0001c Design Checklist - Electrical Services

Document version: 2.0

Published date: 30/11/2022

Disclaimer: The information within this document once printed/exported will be classed as an uncontrolled copy. Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

Table of contents

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

List of tables

List of figures

00 Design principles

0.01 Main considerations

It is a requirement to undertake the 00 PLANNING AND DESIGN/ 0001R - DESIGN REFERENCE and GLOSSARY OF TERMS information into all aspects of design, detailing and delivery when developing the content here within. Clear demonstration of adherence to these requirements is part of the services and will be called upon at key points in the project and during at the discretion of the Department of Education (DoE).

0.02 Scope

Provide at least the following electrical services in Schools:

- Main Switchboard (MSB).
- Distribution boards (EDBs), with RCD protection, controls, circuit breakers and labels.
- Underground reticulation for submains, consumers mains, sub-circuit, communications and control cabling.
- Power installation.
- Lighting installations
- Fan, heating and period bell installation.
- Structured cabling system (SCS) to enable the school administration and management software, learning computer networks, Audiovisual, Public Address and Telephone systems to be reticulated throughout the school.
- Provide the additional electrical services in schools where required:
- Electronic security, Including CCTV or conduits for installation at a later date, as nominated for a particular project.
- Energy conservation devices or equipment.
- P.A.B.X. or Key system.
- Fire Detection (dry fire).

The completed system is to meet the regulatory requirements of the following:

- National Construction Code (NCC), Building Code of Australia (BCA)
- Australian Standards AS/NZS 3000
- Relevant Power Supply Authority requirements.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

0.03 Minimum Documentation

- As part of the design process the following documentation is to be produced for all jobs:
- Design drawings
- Construction drawings
- Trade-based Specification
- Work-as-executed drawings.

Provide construction and work-as-executed drawings in industry recognised DWG CADD file format as well as PDF format.

All drawing sets are to include:

- Site reticulation, to scale (1:500 or 1:1000) showing electrical mains, submains and controls, external security and structured cabling system.
- Lighting and Fan layouts, to scale (1:100)
- Voice and Data layouts, to scale (1:100)
- Power layouts, to scale (1:100)
- Electronic Security layouts and schematics
- Single line diagrams for MSB and EDB
- Schematics, controls and other details
- Voice and Data Cabling System block diagram.

0.04 Permanent Supply to Site

Ensure that permanent electrical supply can be made available.

Engage an Accredited Service Provider Designer (ASP/Level3) to prepare the Application for Connection of Load for the local electricity Distribution Network Service Provider (DNSP) as soon as practicable.

To determine the availability of supply the Accredited Service Provider Designer will require information on what is proposed, including:

- The location of the project
- The extent of the works
- The anticipated maximum demand based on new or refurbishment works including the deduction for any load being removed

The following information will also be required:

- the proposed method of supply
- the preferred sub-station location, if required, or point of attachment
- fault level at point of supply
- any other requirements of the DNSP
- and any additional information likely to influence their deliberations

Substation Location

The preferred location for the substation is at the site boundary to the road reserve (away from school playground). There may be situations where this may not be the most cost-effective solution:

- where it results in a long (and costly) low voltage service/consumers mains;
- if the DNSP nominates a maximum length for the service mains.

Alternate substation locations need to be discussed with DoE to ensure that they are appropriate and do not pose a risk to the school community. Generally, locate substations adjacent to the school car park as this allows access for maintenance and locates the substation away from play areas. 24 hour access to the substation will be required, any gates must allow dual key access.

With deregulation of the electricity industry provision of electricity supply is divided into two categories:

- Monopoly: costs of work that must be provided by the DNSP. These include the analysis of the network, providing information for the design process, inspection fees and commissioning fees.
- Contestable: this is normally undertaken by an Accredited Network Service Provider (ASP) – Level 3, registered with the NSW Department of Trade and Investment, [Refer to their website for a list of certified designers]. This includes both the design of the system and the construction of the works.

Monopoly work is to commence as soon as possible in the design phase. The electrical project officer submits forms on behalf of DoE (as the developer) to the DNSP along with payment of any fees.

Contestable work (both design and construction)

A Level 3 Accredited Network Service Provider should be engaged as part of the design process and the design documents should be included with the tender documents.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

Construction work should be included as part of the contract works. Construction work should be based on advice as received from the DNSP. The Contractor is to provide the contestable services using an Accredited Network Service Provider:

A Level 1 ASP will be required to extend the overhead or underground network to reach the school property, or if the capacity of the existing network needs to be increased. This may include high and low voltage works, substations and metering.

A Level 2 ASP will be required to:

- install, repair or maintain the overhead or underground service lines between the electrical wiring on the school premises and the electricity network
- install electricity metering equipment
- connect school service lines to the network and make the connection 'live'
- disconnect school premises from the network.

