



THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA

The University of Newcastle
Infrastructure and Facilities Services
Project Briefing Document
Main Switchboard Specification

21st January 2021

Version 1.3

UON-ESS-112

Revision Record

Rev No.	Date	Description	Prepared by:	Checked by:	Approved by:
Draft	15/06/2016	Issued for Approval	R.Eyre	D.Alexander	Lynn Herd
1	20/09/2016	Released	R.Eyre	D. Alexander	Lynn Herd
1.1	27/01/2019	Revised Sections 4.1, 4.2 and 7	R.Eyre	D. Alexander	Mark Mazzitello
1.2	10/02/2020	Revised Sections 4.13, 4.5, 4.7, 4.8, 7 and 9	R.Eyre	Tim Fox	Mark Mazzitello
1.3	10/02/2021	Revised Sections 2.1, 4.2, 4.8, 4.9, 4.13 and 4.1	R.Eyre	Tim Fox	Andrew Bull

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1. Scope

This Specification covers the general requirements applicable to the design, manufacture, performance, and delivery of MSB's (Main Switchboard) at UON (University of Newcastle). Specific requirements are detailed in Appendix 1 - University Requirements and/or Appendix 3 – List of Attachments.

It is not the intention to specify details of design and construction except where necessary to establish performance requirements, nor is it the intention to set forth those performance requirements which are adequately specified by the applicable Standards.

This specification shall be read in conjunction with Standard Specification UON-ESS-101 Electrical Design Criteria.

2. Standards, Specifications and Statutory Obligations

All aspects of design, manufacture, testing, supply, plant, equipment, accessories, materials, construction, erection, installation, operation and performance shall comply with this Specification and the current issue of the relevant Australian Standards, the relevant International Standards, the UON Standard Specifications, as well as all Statutory Acts, Codes, Regulations and Requirements of the relevant Authorities having jurisdiction over them unless specified otherwise within this Specification.

These shall include but not be limited to:

Australian/International Standards

AS 1627	Metal finishing – Preparation and pre-treatment of surfaces.
AS 60044.1	Instrument transformers - Current transformers.
AS 60529 (IP Code).	Degrees of protection provided by enclosures for electrical equipment
AS 2700	Colour Standards for general purposes.
AS 2756	Low-voltage switchgear and control gear - Mounting rails for mechanical support of electrical equipment
AS 3000	Wiring Rules
AS 3008	Electrical installations - Selection of cables
AS 3017	Electrical installations – Testing and inspection guidelines
AS 3111	Approval and test specification - Miniature overcurrent circuit-breakers
AS 3439	Low-voltage switchgear and control gear assemblies
IEC 60947	Low-voltage switchgear and control gear
IEC 60947.4.1	Low-voltage switchgear and control gear - Contactors and motor-starters - Electromechanical contactors and motor-starters
AS 5000.1	Electric cables – Polymeric insulated - For working voltages up to and including 0.6/1 kV
AS1100	Computer Aided Drafting.
AS 3858	Fault Capacity 10kva
HB 300	Electrical installations – Guide to using the wiring rules
HB 301	Electrical installations – Designing to the wiring rules

University of Newcastle Standards

UON-DG-001	UON Computer Aided Drafting Specification
UON-ESS-101	General Electrical Specification.

Technical Guidelines

Authorities and Statutory Acts, Codes, Regulations and Requirements

NCC
Worksafe NSW
NSW Electrical Licencing & Regulation
NSW Service and Installation rules.

Where the stipulations of this Specification, the data sheets and the drawings do not comply with the minimum requirements of the Australian Standards and Statutory Regulations, the latter shall prevail.

Where the stipulations of this Specification, the data sheets and the drawings are more exacting than the minimum requirements of the Australian Standards and Statutory Regulations, the former shall prevail in the following order:

- a) Data sheets and detail drawings
- b) Specification and standard drawings.

For the purposes of this document the MSB located in a substation, used to distribute power surrounding buildings will be called the SMSB or Substation Main Switchboard. The first switchboard within a building will be the MSB Main Switchboard. Any boards for the purpose of power reticulation downstream from the MSB will be referred to as a DB (Distribution Board). This document covers both SMSB's and MSB's.

2.1. Distribution System Terminology

For the purposes of this document and when dealing with the UoN the following distribution terminology applies.

High Voltage Substation

This is the building, high voltage transformer and switching equipment that provide power to the Low Voltage Substation.

Low Voltage Substation

This is the building and equipment that receives power from the High Voltage Substation and distributes it the Main Switchboard housed in each building.

Main Switchboard or MSB – This is the initial electrical board in a building that provides power to the distribution boards. This board receives power from the Low Voltage Substation.

