



For the Government of Niue

Liolau Accommodation Upper Block

MES: 500 Building Services

Electrical Services Specification





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Table of Contents

MES: 501 ELECTRICAL SYSTEMS – SCOPE	1
1 GENERAL.....	1
1.1 Introduction.....	1
2 SCOPE.....	1
2.1 Requirements	1
3 REGULATIONS AND STANDARDS.....	5
4 INTERFACE REQUIREMENTS	9
5 WORK BY OTHERS	9
MES: 504 ELECTRICAL SYSTEMS POWER SUPPLIES AND EARTHING	10
1 MAIN SUPPLY.....	10
1.1 General.....	10
1.2 Service connection	10
1.3 Service charges	10
1.4 Electricity supplier metering.....	10
2 EARTHING.....	10
2.1 Earth continuity conductors.....	10
2.2 Main earth.....	10
2.3 Equipotential bonding	11
2.4 IT and communications earthing.....	11
2.5 Test results.....	11
MES: 505 ELECTRICAL SYSTEMS – SWITCHBOARDS.....	12
1 GENERAL.....	12
1.1 Upper Block Distribution Board (DB-UB) Design Criteria	13
1.2 Test certification.....	13
1.3 Inspection of switchboards.....	13
1.4 Busbars.....	14
1.5 Tariff metering provisions	14
1.6 Wiring	14
1.7 Finish.....	15
1.8 Labels	15
1.9 Accessories.....	15
1.10 MCB protection	15
1.11 HRC protection.....	15

1.12	MCCB protection	15
1.13	RCD protection	15
1.14	Fuse - switches.....	16
1.15	Isolation switches	16
1.16	Terminal blocks	17
1.17	Instrumentation	17
1.18	Current transformers	17
1.19	Hour-run meters	17
1.20	Contactors.....	18
1.21	Load transfer devices	18
1.22	Voltage sensing relays.....	18
1.23	Relays	19
1.24	Push buttons	19
1.25	Extra low voltage power supplies.....	19
1.26	Signal lamps.....	19
1.27	Time switches	19
1.28	Timing relays	20
1.29	Alarm sounders	20
1.30	Power controllers	20
1.31	Mimic panels	20
MES506: ELECTRICAL SYSTEMS WIRING SYSTEMS		21
1	MAINS AND SUBMAINS	21
1.1	Identification	21
1.2	Installation.....	21
2	SUB-CIRCUIT WIRING	21
2.1	General.....	21
2.2	Plant rooms and service areas	22
2.3	Outside areas	22
2.4	Occupied areas.....	22
2.5	Concealment	22
2.6	Installation, fixing and support.....	22
2.7	Sub-circuit cables installation	23
2.8	Thermal insulation.....	23
2.9	Coloured sheaths	23
3	WIRING IN CONDUIT OR TRUNKING	23
4	UNDERGROUND CABLES.....	24
4.1	Existing services	24
4.2	Trenches.....	24
4.3	Cable ducts.....	24
4.4	Cable installation.....	24
4.5	Backfilling and reinstatement	25
4.6	Route identification.....	25

5	TERMINATIONS	25
6	CABLE SUPPORT SYSTEMS.....	26
6.1	General.....	26
6.2	Cable tray and ladder systems.....	26
6.3	Cable tray.....	26
7	CONDUITS	27
7.1	General.....	27
7.2	Conduit types.....	27
7.3	Embedded conduit.....	27
7.4	Flexible conduit.....	27
8	TRUNKING	28
8.1	General.....	28
8.2	Steel trunking.....	28
8.3	Extruded aluminium trunking.....	28
8.4	PVC Trunking.....	28
MES: 507 ELECTRICAL SYSTEMS - ACCESSORIES		29
1	FIRE RATED WALLS.....	29
2	FLUSH BOXES AND PLATES	29
2.1	General.....	29
2.2	Fixings.....	29
3	SWITCHES, SOCKETS AND FIXED OUTLETS.....	29
3.1	Switches, socket outlets and fixed outlets.....	29
3.2	Surface type.....	30
3.3	Damp/external requirements.....	30
3.4	Light switches.....	30
3.5	Socket outlets.....	30
3.6	Industrial outlets.....	30
4	FIXED WIRING OUTLETS.....	31
4.1	General.....	31
MES: 508 ELECTRICAL SYSTEMS – LIGHTING		32
1	LUMINAIRES	32
1.1	Diffusers.....	32
1.2	Fixings.....	32
1.3	Damp situations.....	32
1.4	Power factor correction.....	33

2	LED LIGHTING	33
3	FLUORESCENT LIGHTING	33
	3.1 Luminaires.....	33
4	EXTERIOR SITE LIGHTING	33
	4.1 Control	33
	4.2 Installation.....	33
5	LIGHTING COLUMNS	33
6	EMERGENCY LIGHTING	34
	6.1 General.....	34
	6.2 Self-contained single point systems.....	34
	6.3 Testing and monitoring facility	34
7	LIGHTING CONTROL SYSTEMS	34
	7.1 General.....	34
	7.2 Detailing.....	35
	7.3 Light switches (Manual)	35
	7.4 Occupancy Sensors.....	35
	7.5 Integration with Third Party Systems.....	36
	7.6 BMS Interface	36
	7.7 Lighting control training.....	36
	7.8 Notes to contractor.....	36
8	OTHER REQUIREMENTS	37
	8.1 Lamps.....	37
MES: 509 ELECTRICAL SYSTEMS – APPLIANCES		36
1	CONNECTIONS	36
	1.1 Terminations	36
	1.2 Kitchen Appliances.....	36
2	HAND DRIERS	36
3	STORAGE WATER HEATERS	36
4	UNDER BENCH WATER HEATERS.....	37
5	WATER MISERS.....	37
6	LTX (FIRE ALARM TRANSMITTER DEVICE).....	37

7	FIP (FIRE INDICATOR PANEL).....	37
8	PANEL HEATERS.....	37
	MES: 524 ELECTRICAL SYSTEMS COMMISSIONING.....	38
1	GENERAL.....	38
2	COMMISSIONING PROCEDURES.....	38
3	ACCEPTANCE.....	38
4	TEST SHEET BLANKS.....	38
5	MAIN SWITCHBOARD (MSB).....	39
6	DISTRIBUTION BOARDS (DBs).....	40
7	WIRING INSULATION AND CONTINUITY TESTS.....	41
8	RCD - DISTRIBUTION BOARD TEST SHEETS.....	42
	8.1 Commissioning tests.....	42

MES: 501

ELECTRICAL SYSTEMS – SCOPE

1 GENERAL

1.1 Introduction

This contract is for the Electrical, Telecommunications and minor Mechanical Ventilation services required for a Government of Niue project refurbishing the Liolau Accommodation, Upper Block, located in Avatele, Niue.

The following scope section describes the work under this contract and the sections beyond the Scope are in the form of a Standard Technical specification (called upon on technical requirement of the discipline where specified). The detailed scope take precedence over general items in the specification. If in doubt or if there is considered ambiguity in the documents, confirm items with the Engineer through the Project Manager.

This specification shall be read in conjunction with MES 200: Preliminary and General Services Specification.

2 SCOPE

2.1 Requirements

The scope of work required by this section of the specification is the design (where applicable), supply, delivery, storage, assembly, installation, testing and commission all the materials required and the work necessary for the complete working installation set out in this specification, of the Electrical system(s) that form part of this contract. The contractor is to ensure that coordination is strictly controlled.

Anything shown on the drawings but not specified in this specification shall be equally binding as though in both.

The specific requirements for the Electrical Systems include, but are not limited to:

- a. Supply, installation and commissioning of the electrical and minor mechanical ventilation services works as detailed herein and on the electrical services drawings.
- b. Electricity Supply:
 - i. Liaise with the Government of Niue project representative or their nominated electrical contractor to have supplied, installed and commissioned a new single phase electrical supply to the location of a new distribution board (DB-UB) as indicated on the electrical services drawings.

c. Distribution Board (DB):

- i. Supply, design, installation and testing of a new distribution board (DB-UB).
- ii. The arrangement of each DB shall be carried out by a specialist switchboard manufacturer in consultation with the Engineer under this contract and shall include all the requirements set out in section MES 505 (Switchboards) of this specification and accompanying Electrical Services drawings package.
- iii. The size of the DB shall not exceed the available wall space within the room in the location shown taking into consideration the legislated clearances around switchboards.
- iv. The design of each DB shall take into consideration cable access and cable duct penetrations to facilitate sub-mains and final circuit cabling.
- v. The distribution board shall contain general lighting and power (MCB and RCBO) distribution cabinets and separate lighting/power control cabinets.
- vi. Refer to Switchboards section (MES 505) of this specification for specific DB requirements.
- vii. Provision of DB shop drawings for review and acceptance by the Engineer prior to construction.

d. General power outlets and connections:

- i. Supply and install power outlets and connections to equipment and plant shall be as shown on the Electrical Services drawings.
- ii. Minimum electrical cable size shall be 2.5mm² Cu 2C+E FLAT TPS PVC/PVC for all power circuits unless otherwise stated. Where cable glands to power outlets and connections to equipment and plant equipment require circular cables, the equivalent cable size in circular cable shall be supplied and installed.

e. Lighting:

- i. Luminaires types shall be as detailed on the Electrical Services drawings. All luminaires shall be as specified and alternatives shall not be considered. Any departure from these specified luminaires will void design compliance and any re-design on alternative types will be subject to an engineering re-design variation with costs borne by the client and/or contractor.
- ii. All luminaires shall have electronic ballasts.
- iii. Minimum electrical cable size shall be 1.5mm² Cu 2C+E FLAT TPS PVC/PVC for all lighting circuits unless otherwise stated. Where cable glands to luminaires require circular cables, the equivalent cable size in circular cable shall be supplied and installed.

f. Lighting Controls:

- i. The control of the lighting throughout the Upper Block premises shall be achieved through the use of manual switches and photocell operation.
- ii. Refer to the table below for specific details regarding the lighting control requirements throughout the project.