If a sub-station and/or HV cable easement is required, notify the client in writing so that Forms from the DSNP may be signed agreeing to provide an easement.

Where a site is to be serviced from a street pole adjacent to the boundary, request permission to utilise the electricity distributor’s distribution pole. This is preferable to installing an additional consumer’s pole on the school property. Use a pillar box with protective device at the property boundary as the point of supply

0.05 Emergency Power Supply to Site

A quick connection point for emergency backup portable generators is required for all projects in new and refurbished schools that are identified as at risk of power loss due to bushfire, flood, adverse weather events, and schools identified as a Community Evacuation Facility (CEF).

The MSB design shall provide a quick connection point in the form of a Power Lock or Busbar Cable connection facility to a temporary mobile generator which may be installed in the event of a prolonged power supply failure. The connection facility and generator capacity shall provide for full operation of the school.

Location of temporary portable generator

The portable generator may be positioned up to 200m maximum from the MSB without voltage drop.

Truck Access

Design is to allow for vehicle access to the MSB (including trucks for delivery of the generator and refuelling), space provision for the portable generator and potential noise impacts to learning spaces and adjacent properties caused by operation.

Delivery

Access for large trucks, refuelling tanker and crane is required. A generator is delivered to site on a trailer. It can be left on the parked trailer, or lifted off the trailer with a side loader and placed on the ground, or lifted off the trailer by a mobile crane and placed closer to the MSB. A typical containerised 500kVA portable generator is 6m long x 2.4m wide x 2.6 high, Weight with fuel 10800kg, 1289 litre fuel tank capacity.

Generator

The Generator will need to be installed in a level location cleared of vegetation and any other obstruction to the operation of the generator and ideally no overhanging foliage. In some instances, there may be a requirement to house a more permanent generator for a longer period. In this instance, provision must be made for servicing of the generator to ensure its ongoing operation. Location of the generator should not impact universal access to the site. Any connection cables from the generator to the MSB must be suitably secured to not provide a trip hazard.

Refuelling

Typically, the generator supplier refuels the inbuilt tank on the generator. Fuel consumption and generator use is monitored remotely. A diesel tanker requires access to refill the generator when needed. If operating at max capacity 8 hrs/day – the generator will typically require to be refilled every 2nd day. In preparation for refuelling, sandbags should be installed as a barrier around the generator to ensure that any diesel spills during refuelling are contained.

Vehicle Safety

Allow for safe manoeuvring and parking of the diesel fuel tanker, with no safety risk to students and adult users of the school or the public is required in assessing location of the generator. Provide bollards where truck access is adjacent to buildings or student play and circulation areas.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

Acoustic impact on school operation

Noise generated by the portable generator has potential impact on school teaching operations and adjacent residential areas. An Acoustic Report evaluation of acoustic impact on learning spaces, library, admin and staff is to be considered in assessing the location of the generator.

0.06 Electricity Contract and Metering

With Deregulation of the electricity industry, electricity for any site may be purchased on a competitive basis from an NSW licensed electricity retailer. The retailer may be different to the local Distribution Network Service Provider.

All schools are eligible to purchase electricity using the NSW Procurement Electricity Contracts 777& 776.

NSW Procurement Electricity Contracts are to be used. Rates and assistance are available from NSW Procurement.

The school site is to use or remain on the government electricity contract.

Note 1: All DoE sites using an electricity contract are to purchase a minimum percentage of Green Power, currently 6% (2014).

The system is to include an electricity meter type as per the National Electricity Rules and DNSP requirements.

NSW Procurement has a meter contract where DNSP provides metering for Comms 4D Meters if standard meters or Comms 4C if CT Meters.

Only the incumbent retailer can request a metering change so this should be coming through the electricity retailer as part of the new connection/contract process.

All new schools and projects are to include a data cable outlet and power outlet installed near electricity meter. It should also include a telephone line for metering communication. The meter is panel-mounted and requires provision for voltage and current connection, either directly or via current transformers as for standard metering

A tariff analysis and electricity contract decision for a new building/site must be made prior to project practical completion.

When all options have been investigated and a tariff decision cannot be made, the Project Manager is to advise DoE of the outcome so that a follow up analysis can be scheduled within two months.

For guidance:

- A typical small Primary School normally uses less than 100 MWh/year, so a single rate tariff (preferably) or a time of use tariff can be used.
- A typical large Primary School, all High Schools and Central Schools normally use more than 100MWh/year, so a time of use tariff is the only option.

The procedure is:

Request a network connection from the local Distribution Network Service Provider advising estimated loads. The local DNSP will also install a standard meter to record energy use during the construction phase.