Distribution Board or DB – This is the board that supplies power to the final sub circuits. The DB is fed from the Main Switchboard.

3. Equipment Ratings

The Main Switchboards shall be rated to operate continuously, supplying the maximum demand load, at the applicable site conditions.

4. Design and Construction Details

4.1. General

The supply system is a three phase and neutral 230/400 V +10% - 6%, 50 Hz, solidly earthed system.

The Main Switchboards shall be constructed of mild steel for indoor installations; or type 316 stainless steel if the board is to be installed outdoors. The board shall be of dead-front construction.

The Main Switchboards shall have a minimum Form 4a construction in accordance with AS 3439.1, Clause 7.7.

The board shall be equipped with a suitably rated fault current limiting circuit breaker and shall have a minimum 40% spare capacity once installed.

The power supply shall be from an MSB, and the feeder shall be equipped with a suitably rated fault current limiting device.

If a DB is to be integrated into the MSB it shall have a dedicated main switch to provide isolation of the entire DB cubicle to allow work to be undertaken on that DB without isolating power to the MSB.

When replacing an existing Main Switchboard, redundant control functionality should not be reproduced in the new MSB. Any control functionality still in use shall be reproduced in the new MSB. The required control functionality of a new MSB shall be discussed with the UON representative.

Maximum ambient temperature: 50°C
Minimum ambient temperature: -5°C
Humidity: between 30% and 95%.
Altitude: not exceeding 1000 m above sea level.

4.2. Enclosure

All enclosures shall be constructed from mild steel for Indoor installations; and type 316 stainless steel for outdoor installations, with a minimum thickness 1.6 mm.

The enclosure, including doors, shall have the rigidity and strength to withstand without damage the stresses imposed by short circuit forces, winds and the rigours of handling and road transport to the University of Newcastle sites. Where necessary to provide the required rigidity, the sheet metal shall be folded or reinforced with formed section.

The enclosure shall be formed by folding and welding. All welds shall be continuous.

The Main Switchboards shall have the following degree of protection in accordance with AS 1939:

- a) Indoor locations – IP42
- b) Outdoor locations – IP65

Outdoor boards shall utilise bottom cable entry only. All boards shall have removable, gasketed and undrilled gland plates fitted to the top and bottom of each enclosure for indoor Main Switchboards, and as a minimum, at the bottom for outdoor Main Switchboards. Gland plates shall be minimum 4mm thick aluminium. Gaskets shall be neoprene. All doors shall have skinned neoprene seals.

Main Switchboards shall have hinged lift-off doors. Doors up to 1000 mm high shall have two hinges; doors over 1000 mm in height shall have three hinges. Hinges shall have pins of increasing length for ease of removal and replacement.

No Circuit Breaker or operable device shall be higher than 1800mm or lower than 300mm once installed. A plinth shall be installed or the DB Mounted to a support structure to ensure compliance with the above height requirements.

All Main Switchboard doors shall require the use of a tool to open, this can be a B&R type tool. Outdoor MSB shall include stainless Steel, pad-lockable type swing handle as per the preferred equipment list to restrict access. Doors 1200 mm and above in height shall have three-point locking. Doors less than 1200 mm may have single-point locking.

Doors for outdoor enclosures shall be fitted with steel door stays to prop the outer door open.

All Main Switchboards shall include an A4 size bound document/booklet that contains all information relevant to that board and as detailed in section 7 of UON-ESS-112 Main Switchboard Specification. The document/booklet shall be contained in a metallic holder, painted X15 orange, on the outer skin of the Main Switchboard.

Main Switchboards for outdoor locations shall have a sloping rain/sunroof, extending out 200 mm front and rear from the cubicle.

4.3. Busbars

Busbars shall be hard-drawn, high-conductivity copper and shall have phase-coloured (red, white, blue) thermosetting insulation.

Fault rating shall be at a minimum 22kA of a period of 1 Second.

Busbar arrangement shall be vertical unless otherwise stipulated or approved, with the main incoming switch (where required) fitted at the top of the busbar chassis. The feeder circuit breakers shall be horizontally mounted on either side of the busbar chassis.

The neutral busbar shall be copper, having sufficient number of suitably sized termination ways in it to cater for the incoming feeder cable neutral, all outgoing feeder cable neutrals, plus 25% additional ways.

The earth bar shall be copper, having sufficient number of suitably sized termination ways in it to cater for the incoming feeder cable earth, all outgoing feeder cable earths, enclosure frame and gland plate earths, plus 25% additional ways.

