PowerWater

Design Standards for Upper Level Substation Chambers

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1. Contents

2. Introduction

This Network Standard applies to site selection, design and construction of new contestable and non-contestable upper level substation chamber installations. This document is to be read in conjunction with Power Water Corporation (PWC) indoor substation standards (Vol 2 section 2, subsection 7 – Construction Drawings). Any details not noted within these design guidelines are to be referred back to the PWC indoor substation standards, otherwise this document will take priority regarding upper level substation chambers.

The requirements of these guidelines shall apply throughout PWC's supply area. Substation electrical design, electrical construction and electrical equipment are not covered in these guidelines. These topics are coved in the relevant PWC Standards Drawings online.

The requirements of all relevant Australian Standards, the Building Code of Australia (BCA) as applicable and all statutory bodies are regarded as minimum requirements for the establishment of substation chambers. Where this document exceeds those requirements, this document is the minimum standard acceptable by PWC.

3. Upper Level Substation Chamber

In general the construction of the substation chamber (including access chambers) shall provide a chamber which is dry and completely isolated from the remainder of the building with walls, floor, ceiling and doors providing a minimum Fire Resistance Level (FRL) of 2 hours 120/120/120 where there is no oil-filled equipment.

Substations which may be classified under the OH&S Legislation as 'confined spaces' will not be approved for use as substation chambers by PWC.

3.1. General

Upper level substation chambers have a floor level that is greater than 4000mm above the lowest point of the adjacent street or roadway from where personnel and equipment access is gained.

- An upper level substation chamber must not contain oil filled equipment.
- Lifting requirements and personnel access shall be in accordance with section 4.
- All proposals and designs shall be approved in writing by PWC prior construction .

4. Access Requirements

Compliance with the following conditions is necessary to gain approval to receive supply from PWC.

- PWC personnel must have dedicated access 24 hour/ seven days a week.
- Doorways must be 1200mm wide when the door is in the open position.
- No public or occupant access is permitted through the PWC dedicated access ways. This includes during periods of emergency evacuation when PWC or fire fighting personnel may require unhindered access into the substation chamber and associated access ways.
- There must not be any requirement to move any material or traverse around any item or persons in or at the entry/exit points of the access ways.

4.1 Prohibited Locations

Access ways must not be located in areas where access may be obstructed by persons, vehicles, equipment, material storage areas, site usage, enclosed or partially enclosed car parks, loading docks, similar facilities or any other possible impediment.

At least one of the two personnel access ways to substation chambers must not access into or through other areas of the building. Including but not limited to courtyards, car parks, foyers, etc. A direct route to the substation from outside of the building must be provided.

Access ways must not involve access through areas which may be deemed to be dangerous to personnel. This includes, but is not limited to, access through areas patrolled by guard dogs, operations involving vehicles or machinery or mechanical plant and equipment rooms.

Access to an upper level substation chamber is not acceptable from a nominated public or occupant fire stair or through parts of the building which may be occupied or tenanted.

4.2 Prohibited Items

Except for services, facilities or installations directly associated with the substation, no other services, facilities or installations are permitted within the substation or the dedicated access way.

Consumer's mains, switchboards, metering or any other parts of the consumer's installation are not permitted in a substation access way.

No materials, equipment or other objects are to be stored or placed within an access way.

4.3 Construction and Loadings

Substation access ways and building openings in the vicinity of any substation chamber openings, must comply with all BCA fire resistant construction requirements and fire segregation requirements.

All openings and access ways must comply with local authority requirements.

All access ways or roadways servicing access points must be capable of withstanding construction and service loadings and loads applied by vehicles transporting or moving equipment to and from the substation and ensure clear access at all times. Refer to section 5 for details.

4.3 Rights of Way

All accesses for upper level chambers through buildings must be subject to an approved a Right of Way (ROW) to enable 24 hour unimpeded access seven days a week.

A permanent ROW in favour of PWC is required to be created by the customer at the customer's expense. The ROW must cover the following:

- On the same level as the upper level substation chamber, a ROW from a convenient lift or stairway to access doors of the substation chamber;
- At street level, a ROW between the public street and lift or stairway; and
- ROW at ground level to dedicated access way

ROW shall be submitted to PWC for approval. Any future development, extensions or change of ownership of the building must make acknowledgment of this ROW and maintain this arrangement. Approved drawings are to be provided to PWC in electronic format for inclusion in the Asset System.

