Specification

LV Switchboard Modification Specification

1. Purpose

This document set out the requirements for determining whether LV switchboard modification work can be proceeded or not at the scoping stage. And if determined the LV switchboard is to be modified, this document also set out the requirements for performing the work at the design and implementation stages.

2. Scope

The scope of this specification covers the decision-making criteria to determine whether switchboard modification work is suitable or not. Where switchboard modification work is suitable, this -document will outline the design and routine verification work required prior to the modification work, and the documentations required.

The document is oriented toward LV switchboard modification work. It must be read in conjunction with relevant Australian Standards, International Standards, and other Sydney Water standards/specification documents.

Where conflicts exist between this document and any statutory requirement (e.g., the Work Health and Safety Act and Regulations), the statutory requirement prevails.

Where conflict exists between this document and any other nominated Contract document, SWC must be given prior notification in writing to nominate which will take precedence.

3. Objective

The objective of this specification is to provide requirements for work involving LV switchboard modification, to assist determine whether the related work is suitable to be carried out or not. For switchboard modification work deemed to be suitable, this document provides detailed tasks to be performed to satisfy design and routine verification requirements.

4. Background

Sydney Water has a large number of low voltage switchboards in service ranging from 40 plus years old to the latest modern-day equipment.

There are many reasons to modify a switchboard through the life of the equipment, for example, load changes, reliability upgrade and protection improvement.

AS/NSZ 3000 wiring rules and the full adoption of the IEC switchboard standard AS/NZS 61439 have introduced updated requirements on how a switchboard is to be designed, verified, modified, and installed. This has reformed the way switchboard modification work is to be carried out compared to before these two referred standards came to full force.

There are 5 steps in a complete switchboard modification workflow, they are covered from section 5 to 9 in this document. The steps are to be executed following the orders written in this document. Information Gathering and Pre-determination steps are to be completed at the scope development stage of a work. Design verification, Routine verification and Documentation steps are to be completed at the implementation stage of a work.

5. Information Gathering

The initial phase of switchboard modification work requires information to be gathered. Subsequently, a determination will be made regarding the suitability of modifications for both device substitution (simple modification) and complex modification. The insights obtained during this stage are to be used in the pre-determination phase pertaining to the intended modifications.

Two categories of information are required to perform further analysis of the work. They are:

- Sufficient details of the proposed work, including the proposed changes from both the physical and system aspects.
- Information relating to the existing equipment. Where the switchboard OEM and/or assembly manufacturer is still in operation, they must be consulted regarding the details of the existing installation, and/or advice on the suitability of the proposed modifications. Regardless of where this information is.

The minimum required information to be gathered is listed in Appendix A of this document. For proposed switchboard modification work, the required information must be obtained at the scoping stage of the work to help assess the adequacy of the design decision and de-risk the project program.

6. Pre-determination

This is the second step of a LV switchboard modification workflow. Most of switchboard modification work can be categorised as either simple modification or complex modification.

Simple modification refers to use the functional units of a switchboard for what it has been originally designed for. This includes, but is not limited to:

- Functional unit device substitution
- Use of spare cells under the original design name plate rating.
- Change of motor starter to the same type with equal or less in kW rating.

Complex modification refers to other switchboard modification work that does not meet the above.

Appendix A has provided assessment criteria to determine whether the intended work is suitable to be carried out or not.

For modification work planned to have a short service life (temporary equipment to be in operation for less than 3 years) but not able to meet some of the criteria listed in the Pre-determination, prior approval is required from Sydney Water before this work can be considered.

It is the project's decision and responsibility to use the information provided to proceed with the design option selected.

7. Design Verification

The verification tasks to be performed at the design stage for switchboard modification work are listed under "Design Verification" in Appendix A. At this stage, the planned switchboard modification should have been assessed as suitable and the design is under way. The list contains tasks which require designers and design verifiers with switchboard design and manufacture experience and appropriate assessment tools to perform.

The outcomes of the design verification be submitted as part of the design deliverables during project early-stage review gateways for review as part of the electrical design package.

8. Routine Verification

The verification tasks to be performed at the installation and testing stage of the switchboard modification work are listed under “Routine verification” in Appendix A. At this stage, the switchboard modification design and design verification would have been completed and reviewed by Sydney Water.

The Routine verification tasks are to be included in the Installation and Testing Plan for the designated work.

9. Documentations

The documents must be submitted as part of the work are listed under “Documentation” in Appendix A. It also includes the labelling requirements for the modified cell.