- Please note Ausgrid will provide the NMI upfront as part of their Permission to Connect. Endeavour and Essential will only provide the NMI once the retailer raises the Allocate NMI Service Order and there is a retail contract in place

A tariff cost comparison must be undertaken assessing all available tariff options, considering the franchise tariffs and the contract options available. The calculations and the recommendation must be presented to the Project Manager for transmission to the client. For Commercial and Industrial clients- the network will determine the tariff based on the connection application

Apply to the electricity retailer currently holding the NSW Procurement Electricity Contracts. Include the estimated annual consumption where past accounts are not available to provide a consumption history. The appropriate contract application form is available from NSW Procurement. The contract needs to be executed by a representative of DoE.

The electricity retailer will arrange the installation of the smart meter that needs to be Modbus compatible and install the required metering with the required meter structure (Bi-Directional net metering structure).

0.07 Design Approach

Ensure effective coordination between disciplines.

Organise the information from all sources to meet a set program.

The design of the electricity supply system and the selection of equipment is to be undertaken based on Whole of Life (WOL) principles.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

Refer 00 PLANNING AND DESIGN/ 0001r DESIGN REFERENCE

During the design process, and by the Developed Design stage:

- Locate the main switchboard (MSB) and electrical distribution boards (EDBs) in consultation with the Architect, taking into consideration the point of supply and consumers mains length.
- Design cable reticulation system (including pits and other items involving other disciplines).
- Design switchboards, determine fault level and verify switchboard cupboard access and sizes, etc. Reassess switchboard locations if necessary.
- Develop an energy usage statement.
- Prepare schematic diagrams for the structured cabling system (SCS) including the various systems attached to it.
- Co-ordinate power to other services including architectural disciplines
- Prepare cost estimates as required.
- Develop Electronic Security layout, in conjunction with the DoE Security Unit where a security system is to be included.

Contact the local Telstra District office regarding specific requirements especially earthing details for communications system.

0.08 Location of Main Switchboard (MSB)

Locate the site MSB optimally with due regard to:

- The proposed Point of Supply – locate as close as possible and preferably within 50 metres.
- cost of consumers mains versus submains.
- preliminary maximum demand information.

Final main switchboard location will be influenced by discussions with Architects and the respective electricity distributor.

Provide an engraved notice near the main public entry door to the administration block indicating the location of the main switchboard.

0.09 Rooms and Cupboards for MSB

Secondary Schools

House the MSB in a separate main switchroom with the following features:

External access for meter reading, out-of-hours operations etc.

- 2 hour (120/120/120) fire separation, including doors, from the remainder of the building, except where there is a greater requirement by AS or BCA
- Depth not less than 1.8m
- One straight wall of minimum length 3.0m, for MSB length up to 2.4m; or
- One straight wall of minimum length 4.2m, for MSB length from 2.4 to 3.6m
- Where MSB length is greater than 3.0m; or MSB prospective short-circuit current is 15kA or greater; or MSB is supplied by a circuit with a nominal capacity equal to or greater than 800 Amps per phase; or MSB frontal clearance is less than 3.0m; then provide two access doors, spaced well apart for adequate alternative egress paths from room
- Floor level 75 mm above corridor and adjacent rooms, to minimise danger of water entering cabling pits due to hosing down floors in adjacent areas, flash-flooding, etc.
- Artificially illuminated, to a minimum level of 160 lux. Position the luminaires to avoid casting shadows into the switchboard when switchboard covers are removed and not above equipment to enable safe access to lighting for maintenance
- Provide one double socket outlets for general maintenance use
- Provide natural ventilation to an adjoining area to remove generated heat. Ventilation should be to outside and all ventilation openings must retain the fire integrity of the room
- Cable pit under the MSB to facilitate the entry of the consumer's mains and submains may be required.

Refer 09 ELECTRICAL/ 0900 ELECTRICAL SERVICES / CABLE DRAW-IN PITS

A typical drawing detailing the pit dimensions and architectural, structural & hydraulics requirements of the pit is included in the Specification Guide

Switchroom doors should:

- Be minimum 850 x 2100 (single) clear and/or 1600 x 2100 (double) clear

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

- Open outwards and be operable from within the room without the use of a key or tool
- Be lockable with DoE “E” Keys
- Have facility to be held in the open position without blocking passageways or pathways
- Doors which include access to electricity metering must have dual locking function for local electricity distribution network service provider and PWD “E” keys
- Provide work-as-executed site reticulation drawing on A3 laminated sheet within main switch room or cupboard

Primary Schools

Basic floor plans, such as the Component Design Range, include main switch rooms, and the details show the minimum size of these rooms.

Generally, comply with secondary school switchroom requirements.