4.4 Personnel Access Requirements

Each substation chamber must be provided with two separate access ways for personnel. Where two or more substations are located adjacent to each other, it is not acceptable for any of the access doors or passageways to be shared between substations. Each substation chamber must be separate and each chamber must have separate access arrangements applicable. The two separate access ways within a substation shall not share the same exit point. Both access ways must have separate exit points in different parts of the building. If one of the access enters the buildings common areas, the inside of the access door must be labelled "emergency exit only".

Throughout the substation chamber a minimum of 1000mm clear opening shall be provided from any part of the structure to equipment and minimum of 900mm between equipment to equipment within the substation chamber.

Substation chamber access doors should be diagonally opposite where possible or at either extreme end of the substation chamber.

Within all substation chambers, personnel access doors must be positioned to enable unimpeded access from all locations within the chamber area for normal operations and inspection.

In particular one door shall be installed adjacent to the LV switch board and operational side of the switchgear access is required for operations and inspections involving:

- The front of the low voltage switchboard
- The operation side of each high voltage switch

Personnel access to upper level substation chambers is to be obtained from within the customer's building via the ROW discussed above.

4.5 Doors to Upper Level Substations and Access Chambers

Personnel doors must achieve a FRL of 2 hours.

Upper level substation chamber, substation chamber openings and building ventilation in the vicinity of the substation opening must comply with BCA fire resistant construction and fire segregation requirements.

4.6 Access Chamber

Upper level substation chambers must have a dedicated access chamber outside each substation chamber access door. In some cases, the stairways can form the access chamber.

The access chamber must comply with and be of the same construction and fire resistance level (FRL) required for the upper level substation chamber.

Doorways must be provided to form an airlock within the access chamber, i.e. doors must be provided between the substation chamber and access chambers and between the access chamber and the common area or lift foyer.

The door on the doorway between the common area or lift foyer and the access chamber shall swing into the access chamber. The door between the substation chamber and the access chamber shall swing into the access chamber.

4.7 Dedicated Access Ways

The two dedicated access ways must be approved in writing by PWC.

Access ways can only be chosen from the following options described below.

Option A is strongly preferred and at least one of the access ways shall be of this type. Option B is permitted only when option A is not physically practicable. All final decisions regarding the use of option A or B shall be made by PWC.

Option A

Each access way is through a separate doorway which is located at street level in an external wall of the building. The external door opens into an access chamber which leads to a stairway. At the top of the stairway is another doorway into the substation chamber.

Option B

One access way is per option A. The second access way can be shared with the building's common areas, such as courtyards, car parks, foyers, etc. This access is intended for PWC emergence use only and shall be labelled as such from the inside for the substation chamber.
It is PowerWater's preference to have the ability to replace all equipment within the substation chamber via the louvered transformer door. Large items such as RMUs and dry type transformers shall have a clear path out of the chamber without the need to move any other items.

Alternatively at least one of the personnel access ways shall incorporate a vertical 1600mm X 900mm shaft from the upper access chamber to the lower access chamber, suitable for transport of small items of equipment and tools to and from the substation chamber. Refer to 4.11 for further details.

All personnel access doors that are also used for small equipment access must provide a clear opening of not less than 2400mm high by 1200mm wide, when the door is in the fully open position.

All street level access chambers must be located at the same level as the public roadway which services the access chamber. However, it could be raised with sufficient area to operate and where cable bending radius is an issue.

All street level access chambers, which can not provide level access from a public roadway, will be subject to review and approval from PWC before design is finalised or construction commences.

4.8 Doorways between External Areas and Access Chambers or Control Point Chambers

Each doorway leading from an external area into a substation, access chamber, or control point is to:

- Have a 120 mm minimum, 190 mm maximum step up from the external level to the access chamber. If more than one (1) step up is required, these additional steps shall be accommodated on the outside of the substation, access chamber or control point and include an appropriate handrail;

- If at street level it is to have bollards placed around doors where there is a risk of personnel stepping onto roadways when using them or there is a risk of the door being blocked by such things as motorcycles, bicycles, delivery vans or the storage of goods being delivered or awaiting collection;

- Be positioned such that its use does not create a personnel hazard;

- Be fitted with doors such that.