Lighting Control Philosophy				
Type	Typical Area	Description	Manual Switch (local)	Daylight Sensor/Photocell
Type 1	Studio units, women’s dorm, kitchen, store, laundry and women’s ablution.	Local manual switching via wall switch available for isolation.	<input checked="" type="checkbox"/>	
Type 2	Exterior lighting (deck)			<input checked="" type="checkbox"/>

- g. Exit and Emergency Lighting:
 - i. Supply and install emergency lighting via self-contained battery backed up units that comply with the requirements of the relevant emergency lighting standard (AS 2293), the relevant sections of the Acceptable Solution F6/AS1 – Visibility in Escape Routes and the Fire Safety Design Report.
 - ii. All luminaires shall have electronic ballasts.
- h. Telecommunication Services
 - i. Liaise with the Government of Niue project representative or their nominated telecommunication/data contractor to supply new incoming telecommunication communication services to the demarcation point located within the Store Room as indicated on the Electrical Services drawings (SERVER-UB).
 - ii. Design and build a CAT 6 Structured cabling solution which shall be wired from the telecommunication/server rack to all data and voice outlets as specified on the Electrical Services drawings.
 - iii. All structured cabling shall be supplied, installed and commissioned by an accredited data contractor. The installation shall be certified for a minimum 20 years.
 - iv. Allow for the installation of a double power socket outlet on a dedicated circuit from DB-UB for the purposes of providing power to server equipment within SERVER-UB.
- i. Master Antenna Television (MATV) System
 - i. Supply, installation and commissioning of a master antenna television (MATV) system incorporating, aerials, associated cabling and wall outlets. The supply and installation of all accessories necessary to provide a complete operational wiring system.
 - ii. Provide an antenna on the roof for receiving television transmission and other head end equipment capable of receiving analogue and digital television services.
 - iii. Provide gain amplifier equipment with associated power supplies which shall be capable of distributing the required signal strength to all the MATV outlets within the Upper Block.
- j. Security Services
 - i. The Liolua Accommodation Upper Block does not require the protection of any electronic security. Protection shall be provided by conventional mechanical locks at each entry point. This recommendation is based on the following observations. Low risk of intrusion due to the low incidence of crime in Niue (Statistics Niue). No pre-existing electronic security in the previous building or the adjacent lower block. The likelihood of occupancy of the building as an accommodation block.
- k. Supply and approval of construction drawings for all works carried out under this contract.
- l. Supply of Operation and Maintenance (O&M) manual complete with AutoCAD as-built drawings as described in MES: 200 (Preliminary and General Specification). Draft O&M manual and as-built drawings are to be submitted for practical completion. Refer to MES: 200 for as built drawings supply agreement.
- m. Supply and installation of all cable support mechanisms, foundations, plinths, ducts and conduits necessary for the completion of these works.

- n. Liaison with suppliers to meet the programme
- o. Attendance on other Trades.
- p. Testing, commissioning and certification of these works. Programmes for the commissioning and testing shall be prepared by the Contractor for review by the Architect.
- q. Defects Liability – refer to the MES 200: Preliminary and General Specification.
- r. Guarantees and warranty – refer to the MES 200: Preliminary and General Specification.

3 REGULATIONS AND STANDARDS

All scope of work carried out under this contract shall comply with the requirements of the latest edition (including amendments) of the New Zealand Regulations, Codes and International Standards relevant to the provision of the work and equipment provided, together with the requirements of Statutory Authorities having jurisdiction over all or part of the manufacture, installation and operation of the equipment.

Reference to any Standard shall include any amendments thereto, and any Standard in substitution thereof, issued up to three months before the closing date for tenders. In the event of this Specification being at variance with any provision of these documents, the requirements of this Specification take precedence over the provisions of the document. Responsibilities of the parties to the Contract are not altered by requirements in referenced documents.

Where no New Zealand Standard exists, work shall conform (in order of precedence) to the most current Australian Standards, British Standards, European Standards and other international standards.

Where conflict exists between these and this Specification, the most stringent requirement shall be satisfied. The Contractor and associated Sub-Contractor(s) shall not deviate from the provisions of the relevant standard without first obtaining agreement in writing from the Principal.

ISO units shall be used.

The Regulations, Codes and Standards (including all amendments) that shall be considered by the Contractor shall include, but not be limited to the following:

Standard	Description
General	
NZS 2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
NZS 4121	Design for access and mobility: Buildings and associated facilities
NZS 4219	Seismic performance of engineer systems in buildings
NZS 4243.1	Energy efficiency - Large buildings - Building thermal envelope
NZS 5807	Code of practise for industrial identification by colour, wording or other coding

Standard	Description
NZS 7643	Code of practise for the installation of unplasticized PVC pipe systems
AS/NZS 1170 (set)	Structural design actions
AS/NZS 2865	Safe working in a confined space
AS/NZS 4600	Cold-formed steel structures
AS/NZS 4677	Steel utility services poles
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS 4792	Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialized process
AS/NZS 60079 (set)	Explosive atmospheres
AS/NZS CISPR (set)	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
AS 1100 (set)	Technical Drawing
AS 1767 (set)	Insulating liquids
AS 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60073	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
Electrical	
NZS 6104	Specification for emergency electricity supply in buildings
AS/NZS 1768	Lightning Protection
AS/NZS 2053 (set)	Conduits and fittings for electrical installations
AS/NZS 3000	Electrical Installations – Australia/New Zealand Wiring Rules
AS/NZS 3001	Electrical Installations – Transportable structures and vehicles including their site supplies
AS/NZS 3002	Electrical Installations – Shows and carnivals
AS/NZS 3003	Electrical Installations – Patient Areas
AS/NZS 3004 (set)	Electrical Installations – Marinas and recreational boats
AS/NZS 3007	Electrical equipment in mines and quarries – Surface installations and associated processing plant
AS/NZS 3008 (set)	Electrical Installations – Selection of cables
AS/NZS 3009	Electrical Installations – Emergency power supplies in hospitals
AS/NZS 3010	Electrical Installations – Generating sets
AS/NZS 3012	Electrical Installations – Construction and demolition sites
AS/NZS 3013	Electrical installation – Classification of the fire and mechanical performance of wiring systems elements
AS/NZS 3014	Electrical installation – Electric Fences
AS/NZS 3015	Electrical installation – Extra-low voltage d.c. power supplies and service earthing within public telecommunications networks
AS/NZS 3016	Electrical installation – Electric security fences
AS/NZS 3017	Electrical Installations – Verification guidelines

Standard	Description
AS/NZS 3019	Electrical Installations – Periodic verification
AS/NZS 3100	Approval and test specification - General requirements for electrical equipment
AS/NZS 3111	Approval and test specification - Miniature overcurrent circuit-breakers
AS/NZS 3123	Approval and test specification - Plugs, socket-outlets and couplers for general industrial application
AS/NZS 3133	Approval and test specification - Air-break switches
AS/NZS 3191	Electric flexible cords
AS/NZS 3760	In-service safety inspection and testing of electrical equipment
AS/NZS 3439 (set)	Low-voltage switchgear and control gear assemblies <i>This standard is available for use where called upon in lieu of AS/NZS 61349 and is to be replaced by AS/NZS 61439 from June 2021.</i>
AS/NZS 4296	Cable trunking systems
AS/NZS 4836	Safe working on or near low-voltage electrical installations and equipment
AS/NZS 5000 (set)	Electric cables – Polymeric insulated
AS/NZS 60076 (set)	Power transformers
AS/NZS 60269.3.1	Low-voltage fuses - Sections I to IV: Examples of types of standardized fuses
AS/NZS 60898 (set)	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations
AS/NZS IEC 60947 (set)	Low-voltage switchgear and controlgear
AS/NZS 61000 (set)	Electromagnetic compatibility (EMC)
AS/NZS 61008.1	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) - Part 1: General rules
AS/NZS 61009.1	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) - Part 1: General rules
AS/NZS 60137	Insulated bushings for alternating voltages above 1000v
AS/NZS 61439 (set)	Low-voltage switchgear and control gear assemblies. <i>This standard is available for use where called upon in lieu of AS/NZS 3439.</i>
AS 2374.8	Power transformers – Application guide
AS 2676 (set)	Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings
AS 3011 (set)	Electrical installations - Secondary batteries installed in buildings
AS 3013	Electrical installations - Classification of the fire and mechanical performance of wiring system elements