4.4. Main Incoming Switch

The main incoming switch shall be either a manually operated load-break switch (preferably) or a non-auto circuit breaker that is lockable without the use of an additional lockout device.

The incoming switch shall be rated for a utilisation category of AC-22B in accordance with IEC 60947.3 Tables II and III.

4.5. Circuit Breakers

Feeder circuit breakers in each Main Switchboard shall be in accordance with AS 3111, with current ratings in accordance with the ratings given on the single line diagrams and/or schedules.

Each circuit breaker shall be lockable without the use of a separate mechanical device unless on a final sub circuit in a Distribution section where a screw-on or clamp-on isolation device for padlocking is sufficient.

The means/method of holding the circuit breakers in place shall not rely on the bolted connection to the busbar stabs for mechanical support.

Earth-leakage protection shall be provided using residual current circuit breakers, having overload, short circuit and earth-leakage functions. Each residual current circuit breaker shall have a test push button, accessible without removing the escutcheon.

Unless covered by an upstream current limiting device, fault Loop Impedance calculations shall be completed to establish the required fault rating for any circuit breaker installed a Main Switchboard.

All interlocks that restrict the opening of a door or enclosure while a circuit breaker is closed shall have an interlock override that requires a tool to operate.

4.6. Cascading

Where possible, the entire mains distribution system shall incorporate circuit breakers of the same manufacture selected to achieve required prospective fault level both by inherent fault capacity and in the case of downstream equipment by applying the principles of cascade protection.

4.7. Discrimination

In addition, discrimination under overload and short circuit fault conditions shall be achieved throughout. All adjustable circuit breakers settings shall be documented and handed over with the handover documentation.

4.8. Metering

All feeds origination at a Main Switchboard will be metered.

All meters shall be selected from the preferred suppliers and equipment list and shall be able to be interfaced to a site energy monitoring system and have the following minimum parameters:

- Instantaneous and average monitoring of:
 - Volts phase to neutral for LV (phase to phase for HV) (3 off).
 - Amps each phase and neutral (4 off).
 - Average power factor each phase and neutral (4 off).
- Watts, kVA, kWh.
- Fitted with a communications module for remote data interface such as Modbus RS485 or TCP/IP Ethernet to allow interfacing back to the existing energy monitoring system software. The remote monitoring shall allow for graphical, archiving and trending of the data equivalent to what is currently undertaken on site.

- Internal storage of MD values and other energy data with date and time when not online to the monitoring software with local retrieval. Automatic download when communications is restored.

Meters must be compatible with and include all required ancillary equipment including Ethernet bridges, isolation switches to connect with the existing energy monitoring system. All communications equipment shall be located in an area/enclosure separate to the main board enclosure to allow access by personnel not holding an electrical licence. This communications area shall have no exposed voltages above 50 Volts.

Panel meters shall include auxiliary power supply & voltage potential isolation fuses/CB, CT shorting links and CT's shall be wired with both legs of CT all the way to meter.

During design, consideration should be given to metering for tenanted properties. Separate energy meters may be required for individual rental properties. Meters shall be readable without opening the escutcheon panel and but not mounted on the escutcheon panel.

As part of the handover documentation, screenshots of Voltages, Currents, Power Factor, kW shall be provided. A kWh screenshot shall be provide showing kWh after a minimum of three days of operation. The kWh photo shall be dated. Any anomalies in metering shall be rectified by the installation contractor.

All metering equipment shall be as per UON preferred equipment list.

4.9. Surge Protection

All new boards shall incorporate surge protection. If necessary install new surge diverters in enclosures beside MSBs within MSB cupboards.

Surge protection to be installed in accordance with manufacturer's recommendations.

For the surge diverters BMS alarm; provide the BMS terminal strips in easily accessible locations within MSB cupboards. All hardware, software and configuration required to integrate the surge diverter alarms into the existing BMS shall be included in the Main Switchboard installation.

The connecting leads for the surge diverter are to be kept as short as possible. And be as straight as practical. The total length of connection should not exceed 300mm.

Surge diverters must be mounted so the health indication flags are visible without removing the escutcheon panel. If necessary make alterations to the escutcheon panel - Cut, file and paint to original finish.

Surge diverter shall be as per UON preferred equipment list.

4.10. Wiring and Terminations

Where there is a requirement for a remote signal to be wired into a Main Switchboard (e.g. remote daylight cell into a lighting control circuit), the Contractor shall provide terminals for the incoming signal(s). All power supplies for control signals shall originate from the Main Switchboard that contains the lighting control, that is, once the Main Switchboard main switch is opened, there shall be no other voltages present in the board.

