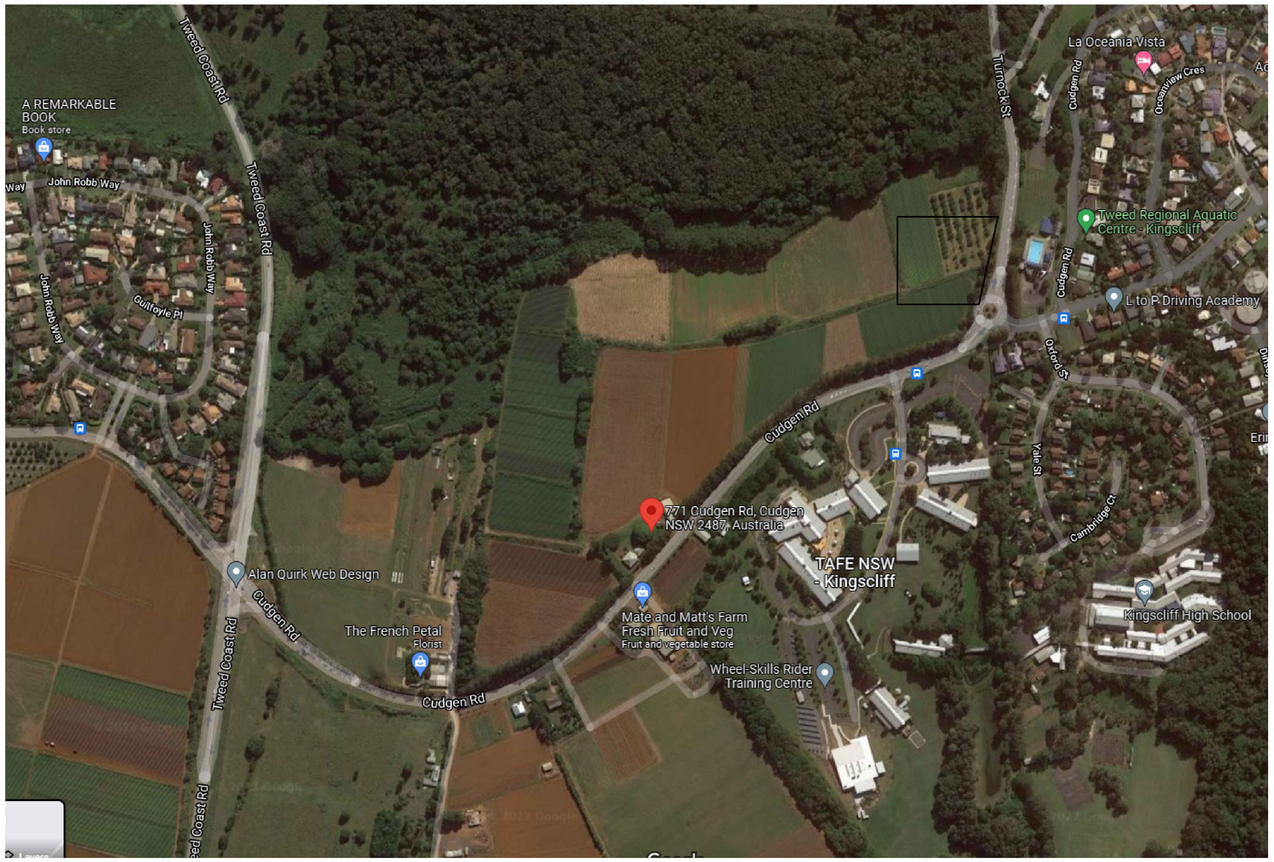
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM - KINGSCLIFF

DISCIPLINE: ELECTRICAL SERVICES

CLIENT: NSW GOVERNMENT HEALTH INFRASTRUCTURE



SITE PLAN

SCALE: N.T.S.

DRAWING LIST

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified
P1	09.02.22	PRELIMINARY ISSUE	J.G.
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified

RAIR
Rural Ambulance Infrastructure Reconfiguration
Building the future response for our state

PROJECT MANAGER
LEVEL 16
44 MARKET STREET
SYDNEY NSW 2000
T +61 2 9299 3566
mace

CLIENT
NSW GOVERNMENT Health Infrastructure
NSW Ambulance

ARCHITECT
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects:
Andrew Hipwell 6562
Daniel Beekwilder 8192
64 Rose Street
Chippendale NSW 2008
Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street,
North Sydney
NSW 2060
Australia
+61 (02) 9437 1000
general@jhengineers.com.au
www.jhservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

KINGSCLIFF, NSW 2487

TITLE
ELECTRICAL SERVICES
COVER SHEET
AND DRAWING LIST

CONSTRUCTION ISSUE

DRAWN	P.C.	SCALE @ A1
CHECKED	J.G.	N.T.S.
APPROVED	J.G.	
CREATED	FEB 2022	
JOB No.	210067	

DRAWING No. **R25-EL-DRG-0000**
REV **1**

S:\JOB No\Job No 20210000–20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0000.dwg

LIGHTING

D1	19W	LED RECESSED DOWNLIGHT, 4000K, CRI 85, WHITE FINISH, PIERLITE MODEL: 9758P4 D - DENOTES DIMMABLE VERSION PIERLITE MODEL 9758P4D3
D2	15W	LED RECESSED DOWNLIGHT, 4000K, WHITE, IP44, FROSTED DIFFUSER. VERSALUX MODEL: COMO WHITE S CWS2.WB.FO4K
F1	28W	LED RECESSED LINEAR, 4000K, WHITE, PIERLITE D-LED. MODEL: DLED2B1234F4 D - DENOTES DIMMABLE
F2	50W	LED SURFACE MOUNTED BATTEN, OPAL DIFFUSER, IP20 PIERLITE MODEL: ECOBAT505E4
F3	30W/34W	LED SURFACE MOUNTED IP66. EAGLE LIGHTING, DENSUS LED MODEL: EL-DENL-2101-000 - DENOTES EMERGENCY PACK TO BE INCLUDED. FITTING TO BE TESTED FROM A TEST SWITCH WITHIN THE MSB, 34W
F4	36W	LED SURFACE MOUNTED IK10, CLEAR FROSTED DIFFUSER, VERSALUX. MODEL: ENDURALUXLEDF975-3280
X1	160W	LED LOWBAY SURFACE MOUNTED 160W, 4K, IP65, IK8 LUMINAIRE. PIERLITE C350 MODEL: C350S150SE84W
P1	48W	LED POLE MOUNTED POST TOP, 4000K, MOUNTED ON 4.6m POLE DIE CAST ALUMINIUM BODY WITH BLACK POWDER COAT FINISH CREE DELTAGUARD, POLE TO MATCH COLOUR OF FITTING, COORDINATE WITH STRUCTURAL FOR RAGBOLT ASSEMBLY DETAILS. ADLT CREE XSP SERIES MODEL: XSP-E-02-3ME-E-40K+-24-BK-Q1-S-00 LIGHT POLE ADLT CROWN-WELD PS MODEL: PS4S15C1BK.
P2	48W	LED POLE MOUNTED POST TOP WITH BACK LIGHT SHIELD, 4000K, MOUNTED ON 4.6m POLE DIE CAST ALUMINIUM BODY WITH BLACK POWDER COAT FINISH CREE DELTAGUARD, POLE TO MATCH COLOUR OF FITTING, COORDINATE WITH STRUCTURAL FOR RAGBOLT ASSEMBLY DETAILS WITH BACK LIGHT SHIELDS (BLS). ADLT CREE XSP SERIES MODEL: XSP-E-02-3ME-E-40K+-24-BK-Q1-S-00 + BLS LIGHT POLE ADLT CROWN-WELD PS MODEL: PS4S15C1BK.
P3	48W	LED POLE MOUNTED POST TOP WITH BACK LIGHT SHIELD, 4000K, MOUNTED ON 6.1m POLE DIE CAST ALUMINIUM BODY WITH BLACK POWDER COAT FINISH CREE DELTAGUARD, POLE TO MATCH COLOUR OF FITTING, COORDINATE WITH STRUCTURAL FOR RAGBOLT ASSEMBLY DETAILS WITH BACK LIGHT SHIELDS (BLS). ADLT CREE XSP SERIES MODEL: XSP-E-02-3ME-E-40K+-24-BK-Q1-S-00 + BLS LIGHT POLE ADLT CROWN-WELD PS MODEL: PS4S20C1BK.
W1	18W	LED EXTERIOR WALL MOUNTED LIGHT FITTING, MOUNTED AT 2.7m AFFL U.N.O., IP65, IK07, 4000K, 14W, T2 OPTICS. LIGMAN LEEDS 4. MODEL: LEE-30011-T2-W40-ND-01
W2	18W	LED EXTERIOR WALL MOUNTED LIGHT FITTING, MOUNTED AT 4m AFFL, IP66, IK07, 4000K, OPTICS TYPE 3ME. ADLT CREE XSPW MODEL: XSPW-B-WM-3ME-2L-40K-UL-BK
W3	18W	LED EXTERIOR WALL MOUNTED LIGHT FITTING, MOUNTED AT 4m AFFL, IP66, IK07, 4000K, OPTICS TYPE 4ME. ADLT CREE XSPW MODEL: XSPW-B-WM-4ME-2L-40K-UL-BK
W4	10W	LED INTERIOR WALL MOUNTED LIGHT FITTING, MOUNTED AT 2.2m AFFL, WHITE FINISH, 4000K, DIMMABLE. ASTRO LIGHTING PETRA 180 SHADE MODEL: 5027001. INCLUDE OSRAM 10W E27 LED SUPERSTAR CLASSIC GLOBE DIMMABLE
W5	10W	LED INTERIOR UP/DOWN WALL MOUNTED LIGHT FITTING, MOUNTED AT 3m AFFL, WHITE FINISH, 4000K, IP20, NON-DIMMABLE. DELTA LIGHT GALAT 930 MODEL: 12220 9300
LED		RECESSED EMERGENCY LUMINAIRE, NON-MAINTAINED, SINGLE POINT TESTING SYSTEM FROM THE MSB AND COMPLETE WITH EMERGENCY BATTERY PACK. MODEL: CLEVERTRONICS ZLIFE PRO L10 PREMIUM V - DENOTES WITH VANDAL RESISTANT POLYCARBONATE DOME. S - DENOTES SURFACE MOUNTED. PROVIDE SQUARE MOUNTING KIT AS NECESSARY
LED		LED EXIT SIGN, MAINTAINED. WITH INTEGRAL BATTERIES AND DUAL RATE CHARGER, SINGLE POINT TESTING SYSTEM FROM THE MSB. ARROW DENOTES DIRECTIONAL EXIT SIGN. MODEL: CLEVERTRONICS ULTRABLADE L10 PREMIUM, UNLESS NOTED OTHERWISE D - DENOTED DOUBLE SIDED V - DENOTES IP65 VANDAL RESISTANT (4W COLD CATHODE VERSION). MODEL: CLEVERTRONICS WEATHERPROOF RANGE. C - DENOTES CARPARK SUITABLE EXIT SIGN (4W COLD CATHODE VERSION) MODEL: CLEVERTRONICS CLEVERFIT EXIT RANGE.
		360° DUAL TECHNOLOGY MOTION SENSOR, WITH TIMER. STEINEL 3000 SERIES RANGE. WHERE LOCATED IN THE AMBULANCE PLANT ROOM, DETECTOR MUST BE SUITABLE FOR THE INSTANT DETECTION OF ENTERING VEHICLES. DP - DENOTES DOUBLE POLE CONTACTORS. S - DENOTES SURFACE MOUNTED. PROVIDE SQUARE MOUNTING KIT AS NECESSARY HB - DENOTES MOTION SENSOR TO BE INSTALLED AT HIGH LEVEL TO BE MX HIGHBAY FROM STEINEL OR SIMILAR C - DENOTES MOTION SENSOR COVERAGE SHALL BE SUITABLE FOR CORRIDORS
		USE CONTACTOR FOR SWITCHING IF LIGHTING LOAD EXCEEDS SENSOR CONTACT RATING. CONTACTOR MUST BE IN ACCESSIBLE LOCATION. ALL SENSORS IN A ROOM TO BE OPERATED BY A SINGLE OVER-RIDE SWITCH UNLESS NOTED OTHERWISE
		LIGHT SWITCH MOUNTED AT 1000mm WP - DENOTES IP65 RATED OR - DENOTES SWITCH FOR PIR OVER-RIDE OFF WHERE A DETECTOR SHOWN IN ROOM 2W - DENOTES 2 WAY SWITCHING D - DENOTES SWITCH WITH SEPARATE DIMMER ON SAME FACEPLATE xG - DENOTES "X" GANG LIGHT SWITCH, WHERE "X" IS THE NUMBER OF GANGS
LCP		LIGHTING CONTROL PANEL SWITCH MOUNTED AT 1000mm WP - DENOTES IP65 RATED 2W - DENOTES 2-WAY SWITCHING 4G - DENOTES 4-GANG LIGHT SWITCH

FIRE DETECTION SYSTEM

RFP	RESIDENTIAL FIRE ALARM PANEL (SIMILAR TO BROOKS RFP12V2 WITH ZONE OUTPUT CARD SUB365)
	SMOKE ALARM (SIMILAR TO BROOKS EIB650IWX WITH INTERFACE BASE BAX16)
	HEAT ALARM (SIMILAR TO BROOKS EIB603CX WITH INTERFACE BASE BAX16)
	SMOKE ALARM CONCEALED (SIMILAR TO BROOKS EIB650IWX WITH INTERFACE BASE BAX16)
	HORN TYPE EMERGENCY SPEAKER. WATERPROOF TYPE FOR EXTERNAL AREAS
	VISUAL ALARM INDICATOR
	SOUNDER ALARM INDICATOR. WP DENOTES IP-RATED TYPE
	MAGNETIC DOOR HOLDER DEVICE WITH LOCAL RELEASE BUTTON . LINKED TO RFP. MOUNT AT 2200MM AFFL

PHOTOVOLTAIC & BATTERY STORAGE SYSTEM

	PHOTOVOLTAIC SOLAR PANEL DIMENSIONS: 1600(L)x1000(W)x50(H)mm. MINIMUM OF 335W POWER RATING
P-INV	PHOTOVOLTAIC SOLAR INVERTER FOR THE PV SYSTEM IN THE ROOF
B-INV	PHOTOVOLTAIC SOLAR INVERTER TO CHARGE THE BATTERY STORAGE UNIT
BAT	WALL-MOUNTED BATTERY STORAGE UNIT