Refer ELECTRICAL SERVICES / 0.09 ROOMS AND CUPBOARDS FOR MSB / SECONDARY SCHOOLS

There may be situations where only a cupboard may be required for the main switchboard rather than a switchroom. Provide a cupboard with the following features:

- External access for meter reading, out-of-hours operations etc.
- Minimum clear internal dimensions 2.0W x 0.7D x 2.5H
- Lockable doors with PWD “E” Keys, with a minimum door opening of 1.7 wide x 2.1 high
- 2 hour (120/120/120) fire separation, including doors, from the remainder of the building, except where there is a greater requirement by Code or BCA
- One double socket outlet for general maintenance use and future use
- To be in a sheltered location such as a covered entry where there is a covered area extending no less than 1000mm in front of the doors to allow all-weather access to the main switchboard

Depending upon cable sizes being installed, a cable pit may be required under the main switchboard or alternatively externally to the main switchroom or cupboard.

If meters are located in a separate cupboard adjacent to the MSB cupboard, the meter cupboard size should be a minimum 1.2m x 1.2m x 0.6m deep, subject to approval by the

local electricity Distribution Network Service Provider. Provide a pair of cupboard doors the same size as the cupboard.

If the meter and MSB are located in the same cupboard, the minimum clear internal dimensions are to be either (2.6W x 0.7D x 2.5H) or (2.0W x 1.5D x 2.5H preferred option).

0.10 Location of Electrical Distribution Boards (EDB)

Electrical Distribution Boards are to be readily accessible, situated within a cupboard specifically designed for the purpose and strategically located to reduce cable runs.

Refer ELECTRICAL SERVICES / 0.11 CUPBOARDS FOR ELECTRICAL DISTRIBUTION BOARDS

Allocate EDBs within each building on the following basis:

- At least one per separate building. Buildings joined only by roofs or at corners are to be considered as separate buildings.
- At least one per level (except for small mezzanines and stores).
- Determine the number of EDBs in a building by voltage drop considerations and the number of conduits in the slab.

Refer within ELECTRICAL SERVICES / 0.19 RETICULATION DESIGN / ELECTRICAL SERVICES / CONDUITS IN CONCRETE

- Determine EDB location and spacing to prevent excessive voltage drop in final subcircuits. In general, locate EDBs on the basis that the distribution board cannot supply equipment outside a radius of more than 25m. This means that a long building may need two or more EDBs.
- There are situations where this 25m radius criterion needs to be varied. For example, In a heavily loaded building such as Materials Technology or Science, or where air conditioning is employed, the 25m radius criterion may need reducing.
- In some lightly loaded areas, it may be feasible to slightly increase the 25m radius limit, by using slightly longer final subcircuit cable lengths with a corresponding reduction in the permissible submain/s voltage drop from the originating power source to the EDB.
- Additionally, the 25m radius criterion may need to be reduced in heavily serviced buildings to limit the number of conduits in the slab at the EBD.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

0.11 Cupboards for EDB

In every new building, and wherever possible in old buildings, provide lockable cupboards for EDBs. Where this is not possible EDBs need a lockable door. Locate cupboards so that access is available only directly from general circulation areas. It is not acceptable to walk through classrooms etc. to gain access to EDBs, or to locate them in storerooms.

These cupboards should have the following features:

- Minimum clear width dimensions to suit the electrical distribution board (including spare capacity) x 2.1metres high. Allow space on either space of the board to facilitate servicing
- Lockable doors with DoE “E” Keys
- Outward opening doors, the full width of the cupboard, 180 degrees swing with latches to hold the doors in this position. In the open position doors must not obstruct passageways
- Unimpeded access to the EDB from the floor to door head height with cupboard doors open
- 1 hour (60/60/60) fire separation, including doors, from the remainder of the building, except where there is a greater requirement by AS or BCA
- Provide smoke seals on cupboard doors where cupboards is within path of egress where required by AS or BCA

Illuminate all EDBs to minimum 160 lux. Install lighting and a double socket outlet within each cupboard or switchroom.

0.12 Services / Consumer Mains

General

The DNSP will provide details of point of supply and connections to its equipment. For aesthetic and safety considerations, permanent electrical supply is to be reticulated underground.

In all cases, the service/consumers mains must be fire protected, preferably by installation underground or under concrete slabs.

Run service/consumers mains clear of buildings where possible. Consult with the Architect to ensure the planned route does not interfere with future development.

Sizing of Service / Consumer Mains

It is quite common for schools to undergo major modification during their life-time, resulting in increases of up to 30% in electrical load. This is usually beyond the capacity of the original service/consumers mains. The original service/consumers are either discarded entirely, or a parallel set is needed.

The table below nominates the minimum service/consumer's mains capacity to be installed for schools, based on student numbers or school type.

The tables provide a direction on the consumer main size required. The designer should complete a maximum demand calculation for confirmation.