Standard	Description
AS 60890	A method of temperature-rise assessment by extrapolation for partially type-test assemblies (PTTA) of low-voltage switchgear and controlgear (IEC 60890, Ed. 1.0 (1987) MOD)
AS 62040 (set)	Uninterruptible power systems (UPS)
IEC 60076.11	Power transformers – Dry type transformers
IEC 60269 (set)	<u>Low-voltage fuses</u>
IEC 60669.2.1	Switches for household and similar fixed electrical installations
IEC 61643 (set)	Low-voltage surge protective devices
<i>Data/Telecommunications</i>	
AS/NZS 3080	Information technology - Generic cabling for customer premises
AS/NZS 3084	Telecommunications installations – Telecommunication pathways and spaces for commercial buildings
AS/NZS 3085.1	Telecommunications installations - Basic requirements
AS/NZS IEC 61935.1	Specification for the testing of balanced and coaxial information technology cabling - Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards
AS/NZS IEC 61935.2	Testing of balanced communication cabling in accordance with ISO/IEC 11801 - Patch cords and work area cords
<i>Interior/Exterior Lighting</i>	
NZS 4243.2	Energy efficiency - Large buildings - Lighting
AS/NZS 1158 (set)	Lighting for roads and public spaces
AS/NZS 1680 (set)	Interior and workplace lighting
AS/NZS 2293.2	Emergency evacuation lighting for buildings - Inspection and maintenance
AS/NZS 3827 (set)	Lighting system performance – Accuracies and tolerances
AS/NZS 4783 (set)	Performance of electrical lighting equipment – Ballasts for fluorescent lamps
AS/NZS 60155	Glow-starters for fluorescent lamps
AS/NZS 60598 (set)	Luminaires
AS/NZS 60921	Ballast for tubular fluorescent lamps – Performance requirements
AS/NZS 60929	A.C. supplied electronic ballasts for tubular fluorescent lamps - Performance requirements
AS/NZS 61347 (set)	Lamp controlgear
AS/NZS 62560	Self-ballasted LED-lamps for general lighting services by voltage greater than 50 V - Safety specifications
AS 2560 (set)	Sports lighting
AS 4282	Control of the obtrusive effects of outdoor lighting
IEC 60081	Double capped fluorescent lamps – Performance specifications
IEC 62386 (set)	Digital addressable lighting interface (DALI)

Standard	Description
IES LM (set)	Illuminating Engineering Society (IES) Approved Method
IES TM (set)	Illuminating Engineering Society (IES) Approved Method
<i>New Zealand Legislation</i>	
-	New Zealand Health and Safety at Work Act 2015
-	New Zealand Building Act 2004
-	New Zealand Building Regulations 1992
-	New Zealand Building Code
-	New Zealand Electricity Act 1992
-	New Zealand Electricity (Safety) Regulations 2010
-	New Zealand Electrical Code of Practice for Electrical Safe Distances – (ECP 34)
-	New Zealand Electrical Code of Practice for Power Systems Earthing – (ECP 35)
-	New Zealand Electrical Code of Practice for Harmonics Levels – (ECP 36)
-	New Zealand Electrical Code of Practice for High Voltage Live Line Work – (ECP 46)
-	New Zealand Electrical Code of Practice for Homeowner/Occupier’s Electrical Wiring Work in Domestic Installations – (ECP 51)
-	New Zealand Electrical Code of Practice for the Installation of Recessed Luminaires and Auxiliary Equipment – (ECP 54)

4 INTERFACE REQUIREMENTS

Ensure that all interfaces with this trade are effectively co-ordinated and allow for all necessary provisions.

Trades include but are not limited to:

- a. Mechanical services
- b. Hydraulic services
- c. Fire protection services

5 WORK BY OTHERS

- a. All in ground conduits chased into the floor slab shall be installed by the main contractor. Allow to liaise with the main contractor to ensure all requirements set out in this specification and in the Electrical Services drawing package are met.
- b. Mechanical and Hydraulic services shall be by others.
- c. Fire protection services shall be by others.

MES: 504

ELECTRICAL SYSTEMS

POWER SUPPLIES AND EARTHING

1 MAIN SUPPLY

1.1 General

- a. Ensure that ducts are installed to comply with all requirements, fitted with draw wires and free from all obstruction.
- b. Allow to install the ducts within the foundations.

1.2 Service connection

- a. Liaise with the Government of Niue project representative or their nominated electrical contractor to have supplied, installed and commissioned a new single phase electrical supply to the location of a new distribution board (DB-UB) as indicated on the electrical services drawings

1.3 Service charges

- a. Arrange with the Electricity Network Operator to terminate the main supply cable and connect to their supply.
- b. Obtain a quotation for the work to be carried out by the Electricity Network Operator, submit for approval and authority to proceed, and subsequently pay all charges before the work is carried out. This work shall be allowed for in the tender.

1.4 Electricity supplier metering

- a. Arrange for the installation to be metered on the Electricity Network Operators tariff and forward details for approval.
- b. Arrange for the Electricity Supplier to monitor the building's load profile, two months after practical completion of the contract, for a minimum of two standard working weeks.
- c. At the completion of the monitoring period, supply copies of the recorded data in graphical form and on computer disk/USB, the Electricity Suppliers current tariffs and the recommended tariff.

2 EARTHING

2.1 Earth continuity conductors

Conductors shall be installed with the wiring to all lighting, switch, power or other connection points.

2.2 Main earth

- a. Allow a provisional sum for testing the Main Earth.

2.3 Equipotential bonding

Equipotential bonding shall not be part of the earth fault path of the protective conductor system.

Bond to earth all enclosures, equipment, exposed conductive parts, extraneous conductive parts, metallic trunking, metallic conduits, metallic cable trays and any other metalwork, other than any live part, forming protection or part of the electrical installation, including apparatus and appliances.

Provision of equipotential bonding conductors to all benches that have power outlets in the vicinity or water fixtures associated with them, whether or not they currently have metal surfaces.

2.4 IT and communications earthing

Connect dedicated IT/Communications earth bar to the “highest level” distribution board in the building using a 10mm² earth cable.

The electrical contractor shall install separate 6mm² earth wires from the IT/Communications earth bar, to all IT and Communication cable trays, metal trunking, cabinets and frames within the building.

All IT and Communication earths shall be dedicated and not looped. There shall be no joints in any IT/Comms earth cables and each cable shall be connected directly to the comms earth bar and shall be labelled accordingly.

2.5 Test results

- a. Main earth system
 - i. Allow to measure the earth resistance of the main earth using approved instruments and methods, and to repeat the test in the presence of a nominated witness. The main earth resistance shall not exceed 15 ohms
 - ii. Submit test results for review
- b. Earth fault loop impedance testing
 - i. Provide an earth fault loop impedance test at MSB using high resolution instruments and methods, and to repeat the test in the presence of a nominated witness.
 - ii. Provide earth fault loop impedance testing of all power and lighting circuits using approved instruments and methods, and to repeat the test in the presence of a nominated witness.
 - iii. Submit test results for review.
- c. Other earthing systems
 - i. Provide all testing of earthing systems required under AS/NZS 3000 using approved instruments and methods, and to repeat the test in the presence of a nominated witness.
 - ii. Submit test results for review.

MES: 505

ELECTRICAL SYSTEMS –

SWITCHBOARDS

1 GENERAL

The requirements for the Distribution Board within the Liolau Accommodation Upper Block is detailed in this section.

All Circuit Protective Devices (CPD's) shall be as specified in the accompanying Electrical Services drawings package and this section of the specification. Any departure from these specified CPD's will void the certified design compliance and any re-design on alternative CPD's will be subject to an engineering re-design variation with costs borne by the contractor. Main Switchboard (MSB) Design criteria.

1.1 Upper Block Distribution Board (DB-UB) Design Criteria

Criteria	Requirement
Standards	AS/NZS 3439 (set) Low-voltage switchgear and controlgear assemblies
Supply system	400V ac 50Hz, three phase, earthed neutral
Service conditions	Indoor Ambient temperatures -5°C to +35°C Max +40°C Humidity 20-100%
Environmental Rating	Indoor IP54 minimum
General arrangement	Electricity tariff meter MCB lighting and power distribution section Lighting control cabinet Cableway 80A main switch, 1P 25% Spare capacity for future sub-circuit distribution
Enclosure type	Multi-cubicle
Fault level	10kA minimum
Mounting	Wall mounted
Access	Side Front Top Bottom Contractor shall ensure that a minimum unimpeded clearance of 600mm is provided at all times around the switchboard with doors open or equipment located in the withdrawn position.
Extendable	Yes
Cable entry position	Top
Type test to AS/NZS 3439 (set)	Full
Segregation to AS/NZS 3439 (set)	Form 2B

1.2 Test certification

All type test certificates shall be by a laboratory registered by TELARC or similar overseas registration scheme.

1.3 Inspection of switchboards

Switchboards shall be inspected before their despatch from the works. If the inspection is to be carried out at a location more than 100km from the nominated person's normal place of work then allow for payment of all travel expenses and time.