POWER

	DOUBLE 10A GENERAL PURPOSE OUTLET UNO. REFER TO GENERAL ABBR.
	SINGLE 10A GENERAL PURPOSE OUTLET UNO. REFER TO GENERAL ABBR. (OUTLETS INSTALLED 300mm AFFL UNLESS OTHERWISE NOTED OR AS SHOWN ON ARCHITECTURAL DETAILS.
SP	FLOOR TO CEILING SERVICE POLE. TO MATCH WORKSTATION. INTERNAL SEGREGATION BETWEEN POWER & COMMS CABLING. PURCHASE SERVICE POLE FROM MANUFACTURER OF WORKSTATIONS.
3N 40A	DIRECT CONNECTION WITH ISOLATOR, UNLESS OTHERWISE STATED. REFER TO GENERAL ABBR. (IP56 TYPE WHERE SHOWN EXTERNAL TO A BUILDING) No. - DENOTES CURRENT RATING . 1N - DENOTES NO. OF PHASES (I.E 3N DENOTES 3 PHASE) RSD - DENOTES FOR ROLLER SHUTTER
	SWITCHBOARD
MP	AUTHORITY METER PANEL
UPS	UNINTERRUPTED POWER SUPPLY
	MAIN SWITCHBOARD
	MCC BOARD (MECHANICAL TRADE)
DB-P* ES	CIRCUIT DESIGNATION. ES - DENOTES CIRCUIT CONNECTED V/A EMERGENCY STOP CONTACTOR L - DENOTES LIGHTING CIRCUIT P - DENOTES POWER CIRCUIT No. - DENOTES DISTRIBUTION BOARD NUMBER
TS PE	DISTRIBUTION BOARD NUMBER. DENOTES CIRCUIT CONTROLLED BY COMBINED MULTICHANNEL TIME SWITCH/PHOTO CELL WITH OVERRIDE ON DISTRIBUTION BOARD. REFER SCHEMATIC.
TSL	DENOTES CIRCUIT CONTROLLED BY 24hr TIME SWITCH LOCATED NEAR DEVICE.
	NUMBER OF PHASES. - DENOTES SINGLE PHASE. - DENOTES THREE PHASE.
TS T	DIGITAL PROGRAMMABLE TIME SWITCH. (24hr, 7 day MIN 6 CHANNEL).
20A	ON-LOAD ISOLATOR (No. DENOTES CURRENT RATING)
20A	CIRCUIT BREAKER No. - DENOTES CURRENT RATING.
20A 30mA	EARTH LEAKAGE CIRCUIT BREAKER 30mA SENSITIVITY. 10mA SENSITIVITY WHERE NOTED.
C	CONTACTOR COIL.
E	ELECTRICAL UNDERGROUND CONDUIT ROUTE.
DPM	DENOTES LAN-CONNECTED MULTIFUNCTION METER WITH RS 485 & RJ45 CONNECTIONS. PROVIDE WHOLE CURRENT OR CT METERING TO MANUFACTURER RECOMMENDATIONS.
	UNFUSED TEE. DO NOT BREAK CABLE GAUGE. PROVIDE ENCLOSURE ABOVE FIRST BOARD IN CHAIN WHEN TEE IS NOT WITHIN AN ELECTRICAL CUPBOARD.
FB1	6-OFF MODULE FLOOR BOX CONTAINING 1-OFF DGPO, 1-OFF STARTER SOCKET TO SERVE TABLE BOX, 2-OFF DOUBLE DATA/ TELEPHONE OUTLETS MOUNTED ON 4-WAY FACEPLATES. PROVIDE A BLANK MODULE FOR THE UNUSED POSITION, 2- OFF BLANK FACEPLATES READY FOR AV CONNECTIONS/CABLING BY AV CONTRACTOR. CONTRACTOR TO SUPPLY AND INSTALL UMBILICAL CORD AND EXTEND DATA OUTLETS TO TABLE BOX.
TB1	TABLE BOX TO BE PART OF WORKSTATION MANUFACTURER'S SCOPE. TO CONTAINING 4-OFF GPO'S, 2-OFF USB-A CHARGING PORTS, 4-OFF DATA/ TELEPHONE OUTLETS MOUNTED ON 4-WAY FACEPLATES. PROVIDE A BLANK MODULE FOR THE UNUSED POSITION, 2- OFF BLANK FACEPLATES READY FOR AV CONNECTIONS/CABLING BY AV CONTRACTOR.
SS	POLE MOUNTED 1PH 20A STARTER SOCKET OUTLET
GL	GENERATOR LINK BOX
E	HEAVY DUTY TYPE 'B' ELECTRICAL PIT WITH LOCKABLE STEEL LID. (LABELLED ' ELECTRICAL') UNLESS NOTED OTHERWISE. IF PIT IS LOCATED IN VEHICLE TRAFFIC AREA, A PIT CLASS 'D' MUST BE USED INSTEAD. EX - DENOTES EXISTING. E1 - DENOTES 600 x 600mm PIT WITH 1265mm DEPTH. E2 - DENOTES 450 x 450mm PIT WITH 1140mm DEPTH.
	ROD SUSPENDED CABLE TRAY DEDICATED FOR ELECTRICAL SERVICES. UNISTRUT SUPATRAY OR SIMILAR

PUBLIC ADDRESS

	RECESSED/SURFACE PUBLIC ADDRESS SPEAKER WIRED BACK TO PUBLIC ADDRESS HEAD END. S - DENOTES SURFACE MOUNTED. LOCAL - DENOTES LOCAL SEPERATE ZONE. REFER TO SPECIFICATION FOR DETAILS.
PA-H	NEW PA EQUIPMENT HEAD END RACK.

MATV

TV	DUAL GANG MATV OUTLET (75ohm)+ FOXTEL OUTLET (TYPE F). ON ONE FACE PLATE. MATV CABLING WIRED TO MATV SYSTEM. FOXTEL CABLING TO BE CONSOLIDATED INI CUPBOARD. REFER TO SPECIFICATION & SCHEMATICS.
MATV	MATV ANTENNA. PROVIDE BRACKET TO MOUNT ON ROOF AS REQUIRED.

SECURITY

CR	CARD READER. WHERE CARD READER IS SHOWN OUTSIDE OF BUILDING, IN A CUSTODIAL AREA OR WITHIN THE PUBLIC FOYER, PROVIDE AN IP65-RATED CARD READER.
CTV	SINGLE RJ45 OUTLET CABLED WITH CAT 6A F/UTP BACK TO CCTV RACK. GREEN SHEATH.
ES	ELECTRIC DOOR STRIKE. EQUIVALENT TO PADDE ES2000 C/W STRIKE MICRO-SWITCH
G	WEATHERPROOF NEAUTROL AIRKEY RECIEVER. PROVIDE ALL OTHER ELECTRONICS, ADAPTER PANELS, AIRKEYS FOR A FULLY COMPATIBLE & WORKING SYSTEM WITH ACCESS CONTROL SYSTEM.
I	AUDIO INTERCOM, VANDAL RESISTANT, STAINLESS STEEL FACEPLATE. WHERE INTERCOM IS SHOWN OUTSIDE OF BUILDING, PROVIDE AN IP65-RATED INTERCOM STATION. WHERE MOUNTED ON POST, PROVIDE MOUNTING HARDWARE AS NECESSARY.
IH	AUDIO INTERCOM HANDSET WITH DOOR RELEASE PUSHBUTTONS. ONE LABELED PUSHBUTTON FOR EACH CONTROLLED DOOR. SEPARATE PUSH BUTTONS ARE ACCEPTABLE
IHB	2-WAY INTERCOM HANDSET LINKED AS SHOWN ON DRAWINGS.
IHC	2-WAY INTERCOM HANDSET LINKED TO VIDEO INTERCOM HANDSET 'IH'
KP	PIN & PROXIMITY READER COMBO DEVICE. TO BE WEATHERPROOF WHEN LOCATED ON EXTERNAL OR WET AREAS. HID SIGNO 40K
ML	ELECTRIC MORTICE LOCK COMPLETE WITH BUILT IN MICRO SWITCH.
MI	MASTER VIDEO INTERCOM WITH DOOR RELEASE PUSH-BUTTON PANEL. ONE LABELLED PUSHBUTTON FOR EACH CONTROLLED DOOR. LABELS TO BE PAINT-FILLED ENGRAVED. SEPERATE PUSH BUTTONS ARE ACCEPTABLE
D	DURESS CALL BACK TO COMMS ROOM.
R	REED SWITCH AT TOP LEADING EDGE OF DOOR OR EDGE OF ROLLER SHUTTER - TO ACTIVATE WHEN DOOR IS OPEN TO 50mm OR LESS.
SEC-H	SECURITY ACCESS CONTROL/ INTRUDER DETECTION SYSTEM HEAD ENDS MODEL: INTEGRITI FROM INNER RANGE
	BLUE WEATHERPROOF STROBE LIGHT TO FLASH WHEN SECURITY CALL FROM THE RED PHONE CALL POINT..
	STATIONARY WATERPROOF & VANDALPROOF CCTV CAMERA, WITH BRACKET TO ALLOW MOVEMENT TO FOCUS ON A FIXED AREA. PROVIDE RJ45 OUTLET AT LOCATION AS REQUIRED. P - DENOTES POLE MOUNTED. MP - DENOTES MEGAPIXEL CAMERA.
PB	PUSH BUTTON FOR DOOR EXIT OVERRIDE

COMMUNICATIONS

	RJ45 CAT6A OUTLET CABLED WITH UTP BACK TO COMMS RACK UNLESS NOTED OTHERWISE. ON VERTICALLY ORIENTED FACEPLATE. # - DENOTES NUMBER OF DATA SOCKETS PA - DENOTES DIRECT UTP CABLE BETWEEN OUTLETS MARKED PA. PAL - DENOTES PAL PHONE OUTLET MOUNTED AT 1400MM WITH DIRECT DIAL TO NUMBER TBA. T - DENOTES WALL PHONE OUTLET MOUNTED AT 1400MM AFFL ON A RJ12 JACK. U - DENOTES DESK TOP PHONE FOR PUBLIC USE. WAP - DENOTES WIRELESS ACCESS POINT. CEILING MOUNT
	DIRECT EXTERNAL TELEPHONE CONNECTION (NOT VIA PABX) MOUNTED ON VERTICALLY ORIENTED FACEPLATE T - DENOTES WALL PHONE OUTLET MOUNTED AT 1400 AFFL. P - DENOTES PRISONER PHONE OUTLET MOUNTED. DUPLICATE IN CUSTODY MANAGER OFFICE L - DENOTES CONNECTION TO LIFT IN 2hr FIRE-RATED CABLE. CONNECT TO LOCATION ADVISED BY LIFT INSTALLER VM- DENOTES PHONE FOR VENDING MACHINE. FIP - DENOTES CONNECTION TO FIP IN 2HR FIRE RATED CABLE. FDT - DENOTES FRONT DOOR TELEPHONE. LEAVE 2M TAIL FOR TERMINATION BY OTHERS
	SIMILAR TO KRONE HIGHWAY MEDIA WALL PHONE MOUNTING KIT 6467-1-114-10
CM, CAM	SINGLE RJ45 DATA OUTLET WIRED IN 4 PAIR CAT 6A CABLES, CAM - DENOTES OUTLET DEDICATED FOR CCTV CAMERA, ALLOW FOR ALL PATCH LEADS FROM OUTLET TO CAMERA.
C	COMMUNICATIONS UNDERGROUND CONDUIT ROUTE.
C	HEAVY DUTY TYPE 'B' COMMUNICATIONS PIT WITH LOCKABLE LID (LABELLED "COMMUNICATIONS") UNLESS NOTES OTHERWISE. IF PIT IS LOCATED IN VEHICLE TRAFFIC AREA, A PIT CLASS 'D' MUST BE USED INSTEAD. EX - DENOTES EXISTING. C1 - DENOTES 600 x 600mm PIT WITH 1265mm DEPTH. C2 - DENOTES 450 x 450mm PIT WITH 1140mm DEPTH. T - DENOTES EXISTING TELSTRA PIT T1 - DENOTES PS TYPE NBN APPROVED PIT 715 (L) x 465(W)mm WITH 635mm DEPTH, LID LABELLED "NBN"
	ROD SUSPENDED CABLE TRAY DEDICATED FOR COMMUNICATION SERVICES. UNISTRUT SUPATRAY OR SIMILAR
IR	INFRA RED ILLUMINATOR FOR HEARING AUGMENTATION AT 2500mm AFFL..
MDF	MAIN DISTRIBUTION FRAME/ TEST POINT FRAME.
PCD	NBN EQUIPMENT: PREMISES CONNECTION DEVICE
NBN	NBN EQUIPMENT: NETWORK TERMINATION DEVICE
SR	COMMUNICATION RACK
HL	INDUCTION HEARING LOOP

NSW AMBULANCE RADIO

NSWAR	NSW AMBULANCE RADIO EQUIPMENT
UHF RADIO	UHF RADIO ANTENNA. PROVIDE BRACKET TO MOUNT ON ROOF AS REQUIRED.

GENERAL NOTES

GENERAL

1. ALL WORK TO BE IN ACCORDANCE WITH SAA WIRING RULES, AS/NZS 3000:2018.
2. MARK ALL EQUIPMENT INCLUDING SWITCHES, POWER OUTLETS, ETC., WITH DISTRIBUTION BOARD NUMBER/CIRCUIT NUMBER AND DESTINATION AREAS.
3. LOCATIONS OF ELECTRICAL EQUIPMENT SHOWN ARE INDICATIVE ONLY. CO-ORDINATE FINAL ELECTRICAL EQUIPMENT LOCATIONS WITH ALL OTHER SERVICES DETAILS AND TRADE DISCIPLINES ON SITE AND WITH REFERENCE TO ARCHITECTURAL, HYDRAULIC AND MECHANICAL DRAWINGS.
4. PENETRATIONS THROUGH FIRE RATED WALLS AND FLOORS ARE TO BE SEALED WITH FIRE STOPPING MATERIAL EQUAL TO THE LEVEL OF PROTECTION OF THE SURROUNDING BARRIER.
5. MOUNT DISTRIBUTION SWITCHBOARDS 1800mm AAFL TO TOP, UNO.
6. PLACE ALL CONTROLS WITHIN DISTRIBUTION BOARD. UNO.
7. ENSURE SEGREGATION BETWEEN LV, ELV CABLING IS SEPERATED TO COMMUNICATIONS CABLING TO S-009 REQUIREMENTS & THE BTS STRUCTURED CABLING SPECIFICATION.
8. PROVIDE ACOUSTIC WALL BOXES TO ALL POWER & DATA OUTLETS TO ALL ACOUSTICALLY RATED AREAS.

LIGHTING

1. WHERE LIGHT SWITCH WIRE LINES ARE NOT SHOWN, SWITCH FITTINGS BY SWITCH(ES) ADJACENT TO ROOM ENTRANCE DOOR. PROVIDE MINIMUM OF ONE LIGHT SWITCH TO OPERATE ALL LIGHTS WITHIN EACH ROOM, UNO. MOUNT ALL LIGHT SWITCHES AT 1000mm AAFL, TO CENTRELINE UNO.
2. MOUNT EXIT LIGHTS ON CEILING ONLY.
3. PROVIDE 30mA RCD PROTECTION TO ALL LIGHTING & POWER CIRCUITS AS PER AS/NZS 3000:2018.
4. LOCATE THE LIGHTING CONTROL EQUIPMENT WITHIN DISTRIBUTION BOARD.
5. UNLESS NOTED OTHERWISE ALL SWITCHPLATES SHALL BE CLIPSAL C2000 SERIES COMPLETE WITH SNAP ON STAINLESS STEEL COVERPLATES & WHITE KEY INPUT UNITS. THE POSITION OF THE LIGHT SWITCHES, AC CONTROL PANELS, PA/PR ATTENUATORS, ETC ARE TO BE POSITIONED TOGETHER BY THE ENTRY DOOR OF EACH ROOM, UNLESS OTHERWISE INSTRUCTED.

POWER

1. MOUNT ALL OUTLETS AT 400mm AAFL TO CENTRE, UNO., OR AS REQUIRED BY AS/NZS 3000:2018.
2. UNLESS ARCHITECTURAL JOINERY DRAWINGS SHOW OTHERWISE , MOUNT ALL OUTLETS MARKED "AB" AT 150 TO BOTTOM OF OUTLET ABOVE BENCH TOP. REFER TO ARCHITECTURAL JOINERY DWGS FOR EXACT LOCATIONS.
3. MOUNT OUTLETS LOCATED NEAR SINKS AND TUBS, OUTSIDE THE "DAMP AREAS RESTRICTED ZONE" AS REQUIRED BY AS/NZS 3000:2018.
4. INSTALL AN ISOLATOR ADJACENT TO ALL EQUIPMENT THAT IS NOT IN THE IMMEDIATE VICINITY OF ITS CONTROL PANEL OF EQUIPMENT AS REQUIRED BY AS/NZS 3000:2018.
5. PROVIDE COMBINED RCD/CIRCUIT BREAKER FOR ALL POWER AND LIGHTING CIRCUITS THROUGHOUT AS DETAILED IN SPECIFICATION AND AS/NZS 3000:2018.
6. ALL NON WORKSTATION MOUNTED POWER OUTLETS SHALL BE CLIPSAL C2000 SERIES COMPLETE WITH SNAP ON COVER PLATES & WHITE MECHANISMS.
7. AVOID BACK TO BACK OUTLETS IN ALL ACOUSTIC & FIRE RATED WALLS. ENSURE A SEPARATION OF A MIN OF 600MM BETWEEN SUCH OUTLETS.

