensland equipment and protection panel and suppression systems.

Provide common outputs [three [3] only] for ISOLATE, FAULT and ALARM for any alarm group on the FIP to the Energy Queensland communications network [SCADA].

Provide monitoring of all fire pumps [ON/OFF].

Provide monitoring to isolating valve positions on all wet fire suppression systems. Provide monitoring of all pressure and flow switches on all wet suppression systems. Provide water level monitoring of all water supply tanks.

8.4.2 Control Functions and Sequence of Operations

Provide the following control functions and sequence of operation as the minimum functional requirements.

Activation of any smoke detector, manual call point and multi point aspirated smoke detection system shall initiate the following actions and indications:

- Display a custom message describing the device initiating the alarm condition at the fire indicator panel LCD alphanumeric display [with detection zone, device address, room location type etc].
- Provide indication on the FIP via the light emitting diode to indicate the room in alarm.
- Provide indication on the FIP alphanumeric display.
- Activate the local visual alarms.
- Activate the SCADA.
- Automatically transmit an alarm signal to the Local Fire Authority.
- Place the building's air handling systems into the fire control mode.
- Shut down all non-essential mechanical plant and equipment.
- Send the correct signals to the localised control panels associated with the gaseous fire extinguishing system and water mist system.

It shall be possible to mute the audible signal from the Fire Indicator Panel by an alarm acknowledgement push button. The audible alarm signal shall re-sound for a subsequent alarm condition, reported by a different device. The Fire Alarm Visual Indicator shall remain ON until the last fire alarm input is cleared.

Receipt of a fault report [primary power loss, open or grounded circuit wiring, open grounded or shorted indication system wiring, device communication failure, battery disconnect at the Fire Indicator Panel] shall cause the following actions and indications.

- Display at the alarm control panel alphanumeric LCD display the location [address] of the faulty device.
- Activate fault audible signal at the FIP.
- Illuminate the system fault indicating light.
- Send a fault indication to the SCADA system via the low level interface as specified.

The audible signal shall be silence-able from the Fire Indicator Panel by a fault acknowledgement switch [push button] and at the same time the fault alarm shall be transferred to the "fault alarm" visual indicator. The fault signal shall resound for a subsequent fault condition reported by a different device.

8.4.3 Fire Control Mode

Provide control and indicating equipment, contactors, relays, switches and the like to meet the minimum requirements of AS 1670 and as specified below:

- Provide isolation facilities at the FIP to allow the signal to be isolated.
- Provide all fire mode control wiring between the FIP and field devices including addressable devices and control panels.

8.5 Occupant Warning System

8.5.1 General

Provide sound system for emergency purposes in accordance with the requirements of the Building Code of Australia, AS 1670.4, AS 60849 and AS/CA S009.

Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

8.5.2 Basic Detection System

The fire detection requirements for zone substations/switching stations remote from CBD areas, which supply rural and/or residential loads, are set out below:

- A standard and basic type of fire detection system using point smoke or heat detectors must be used to send a signal to the fire protection panel.

The following alarms must appear on the substation HMI and the control room master station as priority alarms:

- Fire alarm Operated/restored
- Fire system status Activated/disarmed
- Fire equipment failure Operated/restored
- Fire system AC supply failure Operated/restored

Fail safe contacts with a minimum rating of 120V DC must be used for inputs to the SCADA system.

At the substation fire protection panel, LED indication must show the system status (activated/disarmed), zones in alarm, and zones disabled. The fire alarm must initiate audible warnings by the use of internal sirens and a single fire bell located outside of the control building that houses the fire panel. Visual warnings must be provided by a single strobe light located outside of the control building housing the fire panel. This strobe light must be located in a prominent position that can be easily seen from the front property boundary.

The fire system must accommodate fully expandable inputs and outputs.

9 Emergency Evacuation Plan

9.1 General

An evacuation plan is required in all indoor substations apart from Class 10 modular buildings.