10. Context

10.1 Ownership

Role	Title
Group	Asset Lifecycle
Owner	Engineering Manager
Author	Technical Director - Electrical

10.2 Revision History

Version	Issue Date	Approved by	Change log
1	Asset Lifecycle	Norbert Schaeper	New document

10.3 References

AS/NZS 3000 – Electrical Installation – ‘Wiring Rules’

AS/NZS 61439 series – Low-voltage switchgear and control gear assemblies

AS/NZS 3439 series - Low-voltage switchgear and control gear assemblies (SUPERSEDED)

AS/NZS 3017 – Electrical installation verifications guideline

IEC TR 60890 - A method of temperature-rise verification of low-voltage switchgear and controlgear assemblies by calculation

Sydney Water Technical Specification – Electrical

Sydney Water Technical Specification – Arc Flash

Sydney Water Engineering Competency Standard

Appendix A - Switchboard Modification -Specification

Information Gather of existing switchboard

1. Age of the board (AS1136 and prior standard made board should not be considered for modification)
2. Condition of the switchboard (SW Condition Assessment Standard to be followed)
3. Operating capacity and redundancy
4. Number of in service cells and sizing of cells (Amp, kW, dimension, busbar rating, bus dropper size/rating)
5. Number of spare cells and sizing of the cells(Amp, kW, dimension, bus rating, bus dropper size/rating)
6. Size of the cable zone.
7. Form factor of the switchboard
8. Check whether the busbar is insulated or not
9. Check there are sufficient spare capacity in the pit and conduits system as part of the reticulation
10.Gather info from the switchboard assembly manufacture for any related information on switchboard, request their assistance on the potential switchboard modification tasks. If the switchboard original OEM/assembly manufacture oppose to or reject the liability of the proposed modification work, SW Risk Assessment process should be followed to determine whether the work should proceed or not by the working party

Input from the proposed work

1. Total load changes
2. Number of proposed loads
3. What are proposed new loads will be replacing existing loads
4. What loads will be using the spares cells
5. What is the redundancy consideration for the new and existing loads

Pre-determination

Simple Modification
Must satisfy pre-determination criteria 1,2 3,4,5 and 14 to be deemed as suitable

Complex Modification
Must satisfy all pre-determination criteria to be deemed as suitable

Pre-determination criteria
1. For AS/NSZ 61439 or IEC 61439 switchboard, the modification must follow the design and verification requirement of the standard
2. For AS/NZS 3439 built switchboard, The modification must follow the design and verification must follow requirements from AS/NZS 3439 or 61439
3. The switchboard has less than 5 years design life left or on the work program to undergo capital work in the following 5 years must not be modified
4. If the intended modification will only have a short service life (temporary equipment), the modification work can be considered subjected to prior approval.
5. The overall load of the board post modification under the worst case load scenario must not surpass either busbar size or incomer size whichever one is smaller
6. The overall load under emergency scenario must not surpass the generator incomer, generator connection panel and the generator size
7. Proposal to merge or split function units must not be considered.
8. The planned cell must not exceed the capacity of the highest rated cell in the same physical cell dimension on the same switchboard
9. The let through current rating of the propose CB or fuse must not cause overheating on the terminations.
10. The tier with planned modification must not exceed the bus dropper size of the tier
11. The tier or cell with planned modification must not exceed the space or loading limit in the respective cable zone.
12. Physical sizing and clearance of the new equipment must be suitable for the cell to be put in and in accordance with OEM requirements of the new components.
13, Incomers, bustie and busbar must not be modified with increased size.
14. Requirements for motor starting current, voltage drop, power factor and harmonic set out in Electrical Tech spec must be complied with.

Design Verification

1. Design the IP rating to be consistent with the existing switchboard
2. Size the cable for short circuit , current carry considering derating and grouping in accordance with AS/NZS 3008
3. Carry out temperature rise assessment in accordance with IEC60890 under the most onerous operating condition and compare with the most similar cells and tiers
4. Design clearance for uninsulated parts to be greater than minimum AS requirements
5. Design creepage distance between live parts to be greater than minimum AS requirements
6. Design contacts of relays to have correct current rating for upstream protective device and the correct utilisation category for the load
7. Design terminal size to be suitable for the bus dropper and current carry capacity.
8. Review and validate the incident energy level, and implement mitigation design in accordance with SW Arc Flash spec

Routine Verification

1. Check connections are done adequately
2. Check phase colour is correct and maintain consistency with existing switchboard
3. Check phase rotation is correct
4. Check all equipment is installed as per OEM requirements with necessary shrouds and phase barriers
5. Perform IR test
6. Perform ductor test
7. Perform dielectric test (if required)
8. Perform earth resistance test for all metallic parts of the modified cubicle to the main earth bar, the result to be less than 0.1 ohm
9. Perform point to point test of all circuit and visually inspect all connections to make sure they are done correctly.
10. Check clearance and creepage distance to meet AS standards requirements
11. Ensure protection grading is achieved with both upstream and downstream in accordance with SW Elec Tech Spec and Protection spec requirements

Documentation

1. Document results for design verification and routine verification
2. New name plate for individual modified cell (including Amp/kW rating, year of modification, IP rating if it is different from the switchboard IP rating, company who carried out the modification)