Wiring looms crossing from fixed to hinged panels shall be mechanically supported on both panels, adjacent to the hinged side, by means of saddles or compression-type supports.

All control, metering and protection wiring shall be identified at each end by full circle, clear-plastic ferrules, having slip-in numbers and letters (e.g. Grafoplast or equivalent). Clip-on ferrules shall not be used.

All control wiring and power wiring up to and including 16 mm² shall be terminated using insulated crimp pins.

All control wiring is to be documented on a schematic diagram which is to be displayed in a clear plastic holder on the inside of the front door.

Straight-through joints are not to be used without permission of University Representative. If approved the links are to be in line crimp link with resin filled heat shrink for insulation and be readily accessible.

All cable terminations will have either lug or bootlace lugs. All cables above 16mm Squares will be stud and lug.

Cable shall be multi-stranded copper type,
PVC insulated cables: Use V75 minimum insulation.
Use multi-stranded copper cable or fire rated cables, where nominated on drawings.

Minimum size: 4.0mm² for power circuits, 2.5mm² for lighting circuits.
TPS cables in false ceilings or enclosed areas.

4.11. Earthing

All metallic, non-current-carrying parts of the Main Switchboard shall be electrically bonded to the earth bar.

All doors, removable panels, gland plates and escutcheon plates shall have a flexible earth connection to the Main Switchboard frame. This connection shall be of 2.5 mm² cross section. Connections should not be "Pig tail" or coiled type connections.

4.12. Nameplates, Labels and Circuit Identification

Assembly Name Plates

All Main Switchboards shall be labelled on the front door with essential markings as per AS/NZS3439.1 and AS/NZS3000 plus the following:

- Building Name (15mm)
- Main Switchboard Name (10mm)
- UON Asset number. (6mm)
- Fed from (6mm)
- Manufacturer's name and company details. (4mm)
- Specification used eg AS3439.1 2002 (4mm)
- Form of segregation. (4mm)
- IP rating (4mm)

- Rated Voltage and Frequency (4mm)
Main Switch rating. (4mm)
- Busbar current rating. (4mm)
- Manufactured date. (4mm)

If the board is replacing an existing asset, the existing Asset number will be maintained. In the case of a new installation, an asset number should be requested from the UoN.

All outgoing ways (i.e. feeder circuit breaker poles) shall be clearly identified, in accordance with the single line diagrams and schedules. Legends shall be installed upon completion of the board, permanent printed legends shall be in place within a week of completion.

All components both interior and exterior to the board shall be labelled in accordance with the Main Switchboard single line diagram or schematic diagram. Labels shall be located such that wiring or equipment does not obscure them. Labels shall not be fixed to removable equipment, such as duct covers.

All external labels on Main Switchboards shall be engraved labels. If the board is installed in an outdoor location, external labels shall be 316 Stainless Steel.

All internal labels shall be traffolyte labels with engraved black letters on a white background. Danger and warning labels shall be traffolyte labels with engraved white letters on a red background. Labels completely contained within the board may be fixed using adhesive, labels on escutcheon or exterior to the board shall be attached by screw or metal thread. All screws on externally installed boards shall be of type 316 stainless steel. Labels larger than 100 mm x 50 mm shall have four fixing screws.

Component label letter sizes shall be as follows:

- Component labels (external) 6 mm
- Component labels (internal) 4 mm

Any MEN link shall be labelled "MEN LINK" on the link and on the escutcheon or cover that obscures the MEN link.

All warning labels must be installed as required by Australian Standards or Supply Authority rules.

Where the removal of any barrier or shrouding could lead to the possibility of direct contact of live conductors, a warning label shall be installed highlighting the danger:

Description	Text Size
DANGER	10mm
ISOLATE ELSEWHERE BEFORE REMOVING COVER	4mm

Where a cabinet contains electrical equipment, a label should be provided on all doors, covers and escutcheon plates or similar, to identify this, an example being:

Description	Text Size
DANGER	15mm
415V	10mm

Where spare cubicles or sections exist in a switchboard, either provided to allow for future expansion, or made spare by the removal of equipment, attach the following label:

Description	Text Size
SPARE	10mm

When a circuit breaker is installed as a spare for future expansion, the sub circuit schedule should reflect this.

Where an internal switchboard is located in a room designed to house a switchboard, or in a cupboard, the door must identify electrical components using the following labels:

Description	Text Size
AUTHORISED ACCESS ONLY	15mm
MAIN SWITCHBOARD	15mm
SWITCHBOARD NAME	10mm
ASSET NUMBER	10mm

The label must be clearly visible. The minimum size of these labels shall be 200mm X 80mm.