Where required, the evacuation shall be reviewed and approved by Queensland Fire and Emergency Services (QFES).

9.2 Fire Sign/Plan

Provide a framed evacuation sign with a 1:200 plan [or as otherwise agreed with Energy Queensland] including the following information:

- The name of the Building and Floor number or area description.
- A brief statement of evacuation procedures:
  - Alert Fire Brigade, and other assistance required.

- Alert all personnel in the vicinity.
- Evacuate the substation if necessary.

- A floor or area plan showing the location of:
- Fire exits and escape routes.
- Manual alarm points.
- Fire extinguishers and fire hose reels.

9.3 Floor Plan Features

The floor plan must clearly show corridors, rooms and exits. Symbols used on the plan shall be based on standard graphical symbols for fire protection drawings. Symbols for the fire extinguishers and hose reels to be coloured red and the symbols for egress paths and exits coloured green. The plan to be drawn so that when it is mounted on the wall it is correctly oriented with respect to the building The plans shall have a “you are here” symbol. All room names, room numbers etc shall be correctly oriented to suit the evacuation plan and its physical location within the substation.

9.4 Draft for Approval

Submit a draft fire sign/plan [for each orientation] for review by the Energy Queensland prior to installing the final Evacuation plans.

9.5 Quantity

Required quantity; One [1] at each substation level.

10 Electrical

10.1 Licensed Electricians

The electrical works associated with the fire services shall be carried out only by competent qualified tradesman holding a current electrical license.

10.2 Authorities, Rules and Regulations

The installation shall be carried out in strict accordance with the current rules and regulations of the Supply Authority and shall conform to the requirements of any Authority, which may have jurisdiction over the installation.

Carry out all works and provide equipment in accordance with the latest appropriate issued copies of the following:

- AS 1670 –Automatic Fire Alarm and Detection Systems.
- AS 3000 – Electrical installation works generally.
- AS/CA S 009 – Installation requirements of customer cabling.
- Building Code of Australia.

10.3 Identification of Circuits and Cables

Each cable that forms part of the installation shall bear an identifying number at both ends and at all connected services. The cable shall be numbered by means of approved wiring ferrules or other approved identifying fittings. Numbers shall be printed, embossed or engraved so that they are neat in appearance and permanently legible, and fittings shall be securely attached so that they will not slip off when the cable is removed from its terminal. Handwritten numbers or adhesive tape bearing numbers will not be acceptable.

All numbering shall be as shown on the “as – constructed” diagrams.

10.4 Wiring Diagrams

A complete set of wiring diagrams shall be provided and permanently attached to the inside of the fire services panels.

A copy of each drawing shall be plasticised and installed in a holding frame which shall be wall mounted adjacent the FIP.

10.5 Cables and Wiring

Cable sizes for each circuit shall be selected to ensure that current carrying capacity is adequate and that voltage drop at the equipment served will not be excessive. Cabling shall generally be installed as follows whichever is applicable to the relevant part of the building installation:

- Install 150 mm, 200 mm or 300 mm wide cable tray as required in a vertical arrangement offset from the wall using uni-strut brackets. This wiring method will generally apply to inter level wiring and main trunk and tee- off runs at each level. Wiring within individual rooms will generally be in surface fixed conduits, which will connect with the cable tray system.
- The cable trays shall be fixed to structural walls and slabs as appropriate.
- The conduits shall be installed such that they drop behind the cable tray and thereby the cable transition from the tray to conduit is concealed behind the tray.

Cables shall, as far as practicable, be run in locations that will be accessible in the finished installation.

Provide a means of accessing the concealed conduits at both ends to allow easy replacement and installation of additional cables.

10.6 Fire Rated Cables

Cables for essential services or where required by the BCA and AS 1670 shall be two [2] hour fire rated [WS52W] polymeric type.

Fire rated cables shall be fixed and supported with components equal to those used in testing cables and components for compliance with AS 3013.