    - Swing into the access chamber or control point;
    - Are positioned so that suitable clearances are maintained from any internal stairways when the doors are in the fully open position;
    - Have an appropriate safety sign fixed to it as indicated by Clause 7.8.9 of AS/NZS 3000. (Standards Drawing S02-2-7-04)
    - Are fire resistant;

- Are weatherproof if leading from an outdoor area;
- Appropiate drainage to provide water from entering the substation.
- Are fitted with fire rated hydraulic door closers; and
- Swing on their frame with heavy-duty non-corroding metal hinges.

4.9 Stairways

Stairways must be large enough to allow for the passage of equipment or personnel, and must be not less than 1200mm wide. Stairway headroom must be a minimum of 2200mm.

Stairways must be fitted with appropriate handrails, lighting and must be constructed and installed in accordance with AS1657 and other relevant Australian Standards and Building Codes. Refer to S2-2-7-63 for chamber lighting requitements.

4.10 Doorways between Access Chambers and Substation Chamber

Each doorway leading from an access chamber into a substation chamber is to:

- Be fitted with doors that:
  - Swing into the access chamber;
  - Are 2 hour fire resistant;
  - Are fitted with fire rated hydraulic door closers; and
  - Swing on their frame with heavy-duty non-corroding metal hinges.
  - Panic push bar for exit

4.11 Combined Personnel Access and Small Equipment Access Way Requirements

This access way is for personnel and small equipment access. The upper access door shall be located on the same side as the HV switchgear of the substation chamber.

The upper access chamber must incorporate a landing of not less than 1700mm x 1700mm, to facilitate moving and turning of equipment. A shaft from the upper access chamber to the lower access chamber must be located beside the upper access chamber landing. A one tonne monorail and trolley, suitable for attaching a lifting device for lifting and lowering tool boxes and small items of equipment from the upper access chamber to the lower access chamber, must be located over the centre lines of the shaft and the upper access chamber landing. It is also preferable to have the centre line of the door align with shaft centre line. PWC personnel will attach a lifting device to the trolley when required. The attachment point on the trolley is to be between 3000mm and 3200mm above the upper access chamber landing.

The shaft must be not less than 1700 mm x 1000 mm. Self-closing, self-latching gates must be fitted between the landing and the shaft. The gates must swing over the landing. The monorail, trolley, gates and their installation must be in accordance with relevant Australian Standards, and must be labelled as required in those Standards. The lower access chamber must be not less than 1700 mm x 1700 mm wide to facilitate moving and turning of equipment. The headroom must be suitable for the lifting facilities as specified for the upper chamber, and must otherwise have minimum headroom of 2600 mm. The lower access chamber must be located beside

the equipment shaft. The floor of the shaft must be level with the floor of the lower access chamber.

The door to the street level access chamber must be located in a position where a truck with a hoist can stand and deliver tool boxes and small items of equipment. The door to this access chamber must provide a clear opening of not less than 2400 mm high and 1200 mm wide, when the door is in the fully open position. A suitable clearance is to be provided in front of the door to facilitate handling of equipment.

4.12 Equipment Access and Handling

Access for all substation equipment must be through an approved access door in the external wall of the Substation Chamber .

The Substation Chamber access door must be accessible at all times for lifting equipment required for replacing or servicing the equipment within the Chamber Substation.
Equipment handling also requires a suitable access way or road with turning circles, safety clearances, parking areas and roadway load capacity requirements.

Where direct unimpeded access is not possible, switchgear access and handling arrangements must be included in the initial substation design and be approved by PWC prior to the construction commencing.

Equipment weighing more than 70kg but less than one tonne (not including transformer) is classified as HEAVY and must be lifted by an appropriate crane or lifting mechanism.

The build owner or occupant must supply a suitable crane or lifting device at no cost to PWC, and must be approved by PWC whenever it is required.