The minimum current capacity must be achieved while also complying with the AS voltage drop requirements for that minimum electrical load.

Where service mains (a direct connection to substation low voltage terminals) are to be installed, the minimum cable size must also comply with the network authority requirements for fault levels withstand (nominally minimum 240 mm² Cu cable).

Service/Consumers mains to be copper conductor cables. Aluminium conductor cables are not to be used from the Point of Supply.

An acceptable solution, when service/consumers mains need to be larger than 240 mm2, is the following:

- Run two parallel cables
- Run a spare conduit sized to suit the later installation of an additional parallel cable
- Provide flags on the switchboard capable of connecting three sets of cables

In many instances, demountables are installed on site soon after the completion of the permanent accommodation. Ascertain the numbers, locations and types, then design and install the reticulation system to cater for them. Note in particular that demountables use reverse cycle air-conditioning.

In all cases, allow the spare capacities detailed.

Refer within ELECTRICAL SERVICES / 0.25 SPARE CAPACITY

Note that some DNSP's require double insulated cables in HD-uPVC conduit. Further, where fire protection equipment and/or lifts are proposed, comply with relevant requirements of AS.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

Refer AS3000

Table 01: Spare Capacity - Primary Schools

Number of Enrolled Students	Minimum Services / Consumers Mains Capacity
1 to 50	100 Amps/phase
51 to 200	200 Amps/phase
201 or more	400 Amps/phase

Table 02: Spare Capacity - Central and SSP Schools

Number of Enrolled Students	Minimum Services / Consumers Mains Capacity
Not applicable	400 Amps/phase

Table 03: Spare Capacity - High Schools

Number of Enrolled Students	Minimum Services / Consumers Mains Capacity
1 to 600	500 Amps/phase
601 to 1000	630 Amps/phase
1001 or more	800 Amps/phase

0.13 Sub mains and Conduits

Generally, submains may be run underground, or within the building structure (on cable tray, ladder or troughing). During planning, consider relevant site features and choose routes that will not affect future building development.

Submains are to be copper conductor cables. Aluminium conductor cables are not to be used.

Provide spare capacity as stated.

Refer within ELECTRICAL SERVICES / 0.25 SPARE CAPACITY

Conduit diameters to be sized in accordance with the relevant AS and general installation practices.

The follow space factors are recommended:

- 0 -10 metres 50% space factor for single cables

- 0 -10 metres 40% space factor for multiple cables
- 10 - 30 metres 33% space factor
- 30+ metres 25% space factor
- Each 90 degree change of direction is to be considered equivalent to 10 metres of conduit run.

Wherever practicable, run other services in the same trench as the electrical cables with due separation of services, both for safety and to avoid interference. This limits excavation costs and avoids a network of underground services, which could interfere with future site development.

Refer 00 PLANNING AND DESIGN/ 0001c DESIGN CHECKLIST - COMMUNICATIONS

0.14 Spare Conduits for Future Use

Provide as a minimum the following spare conduits with draw cords along all cable routes:

- 2 x 32 mm uPVC
- 1 conduit of sufficient size (minimum 32 mm dia.) to enable an extra parallel leg of the designated submain to be installed

Larger conduits will be required for many runs. Size conduits in proportion to those installed for the initial installation.

From each EDB provide at least the following spare conduits:

- For the future buildings included in the overall design to a point 1m clear of hard surfaces in the direction of the possible loads.

Refer within ELECTRICAL SERVICES / 0.24 PROVISION FOR OTHER BUILDINGS

- In addition, provide 4 x 50 and 4 x 32mm conduits for “unknown” future use, again to 1m clear of hard surfaces in the direction/s of the possible loads.

Instead of running a number of small diameter conduits, a smaller number of larger diameter conduits (say 50mm) allow greater flexibility of use. Smaller conduits may then be extended as required via an underground junction box or cable pit.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

0.15 Cable Draw-In Pits

Underground cable draw-in pits should be installed in suitable locations to minimise damage during initial installation or subsequent replacement of cables. However, minimise the use of pits as they are expensive, lead to drainage and insulation problems and are subject to damage.

Provide pits under large switchboards to allow entry of large cables and to facilitate turning these cables to enter the switchboard. Pits are to be drained to the stormwater system via a valve that will prevent surcharging. In addition, the floor of each cupboard or switchroom containing a pit must drain to the outside of the building.

Acceptable pits include:

- moulded fibre cement (communications type)
- Polymer concrete
- special purpose brick or concrete pits.

Any electrical/communications pit should be:

- dimensioned by the Electrical Engineer
- constructed with adequate drainage and in accordance with the NATSPEC documents.

Care must be taken on a sloping site with conduits entering pits, to prevent the ingress of water via the pits and conduits into switchrooms and EDB cupboards. Effectively seal these conduits at both ends.