10.7 Conduit

Where changes of direction are necessary in conduits use either junction boxes or bend conduits in undistorted easy sets.

Do not use more than two [2] bends including sets between any two cable draw in points. Provide draw boxes at not greater than 25 metre centres. Make draw boxes and outlet boxes readily accessible.

10.8 Control Board and Control Cabinet Wiring

Enclose front of panel wiring in insulated troughing complete with clip on lid. Adhere to AS

3008.1 rating requirements when installing bunched or loomed wiring. Ensure that final current rating requirements are maintained. At terminating points fit cable end lugs for each cable end.

Identify cable ends with push on and retained purpose made marker. Adhesive markers will not be accepted. Numbering shall coincide with that shown on the associated final circuit diagrams. Number duplication will not be acceptable. Shroud all live parts subject to exposure when doors or panels are removed.

10.9 Cabling Systems and Accessories Installation

All detector wiring must be separated from all other wiring with the minimum spacing to AS/CAS009 requirements.

10.10 Integration with other Fire Systems

The fire detection and alarm system to be fully integrated with fire systems described herein.

Ensure that the FIP and associated equipment is fully compatible [and interconnected/interface as appropriate] with the other fire systems detailed.

11 Smoke Ventilation Systems

11.1 General

11.1.1 Application

Mechanical smoke ventilation systems shall be provided in accordance with the requirements of the Building Code of Australia and AS 1668.1.

A Fire Fan Control Panel [FFCP] shall be provided in accordance with the requirements of the Building Code of Australia and AS 1668.1.

Provide all wiring interfaces between the FFCP and the FIP for automatic operation of the smoke exhaust management fans in fire mode.

Operation of the smoke ventilation systems shall be monitored by the SCADA

12 Testing and Commissioning

12.1 General

Fire System commissioning tests must be conducted to determine that construction work, assembly and installation has been carried out in accordance with the design and prove compliance with the specified requirements in terms of functions, characteristics, capacity and performance of the equipment and plant under working conditions independently of any tests which may already have been carried out at the manufacturer's works.

Specifically, the tests must verify that:

- Equipment has not been damaged during transit.
- The plant has been installed in accordance with the design.
- The plant has been installed with good workmanship.
- The plant will perform in accordance with the design.
- The design will enable the plant to function as intended.
- The plant can be energised and put into service safely.

Sufficient inspection and testing must be performed to prove that all plant and equipment:

- Has been installed correctly.
- Will operate with the designed characteristics in accordance with the intended design, the relevant design, the relevant drawings and specifications.
- Is fit for commercial operation.

The costs of all tests and inspections including the supply of testing equipment will be borne by the Contractor and will be included in the Contract Price.

The Contractor shall provide an Inspection and Test Plan [ITP] to Energy Queensland for approval at least 14 days prior to undertaking the tests. Testing of the fire protection system will be performed according to the requirements of AS 1851.

12.2 Test Reports

A preliminary test report including copies of draft test results must be issued immediately after completion of each test.

In addition, the report must also detail a summary of problems and defects found during testing and a list of any outstanding work items that require completion.

Within four weeks of completion of the tests, a final Test Report must be submitted to Energy Queensland.

The Test Report will consist of the completed Test Result Sheets and Remedial Work Sheets.

In addition, the report must also detail a summary of any problems and defects found during testing.

Should any equipment or part of equipment fail under test to give the required performance, further tests which are considered necessary by Energy Queensland must be carried out and the whole cost of the repeated tests will be borne by the Contractor.