The major equipment in the control point chamber (HV switchgear) is less than one tonne and so can be delivered via the designed combined personnel and equipment access way.

5 Transformers landing and Heavy vehicle access

Large pieces of equipment such as transformers require a mobile crane and a low loader or truck for movement to and from the substation. A heavy duty access roadway and plan for lifting and movement of equipment and associated transformer landing area must be provided and approved by PWC prior to equipment delivery and build construction.

5.1 Heavy-duty Access Roadway

The heavy-duty access roadway and associated transformer landing area must be suitable for use under all weather conditions. The access roadway must be constructed to withstand all loads likely to occur from the installation of transformers and shall comply with or exceed the requirements of this Network Standard.

There are various methods of heavy equipment delivery. The Designer must select the method of delivery which is most appropriate for the site and nominate the chosen method on the architectural drawing.

Common methods of heavy equipment delivery are as follows:

a) Articulated crane (eg. Franna).

This is the most common method of transformer delivery. For a 20 tonne Franna crane lifting a 5 tonne transformer, the roadway must be suitable for a front-axle loading of 15 tonnes. The rear-axle loading should not exceed 12 tonnes and the overall loading of the crane with transformer would be 25 tonnes spread across the two axles.

b) Mobile crane and truck.

The surface of the Right of Way (ROW) from the street to the transformer delivery point must be capable of withstanding a rear-axle loading of 21 tonnes.
Where the crane with outrigger pads extended, lifts the transformer from the truck in the maneuvering area adjacent to the substation, the surface of the ROW must be capable of withstanding a rear-axle group or outrigger loading of 21 tonnes. The loading on any one pad may be up to 15 tonnes with a total loading on any two pads of 21 tonnes.

This loading must be provided for in the design of any paving or suspended slab within 1.9 meters of the roadway kerb in those cases where the position to which the transformer has to be lifted is more than 4 meters from the kerb.

In this regard, 5.2 meters from kerb to transformer centre line at the landing position is the maximum reach with a 1500 kVA transformer unless approved in writing by PWC.

c) Self-loading truck.

(eg. Heavy table-top truck with boom-lift crane, eg. Hiab or Palfinger.)
This method is generally only suitable in cases where the truck can park immediately adjacent to the transformer landing area in front of the substation louvers. This is because the boom-lift crane can only set the transformer down immediately adjacent to the truck. From this point it is necessary to winch the transformer into the substation. The surface of the ROW should be capable of withstanding a rear-axle group or outrigger loading of 21 tonnes, with the loading on any one pad being up to 15 tonnes.

d) Permanent monorail and trolley.

This is the usual method for Upper Level Chamber Substations. A site-specific design is required. The monorail, trolley and a transformer lifting beam shall be included. All items must be able to handle a minimum load of 5 tone and shall comply with the requirements of AS 1418. A certificate of compliance to the Northern Territory of Australia Building Act (section 40) shall be submitted to Power Water along with the design. For details of the transformer lifting beam refer to S02-1-6-09.

A certification plate shall be installed on the monorail and trolley detailing the maximum loadings.

It is the responsibly of the building designer to insure that a minimum of 100mm height clearance is maintained within the chamber when maneuvering both the transformer and lifting equipment. It is advisable for the developer to utilize a low headroom push girder troller-vital hand chain block similar to the "Harrington SHB050".

e) Landing platform.

Transformer landing platforms must be able to handle a minimum load of 5 ton and comply with the requirements of AS 1418 and a certificate of compliance to the Northern Territory of Australia Building Act (section 40) shall be submitted to Power Water along with the design.

Removable balustrades are required on all landing platforms. Refer to S02-2-7-63 for details.

For Upper Level Chamber Substations, methods (d) and (e) above will normally need to be considered in conjunction with method (a), (b) or (c).

In each case, the height and width of the access way must be a minimum 4 meters for reasonably straight routes, with increased width at bends and in the maneuvering area adjacent to the substation, where lifting operations will be carried out. The surface grade along the ROW should not exceed 1:8 and in the transformer handling area should not exceed 1:20.

Headroom of not less than 4 meters (clear), for structures on a level access route, is required along the route to be taken by vehicles to and from the transformer handling and vehicle maneuvering areas, to ensure operation of the crane is not impeded.