Consult with the Architect and Hydraulic Engineer to ensure drainage provisions are made and the pit is included in the Architectural documents.

Pits are not to be used to join cables.

Communication services and security services must be supplied with their own separate pits.

0.16 Switchboard Design - General

Switchboards and equipment must be of current and proven design and in accordance with the requirements of the local DNSP and the relative AS.

Design and manufacture switchboards for the current rating of the incoming mains and fault level that is expected with electricity supply necessary for the completed school.

Provide all indoor switchboards with minimum IP42 rated enclosures with only the operating toggle of control equipment such as circuit breakers protruding through escutcheons or covers. Provide escutcheons or covers with fixings that require a tool be used for their removal.

An overall door with a DoE E-key lock with 2 set of keys is required at any switchboard that is not in a plant room, switchroom or switchboard cupboard.

Single-phase boards are not to be used except in very special cases.

Do not use fuses for overcurrent protection.

Single line diagrams on contract documents for all power distribution and mechanical boards should show:

- Switchboard designation (eg. main switchboard).
- Input fault level as determined and associated time period
- Any deviations from NATSPEC standards, eg. mounting method, paint colour
- Type of mounting, eg. flush, surface or floor
- International Protection (IP) rating

For an externally located switchboard, eg. in the open space of a demountable school, its enclosure shall be IP 56 minimum. All external Switchboards must include anti-condensation heaters as per NATSPEC requirements.

Incorporate single line diagrams into contract documents so that all relevant information including notes are received by the switchboard manufacturer during the tender period. This can be achieved by placing the information on sheets separate from site plans, floor plans, etc. Cross-reference the notes to the relevant specification clauses.

Where single line diagrams are placed on drawings with other information, place any relevant notes adjacent to the diagram.

0.17 Main Switchboard (MSB)

Where the total connected electrical load exceeds 100 amps per phase use one of the following options:

- Custom-built MSB
- A combination of custom-built and proprietary enclosures, with each section controlled by a main switch

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

The main control on all MSBs shall be a fault make and load break switch, which will be on the load side of the Service Protection Device (SPD) for MSB local isolation. Generally, house the MSB in a switch room, external MSB is not to be installed unless approved by the Electrical Engineer representing DoE.

Refer within ELECTRICAL SERVICES / 0.09 ROOMS AND CUPBOARDS FOR MSB'S

Include electricity-metering requirements as described elsewhere in the Design Guide and as acceptable to the local electricity DNSP.

Separate metering for the canteen or FSU is required, so provide separate metering within the MSB along with separate submains and an EDB for the canteen or FSU.

Include metering current transformers and potential fuses within the MSB, but the meter/s may be on a separate panel adjacent to the MSB where it is in a switchroom or switchboard cupboard. Consider an option of locating meter panels externally to the MSB Switchroom/Cupboard, complying with the DNSP's requirements, for both modified and new main switchboards.

Where the rating of consumer's mains exceeds 100 amps per phase, include a three-phase digital power meter in the MSB along with associated current transformers and potential fuses. Indication is required of:

- current in each phase
- 15-minute maximum demand in amps in each phase
- three line to line voltages
- line to neutral voltage of each phase.

Provide a machine engraved label adjacent to meter reading:

METER TO BE RESET BY AUTHORISED PERSONNEL ONLY –

BEFORE RESETTING ENTER MAXIMUM DEMAND READINGS IN SCHEDULE.

Provide surge protection devices at the Main Switchboard and for communications equipment as recommended by AS1768.

Provide a point of entry 3 phase shunt diverter for the incoming 415 volt supply. The surge protection shall have an indicator showing surges received.

Point of entry protection shall be mounted within the main switchboard to the detailed recommendations of supplier/manufacturer.

Spare spaces for future circuits - specify to a minimum total of:

- 25% of existing spaces or 6 spare spaces for 3 Phase Circuit Breakers, whichever is greater; plus
- The spare spaces required for known future buildings in other stages.
- Allowance to be made within the MSB's for a future Lift/essential services control.
- Busbars are required from the Service/consumers mains connection point to the line side of all circuit breakers.
- Provide minimum 20% spare capacity within the busbars for future loads.

Where high numbers of spare spaces for future large circuits are involved (eg. 5 controls greater than 160 amps), specify the switchboard and switchroom space to be suitable for addition of future extension cubicle/s. Provide busbars sized for the anticipated additional load.

0.18 Distribution Boards (EDB)

Provide the following sections on each EDB:

- Incoming control – whole-current switch or circuit breaker for the incoming submain. It may be mounted on the distribution chassis if appropriately identified.
- Control section - local main switch, submain controls, switches. (Not all EDBs require a control section).
- Distribution section.