Appendix A

Informative

Extracts from AS2067-2016

Table 1: Clearances for Outdoor Transformers

TABLE 6.1

CLEARANCES FOR OUTDOOR TRANSFORMERS

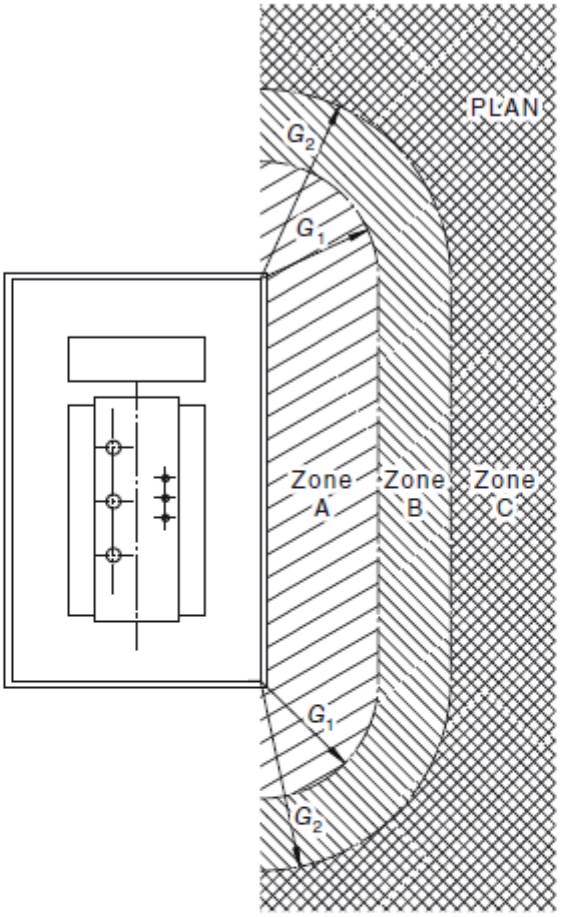
Transformer type	Liquid volume	Clearances to other transformers or equipment	Clearances to buildings		
		Horizontal separation G_1 to other transformers or non-combustible surfaces	Horizontal clearance G_2 to combustible surfaces	Horizontal clearance G_3 to 2 hour fire resistant surfaces of buildings	Vertical extent G_4 for 2 hour fire resistant surfaces of buildings
	L	m	m	m	m
Oil-insulated transformers (O)	100 ≤1000	1	6	1	4.5
	>1000 ≤2000	3	7.5	1.5	7.5
	>2000 ≤20 000	5	10	4.5	15
	>20 000 ≤45 000	10	20	7.5	30
	>45 000 ≤60 000	15	30	7.5	30
	>60 000	23	30	7.5	30
Less combustible liquid-insulated transformers (K) without enhanced protection	100 ≤1000	1	6	1	4.5
	>1000 ≤38 000	1.5	7.5	1.5	7.5
	>38 000	4.5	15	4.5	15
Less combustible liquid-insulated transformers (K) with enhanced protection (refer to Note 1)	Clearance G_1 to other transformers or building surfaces				Vertical extent G_4 for 2 hour fire resistant surfaces of buildings
	Horizontal m				Vertical m
	0.9				1.5
Dry-type transformers (A) Fire behaviour class F_0	1.5				3.0

Table 2: Minimum Fire Safeguards for the Installation of Indoor Transformers

TABLE 6.2

MINIMUM FIRE SAFEGUARDS FOR THE INSTALLATION OF INDOOR TRANSFORMERS

Transformer type (see Note 2)	Liquid volume L	Safeguards
Oil-insulated transformers (O)	≤1000	FRL 120/120/120
	>1000	FRL 120/120/120 or FRL 60/60/60 and automatic fire suppression protection
Less combustible liquid-insulated transformers (K) without enhanced protection		FRL 120/120/120 or FRL 60/60/60 and automatic fire suppression protection
Less combustible liquid-insulated transformers (K) with enhanced protection Dry-type transformer (A)	≤10 MVA and U_m ≤36 kV	FRL 120/120/120 or separation distances 0.9 m horizontally and 1.5 m vertically
	Fire behaviour class	
	F_0	FRL 60/60/60 or separation distances 0.9 m horizontally and 1.5 m vertically
	F_1	Non combustible walls