Where the access route for the crane is on sloping ground or where there are humps or dips in the access route, the headroom for structures must be increased above 4 meters as necessary to compensate for the position of the crane boom at any point along the access route. Each case will need to be determined to the satisfaction of PWC.

The clearance requirements indicated above must be achieved following completion of all building treatments including cladding of overhead structures and paving of the access route.

Any reinstatement which may be necessary, in the event of damage to the paved surface or walls of a Right-of-Way, is the responsibility of the owner of the premises.

5.2 Transformer Handling Area

A transformer handling area with sufficient space for vehicle maneuvering must be included adjacent to the substation. The transformer and equipment handling area shall be of a size which will allow all of the substation transformers to be stored within

the area at any time. The floor grade of the transformer handling area should not exceed 1:20.

5.3 Equipment Handling Within the Substation Chamber

Equipment must be maneuvered into position within the substation chamber using methods acceptable to NT Worksafe and all other appropriate authorities. Pulling rings are to be incorporated into the substation structure to assist this process.

The positioning of any pulling rings is to provide straight pulls, clear of any pieces of equipment which do not obstruct doorways.

Pulling rings shall be designed to pull equipment up to 5 ton on roller wheels.

Where a transformer loading platform is used, removable balustrade and safety harness attachments points must also be included in the design. Designers shall carry out a safety in design assessment on the substation chamber and submit to PWC for approval, along with the certificate of compliance to confirm the substation floor and loading platform load strength.

Clearances around permanent equipment shall ensure the equipment is readily accessible at all times. A minimum of 1000mm clearance opening shall be provided from any structure to equipment and minimum of 900mm between equipment to equipment within the substation chamber. Incorporation of pulling rings or eyes into the substation structure must not impair fire rating, waterproofing or structural integrity of the surrounding structure.

5.4 Transformer and Equipment Access Doors

It is preferable transformer access doors swing outwards. If an access door is required to swing into the substation chamber, it must be PWC approved and positioned to ensure the minimum clearances around equipment are maintained when the door is being opened or is in the fully open position.

Outward swinging doors may need to be fitted with hinges to allow a swing of 180° to provide sufficient maneuvering space in front of the substation entry. Refer to PWC standard drawing S02-2-7-2 for details.

Transformer and equipment access doors are to be operable from the inside only and have removable safety rails installed where a transformer landing platform is not available.

6. Ventilation Requirements

Adequate ventilation must be provided at no cost to PWC, to dissipate heat generated by the substation equipment during normal operation. The chamber shall maintain an operational temperature of under 45˚C. All areas nominated for the purpose of ventilating the substation are to terminate on an external face, to free open air. Vents must not terminate in areas where heat or smoke dissipation will cause inconvenience or are subject to fire risk. Areas such as those under awnings, under carpark ramps or adjacent to the entry to buildings, foyers, lobbies and carparks are to be avoided.

All maintenance of the duct works and ventilation fans/ filters is the responsibility of the building owner. A proposed maintenance method and period is to be submitted for PWC approval before construction.

Louvres can be finished in colours to suit the building decor, however if they are to be left in natural aluminium they must be finished with a grade A coating of clear anodising followed by a coat of clear methacrylate lacquer or equivalent.

Upper level substation chambers require dedicated inlet and outlet ventilations. The louvred transformer access doors can be considered as a suitable outlet. The inlet ventilation ducts of the substation chamber are only to be installed in specified locations as defined in section 6.2.

If for any reason designer cannot comply with the ventilation requirements stated below, designer can submit alterative along with a Computational Fluid Dynamics (CFD) study conducted and approved by a mechanical engineer for PWC's consideration.

6.1 Ventilation Fan

Cooling fans are to have low tip speeds and be thermostatically controlled with an "On/Off/Auto" switch mounted within the substation chamber. The sound pressure level of fans is not to exceed recommendations of the Australian Building Code and in accordance to the Environmental Act.

Ventilation fan control is to be set to operate at 45°C ambient air temperature and cut out at 40°C. Temperature sensors are to be located inside the substation room, up high on the wall housing the outlet vents or transformer doors, and positioned so that they are able to detect the temperature of the outgoing airflow.