1.4 Busbars

- a. All internal wiring carrying current 100 A or greater shall be solid copper bar.
- b. Busbars shall be high conductivity copper and shall be colour identified red, yellow or white, blue on phases and black for neutral for three phase systems.
- c. Busbar links shall be the same carrying capacity as the bar and shall be secured at each end by at least two bolts.
- d. All busbars shall be of high conductivity copper adequately supported to withstand fault currents and shall link all fuses or miniature circuit breakers.
- e. Busbar connection points for both supply tails and outgoing circuits shall be bolted using high tensile steel bolts and nuts with phosphor bronze locking washers.
- f. No live metal shall be exposed to touch or accessible to tools under normal conditions when the panel or cubicle door is open.

1.5 Tariff metering provisions

- a. Revenue metering and any associated current transformers provided by others shall be accommodated in a separate compartment with a suitably glazed, lockable door.
- b. Arrange supply and installation of all fuses, test links, wiring and all items necessary for the correct operation of the revenue metering equipment.
- c. Provide space and mounting arrangements to the requirements of the owner of the revenue tariff meter.
- d. Disconnection points shall be provided adjacent to all busbar or cable mounted current transformers to permit the easy removal of the current transformers.
- e. Water heating control relays shall be provided and mounted within the switchboard when required by the electricity supplier.

1.6 Wiring

- a. Internal wired connections shall be PVC insulated and shall be:
 - i. suitably identified to indicate their function
 - ii. supported adequately using plastic ties or PVC trunking
 - iii. terminated in DIN rail mounted terminal blocks where shown on the drawings
 - iv. provide separate terminals for every outgoing connection
- b. Cable entries for external cables shall be provided as follows:
 - i. TPS - bushed holes (sealed)
 - ii. MICC - MICC glands
 - iii. MIMS/PVC - MIMS glands with plastic sleeves
 - iv. NS - compression type glands
 - v. PLYSS - sealing box and brass wiping gland
 - vi. PLSWAS - sealing box and armour clamping gland
 - vii. XLPE/HT-PVC - compression type glands
 - viii. XLPE/SWA/PVC and PVC/PVC/SWA/PVC - compression type with armour clamp
- c. Earthing rings shall be used in conjunction with armour clamps

1.7 Finish

- a. Surfaces are to be painted to the manufacturer's standard finish and colour.
- b. Surfaces are to be painted to a special finish and colour
- c. Clean boards on completion and repair satisfactorily any internal or external paint damage or any other defect

1.8 Labels

- a. Material: Laminated plastic
- b. Use line gill face lettering:
 - i. 10mm high for board identification and warning labels
 - ii. 6mm high for major items
 - iii. 3mm for minor items
- c. Attach an identifying label to the outside of each cubicle
- d. Identify each internal item or component such that their function is easily identified

1.9 Accessories

All protection devices shall be correctly graded to ensure co-ordination with upstream and downstream protection devices.

1.10 MCB protection

- a. Miniature circuit breakers shall comply with AS/NZS 60898
- b. Miniature circuit breakers shall be rated in accordance with a category of duty no less than 10kA.
- c. Miniature circuit breakers shall be "C" curve type unless otherwise specified.
- d. Any departure from these specified CPD's will void the certified design compliance and any re-design on alternative CPD's will be subject to an engineering re-design variation with costs borne by the contractor.

1.11 HRC protection

- a. Fuses shall be HRC cartridge type providing excess current protection
- b. Spare fuses shall be housed in a spares compartment in each switchboard
- c. Provide three spare fuse cartridges for each size

1.12 MCCB protection

- a. Moulded Case Circuit Breakers (MCCB's) shall comply with AS 60947.2
- b. MCCB types (including trip unit types) shall be as specified on the drawings or approved equal by the Engineer.
- c. Any departure from these specified CPD's will void the certified design compliance and any re-design on alternative CPD's will be subject to an engineering re-design variation with costs borne by the contractor.

1.13 RCD protection

Residual current devices (RCD's) shall:

- i. Be installed in strict compliance with the manufacturer's instructions
- ii. Have automatic overload circuit breaker protection appropriately rated
- iii. Have non-automatic interrupting capacity appropriately rated
- iv. Have an interrupting capacity of 10kA symmetrical
- v. Be a residual current relay used in conjunction with a suitable high speed contactor of rating specified on the drawings
- vi. Have a residual operating current as approved for the application
- vii. Supply and fix labels as detailed in the Appendix of the Specification
- viii. Provide a transparent pocket, mount within the distribution board adjacent to the RCD's, for an A4 size RCD test card as detailed in the Appendix

Complete the following RCD commissioning tests as scheduled in the Appendix

- i. Test a minimum of 10% of the RCD's installed
- ii. Failure any of the sampled RCD's to comply with the requirements of this specification and the Electrical Wiring regulations will require all RCD's to be tested
- iii. Replace RCD's that failed the tests and repeat the tests on all of the new devices

1.13.1 RCBO protection

Residual Current Breaker Overload devices shall comply with the MCB and RCD clauses above and shall be Schneider make or approved equal by the Engineer with a category of duty no less than 10kA.

Any departure from these specified CPD's will void the certified design compliance and any re-design on alternative CPD's will be subject to an engineering re-design variation with costs borne by the contractor.

1.14 Fuse - switches

Fuse-switch gear shall have:

- a. a utilisation category AC 21 minimum
- b. contacts of the high pressure self-aligning type which operate at a speed independent of the operator
- c. operating handles which do not project beyond 100mm when not in use
- d. visual indication of the "on" and "off" conditions
- e. padlocking provisions in the off position

1.15 Isolation switches

- a. Type shall be rotary switches
- b. Contacts shall be suitable for on load operation
- c. Speed of operation shall be independent of the operator
- d. Comply with IEC 60947-3 rated for Utilization Category AC 22 minimum or an approved equivalent standard for general use and Utilization Category AC 23, uninterrupted duty or an approved equivalent standard for use with motor circuits
- e. Terminals and contacts fully shrouded
- f. Switches fitted with approved operating handle and engraved escutcheon plate
- g. Control switches shall be 10 A minimum rating
- h. Control switches shall be flush mounted on door and surface mounted inside cabinets

- i. Switches rated above 63 Amps shall not to be mounted on a door

1.16 Terminal blocks

- a. Type shall be DIN rail mounted complete with mounting rail, supports, and identification accessories. Connectors, where used, shall provide the following facilities:
 - i. Testing of circuits connected to the terminal
 - ii. Linking of adjacent terminals
 - iii. Screw clamp type connections
 - iv. Cross-linking facilities where terminals are associated with current monitoring facilities. This facility shall allow the current source to be short-circuited.
 - v. Isolation facilities where the terminals are associated with voltage monitoring facilities
 - vi. Segregation barriers between extra low voltage and low voltage terminals
- b. Provide terminal blocks correctly sized for the conductors connected thereto.
- c. Terminals shall be arranged so that not more than one conductor is terminated at each terminal.
- d. Allow space for a minimum of 25% spare terminals.

1.17 Instrumentation

Instruments shall be:

- a. industrial grade to BS 89
- b. flush mounted
- c. minimum scale length 90mm
- d. ammeters to have maximum demand and direct acting features with the over-scale portion compressed
- e. reversible scale ratio plate or dual scale where used with dual ratio CT's
- f. accuracy shall be 62.5% of full-scale reading

1.18 Current transformers

Current transformers shall:

- a. comply with AS 1675
- b. have an accuracy class of:
 - i. Class 1 for check meter and revenue metering applications
 - ii. Class 3 for general purpose metering applications
 - iii. Class 10P for protection applications
- c. be of 5VA minimum burden unless specified otherwise
- d. Test links shall be provided in switchboards for all current transformers

1.19 Hour-run meters

Hour run meters shall:

- a. be minimum 5 digit type
- b. be complete with concealed reset facility

- c. Have provision for retaining their latest value for a minimum of 250 hours on loss of power (when electric type)

1.20 Contactors

Contactors shall:

- a. comply with IEC 60947-4
- b. be rated for:
 - i. continuous operation
 - ii. intermittent duty Class 0.1
 - iii. utilisation Category AC 3, under standard conditions and in non-ventilated enclosures
- c. Be fitted with changeover type auxiliary contacts, rated at 230V 10A a.c., as necessary, but not less than one set
- d. incorporate visual external indication of the open or closed condition
- e. have wiring from the coils and auxiliary contacts brought out to accessible terminals
- f. be rated for making and breaking short circuit current in coordination with their associated short circuit protection devices

1.21 Load transfer devices

1.21.1 Load transfer contactors

Load transfer contactors shall in addition to the above be:

- i. interlocked mechanically and electrically so that only one contactor can be closed
- ii. latched type for the mains supply with a 230 V trip
- iii. coil hold on type for the supply from the standby power source

1.21.2 Motorised load transfer circuit breakers

Motorised load transfer circuit breakers shall have:

- i. normal duty capability of making and breaking the full load current
- ii. overload and short circuit features which shall be adjustable
- iii. drive motors operated by 230 V a.c. supplies
- iv. manual operating facility for emergencies
- v. interlocking both mechanical and electrical so that only one set of contacts can be closed
- vi. wiring for drives and auxiliary contacts brought to a compartment accessible to external wiring

1.22 Voltage sensing relays

Voltage sensing relays shall have:

- a. connections from back-up non-essential busbar mounted fuses to relay protection fuses
- b. connection upstream of main isolator
- c. operating set point adjustable between normal mains voltage and 20% of normal mains voltage on any or all phases

- d. switching differential adjustment between 0 and 5% of normal mains voltage
- e. delayed operation adjustable up to three seconds
- f. contacts minimum of one normally open and one normally closed
- g. wiring from contacts brought back to terminals in a compartment accessible to external wiring

1.23 Relays

- a. Relays shall:
 - i. be plug in type
 - ii. have accessible standard terminations
 - iii. incorporate clear plastic dust-excluding covers
 - iv. be 11 pin configuration
- b. contact rating shall be suitable for the connected load and in no case shall it be less than 10A
- c. interchangeable relays shall have coils operating on the same voltages
- d. relays shall have wire retention clips when mounted horizontally
- e. provide indication of the status of the contacts (energised/de energised)

1.24 Push buttons

Push button switches shall have pushes coloured:

- a. Red for stop/off
- b. Green for start/on
- c. Mushroom head latching type for emergency stop

1.25 Extra low voltage power supplies

- a. Extra low voltage supplies for controls shall be supplied from a 230V to 24V transformer or other secondary voltage if required
- b. The secondary winding shall be fully isolated
- c. Both ELV legs shall have HRC fuse protection
- d. Rating shall be suitable for the connected load

1.26 Signal lamps

Signal lamps shall be:

- a. in compliance with BS4099 for all indicator and operator colours
- b. transformer type unless supplied from a low voltage power supply
- c. designed to match the push button switches
- d. press to test type unless provided with a lamp test facility
- e. fitted with multiple LED type lamps

1.27 Time switches

Time switches shall be:

- a. electrically operated with a minimum of 12 hours operating reserve

- b. where the operating reserve is provided by battery backup, provide a minimum of 100 hours operating reserve; backup batteries shall be rechargeable type with charger being an integral part of the time switch
- c. fitted with external push button to cancel present operation
- d. fitted with day omit function
- e. mounted to enable safe operation by unskilled persons

1.28 Timing relays

Fit sequence start relays to all individual motors, or where approved, to groups of motors, to provide sequential switching for minimum line voltage disturbances, with largest motor first and smallest motor last.

1.29 Alarm sounders

Audible alarm sounders shall be 230 V operated "Carrel and Carrel", type "ROSHNI".

1.30 Power controllers

Power controllers shall:

- a. control the indicated load
- b. be solid-state switching devices at zero voltage
- c. control the output power from 0 to 100% in a stepless manner

1.31 Mimic panels

- a. Mimic panels shall be 3.2 mm double sided resin bonded laminate.
- b. Suitably coloured drawings for manufacture of mimic panel will be supplied by the Engineer.
- c. Notify the Engineer in writing at least one month before drawing is required.

MES506: ELECTRICAL SYSTEMS

WIRING SYSTEMS

1 MAINS AND SUBMAINS

1.1 Identification

Attach engraved laminated plastic labels to each end of all main and submain cables to indicate:

- a. destination of cable
- b. size and type of cable
- c. cable number

1.2 Installation

- a. Comply with manufacturer's general recommendations for installation and current ratings unless specified otherwise.
- b. Secure single core PVC, XLPE cables with nylon ties at nominal 600mm intervals.
- c. Concealed cables in wall cavities, under floor and in ceiling spaces unless specified otherwise. Where exposed, cables shall be fixed at high level or in protected positions.
- d. Acceptable method for supporting cables up to 6 mm² are:
 - i. enclosed within cable ducts
 - ii. in suitably sized trunking
 - iii. in suitability sized conduit
 - iv. on catenary wire
 - v. on cable tray
- e. Acceptable methods for supporting cables greater than 6 mm² are:
 - i. on cable trays
 - ii. on ladder rack
 - iii. fixed direct to continuous timber or concrete
 - iv. on structural supports under approval
 - v. in suitably sized conduit
- f. All cable runs shall be installed, separated by a minimum distance of 150 mm from all other parallel services.

2 SUB-CIRCUIT WIRING

2.1 General

- a. Cables and flexible cords shall be:
 - i. stranded conductor type unless otherwise indicated
 - ii. minimum size 1.5mm² for lighting circuits

- iii. minimum size 2.5mm² for power circuits
- iv. in parallel with building lines
- b. Joints in point to point cable runs are prohibited
- c. Heat resistant wiring shall be used where ends are exposed to temperatures above 350°C

2.2 Plant rooms and service areas

Install circuit wiring as follows, except as detailed otherwise:

- a. where multiple circuits follow a similar route install wiring in trunking
- b. install single circuits in conduit

2.3 Outside areas

Install circuit wiring in conduit except as detailed otherwise.

2.4 Occupied areas

Install circuit wiring in tough plastic sheathed type cable in ceiling spaces and wall cavities etc., except as detailed otherwise.

2.5 Concealment

- a. Conceal all circuit wiring in:
 - i. framed and lined areas
 - ii. ceiling and floor spaces
 - iii. service ducts
 - iv. wall cavities
 - v. conduits, cast into concrete or masonry
- b. All surface run cables shall be subject to the approval of the Engineer.

2.6 Installation, fixing and support

- a. Enclose surface fixed cable, installed below luminaire level, in conduit or cable trunking.
- b. Fix cable neatly:
 - i. With approved clips, in accessible cavities and at high level, to timber structure where available
 - ii. Otherwise to timber battens, cable tray or enclosed in trunking
 - iii. Where and as approved to catenary supports
- c. Space utilisation factors within conduits or trunking shall not exceed 35%.
- d. Maintain a clearance of not less than 150 mm from other services or suspended ceiling surface.
- e. Timber battens shall be clean, dressed and treated against deterioration.
- f. Catenary supports shall be minimum 4mm² plastic coated steel wire between adjustable tensioning devices and secure fixing points.
- g. No more than six cables shall be attached to a single catenary support.

2.7 Sub-circuit cables installation

Sub-circuit cables shall be installed:

- a. flat and free from twists
- b. secured on cable trays and/or and catenary wires by plastic or nylon cable ties
- c. enclosed in conduit when buried in concrete or plaster
- d. enclosed in conduit where timbers have been or may be treated with tar oil, creosote polystyrene or other products liable to cause damage to the sheath
- e. installed so as to avoid subsequent damage from nailing
- f. arranged so that they can easily be removed and replaced

2.8 Thermal insulation

- a. Derate wiring that is packed around with glass wool or other form of thermal insulation, (e.g. polystyrene). Use of non-migratory sheath cable shall be used in these cases (purple coloured sheath).
- b. Thermally insulated cables unavoidably covered with heat insulation shall not be bunched, and shall be:
 - i. installed to minimise thermal resistance between the cable and uninsulated zone
 - ii. derated as for an ambient temperature of at least 500°C

2.9 Coloured sheaths

Application	Sheath Colour
Lighting and power	White
Extra low voltage circuits	Grey
Master Clock Systems	Black
Fire Protection Systems	Red
IT/Comms Earth	Cream

3 WIRING IN CONDUIT OR TRUNKING

Installation of wiring shall be:

- a. simultaneously drawn in for all conductors in the same conduit
- b. fed as well as pulled into conduits
- c. without crosses or twists
- d. friction reducing substances shall not be used when pulling wiring into conduits

4 UNDERGROUND CABLES

4.1 Existing services

- a. Check records to ascertain position of all possible services along route before trenching.
- b. Locate by hand digging such services as indicated and which could be affected by this work before commencing excavation.

4.2 Trenches

- a. Provide the minimum cover specified below:

Location and Depth of Cover			
Cable Type	Open Areas or under footpaths	Under Roadways	Other Situations
EHV & LV	600mm	750mm	As indicated
MV & HV	750mm	1000mm	

- b. Report immediately any services exposed or damaged during trenching.
- c. Excavations shall be open for the minimum possible time and shall be kept free of water and shored up as necessary.
- d. Protection in the form of day and night marking, barricades or covers shall be provided.
- e. Grade trench floors evenly and remove all stones.
- f. Where cables are buried directly into the ground,, the cables shall be enclosed:
 - i. by a minimum 50 mm of sand on all sides of the cables
 - ii. alternatively, by soil which has passed through a sieve with a mesh no greater than 10mm
- g. Where cables are buried encased in duct, the duct may be enclosed in the material previously excavated, providing the material is compacted to the same bearing capacity as the surrounding ground
- h. Trenches under roads, walkways and the like shall be covered with suitable material to allow traffic movement to continue during the installation.

4.3 Cable ducts

- a. Cable ducts shall be checked to ensure they are clear of obstructions, have draw wires fitted and are installed to allow easy drawing in of cable.
- b. Cables in a duct shall all be pulled in simultaneously.