ZONE	BUILDING CONSTRUCTION
A	Fire rated
B	Non combustible materials
C	No requirements

FIGURE 6.2(A) FIRE EXPOSURE PROTECTION FOR BUILDINGS

Figure 2: Fire Exposure Protection for Buildings

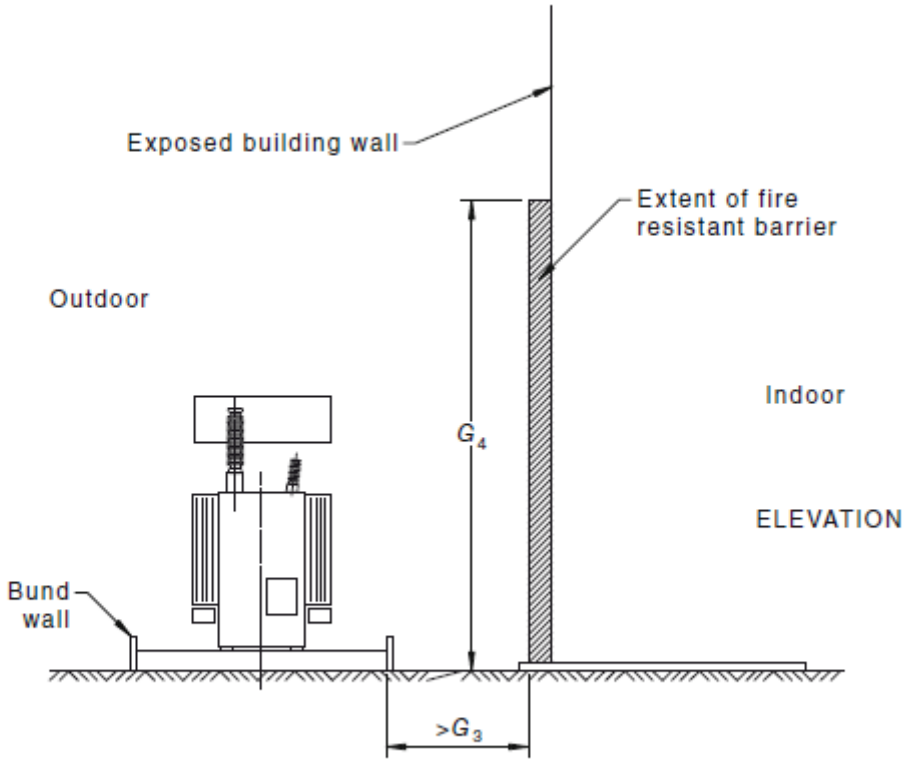


FIGURE 6.2(B) FIRE EXPOSURE PROTECTION FOR BUILDINGS

Figure 3: Fire Exposure Protection for Buildings

Appendix B

Normative

Fire Protection Matrix

B.1 Major Indoor CBD Transmission Substation (e.g., SSCST)

Location	Mist Systems	Gaseous Systems	Fire Extinguishers	Sensors	Comment
Transformer room – enclosed	Yes	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide aspirating smoke detector [ASD] system and photoelectric -point type smoke detection.	Hydrant arrangement to allow for QFRS pump truck connection.
Radiator room - unenclosed	No	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	No	Two hour fire rating for walls. Fire extinguisher requirement to be reviewed as part of risk assessment or as per AS 2067 requirements.
Control Room	No	Yes	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide aspirating smoke detector [ASD] system and photoelectric -point type smoke detection.	
Battery Rooms	No	Only if required under NCC	Yes Provide to meet requirements of AS2444	Provide aspirating smoke detector [ASD] system and photoelectric -point type smoke detection.	Two hour fire rating, ventilation. Hydrogen gas detector may be required as part of risk assessment
11kV Switchgear Rooms	No	Only if required under NCC	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide aspirating smoke detector [ASD] system and photoelectric -point type smoke detection.	