The flow of fresh air into the substation room shall be supplied by a 1250 diameter axial type 6 pole fan similar to Fantech, axial fan model APP1256/9. The fan shall be supplying flow rate of 4m³/s using two 1000 X 1000 grillies per transformer.

The ventilation fan must be fed from the Fire Essential Section of the Main Switch Board. This is to ensure that power to the fan system is continually available from the building's essential services. It should be ensured that the fans can be electrically isolated from the Main Switch Board, to safely allow for maintenance on fans and filters without disabling other essential electrical systems.

All maintenance of the duct works and ventilation fans/ filters is the responsibility of the building owner.

6.2 Control Point Chambers and Chambers for the Control of High Voltage Customer (HVC) Connections

Adequate ventilation must be provided for personnel. Ventilation can be via louvered panels or doors similar to the transformer access door within the substation chamber.

6.3 Ventilation Duct Requirements

All duct work shall be installed outside of the substation chamber where only the inlet openings are visible within the substation chamber. Duct works shall not be located

over any equipment or reduce the available headroom below the minimum levels set out in the relevant Network Standards.

Substation ventilation ducts shall not contain any other services, give access to any other portions of the building or form part of the ventilation system for any other part of the building.
Inlet ventilation ducts shall have filters installed to minimise the dust entering the substation chamber.

Two 1000 X 1000 inlet ducts proving air flow of 4m³/s is required per transformer and its increased proportionately. Therefore two transformer installations would require 4 1000 X 1000 inlets ducts proving 8m³/s of air flow and so on.

An air flow test of the inlet ducts shall be conducted and the results provided to PWC before the commissioning of the substation.

Duct lengths must not exceed 10 metres, excepting where approval for longer duct lengths has been given in writing by PWC. Approval for lengths exceeding 10 metres may include conditions, such as the duct layout being predominantly vertical, with minimal changes in direction, and the cross-sectional area being increased. Duct design shall be such that the overall impedance to air flow is minimised.

6.3.1 External Duct Inlet/Outlet Openings

Ducts shall be to the open air and preferably in different faces of the building. The distance between any part of the termination openings for inlet and outlet ducts or ventilation doors is to be not less than 6 meters, measured in a direct line in free air or around wall faces.

The bottom edge of any duct opening is to be no less than 3 meters above any area where pedestrian traffic can be anticipated. If this is not practicable, the height of the bottom of the opening can be reduced to 2.3 meters providing upward deflecting guide vanes are fitted to the outside of the weatherproof louvers.

6.3.2 Internal Duct Inlet Openings

The inlet ducts is to terminate on the back wall above the transformer facing the transformer louvre doors . The transformer doors can act as an effective outlet in this case. The inlet duct must not terminate behind equipment, doors or cables, or above any piece of equipment that can reduce the available headroom below the minimum levels set out in the relevant Network Standards. The openings should be approximately opposite and must be positioned so that the transformers are located in cross-flow ventilation between the openings, refer to figure 1 - Ventilation Duct Requirements.

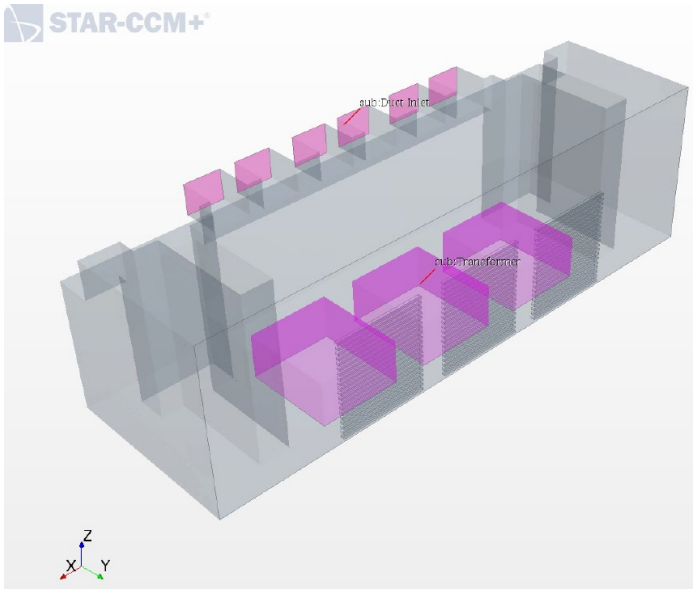

Fig 1: Ventilation Duct Requirements

6.4 Fire Dampers

Upper Level Chamber Substation chambers, substation chamber openings and building ventilation openings in the vicinity of substation openings must comply with BCA fire resistant construction and fire segregation requirements.