These sections may be arranged in a single compartment or in adjacent compartments. Additional compartments may be required to house time switches, contactors, relays, etc. Separate shrouded compartments are not required.

The incoming control may be a fault-make load-break switch or a circuit breaker with a current rating equal to the supply-end submain protection. Discrimination between the incoming control and the submain protection is not required.

Busbars are required from the mains connection point to the line side of all circuit breakers.

Provide

- 25% spare spaces or 6 whichever is greater; for circuit breakers and;
- Spaces for circuit breakers to protect submains to buildings planned for construction in the future and for planned demountable buildings.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

- Energy monitored meters with CT's as required to record consumption of electricity for all buildings with larger floor areas as per BCA requirements.

Refer within ELECTRICAL SERVICES / 0.25 SPARE CAPACITY

0.19 Reticulation Design

Long cable runs are common in schools and, as required by AS/NZS 3000, cable selection needs to address factors additional to current carrying capacity.

One of the factors that must be considered is voltage drop. Calculate voltage drop using maximum demand determined from the process further outlined. In the case of final subcircuits, consider the circuit carrying a current equal to the rating of the circuit protective device. Refer to Wiring Rules AS3000 for voltage drop permissible where there is a direct connection to a substation.

Note that voltage drop must be considered from the point of supply to the last item on any final subcircuit. The permissible voltage drop is the sum of the individual drops in (a) the service/consumers mains, (b) any submain/s and (c) each final subcircuit. The proportioning of the voltage drop across (a), (b) and (c) will vary from site to site to achieve an economic solution.

As a general rule, limit final subcircuit length to servicing loads not more than 25m radius from the EDB. In a heavily loaded building such Science or Materials Technology, the 25m radius criterion may need reducing. There may, however, be other situations where it is economic to slightly increase final subcircuit cable lengths with a corresponding reduction in the permissible submain/s voltage drop from the originating power source to the EDB (e.g if it avoids duplicating an EDB).

Ensure that the maximum voltage drop allowed by relevant AS will not be exceeded at any point in the installation in the future when the spare capacity is used and future buildings are added. In terms of the future, make due allowance for voltage drop in submains to future buildings, and base the calculation on final subcircuits in future being to the 25m radius criterion.

Cables are to be continuous from the point of supply to the MSB, from the MSB to EDBs and between EDBs. Cables are not to be joined.

0.20 Reticulation to Outlets

General

Conceal all wiring and conduits wherever possible. The choice of wiring system will be influenced by the construction and finish of each wall, floor, ceiling, etc. and any potential hazard, eg. exposure to weather, mechanical damage.

Acceptable wiring methods are:

- TPI cables in HD-uPVC conduit for power sub-circuit wiring
- TPI cables in HD-uPVC conduit in slabs or TPS cables within ceiling spaces for sub-circuit wiring to lighting and ceiling fan circuits
- TPI cables or TPS cables enclosed in HD-uPVC conduit at switch drops
- TPS wiring for lighting and power circuits in timber or steel stud partitions
- Where concealment is impractical, enclose wiring in conduit or duct
- Use steel conduit where mechanical damage is possible
- Circuit breaker current ratings and minimum cable sizes:
- Lighting & Power circuits 20A 2.5mm2
- Other circuits – determine by maximum demand of load and relevant AS.
- Use only stranded copper conductor cable.
- Some situations (e.g. surrounded by thermal insulation or longer final subcircuits) may require the use of larger conductor sizes.
- Skirting and wall ducts

Refer 00 PLANNING AND DESIGN/ 0001c DESIGN CHECKLIST - SPECIAL ELECTRICAL SYSTEMS / SKIRTING AND WALL MOUNTED DUCT

Location of Wall Boxes

Consistent with design requirements and wherever possible, minimise costs arising from cutting and chasing masonry by locating wall mounted outlets on accessible walls (eg. cavity walls).

Single brick walls, face both sides, are a common construction in schools, and require “biscuiting” of bricks or other cutting to allow conduit access. Rendered brick walls or other masonry construction require chasing.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

A typical drawing is included in the Specification Guide - Drawings, which relates to orientation of wall-boxes in standard brickwork, and places restrictions on the socket outlet types acceptable.

Inform the Project Architect as early as possible of any need to cut bricks, chase, etc. and provide an indication of the total lengths involved to the Quantity Surveyor.

0.21 Conduits in Concrete

Embedded conduits displace their own volume in concrete and, depending on their location, number and spacing, could affect the structural performance of a slab or column.

A high concentration of conduits occurs at switchroom and switchboard cupboards.

Exercise caution with embedded conduits in areas where slab penetrations will occur, e.g.

- Fixing of machinery in Materials Technology spaces to the floor;
- Fixing of timber sprung floors to the slab in the Multi-Purpose Centre.