CABLE WAYS

1. SEPARATE COMMUNICATIONS CABLING FROM POWER CABLING BY MINIMUM OF 300mm, EXCEPT WHERE ENCLOSED IN METAL DUCT OR METAL CONDUIT. CABLES MAY CROSS EACH OTHER WITH A 50mm SEPARATION.

EARTHING

1. INSTALL EQUIPOTENTIAL BONDING TO METALLIC PIPING, CABLE TRAYS, METAL DUCTS, COMMUNICATIONS EARTHING SYSTEMS AND OTHER METALLIC SYSTEMS.

GENERAL ABBREVIATIONS

15A	- DENOTES 15A OUTLET
AB	- DENOTES ABOVE BENCH (AB HEIGHT APPROX 820MM AFFL TO CENTRE OF OUTLET)
AEC	- DENOTES AMBULANCE ELECTRICAL CHARGING UNIT
BC	- DENOTES MOUNTED ON BOXED OUT COLUMN
BOL	- DENOTES POWER BOLLARD MOUNTED
BWU	- DENOTES BOILING WATER UNIT
CAP	- DENOTES CAPTIVE LOCKING PENDANT OUTLET
CL	- DENOTES CLEANERS OUTLET
CM	- DENOTES CEILING MOUNTED
CS	- DENOTES CEILING SPACE
CT	- DENOTES COOKTOP
DW	- DENOTES DISHWASHER OUTLET. LOCATED UNDER BENCH. NOT TO BE LOCATED DIRECTLY BEHIND DISHWASHER.
DSI	- DENOTES DSI DIMMABLE BALLASTS.
FR	- DENOTES FRIDGE OUTLET
HD	- DENOTES OUTLET DEDICATED FOR HAND DRIER.
HWU	- DENOTES HOT WATER UNIT
HPS	- HIGH PRESSURE HOSE
IP56	- DENOTES IP56 RATED OUTLET (INDUSTRIAL TYPE)
IRON	- DENOTES OUTLET FOR IRON. MOUNT TO SUIT IRONING BOARD
J	- OUTLETS MOUNTED ON JOINERY TO THE ARCHITECTURE DETAILS
LM	- DENOTES LAUNDRY WASHING MACHINE
MW	- DENOTES MICROWAVE
P	- DENOTES PENDANT OUTLET, SUSPENDED TO 2000MM
PD	- DENOTES HANGING PENDANT OUTLET SUSPENDED TO 2000MM AFFL. SIMILAR TO CLIPSAL SS15N
PE	- DENOTES PEDESTAL MOUNTED.
PJ	- DENOTES OUTLET DEDICATED FOR A CEILING MOUNTED PROJECTOR. LOCATED IN CEILING.
PS	- DENOTES MOUNTED IN CEILING FOR THE OPERATION OF A PROJECTOR SCREEN. PROVIDE DOWN/UP MOMENTARY PUSH BUTTON AT NOMINATED LOCATION ON WALL.
RH	- DENOTES RANGE OUTLET
SD	- DENOTES SLIDING DOOR
SIP	- DENOTE SPEAKER IN PHONE FOR A SEPARATE SPEAKER FOR THE PHONE
SK	- DENOTES MOUNTED ON SKIRTING DUCT.
SP	- DENOTES SERVICE POLE MOUNTED.
SS	- DENOTES STARTER SOCKET FOR WORKSTATION SOFT-WIRING
SUS	- DENOTES SUSPENDED
SWP	- DENOTES CONTROL PANEL FOR SEWER PUMP
TC	- DENOTES TASER CHARGING PROVIDED CLIPSAL GANGBUSTER OUTLETS.
UB	- DENOTES UNDER BENCH
V	- DENOTES VANDAL RESISTANT.
VM	- DENOTES VENDING MACHINE OUTLET (DEDICATED CIRCUIT)
W	- DENOTES OUTLET MOUNTED ON WORKSTATION & SOFT-WIRED TO LOCAL STARTER SOCKET.
WIDE	- DENOTES WIDE SWITCH TOGGLE TYPE (35MM).
WM	- DENOTES WALL MOUNTED
WP	- DENOTES WEATHERPROOF

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified
P1	09.02.22	PRELIMINARY ISSUE	J.G.
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified

RAIR — Rural Ambulance Infrastructure Reconfiguration — Building the future response for our state

PROJECT MANAGER
LEVEL 16
44 MARKET STREET
SYDNEY NSW 2000
T +61 2 9299 3366
mace

CLIENT
NSW GOVERNMENT Health Infrastructure
NSW Ambulance

ARCHITECT
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects:
Andrew Hewett 6562
Daniel Beekwilder 5192
64 Rose Street
Chippendale NSW 2008
Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street,
North Sydney
NSW 2060
Australia
+61 (02) 9437 1000
general@jhaengineers.com.au
www.jhaservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

KINGSCLIFF, NSW 2487

TITLE
ELECTRICAL SERVICES
ELECTRICAL LEGEND

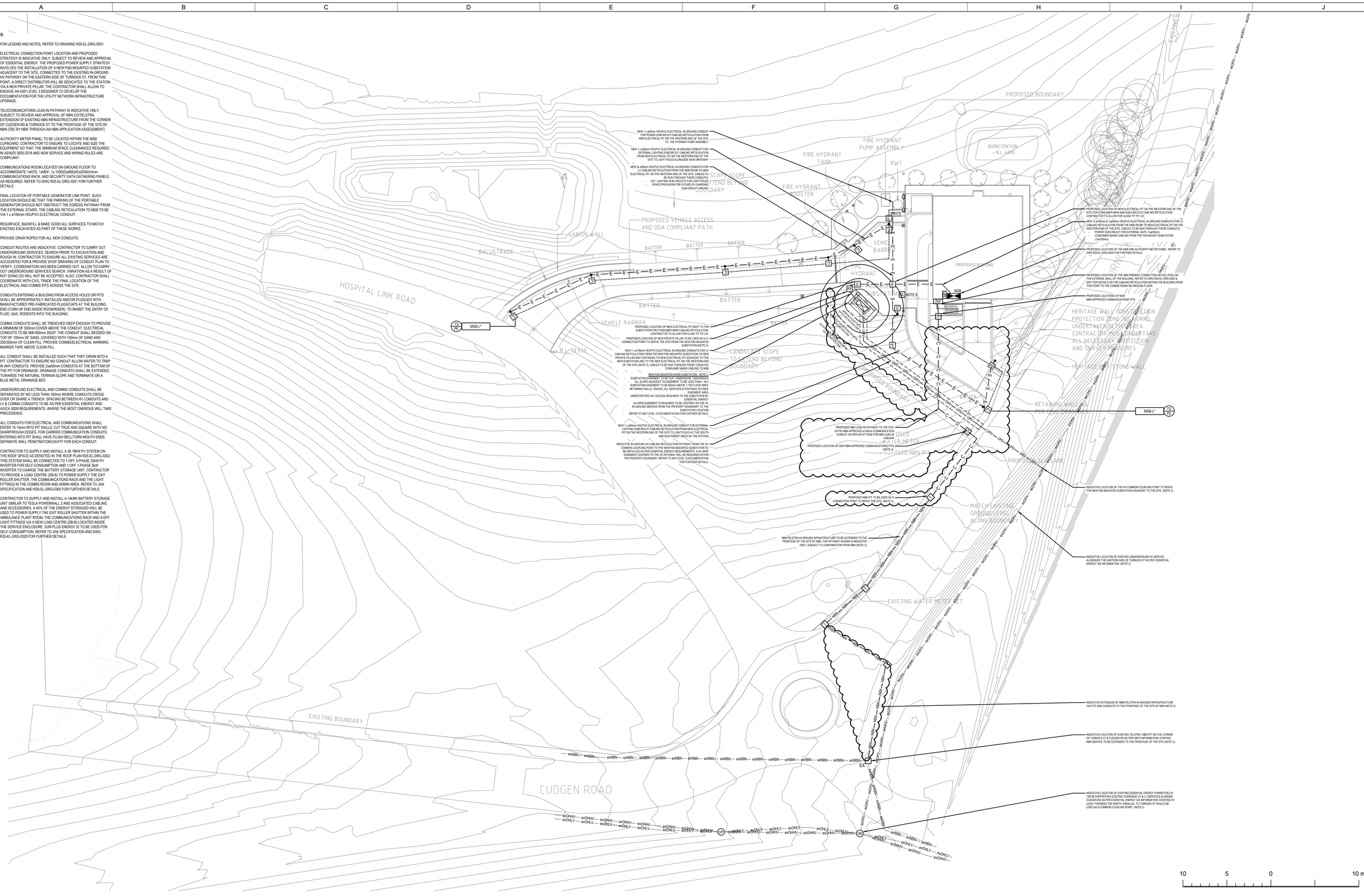
CONSTRUCTION ISSUE

DRAWN	P.C.	SCALE @ A1
CHECKED	J.G.	N.T.S.
APPROVED	J.G.	
CREATED	FEB 2022	
JOB No.	210067	
DRAWING No.		REV
R25-EL-DRG-0001		1

S:\JOB No\Job No 20210000-20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0001.dwg

NOTES:

1. FOR LEGEND AND NOTES, REFER TO DRAWING R25-EL-DRG-0001.
2. ELECTRICAL CONNECTION POINT LOCATION AND PROPOSED STRATEGY IS INDICATIVE ONLY, SUBJECT TO REVIEW AND APPROVAL OF ESSENTIAL ENERGY. THE PROPOSED POWER SUPPLY STRATEGY INVOLVES THE INSTALLATION OF A NEW PAD-MOUNTED SUBSTATION ADJACENT TO THE SITE, CONNECTED TO THE EXISTING IN-GROUND HV PATHWAY ON THE EASTERN SIDE OF TURNOCK ST. FROM THIS POINT, A DIRECT DISTRIBUTOR WILL BE DEDICATED TO THE STATION VIA A NEW PRIVATE PILLAR. THE CONTRACTOR SHALL ALLOW TO ENGAGE AN ASP LEVEL 3 DESIGNER TO DEVELOP THE DOCUMENTATION FOR THE UTILITY NETWORK INFRASTRUCTURE UPGRADE.
3. TELECOMMUNICATIONS LEAD-IN PATHWAY IS INDICATIVE ONLY, SUBJECT TO REVIEW AND APPROVAL OF NBN COTELSTRA. EXTENSION OF EXISTING NBN INFRASTRUCTURE FROM THE CORNER OF CUDGEN RD & TURNOCK ST TO THE FRONTAGE OF THE SITE BY NBN (TBC BY NBN THROUGH AN NBN APPLICATION ASSESSMENT)
4. AUTHORITY METER PANEL TO BE LOCATED WITHIN THE MSB CUPBOARD. CONTRACTOR TO ENSURE TO LOCATE AND SIZE THE EQUIPMENT SO THAT THE MINIMUM SPACE CLEARANCES REQUIRED IN AS/NZS 3000:2018 AND NSW SERVICE AND WIRING RULES ARE COMPLIANT.
5. COMMUNICATIONS ROOM LOCATED ON GROUND FLOOR TO ACCOMMODATE 1xNTD, 1xMDF, 1x 1000(D)x800(W)x2000(H)mm COMMUNICATIONS RACK, AND SECURITY DATA GATHERING PANELS AS REQUIRED. REFER TO DWG R25-EL-ORG-0201 FOR FURTHER DETAILS
6. FINAL LOCATION OF PORTABLE GENERATOR LINK POINT, SUCH LOCATION SHOULD BE THAT THE PARKING OF THE PORTABLE GENERATOR SHOULD NOT OBSTRUCT THE EGRESS PATHWAY FROM THE EXTERNAL STAIRS. THE CABLING RETICULATION TO MSB TO BE VIA 1 x ø100mm HDUPVC ELECTRICAL CONDUIT.
7. RESURFACE, BACKFILL & MAKE GOOD ALL SURFACES TO MATCH EXISTING EXCAVATED AS PART OF THESE WORKS.
8. PROVIDE DRAW ROPES FOR ALL NEW CONDUITS.
9. CONDUIT ROUTES ARE INDICATIVE. CONTRACTOR TO CARRY OUT UNDERGROUND SERVICES. SEARCH PRIOR TO EXCAVATION AND ROUGH IN. CONTRACTOR TO ENSURE ALL EXISTING SERVICES ARE ACCOUNTED FOR & PROVIDE SHOP DRAWING OF CONDUIT PLAN TO VERIFY. COORDINATION HAS BEEN CARRIED OUT, ALLOW TO CARRY OUT UNDERGROUND SERVICES SEARCH. VARIATION AS A RESULT OF NOT DOING SO WILL NOT BE ACCEPTED. ALSO, CONTRACTOR SHALL COORDINATE WITH CIVIL TRADE THE FINAL LOCATION OF THE ELECTRICAL AND COMMS PITS ACROSS THE SITE.
10. CONDUITS ENTERING A BUILDING FROM ACCESS HOLES OR PITS SHALL BE APPROPRIATELY INSTALLED AND/OR PLUGGED WITH MANUFACTURED PRE-FABRICATED PLUGS/CAPS AT THE BUILDING END (TURN UP END INSIDE ROOM/RISER). TO INHIBIT THE ENTRY OF FLUID, GAS, RODENTS INTO THE BUILDING.
11. COMMS CONDUITS SHALL BE TRENCHED DEEP ENOUGH TO PROVIDE A MINIMUM OF 500mm COVER ABOVE THE CONDUIT. ELECTRICAL CONDUITS TO BE MIN 600mm DEEP. THE CONDUIT SHALL BEDDED ON TOP OF 100mm OF SAND. COVERED WITH 100mm OF SAND AND 200/300mm OF CLEAN FILL. PROVIDE COMMS/ELECTRICAL WARNING MARKER TAPE ABOVE CLEAN FILL.
12. ALL CONDUIT SHALL BE INSTALLED SUCH THAT THEY DRAIN INTO A PIT. CONTRACTOR TO ENSURE NO CONDUIT ALLOW WATER TO TRAP IN ANY CONDUITS. PROVIDE 2xø50mm CONDUITS AT THE BOTTOM OF THE PIT FOR DRAINAGE. DRAINAGE CONDUITS SHALL BE EXTENDED TOWARDS THE NATURAL TERRAIN SLOPE AND TERMINATE ON A BLUE METAL DRAINAGE BED.
13. UNDERGROUND ELECTRICAL AND COMMS CONDUITS SHALL BE SEPARATED BY NO LESS THAN 100mm WHERE CONDUITS CROSS OVER OR SHARE A TRENCH. SPACING BETWEEN HV CONDUITS AND LV & COMMS CONDUITS TO BE AS PER ESSENTIAL ENERGY AND AS/CA S009 REQUIREMENTS. WHERE THE MOST ONEROUS WILL TAKE PRECEDENCE.
14. ALL CONDUITS FOR ELECTRICAL AND COMMUNICATIONS SHALL ENTER 10-15mm INTO PIT WALLS, CUT TRUE AND SQUARE WITH NO SHARP/ROUGH EDGES. FOR CARRIER COMMUNICATION CONDUITS ENTERING INTO PIT SHALL HAVE FLUSH BELL/TURN MOUTH ENDS. SEPARATE WALL PENETRATION/CAVITY FOR EACH CONDUIT.
15. CONTRACTOR TO SUPPLY AND INSTALL A 36.18kW PV SYSTEM ON THE ROOF SPACE AS DENOTED IN THE ROOF PLAN R25-EL-ORG-0202. THIS SYSTEM SHALL BE CONNECTED TO 1-OFF 3-PHASE 25kW PV INVERTER FOR SELF-CONSUMPTION AND 1-OFF 1-PHASE 5kW INVERTER TO CHARGE THE BATTERY STORAGE UNIT. CONTRACTOR TO PROVIDE A LOAD CENTRE (DB-B) TO POWER SUPPLY THE EXIT ROLLER SHUTTER, THE COMMUNICATIONS RACK AND THE LIGHT FITTINGS IN THE COMMS ROOM AND ADMIN AREA. REFER TO JHA SPECIFICATION AND R25-EL-ORG-0300 FOR FURTHER DETAILS.
16. CONTRACTOR TO SUPPLY AND INSTALL A 14kWh BATTERY STORAGE UNIT SIMILAR TO TESLA POWERWALL 2 AND ASSOCIATED CABLING AND ACCESSORIES. A 40% OF THE ENERGY STORAGED WILL BE USED TO POWER SUPPLY THE EXIT ROLLER SHUTTER WITHIN THE AMBULANCE PLANT ROOM. THE COMMUNICATIONS RACK AND 4-OFF LIGHT FITTINGS VIA A NEW LOAD CENTRE (DB-B) LOCATED INSIDE THE SERVICE ENCLOSURE. SUR-PLUS ENERGY IS TO BE USED FOR SELF-CONSUMPTION. REFER TO JHA SPECIFICATION AND DWG R25-EL-ORG-0200 FOR FURTHER DETAILS.