4.4 Cable installation

- a. Pull in cable over rollers spaced to avoid the cable rubbing on other cables or suffering mechanical damage.
- b. Cable stockings shall be used for cable pulling.
- c. Generally space cables apart as specified below:

Cable Type	ELV & LV	MV & HV	Telephone	Co-axial	Piped
ELV & LV	25mm	300mm	150mm	150mm	300mm
MV & HV	300mm	50mm	300mm	300mm	300mm
Telephone	150mm	300mm	50mm	50mm	200mm
Co-axial	150mm	300mm	50mm	50mm	200mm

4.5 Backfilling and reinstatement

- Backfilling shall not be carried out until the Engineer has inspected the cable installation.
- Reinstate by back filling in 100mm layers, hand ramming the first two layers, followed by power consolidation.
- Polythene signal strip 100mm wide and coloured orange with a printed warning shall be laid at a depth of 150mm.
- Complete backfilling and consolidation to finish not more than 25 mm above normal ground level.
- Finish to match original surface.

4.6 Route identification

- Cable end markers shall be fitted over the ends of all runs giving voltages and depth of cables.
- Markers shall be permanent material with red words 'LIVE CABLES UNDERGROUND' and a vertical arrow on a white background nominal size 75mm wide by 100mm high.
- Cable end markers shall be fitted at all entries and exits of cables at buildings.
- Flush concrete markers shall be laid over each cable route at 100 m spacing, at each change of direction, at each end of a roadway crossing and over each joint.
- Marker wording shall be impressed in the concrete in 100 mm letters indicating “HV CABLE, MV CABLE, TELEPHONE OR JOINT” as appropriate.

5 TERMINATIONS

- Proprietary cable glands shall be used for "making off" all metal sheathed, armoured, and neutral screened cables.
- Cable bends shall be followed by a minimum of 50mm of straight cable before the cable enters a gland where practical.
- Terminate conductors with compression jointed or soldered cable lugs for direct bolting to equipment terminals, except where equipment terminals are designed to accept cable ends directly under clamp fittings.
- Compression joints shall comply with BS 4579 or an approved equivalent standard and be made with correct sized die.
- Soldered joints shall be made with Silfos hard solder for copper conductors.
- Tinned copper in aluminium to copper joints, or aluminium conductors shall be terminated with bi metal composite cable lugs.

- g. Aluminium surfaces for mechanical jointing shall be prepared and jointed with Utilux No. 4C or equal oxidation inhibiting and jointing compound.
- h. Fit neoprene or PVC insulating sleeves over all exposed cable tails within switchboard enclosures. Cut back PVC serving on cables the minimum necessary. Terminate serving with PVC tape wrapping close to the cable gland.
- i. Fully shroud connections and terminals of switchgear.
- j. Provide phase identification on all cable cores with a coloured PVC sleeve firmly attached to the core.

6 CABLE SUPPORT SYSTEMS

6.1 General

- a. Bends, tees, and fittings shall be of the same manufacture as the straight lengths and of similar material and finish.
- b. Installation shall be in accordance with the manufacturers recommendations and when complete shall be free from sharp edges or other such projections.
- c. Ensure that no conflict will occur with other services before installation commences.
- d. Continuity straps shall be fitted between sections.
- e. Material selected shall minimise any corrosion in this area.

6.2 Cable tray and ladder systems

- a. Show proposed grouping of cables on all branches of the cable route, areas of possible conflict with other services and the size, make and type of system that is proposed
- b. Pull in cables along route using rollers to avoid rubbing on other cables.
- c. Cable bends shall be not less than the minimum recommended and shall be achieved without cables changing their relative position or breaking contact with the tray or ladder.

6.3 Cable tray

- a. Cable tray shall be a proprietary brand and subject to approval.
- b. Material shall be plain sheet steel, perforated or rolled with folded strengthening side flanges.
- c. Thickness shall not be less than 1.5mm for dry situations and 2.5mm for damp situations.
- d. Finish shall be to suit the conditions as follows:
 - i. dry - zinc plating, minimum thickness 0.005mm
 - ii. damp - hot dip galvanised
 - iii. corrosive - PVC coated
- e. Provide tray with a minimum 8mm high return and complete with all necessary proprietary bends, tees, junctions, etc.
- f. Allow to size tray such that, with a completed installation, a nominal 60% of the tray or ladder is filled.

7 CONDUITS

7.1 General

- a. Installations shall not be:
 - i. embedded partially in concrete or plaster, or placed in floor slabs subject to hydrostatic pressure
 - ii. run over seismic joints without provision for movement equal to the width of the joint gap
 - iii. installed complete with the cabling
 - iv. installed such that the cabling cannot be removed and re-installed
- b. Accessible runs shall be installed square and parallel with the building features
- c. Conduit supports shall be at regular intervals of not more than:
 - i. 1.2m horizontal
 - ii. 1.5m vertical
- d. All saddles shall be of the same material as the conduit
- e. Masonry plugs for screw fixings shall be of the metal or plastic type only
- f. Terminations into metal enclosures without tapped spouts shall be by means of couplers and smooth bore male bushes
- g. Bends or other changes of directions may be set on site to suit local conditions

7.2 Conduit types

Conduits shall be:

- a. rigid PVC class B conduit to AS/NZS 2053.1
- b. non-metallic flexible conduit to BS 4607 Part 3

Flexible conduit shall not be used except where a conduit is terminated at an appliance or accessory that may be subject to movement and/or vibration.

7.3 Embedded conduit

- a. Cover not less than 40mm in concrete or 5mm in plaster.
- b. Position all runs as close as possible to the centre of concrete slabs or columns.
- c. Brace conduits to prevent movement when concrete is poured.

7.4 Flexible conduit

- a. Adapters shall be impact resistant plastic type and crimped or screwed to the conduit.
- b. Bending radius shall not be less than twice the minimum-bending radius.
- c. Shall be supported to prevent mechanical damage or sagging.

8 TRUNKING

8.1 General

- a. Trunking shall be a proprietary brand and subject to the Engineer's approval.
- b. Allow to size trunking such that, with a completed installation, a nominal 55% of the trunking is filled.
- c. All sleeves, joints, bends and end plates shall be proprietary components supplied by the trunking system manufacturer.
- d. Fixing of trunking to masonry walls and in damp situations shall be arranged to provide a minimum air space of 5mm.
- e. Vertical runs shall have pin racks or other means of supporting the wiring at intervals not greater than 2m.
- f. Accessories, such as switches, socket outlets and other devices, shall be attached to the body of the trunking.
- g. Where accessories are fitted to the trunking, provide a short length of lid that extends 100mm either side of the accessories.
- h. Metal trunking shall have lid bonding straps attached or sufficient bare metal to enable a satisfactory earth connection.

8.2 Steel trunking

- a. In dry situations, material shall be:
 - i. zinc plated sheet steel
 - ii. 0.005mm minimum zinc thickness with a minimum metal thickness of 0.8 mm
- b. In damp situations, material shall be
 - i. sheet steel with a minimum thickness of 0.8mm
 - ii. galvanised after manufacture
- c. When installed with the lid down or side-wise, cable retention straps shall be inserted

8.3 Extruded aluminium trunking

- a. Lid sections to be snap fit type
- b. Finish shall be the manufacturer's standard powder coat type finish colour
- c. Finish shall be a powder coat type finish colour

8.4 PVC Trunking

- a. Material shall be high impact grade PVC
- b. Lids shall be snap fit type
- c. Colour shall be white unless nominated otherwise

MES: 507

ELECTRICAL SYSTEMS - ACCESSORIES

1 FIRE RATED WALLS

Where accessories are installed in fire rated walls, fire rated flush boxes and suppression pads are to be fitted. Identify such walls before first fix stage and install these fittings as required.

2 FLUSH BOXES AND PLATES

2.1 General

Generally flush boxes and plates shall be:

- a. mounted so that flush plates are true and square with the wall finish
- b. earthed if metal type where metal foil is used in the wall construction
- c. deep metal type in poured concrete

2.2 Fixings

One of the following fixing methods shall be used:

- a. fix through the back by two screws, with a minimum penetration of 20mm, into a dwang or support
- b. by screws through the side to the stud
- c. outlet labels
 - i. label details shall include the circuit and distribution board numbers
 - ii. labels shall be of engraved laminated plastic type fixed to the front of the outlet plate

3 SWITCHES, SOCKETS AND FIXED OUTLETS

3.1 Switches, socket outlets and fixed outlets

- a. Switches, sockets and fixed outlets shall be:
 - i. flush type
 - ii. standard manufactured type, commonly available with clip-on metal or plastic coloured over plates
- b. Light switches, data, fixed and socket outlet plates shall be of the same manufacture throughout the installation.
- c. Outlet labels shall:

- i. Include the circuit and distribution board numbers.
- ii. Be of engraved laminated plastic type fixed to the front of the outlet plate.
- iii. Dymo label machine type labels are not permitted.