In the latter case, run conduits around the floor slab, not across it.

All conduit runs in slab and penetrations to structural elements must be approved by the structural engineer prior to installation.

0.22 Preliminary Maximum Demand

Preliminary maximum demand figures can be calculated using square metre rates as outlined in AS3000.

0.23 Calculation of Final Maximum Demand

The preliminary maximum demand may be used to enable negotiations with the electricity distributor to begin early in the design process. However, for more accuracy, use this section in conjunction with requirements of the relevant AS, particularly when detail layouts are available.

Refer within ELECTRICAL SERVICES / 0.04 PERMANENT SUPPLY TO SITE

For buildings (particularly demountables) being placed on site at the completion of the main project, calculate maximum demand by considering electrical heating figures.

Socket outlets are not intended to be used in schools for the connection of portable electric space heating or cooling appliances. Permanently installed heating is provided, as is cooling equipment where necessitated by the climate conditions. Interpretation of this needs to be agreed to by the relevant authorities for each site.

Calculate the maximum demand of each building to be constructed or refurbished using AS 3000.

For refurbished buildings, the maximum demand calculation must also deduct the electrical loads being removed or being replaced.

Determine the maximum demand of existing buildings that are being connected to the reticulation system by calculation or by installing temporary data loggers within the switchboards to record the demand for a period of minimum 4-weeks.

Design the reticulation to supply all buildings, include those planned for construction in the future and for planned demountable buildings.

Calculate the final maximum demand. Refer Appendix C of AS/NZS 3000

0.24 Provision for Other Buildings

Where the site plan shows proposed or existing buildings which are not part of the project under documentation, make provision in the electrical design for these buildings in an appropriate manner as listed below.

Existing Buildings Being Retained

Incorporate the submains to these buildings in the overall design. Assess their demand, and if necessary, run new submains, controls, and other cabling. Existing external cabling may be re-used if its condition and rating are satisfactory. If a new MSB is required, rationalisation of the cabling may be preferable.

Proposed Extra Buildings

Demountable and other buildings are often placed on site immediately after the completion of the main project, increasing the school's capacity for a few years.

Ascertain the number, locations and type of these additions, then design and install the reticulation to cater for them. Provide submain controls on the appropriate EDB, and run spare conduits to points clear of hard surfaces.

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

Refer ELECTRICAL SERVICES / 0.14 SPARE CONDUITS FOR FUTURE USE

The submains and buildings will be by others. Note that demountables usually have reverse cycle air conditioning.

Future Buildings

Buildings identified as “future” may not be installed for some years, but are to be incorporated into the reticulation using the guidelines below. As part of ‘Whole of life’ approach consider the potential future expansion of service requirements and include allowance where feasible.

0.25 Spare Capacity

Provide spare capacity in service/consumer mains, submains and distribution boards as follows:

Service / Consumers Mains and Submains

Allow spare capacity in the service/consumers mains of 15% of the total loadings calculated above or 30A/phase, whichever is the greater.

Allow spare capacity in each submain of 20% of the total loadings calculated above or 25A/phase, whichever is the greater.

Allow spare capacity in each submain for future addition of Air Conditioning, with allowances of 60VA/m2 of occupied area for air conditioning.

Do not install the cables for future buildings. Install properly sized conduits with draw cords from the appropriate EDB to a point 1m clear of hard surfaces.

Distribution Boards

Size all EDBs to cater for the total reticulation including fault levels.

Refer within ELECTRICAL SERVICES / 0.23 CALCULATION OF FINAL MAXIMUM DEMAND

Allow sufficient space on the board to feed the new buildings; then add the expansion figures detailed in earlier sections.

Provide spaces only, not sub-main controls, for future buildings.

0.26 Operating and Maintenance Instructions

Provide a complete set of operating and maintenance instructions at the time of handover of the building/s.

Include information to guide staff in:

- Operation of all equipment
- Maintenance, including regular testing and maintenance by staff, and that which needs to be contracted to specialists.

Information needs to be developed for the specific installation and application.

Avoid material that is not specific to the installation.

Include all equipment installed or connected as part of the electrical services. This is to include, but is not limited to:

- Circuit breakers, fuses and fuse switches
- Power Systems
- Surge protection
- Appliances
- RCD protection equipment
- Telephone system
- Security and alarm systems
- Sound reinforcing system
- Exit and emergency lighting
- Lighting control systems
- AV equipment
- Fire and smoke alarm systems

© NSW Department of Education, Jun-23
The information within this document once printed/exported will be classed as an uncontrolled copy.
Its currency must be checked by visiting the EFSG/Technical Standards website prior to using the information for any purposes.

0.27 Design Guide Drawings

Figure 01: Conduit to Single Skin Brickwork – Primary and Secondary