REVISIONS / AMENDMENTS			
Rev	Date	Description	Verified
P1	09.02.22	PRELIMINARY ISSUE	J.G.
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS			
Rev	Date	Description	Verified

RAIR — Rural Ambulance Infrastructure Reconfiguration — Building the future response for our state

PROJECT MANAGER
LEVEL 16
44 MARKET STREET
SYDNEY NSW 2000
T +61 2 9299 3566
mace

CLIENT
NSW GOVERNMENT Health Infrastructure
NSW Ambulance

ARCHITECT
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects:
Andrew Hipwell 6562
Daniel Beekwilder 5192
64 Rose Street
Chippendale NSW 2008
Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street,
North Sydney
NSW 2060
Australia
+61 (02) 9437 1000
general@jhaengineers.com.au
www.jhaservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

KINGSCLIFF, NSW 2487

TITLE
ELECTRICAL SERVICES
SITE PLAN

CONSTRUCTION ISSUE

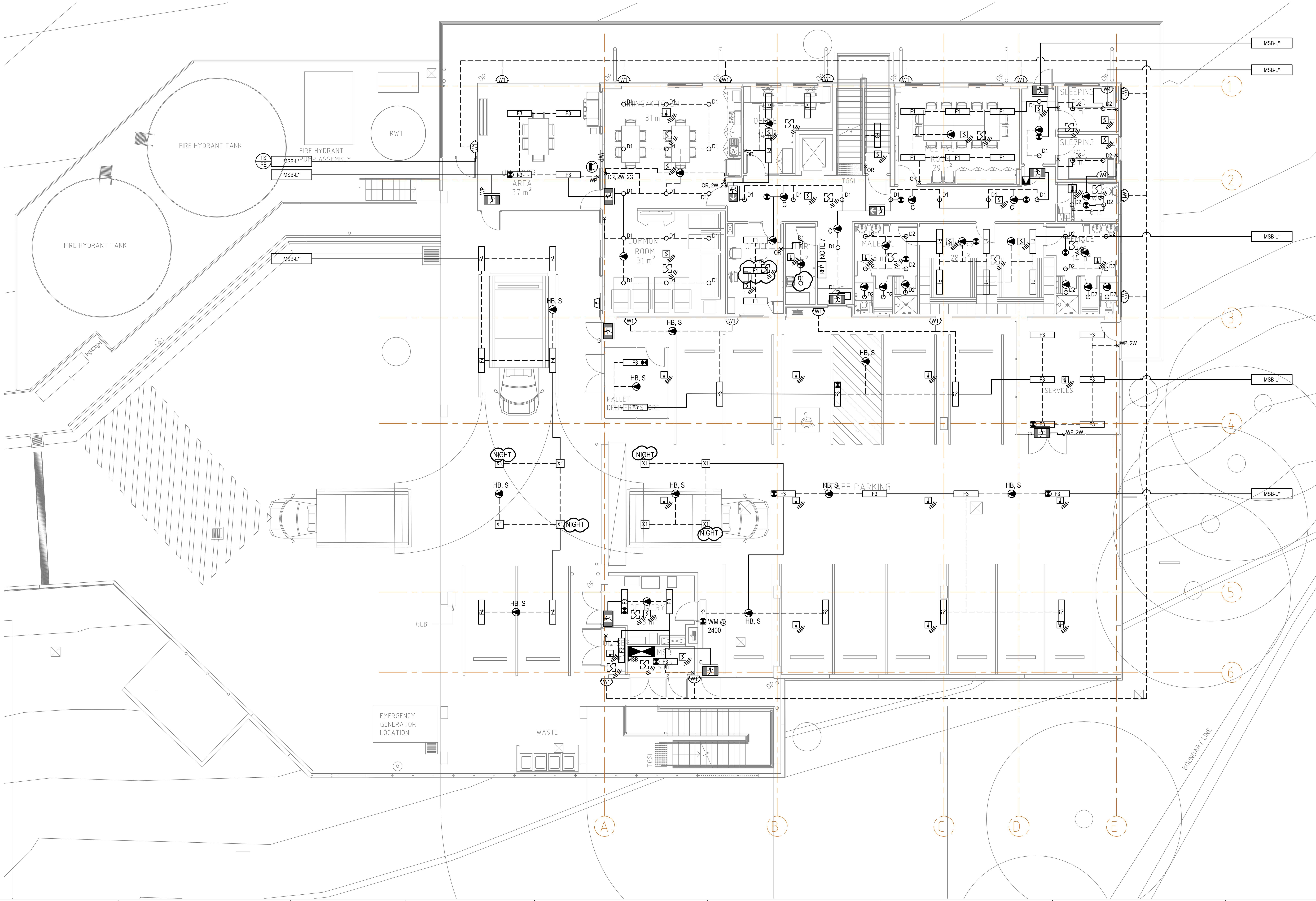
DRAWN	P.C.
CHECKED	J.G.
APPROVED	J.G.
CREATED	FEB 2022
JOB No.	210067

SCALE @ A1 **1:500**

DRAWING No. **R25-EL-DRG-0002**

REV **1**

S:\JOB No\Job No 20210000-20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0002.dwg



NOTES:

1. FOR LEGEND AND NOTES, REFER TO DRAWING R25-EL-DRG-0001.
2. FINAL LOCATION OF ALL EQUIPMENT SHALL BE CONFIRMED ON SITE AND WITH REFERENCE TO ARCHITECTURAL ROOM DATA SHEETS.
3. THE ELECTRICAL CONTRACTOR MUST CO-ORDINATE WITH THE OTHER TRADES BEFORE INSTALLING ELECTRICAL DEVICES AND EQUIPMENT.
4. ALL SMOKE/HEAT ALARMS TO BE SIMILAR TO BROOKS EIB650IWX (SMOKE) AND EIB603CX (HEAT) WITH INTERFACE BASE BAX16. DEVICES TO BE CONNECTED TO THE RESIDENTIAL FIRE CONTROL PANEL
5. SMOKE AND THERMAL ALARMS TO BE CONNECTED TO BUILDING OCCUPANT WARMING SYSTEM (BOWS) TO INITIATE WARNING SYSTEM IN CASE ANY OF THE SMOKE/ THERMAL ALARM IS TRIGGERED.
6. SMOKE/THERMAL ALARM SYSTEM TO BE CONNECTED TO THE SECURITY SYSTEM AND INITIATE SIGNAL TO THE OFF SITE SECURITY COMPANY IN CASE IF SMOKE/THERMAL ALARM SYSTEM IS NOT RESETTED IN CLIENT DEFINE TIME.
7. SEMI-RECESSED RESIDENTIAL FIRE CONTROL PANEL WITH INTEGRATED BACK-UP BATTERY, SIMILAR TO BROOKS RFP12V2 (WITH ZONE OUTPUT CARD SUB365). BATTERY TO BE SIZED TO PROVIDE POWER TO RFP PANEL FOR AT LEAST 72 HOURS.
8. CONTRACTOR TO ADD ADDITIONAL SMOKE ALARMS IN ANY CONCEALED AREA ABOVE THE CEILING WHERE THE HEIGHT IS MORE THAN 800mm. FOR TENDER PURPOSES, CONTRACTOR TO ALLOW FOR 15-OFF CONCEALED SMOKE ALARMS WITH FAMCO BRACKETS PER LEVEL.
9. PERIMETER EXTERNAL WALL MOUNTED FITTING TYPE W1 TO BE CONTROLLED BY THE TIME SWITCH / PHOTOCELL WITH AN OVERRIDE LIGHT SWITCH LOCATED IN THE MSB
10. PERIMETER INTERNAL WALL MOUNTED FITTINGS TYPE F3 IN AMBULANCE PLANT ROOM TO BE MOUNTED AT 3.5m AFFL. LIGHT FITTINGS TYPE X1 TO BE SURFACE MOUNTED ON THE UNDERSIDE OF THE ROOF. THESE FITTINGS ARE TO BE CONTROLLED BY THE LIGHTING CONTROL PANEL (LCP) IN THE AMBULANCE PLANT ROOM. THE LCP TO BE A 4-GANG LIGHT SWITCH.
11. LIGHT FITTINGS TYPE X1 AND TYPE F3 IN LG CARPARK TO BE SURFACE MOUNTED ON THE UNDERSIDE OF THE ROOF AND WALL MOUNTED FITTINGS TYPE W1 TO BE MOUNTED AT 2.7m AFFL. THESE FITTINGS ARE TO BE CONTROLLED BY HIGH-BAY TYPE MOTION SENSORS WITH A TIME DELAY OF 30 MINS. DURING NIGHT TIME, THE LIGHT FITTINGS TYPE X1 DENOTED WITH THE TAG "NIGHT" SHOULD BE TURNED ON BY THE MOTION SENSOR. THE OTHER 4xX1 FITTINGS SHALL REMAIN TURNED OFF TO COMPLY WITH THE AS1680.2.1 REQUIREMENTS FOR UNDERCOVER CARPARKS - MOTION SENSOR SHALL BE SELECTED TO HAVE 1-INPUT/2-OUTPUTS WITH DELAY AND DAYTIME SCHEDULES. THE FITTINGS TYPE F3 SHALL OPERATE AS DESCRIBED ABOVE AT ALL TIMES.
12. REFER TO DWG R25-EL-DRG-0002 FOR REFERENCE TO THE EXTERNAL LIGHTING FOR THE ON-GRADE CARPARK, SERVICE BAY AND DRIVEWAYS. SUCH LIGHT FITTINGS ARE TO BE CONTROLLED BY THE TIME SWITCH / PHOTOCELL WITH AN OVERRIDE OFF SWITCH LOCATED IN LCP IN THE AMBULANCE PLANT ROOM.
13. CONTRACTOR TO SUPPLY AND INSTALL PHOTOCELL FOR EXTERNAL LIGHTING CONTROL ON THE NORTH-EAST CORNER OF THE BUILDING, EXTERNALLY.

2 1 0 2 4 6 8 m

1 : 100-A1 1 : 200-A3

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified
P1	09.02.22	PRELIMINARY ISSUE	J.G.
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified

RAIR – Rural Ambulance Infrastructure Reconfiguration – Building the future response for our state

PROJECT MANAGER
LEVEL 16, 44 MARKET STREET, SYDNEY NSW 2000, T +61 2 9299 3555
mace

CLIENT
NSW GOVERNMENT Health Infrastructure
NSW Ambulance

ARCHITECT
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects: Andrew Hipwell 6562, Daniel Beekwilder 6192
64 Rose Street, Chippendale NSW 2008, Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street, North Sydney NSW 2060 Australia
+61 (02) 9437 1000
general@jhaengineers.com.au
www.jhaservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

KINGSCLIFF, NSW 2487

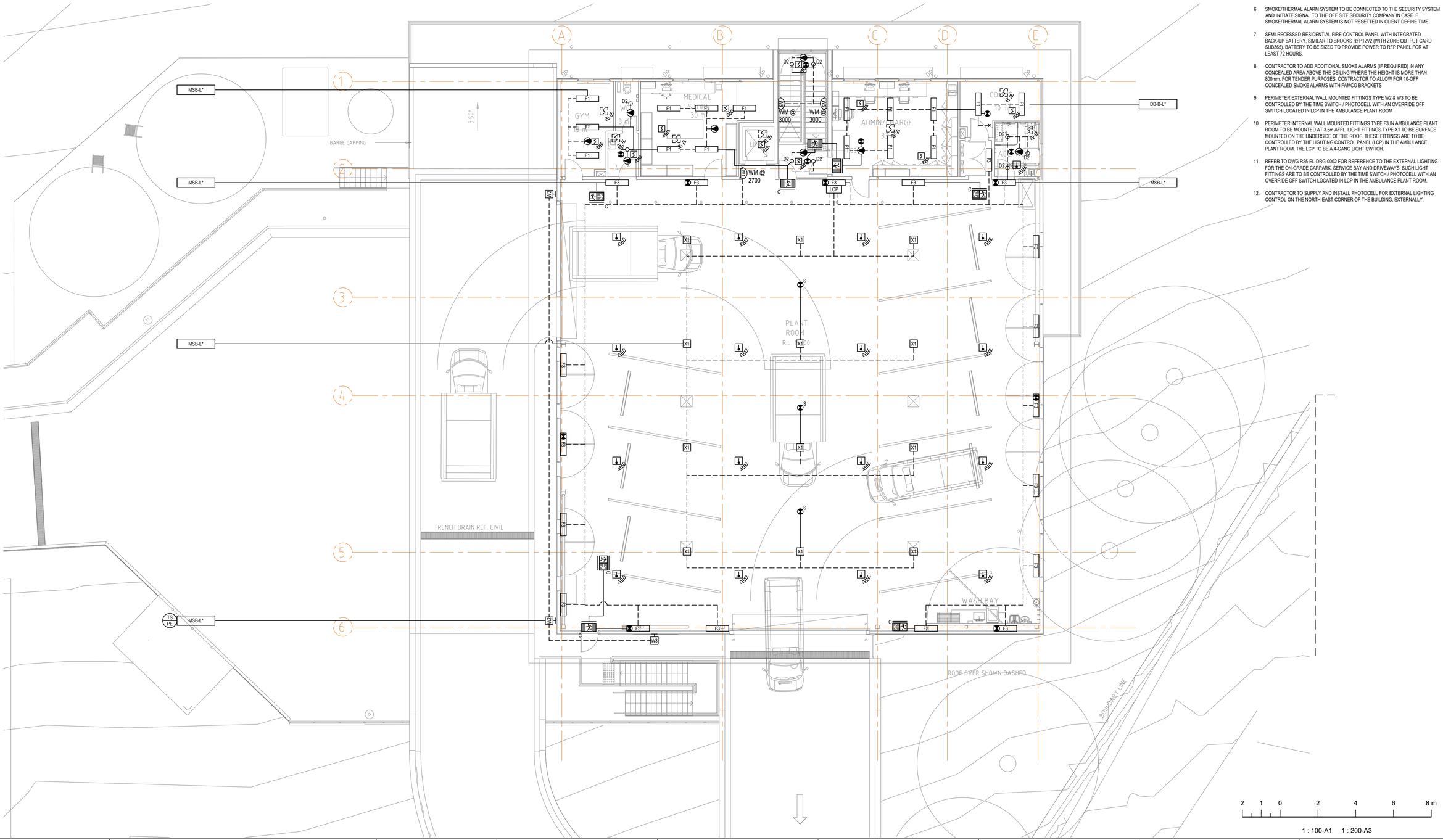
TITLE
ELECTRICAL SERVICES
LOWER GROUND FLOOR LIGHTING AND FIRE DETECTION LAYOUT

CONSTRUCTION ISSUE

DRAWN	P.C.	SCALE @ A1
CHECKED	J.G.	1:100
APPROVED	J.G.	
CREATED	FEB 2022	
JOB No.	210067	

DRAWING No. **R25-EL-DRG-0100** REV **1**

S:\JOB No\Job No 20210000-20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0100.dwg



NOTES:

1. FOR LEGEND AND NOTES, REFER TO DRAWING R25-EL-DRG-0001.
2. FINAL LOCATION OF ALL EQUIPMENT SHALL BE CONFIRMED ON SITE AND WITH REFERENCE TO ARCHITECTURAL ROOM DATA SHEETS.
3. THE ELECTRICAL CONTRACTOR MUST CO-ORDINATE WITH THE OTHER TRADES BEFORE INSTALLING ELECTRICAL DEVICES AND EQUIPMENT.
4. ALL SMOKE/HEAT ALARMS TO BE SIMILAR TO BROOKS EIB650IWX (SMOKE) AND EIB603CX (HEAT) WITH INTERFACE BASE BAX16. DEVICES TO BE CONNECTED TO THE RESIDENTIAL FIRE CONTROL PANEL
5. SMOKE AND THERMAL ALARMS TO BE CONNECTED TO BUILDING OCCUPANT WARMING SYSTEM (BOWS) TO INITIATE WARNING SYSTEM IN CASE ANY OF THE SMOKE/ THERMAL ALARM IS TRIGGERED.
6. SMOKE/THERMAL ALARM SYSTEM TO BE CONNECTED TO THE SECURITY SYSTEM AND INITIATE SIGNAL TO THE OFF SITE SECURITY COMPANY IN CASE IF SMOKE/THERMAL ALARM SYSTEM IS NOT RESETTED IN CLIENT DEFINE TIME.
7. SEMI-RECESSED RESIDENTIAL FIRE CONTROL PANEL WITH INTEGRATED BACK-UP BATTERY, SIMILAR TO BROOKS RFP12V2 (WITH ZONE OUTPUT CARD SUB365). BATTERY TO BE SIZED TO PROVIDE POWER TO RFP PANEL FOR AT LEAST 72 HOURS.
8. CONTRACTOR TO ADD ADDITIONAL SMOKE ALARMS (IF REQUIRED) IN ANY CONCEALED AREA ABOVE THE CEILING WHERE THE HEIGHT IS MORE THAN 800mm. FOR TENDER PURPOSES, CONTRACTOR TO ALLOW FOR 10-OFF CONCEALED SMOKE ALARMS WITH FAMCO BRACKETS
9. PERIMETER EXTERNAL WALL MOUNTED FITTINGS TYPE W2 & W3 TO BE CONTROLLED BY THE TIME SWITCH / PHOTOCELL WITH AN OVERRIDE OFF SWITCH LOCATED IN LCP IN THE AMBULANCE PLANT ROOM
10. PERIMETER INTERNAL WALL MOUNTED FITTINGS TYPE F3 IN AMBULANCE PLANT ROOM TO BE MOUNTED AT 3.5m AFFL. LIGHT FITTINGS TYPE X1 TO BE SURFACE MOUNTED ON THE UNDERSIDE OF THE ROOF. THESE FITTINGS ARE TO BE CONTROLLED BY THE LIGHTING CONTROL PANEL (LCP) IN THE AMBULANCE PLANT ROOM. THE LCP TO BE A 4-GANG LIGHT SWITCH.
11. REFER TO DWG R25-EL-DRG-0002 FOR REFERENCE TO THE EXTERNAL LIGHTING FOR THE ON-GRADE CARPARK, SERVICE BAY AND DRIVEWAYS. SUCH LIGHT FITTINGS ARE TO BE CONTROLLED BY THE TIME SWITCH / PHOTOCELL WITH AN OVERRIDE OFF SWITCH LOCATED IN LCP IN THE AMBULANCE PLANT ROOM.
12. CONTRACTOR TO SUPPLY AND INSTALL PHOTOCELL FOR EXTERNAL LIGHTING CONTROL ON THE NORTH-EAST CORNER OF THE BUILDING, EXTERNALLY.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified
P1	09.02.22	PRELIMINARY ISSUE	J.G.
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified

RAIR
Rural Ambulance Infrastructure Reconfiguration
Building the future response for our state

PROJECT MANAGER
LEVEL 16
44 MARKET STREET
SYDNEY NSW 2000
T +61 2 9299 3555
mace

CLIENT
NSW GOVERNMENT Health Infrastructure
NSW Ambulance

ARCHITECT
djrd
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects:
Andrew Hipwell 6562
Daniel Beekwilder 5192
64 Rose Street
Chippendale NSW 2008
Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street,
North Sydney
NSW 2060
Australia
+61 (02) 9437 1000
general@jhaengineers.com.au
www.jhaservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

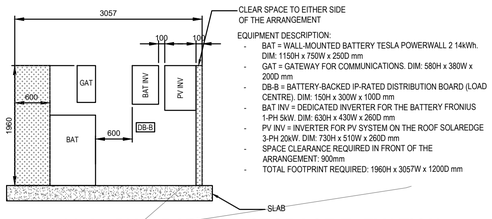
KINGSCLIFF, NSW 2487

TITLE
ELECTRICAL SERVICES
GROUND FLOOR
LIGHTING AND FIRE DETECTION LAYOUT

CONSTRUCTION ISSUE

DRAWN	P.C.	SCALE @ A1
CHECKED	J.G.	1:100
APPROVED	J.G.	
CREATED	FEB 2022	
JOB No.	210067	
DRAWING No.		REV
R25-EL-DRG-0101		1

S:\JOB No\Job No 20210000-20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0101.dwg

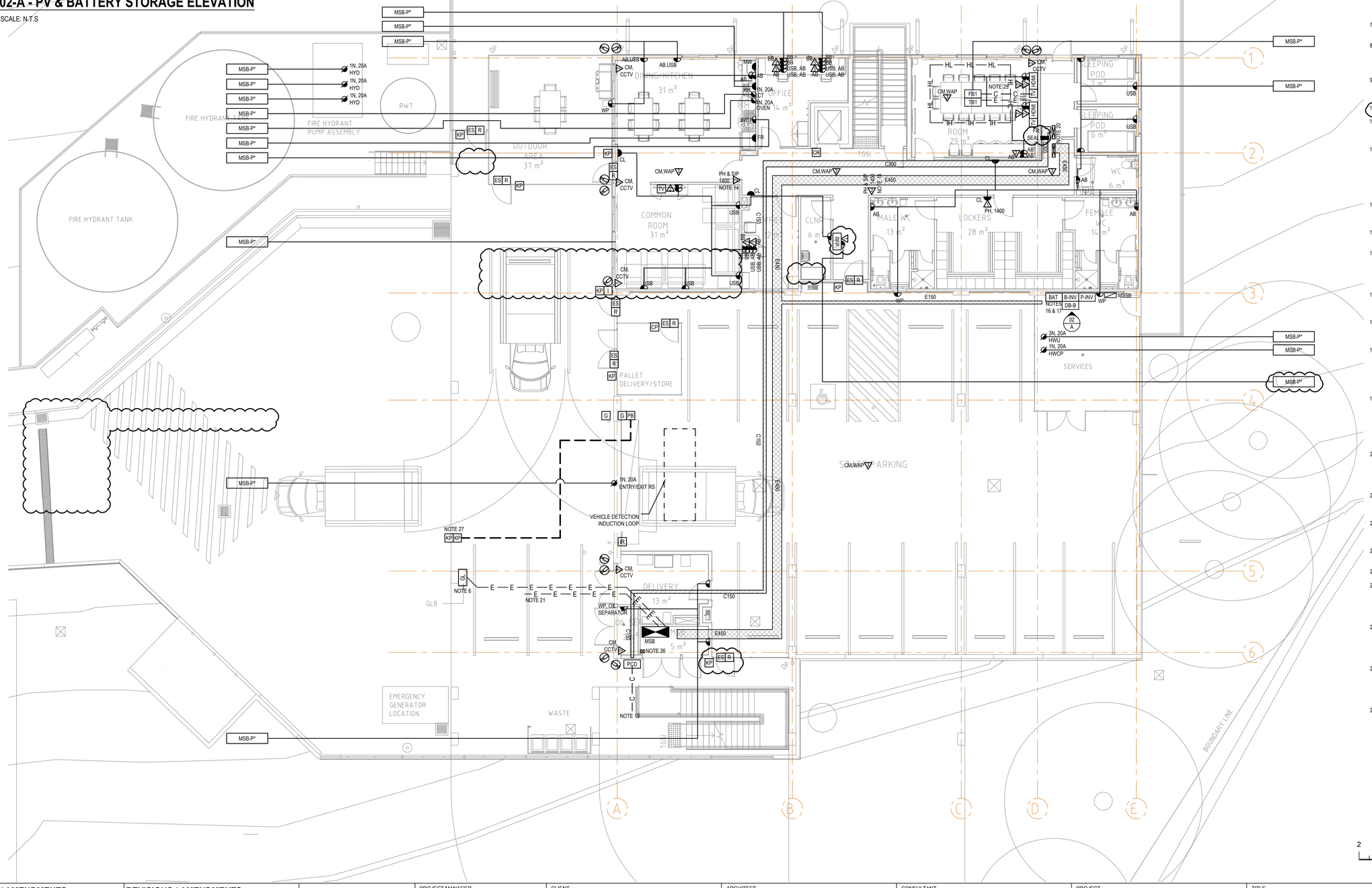


CLEAR SPACE TO EITHER SIDE OF THE ARRANGEMENT

EQUIPMENT DESCRIPTION:
- BAT = WALL-MOUNTED BATTERY TESLA POWERWALL 2 14kWh. DIM: 1150H x 750W x 250D mm
- GAT = GATEWAY FOR COMMUNICATIONS. DIM: 580H x 380W x 200D mm
- DB-B = BATTERY-BACKED IP-RATED DISTRIBUTION BOARD (LOAD CENTRE). DIM: 150H x 300W x 100D mm
- BAT INV = DEDICATED INVERTER FOR THE BATTERY FRONIUS 1-PH 5kW. DIM: 630H x 430W x 260D mm
- PV INV = INVERTER FOR PV SYSTEM ON THE ROOF SOLAREDGE 3-PH 20kW. DIM: 730H x 510W x 260D mm
- SPACE CLEARANCE REQUIRED IN FRONT OF THE ARRANGEMENT: 900mm
- TOTAL FOOTPRINT REQUIRED: 1960H x 3057W x 1200D mm

02-A - PV & BATTERY STORAGE ELEVATION

SCALE: N.T.S



NOTES:

1. FOR LEGEND AND NOTES, REFER TO DRAWING R25-EL-DRG-0001.
2. THE ELECTRICAL AND COMMUNICATIONS CONTRACTORS MUST CO-ORDINATE WITH OTHER TRADES WHEN INSTALLING POWER AND DATA OUTLETS. REFER TO ARCHITECTURAL ROOM DATA SHEETS AS REQUIRED. IF UNSURE OF LOCATIONS, SUBMIT AND RFI FOR REVIEW AND CLARIFICATION.
3. FINAL LOCATION OF ALL EQUIPMENT SHALL BE CONFIRMED ON SITE AND WITH REFERENCE TO ARCHITECTURAL ROOM DATA SHEETS.
4. THE ELECTRICAL CONTRACTOR MUST CO-ORDINATE WITH THE OTHER TRADES WHEN INSTALLING POWER OUTLETS FOR THEIR EQUIPMENT. REFER TO OTHER TRADES DOCUMENTATION FOR FURTHER DETAILS.
5. GPOs DENOTED WITH THE LABEL "AB, BAT" ARE TO BE FED FROM THE BATTERY-BACKED DB DB-B. THESE OUTLETS ARE TO HAVE BLUE COVER-PLATE AND BLUE FINISH.
6. CONTRACTOR TO SUPPLY AND INSTALL A GENERATOR LINK BOX RATED AT 150A TO CONNECT A MOBILE DIESEL GENERATOR TO BACK-UP THE SITE IN CASE OF POWER OUTAGE. REFER TO DWG R25-EL-DRG-0300 FOR FURTHER DETAILS.
7. FINAL QUANTITIES AND LOCATION OF POWER AND DATA OUTLETS FOR MEDICAL STORE ROOM TO BE COORDINATED WITH SPACE LOGIC FURNITURE LAYOUTS.
8. ROLLER DOORS TO BE PROVIDED WITH INTERNAL BEAM DETECTION TO PREVENT THEM FROM CLOSING IF OBSTACLE IS IN THE WAY. ROLLER DOORS SHOULD NOT AUTOMATICALLY CLOSE WHEN ON BATTERY BACK UP POWER SUPPLY.
9. DATA OUTLETS FOR FUTURE PROVISIONS OF CCTV CAMERAS ARE TO BE PROVIDED AND INSTALLED AS SHOWN. CCTV ARE NOT REQUIRED TO BE PROVIDED AT THIS STAGE AS REQUESTED BY THE CLIENT.
10. NOT USED.
11. ALL EXTERNAL ACCESS CONTROL EQUIPMENT TO BE MINIMUM IP65 AND IK08 RATED. BUILDING PERIMETER DOORS WITH ELECTRONIC ACCESS CONTROL ARE TO BE CONFIGURED AS SAFE-SECURED.
12. VEHICLE INDUCTION LOOP TO OPERATE ONLY IN CASE THE DOOR IS IN PROCESS OF CLOSING. IF THE INDUCTION LOOP IS DETECTING VEHICLE DOOR SHOULD OPEN ONLY IN CASE IT IS IN PROCESS OF CLOSING. SIMILAR TO FUNCTIONING PRINCIPLE OF BEAM DETECTOR MOUNTED ON THE SIDE OF THE ROLLER DOORS. INDUCTION LOOP SHOULD NOT BE PASSING THROUGH ANY KIND OF CONSTRUCTION JOINTS. PROVIDE NECESSARY CONNECTION TO THE CAR PARK DOOR CONTROLLER TO MANUFACTURE'S REQUIREMENTS.
13. PUSH (MUSHROOM) BUTTON TO CONTROL EXIT AMBULANCE PLANT ROLLER SHUTTER DOOR FOR EARLY OPENING IN CASE OF EMERGENCY CALL. PROVIDE APPROPRIATE LABELING TO DIFFERENTIATE THE BUTTON.
14. DATA OUTLETS FOR PHONE AND SIP ARE TO BE ABOVE WHITEBOARDS/JOINERY. COORDINATE EXACT LOCATION ON SITE.
15. WALL MOUNTED SPEAKER ABOVE THE PHONE. SPEAKER TO BE CONNECTED TO THE PHONE BELOW. SPEAKER SHOULD AMPLIFY RING TONE OF THE PHONE SO IT WOULD BE POSSIBLE TO HEAR PHONE RINGING REGARDLESS OF THE BACKGROUND NOISE PRODUCED BY EQUIPMENT IN THE WASH BAY AND WHILE WASHING OF THE VEHICLES IS ONGOING.
16. 3-PH 25kW & 1-PH 5kW PV INVERTERS TO BE INSTALLED WITHIN THE SERVICE ENCLOSURE. REFER TO THE TOP LEFT CORNER OF THIS DWG FOR AN ELEVATION VIEW OF THE PV SYSTEM ARRANGEMENT.
17. A 1-PH 14kWh BATERY STORAGE TO BE INSTALLED WITHIN THE SERVICE ENCLOSURE. REFER TO THE TOP LEFT CORNER OF THIS DWG FOR AN ELEVATION VIEW OF THE PV SYSTEM ARRANGEMENT.
18. CONTRACTOR TO SUPPLY AND INSTALL 1xø80mm HDPVC COMMUNICATIONS CONDUITS AND ASSOCIATED WEATHERPROOF ROOF PENETRATIONS FROM THE UHF AND MATV ANTENNAS IN THE ROOF TO THE COMMS ROOM (1-OFF PER ANTENNA). THESE PENETRATION SHALL BE DONE OUTSIDE THE COMMS ROOM FOOTPRINT. REFER TO DWG R25-EL-DRG-0202 FOR PROPOSED LOCATION OF EACH ANTENNA.
19. NBN LEAD-IN CONDUIT FROM THE EXTERNAL NBN PIT SHALL BE TERMINATED WITH A TURN-UP CONDUIT DIRECTLY BELOW THE PCD EQUIPMENT, EXTERNALLY TO THE BUILDING FACADE. A NEW SURFACE-MOUNTED NBN LEAD-IN CONDUIT SHALL BE INSTALLED TO CONNECT THE PCD WITH THE PROPOSED COMMS TRAY INSIDE THE BUILDING AND TO THE COMMS ROOM ON GROUND FLOOR. REFER TO DWG R25-EL-DRG-0002 FOR EXTERNAL CARRIER CABLING RETICULATION AND TO DWG R25-EL-DRG-201 FOR COMMS ROOM ELEVATION DETAIL.
20. ELECTRICAL AND COMMUNICATIONS PENETRATIONS ON GROUND FLOOR SLAB FOR VERTICAL CABLING RETICULATION BETWEEN LOWER GROUND AND GROUND FLOORS. DIMENSIONS: 650x150mm EACH. CONTRACTOR TO PROVIDE FIRE SEALANT PILLOWS OR EQUIVALENT TO PROPERLY FIRE SEAL THE SLAB PENETRATION.
21. ELECTRICAL CONSUMER MAINS TURN-UP CONDUITS TO BE TERMINATED BELOW THE MSB. REFER TO DWG R25-EL-DRG-0002 FOR EXTERNAL ELECTRICAL CABLING RETICULATION.
22. CONTRACTOR TO PROVIDE A INTERCOM SYSTEM TO BE CONNECTED TO THE VoIP PHONE SYSTEM. REFER TO NSW AMBULANCE SECURITY SPECIFICATION FOR FURTHER DETAILS.
23. ACCESS CONTROL SYSTEM TO BE PROVIDED WITH ADDITIONAL BATTERY PACKS TO ACHIEVE A 24H AUTONOMY OF THE SYSTEM.
24. NOT USED.
25. CONTRACTOR TO SUPPLY AND INSTALL THE FOLLOWING IN-GROUND ELECTRICAL & COMMUNICATIONS CONDUITS TO SERVE THE FLOOR BOX FROM THE SOUTHERN WALL IN MEETING ROOM: 2xø32mm ELECTRICAL & 2xø32mm COMMS CONDUITS. HDMI PORTS BEHIND DISPLAYS TO BE WIRED BACK TO TABLE BOX
26. CONTRACTOR TO SUPPLY AND INSTALL NEW 200x150mm ELECTRICAL CABLE TRAY RISER AND ASSOCIATED PENO ON GF SLAB ON THE SOUTH-WEST CORNER OF THE AMBULANCE PLANT ROOM (DIRECTLY ABOVE THE MSB ROOM) FOR LIGHTING & POWER CABLING RETICULATION TO THE DEVICES ON THE SOUTHERN SIDE OF THE AMBULANCE PLANT ROOM.
27. CONTRACTOR TO SUPPLY & INSTALL DOUBLE HEIGHT BOLLARD WITH 2x PIN/PROXIMITY READER COMBO DEVICES AND ASSOCIATED CABLING RETICULATION TO OPERATE THE ROLLER DOOR TO THE LG CARPARK ROLLER DOOR. FINAL LOCATION TO BE COORDINATED ON SITE WITH CLIENT AND ARCHITECT.
28. CONTRACTOR TO PROVIDE DOUBLE-POLE SWITCH ISOLATOR FOR THE OVEN AND COOKTOP AND LOCATE THEM ABOVE BENCH.