3.2 Surface type

Surface wiring type shall have:

- a. Enclosures of the impact resistant, corrosion resistant, surface mounted type
- b. Spare entries permanently plugged
- c. An earth connection if metal clad

3.3 Damp/external requirements

Components located in damp or external locations shall have:

- a. Enclosures rated to a minimum of IP66
- b. Fixings through external lugs
- c. Covers secured by brass screws into blind holes on the enclosures

3.4 Light switches

- a. Adjacent switches on different phases shall be housed in separate or approved partitioned enclosures
- b. Shall be rated at 10A minimum unless specified otherwise
- c. Mount lighting switches at the same height as the door handles and within 200mm of the doorframe on the handle side unless indicated otherwise

3.5 Socket outlets

- a. Socket outlets shall be:
 - i. flat three-pin socket type incorporating a suitably rated switch for single-phase applications
 - ii. round five-pin socket type incorporating a suitably rated switch for three phase applications
 - iii. mounted level 150mm above benches or 500mm above floors unless specified otherwise
- b. Switched socket outlets shall be located in relation to the equipment or appliance such that the isolation point is readily accessible
- c. No more than (6) dual GPOs shall be connected per circuit

3.6 Industrial outlets

Single and poly-phase industrial socket outlets shall be:

- a. to AS/NZS 3123:2005 (or IEC 60309-1)
- b. supplied with matching plug
- c. mounted 1000mm above floor level, unless indicated otherwise

4 FIXED WIRING OUTLETS

4.1 General

- a. Fixed wired outlets shall be located:
 - i. adjacent to the equipment or appliance such that the isolation point is readily accessible
 - ii. as near as practical to the point of entry to the appliance
- b. All fixed wired outlets shall have isolator switches incorporated
- c. Anchoring arrangements shall be provided for the flexible cord within the outlet
- d. Earthing shall be by means of a stud or terminal within the outlet
- e. High temperature grade wiring or flexible cords shall be used where equipment connection boxes operate in conditions above 60°C
- f. Confirm phases and loading with specialist equipment supplier before installation

MES: 508

ELECTRICAL SYSTEMS – LIGHTING

1 LUMINAIRES

1.1 Diffusers

Lighting covers shall be of even density and thickness, and be free of defects.

1.2 Fixings

- a. Surface mounted luminaires on combustible material shall have an air space of 10mm minimum.
- b. Fixings for surface mounted channel type luminaires shall be capable of withstanding three times the weight of the luminaire and shall:
 - i. Prevent flexing or twisting of the spine
 - ii. Use a minimum of two screws per luminaire each having a minimum diameter of 3.2 mm and penetrating at least 40 mm into timber. Alternative fixing methods proposed by the contractor may be considered by the Engineer.
- c. Recessed luminaires shall have:
 - i. Air circulation sufficient to prevent abnormal working temperatures
 - ii. Mechanical attachments to the main elements of the ceiling system designed to carry the weight
 - iii. Independent support wires provided to the supporting structure to provide seismic restraints
- d. Chain suspended luminaires shall have the associated ceiling rose positioned adjacent to one of the suspension anchor points. Earthing for chain suspended luminaires shall be by a core in the flexible cable.
- e. Suspension chains shall be:
 - i. Solid link type
 - ii. Suitably plated for the conditions
 - iii. Fitted with safety hook or other approved securing method to provide the required seismic restraint

1.3 Damp situations

- a. All parts to be suitably protected against corrosion, by being constructed from non-ferrous material, stainless steel, galvanised steel or impact resistant plastic materials
- b. Metals in contact shall not have a galvanic potential difference exceeding 0.25V
- c. Moisture and dust protection shall be IP56 minimum

1.4 Power factor correction

Provide power factor correction to not less than 0.95 lagging in all luminaires with capacitors manufactured to AS 2644

2 LED LIGHTING

Luminaires shall:

- a. Be as scheduled within this specification.
- b. A minimum 5-year manufacturer's warranty shall be supplied on the LED luminaries, drivers/electrical components and the paint finish as part of the O&M Manuals.
- c. The luminaires shall be rated for the input power as detailed within this specification.
- d. Colour rendering index (CRI) shall be greater than or equal to 80.
- e. The luminaire operating temperature range shall be between 0 – 50 degrees Celsius.
- f. Luminaires are suspended and shall be supplied complete with a pendant, hook, plug and cord. All suspended luminaires shall be suspended via an appropriate chain.
- g. The luminaires are single phase and shall be provided to operate to the site's prevailing electrical conditions.

3 FLUORESCENT LIGHTING

3.1 Luminaires

- a. Fluorescent Luminaires shall not be used on the project.

4 EXTERIOR SITE LIGHTING

4.1 Control

- a. Provide a photo sensitive daylight switch in a light industrial enclosure, and mount where indicated on the drawings, but screened from direct sunlight and from any artificial lighting sources.
- b. Adjust sensitivity of daylight switch as may be required for dusk to dawn control.
- c. The daylight switch will be fully DALI compliant and fully compatible with the Lighting Control System

4.2 Installation

Install columns vertically with a cast in-situ concrete base or footings, and complete with neat concrete surround finished smooth and flush with final ground level.

5 LIGHTING COLUMNS

Install complete with luminaire mountings, spigot (where required), luminaire, base mounted terminal block and the gear tray. Gear trays constructed of metal shall be bonded to the column via a copper cable and bolted connection.

Specifications for the columns are as follows:

- a. Columns shall comply with NZS 1170.
- b. Column heights are specified on the drawings.
- c. The luminaires shall be mounted as per the manufacturer's instructions.
- d. Foundation types of columns by civil services contractor. All lighting columns shall be designed and constructed to suit the individual site conditions.
- e. Site investigations required to obtain geotechnical information for design (to ensure appropriate ground conditions) shall be included in the works.

6 EMERGENCY LIGHTING

6.1 General

- a. All emergency lighting shall be LED type
- b. Comply with AS/NZS 2293 and the NZ Building Code
- c. Meet all requirements for Maintained and Non-Maintained system
- d. Duration in Service for a minimum 60 minutes

6.2 Self-contained single point systems

Include:

- a. Luminaires with sealed rechargeable battery cells of sufficient capacity for not less than half an hour of emergency lighting after mains failure
- b. Battery charger with full wave rectifier and automatic 2 rate output
- c. Devices to switch the lamp on when mains voltage fails and off when battery voltage fails
- d. LED lamp to indicate battery charge condition, and test push button to interrupt mains supply
- e. Alternatively one luminaire may incorporate battery cells of sufficient capacity to operate two luminaires with the second connected as a slave

6.3 Testing and monitoring facility

The Emergency Lighting System shall provide group luminaire testing in addition to a software based electronic logbook in accordance with the requirements of the AS2293 suite of standards.

7 LIGHTING CONTROL SYSTEMS

7.1 General

The electrical contractor shall be responsible for the detailing of the lighting controls systems including sub distribution board and sub circuit wiring.

The lighting controls shall be configured to provide functionality as detailed below, scheduled in section 501 and per the electrical services drawings.

In general, two broad categories of control shall be provided;

- a. Manual control via local wall mounted light switches. Typical applications will be within the dormitory, store, laundry, kitchen, ablution, studio units.
- b. Automatic including luminaire switching via photocell sensors. Typical applications include the exterior deck lighting.

In addition to luminaire type and location, the lighting layout drawings identify where specific lighting control types apply.

Refer to Section 501 for a full function description of each control type.

7.2 Detailing

The electrical contractor shall provide lighting controls wiring and hardware within the detailing of the distribution boards, refer to the switchboards section (MES 505) of this specification for details.

Shop drawings shall be prepared and submitted for the engineers review prior to ordering of equipment and construction of the sub distribution switchboards. Drawings shall be prepared in two stages;

- a. Prepare a full schedule off all areas, control types, DBs accommodating the controls, and the schematic drawings to be submitted to the engineer and architect for review
- b. Prepare and issue shop drawings.

Detail control schematics and wiring diagrams shall be developed from typical concept schematics included within the drawings.

7.3 Light switches (Manual)

- a. Generally light switches shall be mounted at a height of 1150 mm. Light switches shall be of the white polycarbonate flush mounted unless specified otherwise in the architects details or specification. Mounting shall be in flush boxes or white polycarbonate mounting blocks as applicable to the positions shown on the Drawings.
- b. The contractor shall allow for 25% “special cases” for switch plate type to suit architectural finishes and detailing. Refer to architects detail drawings/specification or schedules to be provided for these special areas.
- c. Unless otherwise specified, switches shall be within 200 mm of the door frame on the handle side and shall be mounted square and level. Confirm all door swings before installing conduits or cables for light switches.
- d. Adjacent switches on different phases shall be housed in separate or approved partitioned boxes clearly marked to indicate the presence of 400 volts.
- e. Where up to six switches are grouped together, ganged switch plates having the exact number of switch positions required shall be used.
- f. Where six or more switches are grouped together, six-gang switch plates shall be used. Blank off, with proprietary blanking inserts, those switch positions not used.

7.4 Occupancy Sensors

- a. Occupancy sensors may be either separate or combined type -Universal sensors (Dual technology). Sensors shall be located in appropriate locations to minimise energy consumption through occupancy detection control.