A multi-blade fire damper is to be fitted to all inlet duct openings at the substation end.

Dampers shall be positioned to provide testing, ready maintenance and inspection from within the substation chamber. Where dampers project into the substation chamber they shall be provided with guards sufficient to provide protection from personnel injury. Such guards shall not impair the operation of the damper.

Dampers shall be connected to a mechanically operated tripping system that holds them open against gravity or a spring during normal operation. The tripping mechanism shall be activated by fire in the substation chamber and be arranged so moving or discarded parts do not fall onto live equipment.

6.5 Separation between Ventilation Openings

The substation ventilation openings, including substation duct openings and louvered panels, as described in this standard, must be separated from building air intake and exhaust openings, natural ventilation openings and boundaries of adjacent allotments. The separation distance must meet the requirements of all relevant authorities, building regulations, BCA and Australian Standards.

Note: The BCA require a minimum separation distance of 3 meters between ventilation openings and adjacent property boundaries. Within PWC the 3 meters is measured by the shortest straight line between substation ventilation openings and building ventilation system air intake and exhaust opening. This separation requirement by PWC applies irrespective of whether the building or substation is mechanically or naturally ventilated and irrespective of whether or not dampers are installed in the building and/or substation ventilation system.

7. Control Point

As a design option or on the request of PWC an upper level substation chambers may have a control point chamber housing the high voltage switchgear. The control point chamber shall have secure dedicated access at or near the lowest point of the adjacent street or roadway level from where personnel and equipment access is gained. This allows switching of the supply of the upper level substation and local network.

A control point chamber can be considered when the upper level substation chamber is remote from direct unimpeded personnel access from the street or due to spatial requirements the use of a HV cable pit can not be used in the upper chamber. Equipment access shafts at the access chambers will not be essential for designs using control points, as long a provision has been made for easy of access and maintenance to the HV switchgear.

Where PWC provides supply to an upper level substation chamber via a control point chamber, the chamber along with HV switchgear shall be located at ground level. The control point is dedicated to high voltage switchgear for the associated upper level substation chamber and the PWC HV supply loop only. No other services or customer metering equipment (meters, VT's, CT's. etc) are permitted in or through the control point chamber.

Control Point enclosures shall be equipped with a generation access point with appropriate LV cables running to the substation chamber for alternative supply.

7.1 Control point location and access

The control point chamber along with HV switchgear shall be located at ground level. Access requirements and ROW shall be similar to the conditions stated in section 4.

The doorway leading from an external area into the control point chamber is to:

- Have a 120 mm minimum, 190 mm maximum step up from the external level to the access chamber. If more than one (1) step up is required, these additional steps shall be accommodated on the outside of the substation, access chamber or control point and include an appropriate handrail;

- If at street level it is to have removable bollards placed around doors where there is a risk of personnel stepping onto roadways when using them or there is a risk of the door being blocked by such things as motorcycles, bicycles, delivery vans or the storage of goods being delivered or awaiting collection;

- Be positioned such that its use does not create a personnel hazard; and

- be fitted with doors that:

    - Swing outwards from the control point chamber and with a opening of 180˚;
    - Are positioned so that suitable clearances are maintained from any internal stairways when the doors are in the fully open position;

- Have an appropriate safety sign fixed to it as indicated by Clause 7.8.9 of AS/NZS 3000. Standards Drawing S02-2-7-04;
- Are fire resistant;
- Are weatherproof if leading from an outdoor area;
- Are fitted with fire rated hydraulic door closers; and
- Swing on their frame with heavy-duty non-corroding metal hinges.