2 1 0 2 4 6 8 m

1 : 100-A1 1 : 200-A3

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified
P1	09.02.22	PRELIMINARY ISSUE	J.G.
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified

RAIR Rural Ambulance Infrastructure Reconfiguration — Building the future response for our state

PROJECT MANAGER
LEVEL 16
44 MARKET STREET
SYDNEY NSW 2000
T +61 2 9299 3555
mace

CLIENT
NSW GOVERNMENT Health Infrastructure
NSW Ambulance

ARCHITECT
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects:
Andrew Hipwell 6562
Daniel Beekwilder 5192
64 Rose Street
Chippendale NSW 2008
Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street,
North Sydney
NSW 2060
Australia
+61 (02) 9437 1000
general@jhaengineers.com.au
www.jhaservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

KINGSCLIFF, NSW 2487

TITLE
ELECTRICAL SERVICES
LOWER GROUND FLOOR
POWER AND COMMUNICATIONS
LAYOUT

CONSTRUCTION ISSUE

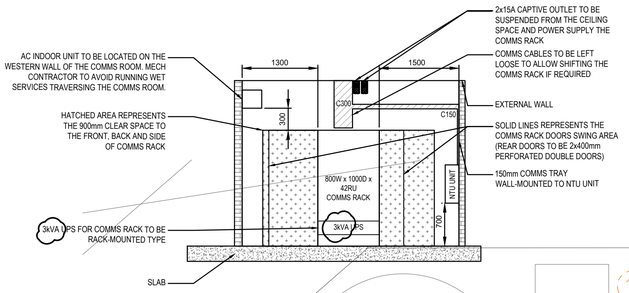
DRAWN	P.C.
CHECKED	J.G.
APPROVED	J.G.
CREATED	FEB 2022
JOB No.	210067

SCALE @ A1 **1:100**

DRAWING No. **R25-EL-DRG-0200**

REV **1**

S:\JOB No\Job No 20210000-20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0200.dwg



01-A COMMS ROOM SECTION

SCALE: N.T.S

2 1 0 2 4 6 8 m

1 : 100-A1 1 : 200-A3

NOTES:

1. FOR LEGEND AND NOTES, REFER TO DRAWING R25-EL-DRG-0001.
2. THE ELECTRICAL AND COMMUNICATIONS CONTRACTORS MUST CO-ORDINATE WITH OTHER TRADES WHEN INSTALLING POWER AND DATA OUTLETS. REFER TO ARCHITECTURAL ROOM DATA SHEETS AS REQUIRED. IF UNSURE OF LOCATIONS, SUBMIT AND RFI FOR REVIEW AND CLARIFICATION.
3. FINAL LOCATION OF ALL EQUIPMENT SHALL BE CONFIRMED ON SITE AND WITH REFERENCE TO ARCHITECTURAL ROOM DATA SHEETS.
4. THE ELECTRICAL CONTRACTOR MUST CO-ORDINATE WITH THE OTHER TRADES WHEN INSTALLING POWER OUTLETS FOR THEIR EQUIPMENT. REFER TO OTHER TRADES DOCUMENTATION FOR FURTHER DETAILS.
5. GPOs DENOTED WITH THE LABEL "AB, BAT" ARE TO BE FED FROM THE BATTERY-BACKED DB DB-B. THESE OUTLETS ARE TO HAVE BLUE COVER-PLATE AND BLUE FINISH.
6. CONTRACTOR TO SUPPLY AND INSTALL A GENERATOR LINK BOX RATED AT 200A TO CONNECT A MOBILE DIESEL GENERATOR TO BACK-UP THE SITE IN CASE OF POWER OUTAGE. REFER TO DWG R25-EL-DRG-0300 FOR FURTHER DETAILS.
7. FINAL QUANTITIES AND LOCATION OF POWER AND DATA OUTLETS FOR MEDICAL STORE ROOM TO BE COORDINATED WITH SPACE LOGIC FURNITURE LAYOUTS.
8. ROLLER DOORS TO BE PROVIDED WITH INTERNAL BEAM DETECTION TO PREVENT THEM FROM CLOSING IF OBSTACLE IS IN THE WAY. ROLLER DOORS SHOULD NOT AUTOMATICALLY CLOSE WHEN ON BATTERY BACK UP POWER SUPPLY.
9. DATA OUTLETS FOR FUTURE PROVISIONS OF CCTV CAMERAS ARE TO BE PROVIDED AND INSTALLED AS SHOWN. CCTV ARE NOT REQUIRED TO BE PROVIDED AT THIS STAGE AS REQUESTED BY THE CLIENT.
10. NOT USED.
11. ALL EXTERNAL ACCESS CONTROL EQUIPMENT TO BE MINIMUM IP65 AND IK08 RATED. BUILDING PERIMETER DOORS WITH ELECTRONIC ACCESS CONTROL ARE TO BE CONFIGURED AS SAFE-SECURED.
12. VEHICLE INDUCTION LOOP TO OPERATE ONLY IN CASE THE DOOR IS IN PROCESS OF CLOSING. IF THE INDUCTION LOOP IS DETECTING VEHICLE DOOR SHOULD OPEN ONLY IN CASE IT IS IN PROCESS OF CLOSING, SIMILAR TO FUNCTIONING PRINCIPLE OF BEAM DETECTOR MOUNTED ON THE SIDE OF THE ROLLER DOORS. INDUCTION LOOP SHOULD NOT BE PASSING THROUGH ANY KIND OF CONSTRUCTION JOINTS. PROVIDE NECESSARY CONNECTION TO THE CAR PARK DOOR CONTROLLER TO MANUFACTURE'S REQUIREMENTS.
13. PUSH (MUSHROOM) BUTTON TO CONTROL EXIT AMBULANCE PLANT ROLLER SHUTTER DOOR FOR EARLY OPENING IN CASE OF EMERGENCY CALL. PROVIDE APPROPRIATE LABELING TO DIFFERENTIATE THE BUTTON.
14. DATA OUTLETS FOR PHONE AND SIP ARE TO BE ABOVE WHITEBOARDS/JOINERY. COORDINATE EXACT LOCATION ON SITE.
15. WALL MOUNTED SPEAKER ABOVE THE PHONE. SPEAKER TO BE CONNECTED TO THE PHONE BELOW. SPEAKER SHOULD AMPLIFY RING TONE OF THE PHONE SO IT WOULD BE POSSIBLE TO HEAR PHONE RINGING REGARDLESS OF THE BACKGROUND NOISE PRODUCED BY EQUIPMENT IN THE WASH BAY AND WHILE WASHING OF THE VEHICLES IS ONGOING.
16. 3-PH 25kW & 1-PH 5kW PV INVERTERS TO BE INSTALLED WITHIN THE SERVICE ENCLOSURE. REFER TO THE TOP LEFT CORNER OF THIS DWG FOR AN ELEVATION VIEW OF THE PV SYSTEM ARRANGEMENT.
17. A 1-PH 14kWh BATERY STORAGE TO BE INSTALLED WITHIN THE SERVICE ENCLOSURE. REFER TO THE TOP LEFT CORNER OF THIS DWG FOR AN ELEVATION VIEW OF THE PV SYSTEM ARRANGEMENT.
18. CONTRACTOR TO SUPPLY AND INSTALL 1xø80mm HDPVC COMMUNICATIONS CONDUITS AND ASSOCIATED WEATHERPROOF ROOF PENETRATIONS FROM THE UHF AND MATV ANTENNAS IN THE ROOF TO THE COMMS ROOM (1-OFF PER ANTENNA). THESE PENETRATION SHALL BE DONE OUTSIDE THE COMMS ROOM FOOTPRINT. REFER TO DWG R25-EL-DRG-0202 FOR PROPOSED LOCATION OF EACH ANTENNA.
19. NBN LEAD-IN CONDUIT FROM THE EXTERNAL NBN PIT SHALL BE TERMINATED WITH A TURN-UP CONDUIT DIRECTLY BELOW THE PCD EQUIPMENT, EXTERNALLY TO THE BUILDING FACADE. A NEW SURFACE-MOUNTED NBN LEAD-IN CONDUIT SHALL BE INSTALLED TO CONNECT THE PCD WITH THE PROPOSED COMMS TRAY INSIDE THE BUILDING AND TO THE COMMS ROOM ON GROUND FLOOR. REFER TO DWG R25-EL-DRG-0002 FOR EXTERNAL CARRIER CABLING RETICULATION REFER TO DWG R25-EL-DRG-0002 FOR EXTERNAL CARRIER CABLING RETICULATION AND TO DWG R25-EL-DRG-0200 FOR COMMS CABLING RETICULATION ON GROUND FLOOR.
20. ELECTRICAL AND COMMUNICATIONS PENETRATIONS ON GROUND FLOOR SLAB FOR VERTICAL CABLING RETICULATION BETWEEN LOWER GROUND AND GROUND FLOORS. DIMENSIONS: 650x150mm EACH
21. ELECTRICAL CONSUMER MAINS TURN-UP CONDUITS TO BE TERMINATED BELOW THE MSB. REFER TO DWG R25-EL-DRG-0002 FOR EXTERNAL ELECTRICAL CABLING RETICULATION.
22. CONTRACTOR TO PROVIDE A INTERCOM SYSTEM TO BE CONNECTED TO THE VoIP PHONE SYSTEM. REFER TO NSW AMBULANCE SECURITY SPECIFICATION FOR FURTHER DETAILS.
23. ACCESS CONTROL SYSTEM TO BE PROVIDED WITH ADDITIONAL BATTERY PACKS TO ACHIEVE A 24H AUTONOMY OF THE SYSTEM.
24. NOT USED.
25. CONTRACTOR TO SUPPLY AND INSTALL THE FOLLOWING IN-GROUND ELECTRICAL & COMMUNICATIONS CONDUITS TO SERVE THE FLOOR BOX FROM THE SOUTHERN WALL IN MEETING ROOM: 2xø32mm ELECTRICAL & 2xø32mm COMMS CONDUITS. HDMI PORTS BEHIND DISPLAYS TO BE WIRED BACK TO TABLE BOX.
26. CONTRACTOR TO SUPPLY AND INSTALL NEW 200x150mm ELECTRICAL CABLE TRAY RISER AND ASSOCIATED PENO ON GF SLAB ON THE SOUTH-WEST CORNER OF THE AMBULANCE PLANT ROOM (DIRECTLY ABOVE THE MSB ROOM) FOR LIGHTING & POWER CABLING RETICULATION TO THE DEVICES ON THE SOUTHERN SIDE OF THE AMBULANCE PLANT ROOM.
27. PROVIDE PID/PROXIMITY CARD COMBO DEVICE MOUNTED ON A BOLLARD EXTERNALLY ON THE EASTERN SIDE OF THE DRIVEWAY AND TO OPERATE THE ENTRY ROLLER DOOR. FINAL LOCATION TO BE COORDINATED WITH CLIENT ON SITE. CONTRACTOR TO PROVIDE 2xø32mm ELECTRICAL AND COMMUNICATIONS CONDUITS CASTED-IN THE GF SLAB FOR POWER & SECURITY CABLING RETICULATION FROM THE MSB ON LG FLOOR AND COMMS ROOM ON GF RESPECTIVELY.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified
P1	09.02.22	PRELIMINARY ISSUE	J.G.
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified

RAIR Rural Ambulance Infrastructure Reconfiguration — Building the future response for our state

PROJECT MANAGER
LEVEL 16
44 MARKET STREET
SYDNEY NSW 2000
T +61 2 9299 3555
mace

CLIENT
NSW GOVERNMENT Health Infrastructure
NSW Ambulance

ARCHITECT
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects:
Andrew Hjwell 6562
Daniel Beekwilder 5192
64 Rose Street
Chippendale NSW 2008
Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street,
North Sydney
NSW 2060
Australia
+61 (02) 9437 1000
general@jhaengineers.com.au
www.jhaservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