All devices external to the Main Switchboard, supplied from that board including light switches and GPO's shall be labelled indicating the Main Switchboard number and circuit number.

4.13. Finish

The external final coat shall be Gloss Orange No. X15 to AS 2700. Internal pans and escutcheons shall be Gloss White.

All painting shall be professional spray paint application completed by a third party applied with a minimum paint thickness of 50µm.

5. Installation

The installing contractor shall satisfy themselves that the board physically will fit in the intended location, any modifications that are required to facilitate the physical installation of the board shall be at the contractor's expense. The contractor is responsible for and equipment or expense involved in delivering the board to its place of installation.

Once installed the door of the board shall be capable of being opened a minimum of 110 degrees, hinged doors larger than 1500mm in height shall include a door stay. Escutcheon doors do not require a door stay.

The contractor is responsible for the removal of all equipment that is made redundant due to the installation of the new board.

The Installing contractor is responsible for all electrical, mechanical, structural or any other modification that are required for the installation of the MSB.

No Circuit Breaker or operatable device shall be higher than 1800mm or lower than 200mm once the board is installed in its final location.

The installation of the board is to be completed at a time to minimise disruption to the University staff and students. The contractor shall liaise with UON to establish acceptable installation times prior to any tender submission or quote for complete the works. Installation times are at the discretion of the UON, variations due to "Out of Hours" works will not be considered.

The contractor is responsible for ensuring that the legend accurately reflects the circuit description. In the event that the contractor is replacing an existing Main Switchboard, the contractor shall ensure that the circuit description on the existing legend is transferred to the new Circuit Breaker location on the new legend.

There shall be only one MSB and single point of power entry per building.

6. Inspection and Test

Final factory inspection shall be carried out in the presence of the UON representative. Routine tests in accordance with AS 3439.1 Clause 8.3 shall be completed. The contractor shall provide 7 days prior notice for testing.

The contractor must submit the Certificate of Compliance – Electrical Work (CCEW), covering all installation work, to the Local Electricity Distributor. As well as supplying the CCEW, the person who conducted all testing must submit test reports certifying the electrical installation.

The CCEW shall include:

- Confirmation of Circuits
- Megger tests
- Load Balance Data
- Phase Rotation
- Trip test of RCD's and provide test sheets with trip times.

The same phase rotation shall be used throughout installation, generally RWB clockwise.

Direction testing shall be completed on all three phase motor upon restoration of power after a MSB installation/upgrade/replacement.

All hard-wired circuits, including lighting circuits are to be energised upon completion of the installation to establish if any earth faults are present. Notification shall be given to the UON immediately of any tripping circuits.

7. Drawings and Data

The Contractor shall supply the following drawings for approval before manufacture, two weeks after award or at such time as stated in the Scope of Works:

The following “as-constructed” drawings and/or documentation are to be supplied on the completion of a new installation:

- Maximo New Equipment Entry sheet.
- Photo of front of MSB
- Electronic copy of legend
- Photo of each Function Unit
- Photo of DB's with from door open.
- MSB General Arrangement Drawing
- Schematic wiring diagram of control circuitry.
- Single Line Diagrams

- Power Meter Manuals
- Surge protection Manuals
- Main CB settings if applicable

A copy of the documents below shall be placed in a document holder affixed to the front exterior of the MSB as described in Section 4.2 of this document.

- MSB General Arrangement Drawing
- Schematic wiring diagram of control circuitry.
- Single Line Diagrams
- Power Meter Manuals
- Surge protection Manuals
- Main CB settings if applicable

All “as-constructed” drawings shall comply with the current version of UON Drafting standards UON-DSS-001 CAD Drafting Standards.

As part of the handover documentation, screenshots of Voltages, Currents, Power Factor, kW shall be provided. A kWh screenshot shall be provide showing kWh after a minimum of three days of operation. The kWh photo shall be dated. Any anomalies in metering shall be rectified by the installation contractor.

The contractor shall also supply manufacturer’s instructions for any equipment that requires configuration or programming.

All adjustable circuit breakers settings shall be documented and handed over with the handover documentation.

The contractor shall complete the Asset Database update as per Appendix 4 and submit to the UoN representative upon the completion of the works.

8. Naming

The MSB shall be named after the building that houses the MSB. E.g. Medical Sciences MSB...

9. Defects and Liabilities

The Defect Liability Period for the project shall be twelve months. During this time all maintenance, including statutory maintenance is the responsibility of the contractor.

10. Miscellaneous

Pay all fees to authorities in connection with applications, inspections and approvals.

Once the works is complete the area is to be cleaned to the point that there is no sign of the work having taken place.