Location	Mist Systems	Gaseous Systems	Fire Extinguishers	Sensors	Comment
33kV Switchgear Rooms	No	Only if required under NCC	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide aspirating smoke detector [ASD] system and photoelectric -point type smoke detection.	
66/110kV GIS Rooms	No	Only if required under NCC	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide aspirating smoke detector [ASD] system and photoelectric -point type smoke detection.	
Capacitor Bank Room	No	Only if required under NCC	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide aspirating smoke detector [ASD] system and photoelectric -point type smoke detection.	
Cable Gallery & Basement	No	If cables are not well spaced apart	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide aspirating smoke detector [ASD] system and photoelectric -point type smoke detection.	In large basements with high risk of lost load in event of fire - Two hour fire sealing floor penetrations, ablative paint on cables entering switchroom.
Fire Hydrant					Required to comply with BCA Clause E 1.3
Fire Alarms					For alarm & monitoring. Fire Indication Panel to AS4428 & SCADA monitoring in built up areas. Monitoring to QFES.

B.2 Masonry Substation Buildings

Location	Mist Systems	Gaseous Systems	Fire Extinguishers	Sensors	Comment
Control rooms	No	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide photoelectric -point type smoke alarm (Clipsal 755RB or equivalent)	Addition of aspirating smoke detector [ASD] system via risk assessment.
Switchgear rooms	No	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide photoelectric -point type smoke alarm (Clipsal 755RB or equivalent)	Addition of aspirating smoke detector [ASD] system via risk assessment.
Battery Rooms	No	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide photoelectric -point type smoke alarm (Clipsal 755RB or equivalent)	Ventilation of air to prevent hydrogen build up, two hour fire rating internal doors and walls.
Fire Hydrant					Where practical provide mains hydrant within 90m of site with required pressure (to be reviewed as part of fire risk assessment)
Fire Alarms					For alarm & monitoring. Fire Indication Panel to AS4428 (smoke detector) &/or monitoring of alarms back to SCADA (smoke alarm).

B.3 Modular Buildings

Location	Mist Systems	Gaseous Systems	Fire Extinguishers	Sensors	Comment
Control rooms	No	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide photoelectric -point type smoke alarm (Clipsal 755RB or equivalent)	Addition of aspirating smoke detector [ASD] system via risk assessment.
Switchgear rooms	No	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide photoelectric -point type smoke alarm (Clipsal 755RB or equivalent)	Addition of aspirating smoke detector [ASD] system via risk assessment.
Hybrid (modular) substations	No	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide photoelectric -point type smoke alarm (Clipsal 755RB or equivalent)	Addition of aspirating smoke detector [ASD] system via risk assessment.
Battery Rooms	No	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Provide photoelectric -point type smoke alarm (Clipsal 755RB or equivalent)	Ventilation of air to prevent hydrogen build up.
Fire Hydrant					Where practical provide mains hydrant within 90m of site with required pressure (to be reviewed as part of fire risk assessment)
Fire Alarms					For alarm & monitoring. Fire Indication Panel to AS4428 (smoke detector) &/or monitoring of alarms back to SCADA (smoke alarm).

B.4 Outdoor Substations

Location	Mist Systems	Deluge Systems	Fire Extinguishers	Hydrant	Comment
Outdoor transformer – fully enclosed	No (unless identified in site specific risk assessment)	No	Provide to meet requirements of AS2444 (Min 1 x DCP & 1 x CO_2)	Where required in site specific risk assessment - Where practical provide mains hydrant within 90m of site with required pressure.	
Outdoor transformer – partially enclosed	No	No (unless identified in site specific risk assessment)		Where required in site specific risk assessment - Where practical provide mains hydrant within 90m of site with required pressure.	

Appendix C

Informative

Revision History

Revision Date	Version Number	Author	Comments
13/07/2026	10	John Lansley	Update Clause 6.3 to give relaxation for certification of fire stop seals for control and auxiliary cables