KINGSCLIFF, NSW 2487

TITLE
ELECTRICAL SERVICES
GROUND FLOOR
POWER AND COMMUNICATIONS
LAYOUT

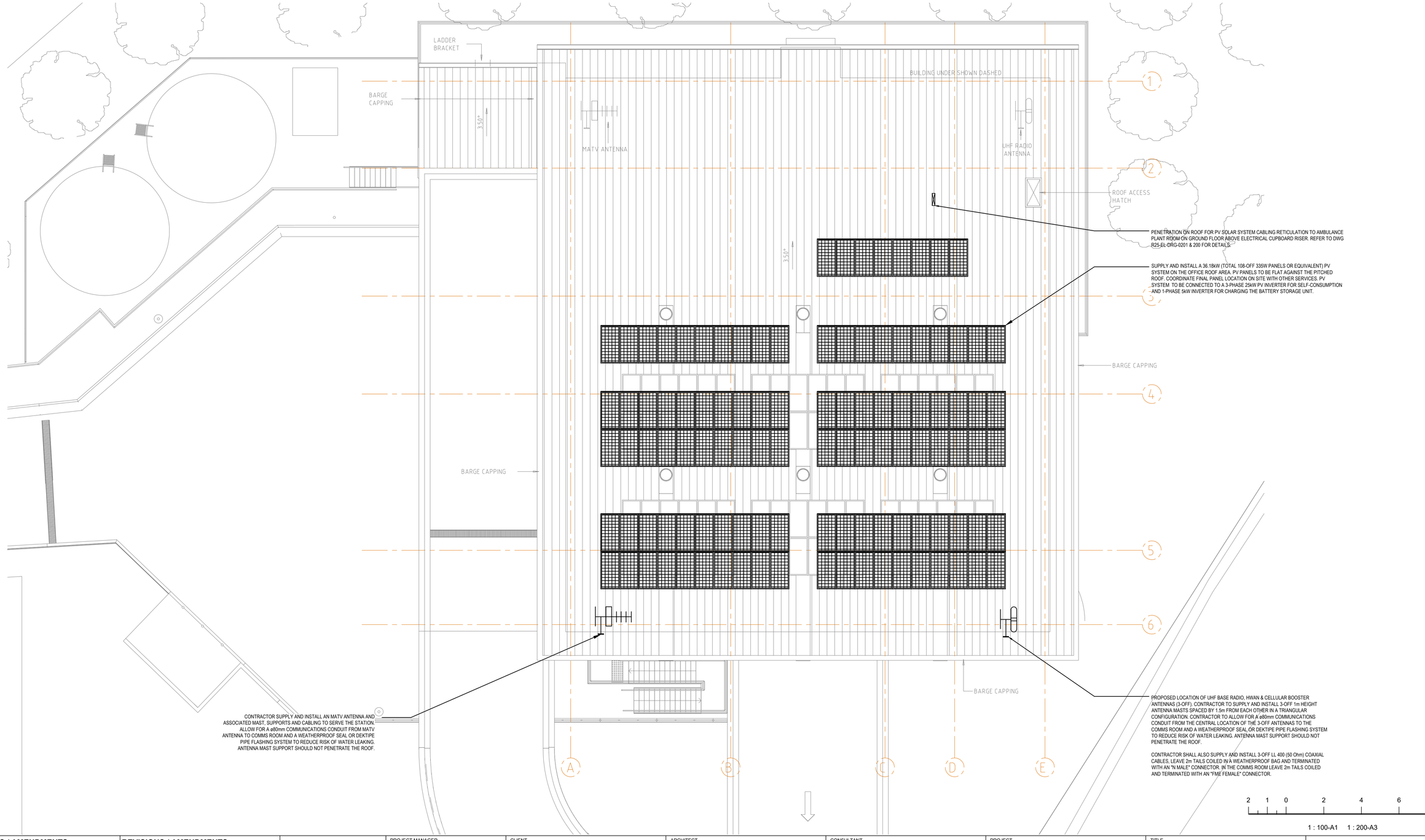
CONSTRUCTION ISSUE

DRAWN	P.C.	SCALE @ A1
CHECKED	J.G.	1:100
APPROVED	J.G.	
CREATED	FEB 2022	
JOB No.	210067	
DRAWING No.		REV
R25-EL-DRG-0201		1

S:\JOB No\Job No 20210000-20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0201.dwg

NOTES:

1. CONTRACTOR TO SUPPLY AND INSTALL A 36.18kW PV SYSTEM ON THE ROOF SPACE AS DENOTED IN THIS LAYOUT. THIS SYSTEM SHALL BE CONNECTED TO 1-OFF 3-PHASE 25kW PV INVERTER FOR SELF-CONSUMPTION AND 1-OFF 1-PHASE 5kW INVERTER TO CHARGE THE BATTERY STORAGE UNIT. REFER TO JHA SPECIFICATION AND DWG R25-EL-DRG-0200 FOR FURTHER DETAILS.
2. CONTRACTOR TO SUPPLY AND INSTALL A 14kWh BATTERY STORAGE UNIT SIMILAR TO TESLA POWERWALL 2 AND ASSOCIATED CABLING AND ACCESSORIES. A 40% OF THE ENERGY STORAGED WILL BE USED TO POWER SUPPLY THE EXIT ROLLER SHUTTER WITHIN THE AMBULANCE PLANT ROOM, THE COMMUNICATIONS RACK AND 4-OFF LIGHT FITTINGS VIA A NEW LOAD CENTRE (DB-B) LOCATED INSIDE THE SERVICE ENCLOSURE. SUR-PLUS ENERGY IS TO BE USED FOR SELF-CONSUMPTION. REFER TO JHA SPECIFICATION AND DWG R25-EL-DRG-0200 FOR FURTHER DETAILS.



2 1 0 2 4 6 8 m

1 : 100-A1 1 : 200-A3

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified
P1	09.02.22	PRELIMINARY ISSUE	J.G.
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified

RAIR Rural Ambulance Infrastructure Reconfiguration
Building the future response for our state

PROJECT MANAGER
mace
LEVEL 16
44 MARKET STREET
SYDNEY NSW 2000
T +61 2 9299 3566

CLIENT
NSW GOVERNMENT Health Infrastructure
NSW Ambulance

ARCHITECT
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects:
Andrew Hipwell 6562
Daniel Beekwilder 5192
64 Rose Street
Chippendale NSW 2008
Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street,
North Sydney
NSW 2060
Australia
+61 (02) 9437 1000
general@jhaengineers.com.au
www.jhaservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

KINGSCLIFF, NSW 2487

TITLE
ELECTRICAL SERVICES
ROOF PLAN
POWER AND COMMUNICATIONS LAYOUT

CONSTRUCTION ISSUE

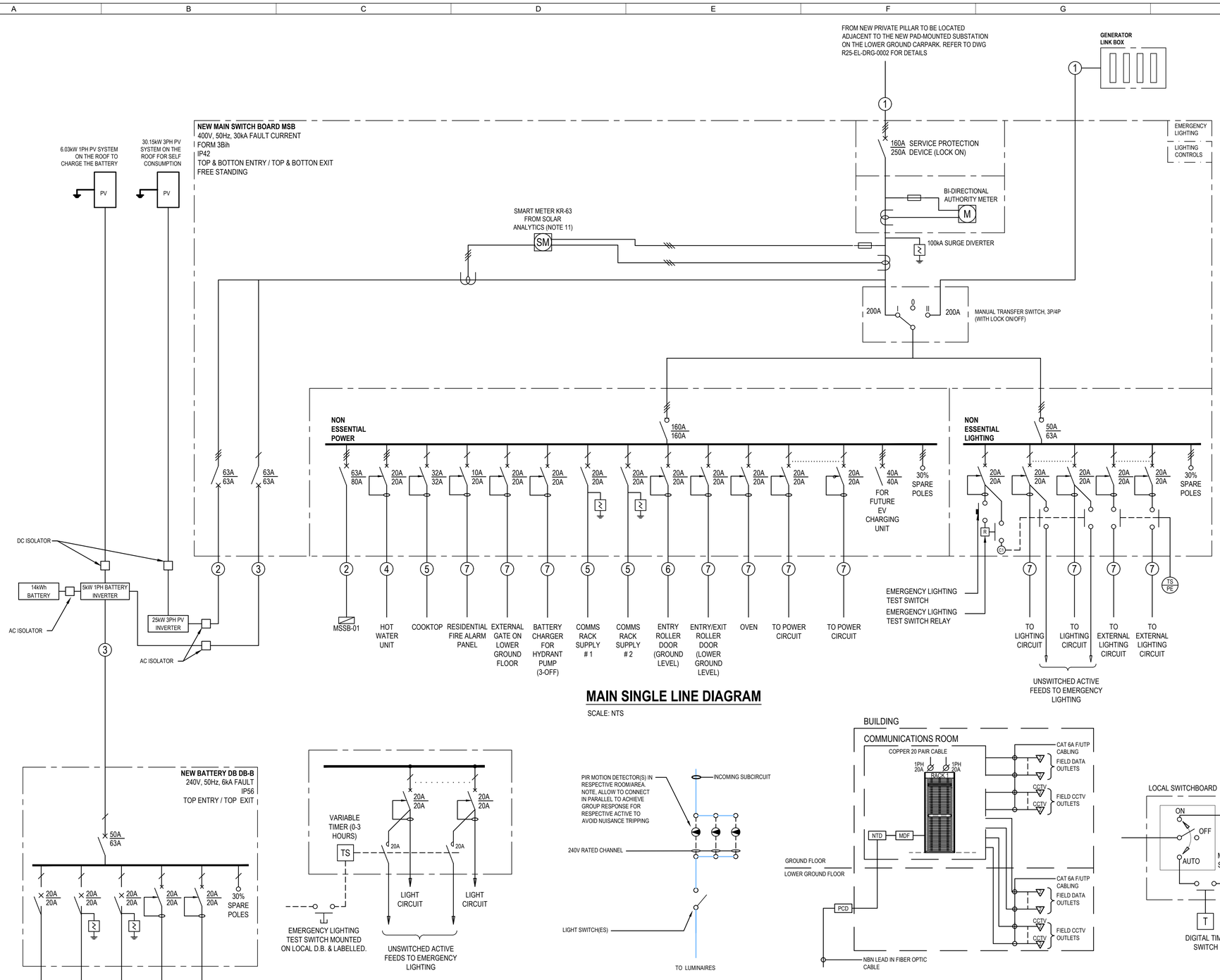
DRAWN	P.C.
CHECKED	J.G.
APPROVED	J.G.
CREATED	FEB 2022
JOB No.	210067

SCALE @ A1 **1:100**

DRAWING No. **R25-EL-DRG-0202**

REV **1**

S:\JOB No\Job No 20210000-20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0202.dwg



MAIN SINGLE LINE DIAGRAM

SCALE: NTS

NOTES:

1. ENSURE THE SWITCHBOARDS ARE SIZED TO FIT THE CUPBOARD SPACE PROVIDED ON SITE. THE CONTRACTOR MUST MEASURE EXACT DIMENSIONS ON SITE PRIOR TO DEVELOPMENT OF SHOP DRAWINGS. THE CONTRACTOR WILL NEED TO CONFIRM IN WRITING AND DEVELOP SHOP DRAWINGS FOR REVIEW PRIOR TO MANUFACTURING.
2. REFER TO THE ELECTRICAL SPECIFICATION FOR FURTHER DETAILS. THE CONTRACTOR MUST ENSURE TO SUBMIT SHOP DRAWINGS TO THE AUTHORITIES PRIOR TO SUBMITTING FOR CONSULTANT APPROVAL.
3. ALL WORKS SHALL BE IN ACCORDANCE WITH AS/NSZ 3000:2018 AND NSW SERVICE AND INSTALLATION RULES.
4. DEDICATED SWITCHBOARD CUPBOARDS ARE TO HAVE "NOT TO BE USED FOR STORAGE" SIGN READILY DISPLAYED.
5. ELECTRICAL CONTRACTOR TO ENSURE ALL CIRCUIT BREAKERS DISCRIMINATES WITH ALL UPSTREAM PROTECTION DEVICES.
6. PROVIDE "AS INSTALLED" SITE RETICULATION DIAGRAM (A3 SIZE) LAMINATED SHEET WITHIN MSB ROOM AND WITHIN EACH MDB CUPBOARD.
7. SEE SPECIFICATION FOR DETAILS FOR INDIVIDUAL CIRCUITS SURGE PROTECTION REQUIREMENT. REFER ALSO TO DRAWINGS FOR RELATED CIRCUITS WHICH REQUIRE SURGE PROTECTION.
8. SUPPLY INDIVIDUAL SURGE PROTECTION TO FINAL SUB-CIRCUITS AS INDICATED ON THE ELECTRICAL SPECIFICATION (DISTRIBUTION BOARDS SECTION).
9. CABLES FOR 20A LIGHTING/POWER SUB-CIRCUIT SHALL BE MINIMUM 1x2c x 2.5mm² Cu PVC + E. ALLOW FOR DEDICATED RCD FOR EACH CIRCUIT TO AS/NZS 3000 REQUIREMENTS.
10. PV AND BATTERY STORAGE SYSTEM IS BASED ON THE 25kW 3PH PV INVERTER, 5kW 1PH SOLAR STORAGE INVERTER AND 14kWh 1PH TESLA POWERWALL 2 EQUIPMENT AS PART OF A SINGLE SOLUTION. A DEVIATION FROM THIS APPROACH WILL REQUIRE A RE-DESIGN BY THE CONTRACTOR OF THE SYSTEM SHOWN AND IT SHOULD BE PRESENTED TO THE PRINCIPAL AND JHA FOR REVIEW AND APPROVAL. REFER TO DWGs R25-EL-DRG-0002, R25-EL-DRG-0200 & JHA SPECIFICATION FOR DETAILS. BATTERY TO BE CONFIGURED TO BACK-UP THE FOLLOWING LOADS:
    - EXIT ROLLER DOOR WITHIN THE AMBULANCE PLANT ROOM
    - 2x20A GPO FOR POWER SUPPLY THE COMMS RACKS
    - 1x10A POWER SUB-CIRCUIT TO SERVE 3xDGPOs IN THE ADMIN AREA
    - LIGHT FITTINGS WITHIN THE ADMIN AREA AND COMMS ROOM
11. CONTRACTOR TO SUPPLY AND INSTALL THE SMART METER KR-63 WITH 4G MODEM MODULE FROM SOLAR ANALYTICS AND THE ASSOCIATED AND COMPATIBLE CT'S FOR THIS CONFIGURATION. CONTRACTOR SHALL PAY FOR A 5-YEAR SUBSCRIPTION FEE FOR SOLAR ANALYTICS MONITORING SERVICE. THE DEVICE SHALL BE CONFIGURED TO MONITOR THE TOTAL ENERGY CONSUMPTION OF THE SITE AND MONITOR THE AC OUTPUT OF THE INVERTERS. CONTRACTOR SHALL ENSURE THAT THE SYSTEM IS COMMISSIONED, TESTED AND THE DATA IS DISPLAYING CORRECTLY. REFER TO JHA SPECIFICATION FOR DETAILS.

CABLE No.	CABLE DESCRIPTION
1	4 x 1c x 70mm² Cu + EARTH XLPE/PVC
2	1 x 4c x 25mm² Cu + EARTH Cu XLPE/PVC
3	1 x 2c x 25mm² Cu + EARTH Cu XLPE/PVC
4	1 x 4c x 4mm² + EARTH Cu XLPE/PVC
5	1 x 2c x 6mm² Cu + EARTH XLPE/PVC
6	1 x 2c x 4mm² + EARTH Cu XLPE/PVC
7	1 x 2c x 2.5mm² + EARTH Cu XLPE/PVC
8	1 x 2c x 10mm² + EARTH Cu XLPE/PVC

CABLE SCHEDULE

TYPICAL EMERGENCY LIGHTING TEST CIRCUIT SCHEMATIC

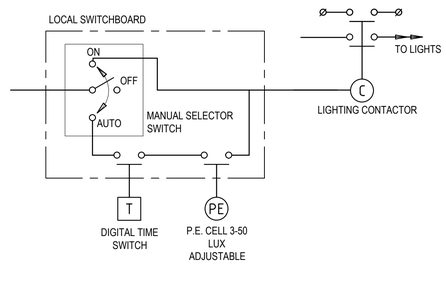
SCALE: N.T.S.

CONTROL CIRCUIT FOR LUMINAIRES CONTROLLED BY MOTION DETECTOR

SCALE: N.T.S.

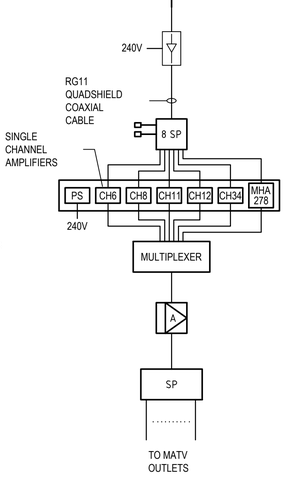
TYPICAL COMMUNICATIONS DIAGRAM

SCALE: N.T.S.