- b. The sensor shall be available in wall mount or ceiling mount packages. The shop drawings will provide locations as co-ordinated with the architects layouts and furniture layouts.
- c. Provide only certified DALI Compliant sensors.
- d. Passive Infra-red (P.I.R.) detectors shall not be positioned where they can receive the sun directly into the sensor.
- e. Controls shall be mounted in such a position to avoid vandalism and deterioration due to environmental effects e.g. subject to prolonged heat from sunlight.

7.5 Integration with Third Party Systems

It shall be possible to easily integrate to third party systems such as:

- a. Building Management Systems
- b. Audio Visual Stage Lighting Systems (DMX)
- c. HVAC Systems
- d. PABX Systems
- e. Security and Access Control Systems

7.6 BMS Interface

The interface controllers shall interface to the BMS via a TCP/IP communications link using data points allocated to each distribution board.

The electrical contractor shall engage a specialist integrator to configure the BMS to provide;

- a. Master time scheduling on a 24 hour 7 day week.
- b. Common areas and spaces shall be controlled according to programmes of on and off times. Each day of the week shall have a separate programme. The software shall include a calendar function. The operator shall be able to enter the date of any public holiday or other required next at least 1 year in advance.

The design of the interface system shall be prepared for the approval of the engineer and client prior to final commissioning.

The specialist integrator shall liaise with the mechanical contractor for using occupancy sensors to control associated local HVAC equipment including room / space FCUs.

7.7 Lighting control training

The contractor shall provide training of the lighting controls system to the Clients nominated persons (caretaker). This is to be arranged with the Client via the Engineer and is to take place in one session.

7.8 Notes to contractor

Allow for an additional 12hrs over and above commissioning time for final adjustments to the lighting controls in conjunction with Engineer and Clients representative.

8 OTHER REQUIREMENTS

8.1 Lamps

- a. Guarantee all lamps for at least 10% of the manufacturer's quoted life from the date of Practical Completion. Replace any lamps that fail within this period free of charge.
- b. For the purpose of determining lamp usage after practical completion it will be assumed that the Principal uses the lighting system for an average of ten hours per day five days per week.

MES: 509

ELECTRICAL SYSTEMS – APPLIANCES

1 CONNECTIONS

1.1 Terminations

Terminations at appliances shall be:

- a. terminated with fixed wiring at a junction box, isolator or outlet located adjacent to the appliance being served, such that the disconnection switch is readily accessible
- b. connected with a PVC sheathed flexible cable
- c. allow sufficient length of flexible cable to permit the removal of the appliance for checking, testing and disconnection

1.2 Kitchen Appliances

When connecting into a removable appliance and that appliance covers the outlet, provide an engraved isolator switch (labelled as to the function of the switch, adjacent or above the appliance).

This requirement applies to, but is not limited to:

- a. dishwashers
- b. refrigerators
- c. microwaves

2 HAND DRIERS

Allow to supply and install the following electric hand driers:

Hand driers shall:

- a. be operated by movement of the hands in the general area of the air outlet
- b. incorporate brushless type motors
- c. be wired via a 20A isolator switch mounted at high level, then in concealed conduit directly into the back of the unit

Supply and install conduit from the ceiling void to a flush box at high then to a flush box mounted at 1200 above floor level for future hand driers. Fit white blank faceplates on the flush boxes. Install draw wires.

3 STORAGE WATER HEATERS

- a. Connect with flexible cord connections to the isolator outlet

- b. Connection cords shall be white unless specified otherwise
- c. Connect through flexible conduit with high temperature cable to the water heater terminal box

4 UNDER BENCH WATER HEATERS

- a. Connect with flexible cord connections to the isolator outlet
- b. Connection cords shall be white unless specified otherwise

5 WATER MISERS

Water Misers shall:

- a. operate from a 230-volt single-phase power supply
- b. be wired via a 4-pin outlet, located on a plastic mounting block within the ceiling void - connect from the outlet to the solenoid valve
- c. be wired via a single 10A switched outlet located on a plastic mounting block within the ceiling void - connect from the unit to the solenoid valve

6 LTX (FIRE ALARM TRANSMITTER DEVICE)

- a. Terminate in a switched single phase 10A socket outlet incorporating clear cover over the socket connection point
- b. Clearly label the protective device supplying this circuit

7 FIP (FIRE INDICATOR PANEL)

- a. Clearly label the protective device supplying this circuit
- b. Terminate in a switched single phase 10A socket outlet incorporating a clear cover over the socket connection point
- c. Wire directly into the panel

8 PANEL HEATERS

- a. Construction shall allow air to circulate between the section containing the element and the back panel of the heater
- b. Fix to the wall to allow air movement between the wall and the back panel of the heater
- c. Mount above the skirting, but not less than 100mm minimum above the floor for free movement of supply air
- d. Connect by a short flex to an adjacent outlet

MES: 524

ELECTRICAL SYSTEMS

COMMISSIONING

1 GENERAL

- a. The Engineer may be present at all inspections and tests.
- b. Responsibility for the commissioning shall belong to the Contractor who shall provide all labour, tools, and instruments as required.
- c. Scope of the commissioning shall be to prove:
 - i. Compliance with all statutory and design requirements, such as The Electricity Regulations and Codes of Practice
 - ii. Safe and proper working of the installation in all respects
 - iii. Programmes for the commissioning shall be prepared by the Contractor for approval by the Engineer
 - iv. Notice of tests shall be given to the Engineer by the Contractor in advance by a period of time mutually agreed early in the contract period

2 COMMISSIONING PROCEDURES

- a. Commissioning procedures shall generally be in accordance with the following stages unless instructed otherwise by the Engineer
- b. Visual inspection at all construction stages
- c. Static tests of wiring and equipment.
- d. Checking and setting of all protection devices and safety interlocks to design requirements
- e. Demonstrating that specific commissioning requirements details in the Electrical Services Sections of the Specification have been complied with
- f. Setting installation to work, checking operations, taking readings, and recording results
- g. Comparing design figures against achieved results and adjusting where required
- h. Completing all test sheets and passing two copies of each to the Engineer

3 ACCEPTANCE

Acceptance of the completed installation will not be considered until satisfactory completion of all testing and commissioning, submission of test and commissioning results that satisfy the requirements of the contract documents, including draft Operating and Maintenance Manual.

4 TEST SHEET BLANKS

Test sheet blanks are included in this specification as samples of the work required.

5 MAIN SWITCHBOARD (MSB)

Location							
Manufacturer							
Serial No.		Date					
Type		Voltage					
Phases							
Incomer 1 – Rating	A	Setting		A			
Incomer 2 – Rating	A	Setting		A			
Incomer 3 – Rating	A	Setting		A			
Pre-commissioning checks							
External condition	Clean	yes/no	Dry	yes/no			
Internal condition	Clean	yes/no	Dry	yes/no			
Busbar bolts torque tested	Yes/no						
Main earth satisfactory	yes/no						
Wiring supported	yes/no						
Insulation resistance satisfactory	yes/no						
Phase rotation correct	yes/no						
Tests - Insulation resistance - Incomer open - Circuit switches closed							
Test	R-W MΩ	W-B MΩ	B-R MΩ	R-E MΩ	W-E MΩ	B-E MΩ	Earth Ω
Date:							
Date:							
Any Other Comments:							

6 DISTRIBUTION BOARDS (DBs)

Location							
Manufacturer							
Board number				Date			
Type				Voltage			
Phases							
Number of circuits							
Number of fused circuits				No of MCB's			
Pre-commissioning checks							
External condition		Clean	yes/no	Dry	yes/no		
Internal condition		Clean	yes/no	Dry	yes/no		
Earthing satisfactory		yes/no					
Insulation resistance satisfactory		yes/no					
Phase rotation correct		yes/no					
Circuit chart provided		yes/no					
Circuit chart satisfactory		yes/no					
Tests - Insulation resistance - Incomer open - Circuit switches closed							
Test	R-W MΩ	W-B MΩ	B-R MΩ	R-E MΩ	W-E MΩ	B-E MΩ	Earth Ω
Date:							
Date:							
Any Other Comments:							

8 RCD - DISTRIBUTION BOARD TEST SHEETS

8.1 Commissioning tests

- a. Test each Residual Current Device's (RCD's) as part of the commissioning procedures. Press the 'TEST' button on the RCD and verify that the device trips.
- b. Recorded the results of these tests on the following schedule.
- c. If an RCD fails to trip, switch off the circuit and replace the device before repeating the test. Notify the Engineer of any RCD that fails this test and await instruction. If several RCD's fail this testing procedure allow to carry out a comprehensive testing of all RCD's installed as part of this contract to prove compliance with the specified requirements. Replace any RCD's that fail the test procedures at no cost to the Principal.
- d. Include a copy of the test schedule in the distribution board.

Routine Testing Instructions:				
<ul style="list-style-type: none"> a. Residual Current Device's (RCD's) must be tested at regular intervals of not more than three months b. The results of these tests must be recorded on this schedule c. Pressing the 'TEST' button on the RCD should cause the RCD to trip d. If an RCD fails to trip, switch off the circuit and call your electrician immediately <p style="margin-top: 10px;">Do not use the outlets connected to the faulty device until the cause of the failure has been identified and the faulty RCD replaced.</p>				
RCD Identification	Tested by	Date dd/mm/yy	P - Pass F - Fail	Comments



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