EXTERNAL LIGHTING TIME SWITCH / PE CELL CONTROL SCHEMATIC

SCALE: N.T.S.



TYPICAL MATV DIAGRAM

SCALE: N.T.S.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified
A	25.02.22	TENDER ISSUE	J.G.
B	29.04.22	REVISED TENDER ISSUE	J.G.
1	20.07.22	CONTRACT SET ISSUE	J.G.

REVISIONS / AMENDMENTS

Rev	Date	Description	Verified

RAIR — Rural Ambulance Infrastructure Reconfiguration — Building the future response for our state

PROJECT MANAGER
LEVEL 16
44 MARKET STREET
SYDNEY NSW 2000
T +61 2 9299 3555
mace

CLIENT
NSW GOVERNMENT Health Infrastructure
NSWAmbulance

ARCHITECT
djrd architects
T +612 9319 2955
ABN: 48 942 921 969
Nominated Architects:
Andrew Hipwell 6562
Daniel Beekwilder 5192
64 Rose Street
Chippendale NSW 2008
Sydney Australia
djrd.com.au

CONSULTANT
JHA
Level 23, 101 Miller Street,
North Sydney
NSW 2060
Australia
+61 (02) 9437 1000
general@jhaengineers.com.au
www.jhaservices.com

PROJECT
RURAL AMBULANCE INFRASTRUCTURE RECONFIGURATION PROGRAM (RAIR)

KINGSCLIFF, NSW 2487

TITLE
ELECTRICAL SERVICES
ELECTRICAL SCHEMATICS

CONSTRUCTION ISSUE

DRAWN	P.C.	SCALE @ A1
CHECKED	J.G.	N.T.S.
APPROVED	J.G.	
CREATED	FEB 2022	
JOB No.	210067	
DRAWING No.		REV
R25-EL-DRG-0300		1

S:\JOB No\Job No 20210000-20210099\210067 RAIR Building Services Consultants\Drawings\Electrical\Kingscliff\R25-EL-DRG-0300.dwg

ENGINEERING SPECIFICATION FOR ELECTRICAL SERVICES

R25 – RAIR KINGSCLIFF
KINGSCLIFF NSW

ISSUE	COMMENT	DATE	PREPARED BY	JOB NO.
A	TENDER ISSUE	25/02/2022	JG	210067
B	REVISED TENDER ISSUE	29/04/2022	JG	210067
1	CONTRACT SET ISSUE	20/07/2022	JG	210067

JHA CONSULTING ENGINEERS

LEVEL 23

101 MILLER STREET

NORTH SYDNEY NSW 2060

PH: (02) 9437 1000

JHA

JHASERVICES.COM

TABLE OF CONTENTS

SECTION 1 - GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 PROGRAMME

Programming

The electrical Contractor shall comply with the builder's construction programme. The following are the key items for the electrical Contractor to procure early to avoid delays.

- Procurement of the main switchboard,
- Purchase of all light fittings,
- Installation and commissioning of the new main switchboards,
- NBN lead-in conduit and cabling

1.1.2 GENERAL

Precedence

Requirements of individual technical sections of the specification override conflicting requirements in this section.

Any discrepancy between specification and drawings shall be advised via RFI during tender.

Co-ordination

The Contractor shall be responsible for continuous and thorough co-ordination with all other services and trades during the installation of electrical services.

This will require that the Contractor read and familiarise themselves with the documents and drawings issued by the architect, structural, mechanical, hydraulic, audio visual and fire services engineers and these documents as required ensuring no interference between the trades before work in an area has begun. The Contractor will be responsible for rectification of any problems or changes that occur as a result of poor or non-existent co-ordination.

General Design Requirements

The requirements of this document are intended to outline the minimum design requirements, to ensure compliance with all relevant statutory authorities and to ensure that the most cost effective and energy efficient solutions are achieved for the proposed project.

In addition, the contractor shall produce design drawings, perform calculations, tabulate results and provide qualitatively descriptive reports to confirm design intent and compliance of all objectives and performance criteria requirements described here-in. Provide as a minimum type written and formatted calculations, tabulated results and qualitative description, provide all other manufacturer data and supporting data and literature showing derivations of calculations, for assessment prior to any approval.

The installer shall, prior to submitting the tender for the project, complete a site visit of the site to fully understand the scope of works and all conditions and restrictions of the site and the installation.

No variations will be accepted for difficulties that arise during the installation that were obvious from a site inspection prior to the tender being submitted and are not outlined within the tender submission.

Space

The Contractor shall ensure that all electrical equipment fits within the spaces provided and is suitable for the conditions. The Contractor shall ensure the availability of acceptable equipment before any electrical work commences.

1.2 REFERENCED DOCUMENTS

Current editions

Use referenced documents, which are editions, with amendments, current at the approval of the Development Application for the site, except where other editions or amendments are required by statutory authorities.

Contractual relationships

Responsibilities and duties of the principal, contractor and project manager are not altered by requirements in referenced documents.

General standards

The work must comply with the following standards;

Electrical work: To AS/NZS 3000:2018.

Switchboards: To AS/NZS 61439.1:2016

Degree of protection: To AS 60529.

Communications: To AS/NZS 11801.1 and AS/CA S008:2020 and S009:2020

Emergency & exit lighting: To AS/NZS 2293 series & NCC 2019

Cables: To AS/NZS 3008

Fire Services: To AS 3786

Lighting: To AS/NZS 1680 series

External Lighting: To AS/NZS 1158 series & AS/NZS 4282:2019

AS/NZS 11801.1:	Generic telecommunications cabling for customer premises Office premises.
AS/NZS 3084:	Telecommunication services pathways and spaces for commercial buildings.
AS/NZS 3085.1:	Telecommunications installations - Administration of Communications Cabling Systems
AS/NZS IEC 61935.1:	Testing of balanced communication cabling in accordance with ISO/IEC 11801—Installed cabling
AS/NZS IEC 61935.2:	Testing of balanced communication cabling in accordance with ISO/IEC 11801—Patch cords and work area cords
AS 4332-2004	The Storage and Handling of Gases in Cylinders – Design Implications – Safety in Design.

ACMA Standard AS/CA S008 (formerly AUSTEL): Requirements of Authorised cabling products.

ACMA Standard AS/CA S009 (formerly AUSTEL): Installation requirements for customer cabling.

Standards Australia Communication Cabling Manuals (CCM)

Building Code of Australia 2019.

NSW Services and Installation Rules.

NSW Health Infrastructure Engineering Services Guidelines (ESG) – 2016

NSW Health Infrastructure ICT Cabling Standard – Rev 3.0 July 2018

NSW Health Protecting People and Property Standard – 2013

NSW Health Wi-Fi Standard

NSW Ambulance – RAIR Group 1 ICT Standard

NSW Ambulance – Electronic Security System – Standard Specification – Rev 3 Jun 2019

NSW Ambulance – How to Build an Ambulance Station – Rev 2.0 July 2021

NSW Ambulance – ICT Cabling Brief NSW Ambulance Stations V1.1

Authorities

Ensure all specifications (diagrammatic or textual), all electrical services, all relevant materials and all equipment comply with the requirements of all regulatory authorities having jurisdiction over the site - including but not limited to the following:

- ACA

- Local Council
- Local Supply Authority
- Telstra (NBN)
- State Government Department of Environment and Heritage
- State Government, Division of Workplace, Health and Safety
- State Fire and Rescue Authority

If any of the responsible Authorities, pursuant to the statutory powers vested in them, elect to perform, supply, inspect or test wholly or part of the works, make all necessary arrangements and co-ordinate with the Authorities.

1.2.1 INTERPRETATIONS

General

Unless the context otherwise requires, the following definitions apply:

Supply: "Supply", "furnish" and similar expressions mean "supply only".

Install: "Install", "fix" and similar expressions mean "install only".

- Provide: "Provide" and similar expressions mean "supply and install".
- Approved: "Approved", "reviewed", "directed", "rejected", "endorsed" and similar expressions mean "approved (reviewed, directed, rejected, endorsed) in writing by the project manager".
- Give notice: "Give notice", "submit", "advise", "inform" and similar expressions mean "give notice (submit, advise, inform) in writing to the project manager ".
- Obtain: "Obtain", "seek" and similar expressions mean "obtain (seek) in writing from the superintendent".
- Proprietary: "Proprietary" mean identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Sample: Includes samples, prototypes and sample panels.

1.2.2 TESTS

Except where otherwise defined in referenced documents, the following definitions apply:

- Pre-completion tests: Tests carried out before completion tests.
- Type tests: Tests carried out on an item identical with a production item, before delivery to the site.
- Production tests: Tests carried out on the purchased equipment, before delivery to the site.
- Site tests: Tests carried out on site.
    - Completion tests: Acceptance tests and final tests.
    - Acceptance tests: Tests carried out on completed installations or systems and, except for final tests, before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements.
    - Final tests: Acceptance tests carried out before completion of the maintenance period.

1.2.3 MAINTENANCE PERIOD

Co-extensive with the defects liability period.

1.3 CONTRACT DOCUMENTS

1.3.1 GENERAL

Diagrammatic layouts: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable. Before commencing

work, obtain measurements and other necessary information and co-ordinate with the latest issue of drawings on site.

1.4 DESIGN

1.4.1 ELECTRICAL SUPPLY SYSTEM

415 V, 3-phase, 4-wire, 50 Hz.

1.4.2 RADIO FREQUENCY INTERFERENCE

Use equipment which generates interference within limits set by AS/NZS CISPR 14.1. If necessary, provide suppression devices. If appropriate, shield equipment to AS/NZS CISPR 14.1.

1.4.3 ELECTROMAGNETIC COMPATIBILITY

Electrical and electronic apparatus: To AS/NZS 61000.6.1.

1.4.4 FAULT LEVEL PROTECTION

To withstand the fault level of the incoming supply at the equipment location (main switchboard busbars shall be minimum 30kA or as confirmed by the supply authority).

Contractor/ switchboard builders to submit grading studies to ensure full discrimination of circuit breakers.

1.5 QUALITY

1.5.1 INSPECTION

Notice

General: If notice of inspection is to be given in respect of parts of the works, do not conceal those parts without approval.

Minimum notice for inspections to be made: 4 hours for on-site inspectors, otherwise 2 working days.

1.5.2 TESTS

Notice

General: Give sufficient notice so that designated tests may be witnessed. Do not carry out designated tests without approval.

Minimum notice for tests to be witnessed:

- 5 working days for site tests; and
- 10 working days for local pre-delivery tests.

Testing authorities

General: Except for site tests, have tests carried out by authorities accredited by NATA to test in the relevant field, or an organisation outside Australia recognised by NATA through a mutual recognition agreement. Co-operate as required with testing authorities.

The Contractor shall make all arrangements to have the total installation inspected by the local Authorities having jurisdiction over the works (i.e.: Supply Authority, AUSTEL etc.) and attend to all notices served by such Authorities complete with the payment of all fees, charges, levies etc. as required.

Site tests

Use instruments calibrated by authorities accredited by NATA.

If tests are to be carried out on parts of the works, do not conceal those parts and do not commence further work on those parts until the tests have been satisfactorily completed and compliance verified.

1.6 SAMPLES

The Contractor shall submit the following samples for approval by the project manager:

- All light fittings;
- All outlets and switches;
- Security card readers, electric strikes/ Mortise locks, duress buttons and reed switches;
- Floor boxes;
- Intercom systems;

1.6.1 APPROVAL

General: Do not commence work affected by samples until the samples have been approved by project manager. Submit further samples as necessary.

1.6.2 RETENTION

Keep approved samples in good condition on site, until practical completion.

1.6.3 INCORPORATION

Incorporate in the works samples which have been approved for incorporation. Do not incorporate other samples.

1.6.4 CRITERIA

Match approved samples throughout the works.

1.7 CONTRACTOR'S SUBMISSIONS

1.7.1 TIMING

General: Submit documents in a timely manner, to suit the construction program. Advise if any of the documents are to be returned.

Delays: Co-ordinate submissions of related items. Do not cause delays by making late or inadequate submissions.

1.7.2 QUANTITY

Bound documents: 3 copies.

Loose documents up to and including A3: One copy.

Loose documents larger than A3: One transparency on heavyweight plastic film the same size as the standard contract drawings.

1.7.3 IDENTIFICATION

Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements and product certification. Identify non-compliances with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

1.7.4 ENDORSEMENT

General: Do not commence work affected by contractor's submissions until, if appropriate, the submissions have been endorsed as satisfactory,

Errors: If a document contains errors, submit a new or amended document as appropriate, indicating changes since the previous submission.

1.7.5 SHOP DRAWINGS

General: Submit dimensioned drawings showing details of the fabrication and installation of all designed services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

The Contractor shall submit the following shop drawings for approval by the project manager:

- Main switchboard;
- Distribution boards;
- Telecommunication services;
- Final lighting, smoke alarm, power, data and security layouts;
- Lighting and Power Switch Panels Engraving Details;
- Cat 6A F/UTP Communications installation details, cabinet layouts and communication rooms layout;
- Intercom system schematics;
- External & Internal Lighting Control
- PV & Battery Storage System

1.7.6 AUTHORITIES

Correspondence: Submit copies of correspondence and notes of meetings with authorities.

Authorities' approvals: Submit documents showing approval of the authorities whose requirements apply to the work.

1.7.7 TESTS

Tests program: Submit a testing and commissioning program which is consistent with the construction program. Include particulars of test stages and procedures.

Test records: For designated tests, including pre-delivery tests, record results and submit reports or certificates in a form suitable for inclusion in operation and maintenance manuals.

1.7.8 MATERIALS AND COMPONENTS

Product data: For proprietary equipment, submit the manufacturer's product data including

- Technical specifications and drawings;
- Type test reports;
- Performance and rating tables; and
- Recommendations for installation and maintenance.

Proposed products schedules: For major products not specified as proprietary items, within 3 weeks of site possession submit a schedule of those proposed for use.
Product certification: If products must comply with product certification schemes, submit evidence of compliance.

1.7.9 INSTALLATION

Fixing of services: Submit typical details of locations, types and methods of fixing of services to structure, before installation.

Embedded services: Submit proposals for embedding services in concrete walls or floors, or chasing into concrete or masonry walls.

Inaccessible services: If services are to be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

1.8 MATERIALS AND COMPONENTS

1.8.1 GENERAL

Proprietary items

Implication: Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.

Alternatives: If alternatives are proposed, submit proposed alternatives and include samples, available technical information, reasons for proposed substitutions and cost. If necessary, provide an English translation. State if use of proposed alternatives will necessitate alteration to other parts of the works and advise consequent costs.

Manufacturers' or suppliers' recommendations

General: Select, if no selection is given, and transport, deliver, store, handle, protect, finish, adjust, prepare for use, and use manufactured items in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Instructions: Submit the recommendations and instructions, and advise of conflicts with other requirements.

Project modifications: Advise of activities that supplement, or are contrary to, manufacturers or suppliers' written recommendations and instructions.

Product certification: If products must comply with product certification schemes, use them in accordance with the certification requirements.

Sealed containers

If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

Consistency

For the whole quantity of each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

1.8.2 FACTORY FINISHES

Joint finishing

Finish visible joints made by welding, brazing or soldering using methods appropriate to the class of work (including grinding or buffing) before further treatment such as painting, galvanising or electroplating.

Preparation for coating

General: Before applying coatings to metalwork, complete cutting, drilling and other fabrication, and prepare surfaces to AS 1627.

Galvanising

General: To AS/NZS 4680 & AS/NZS 4792.

Minimum coating class: Z200.

Coating type for wire: Type A.

Thermoset powder coating

Preparation: Use chemical pre-treatments. If recommended, provide conversion coatings.

Internal use: To GPC P-155/1 or 4.

External use: To GPC P-155/2 or 5.

Finish: Full gloss.

Equipment paint system

Brush or spray application using paint to GPC specifications as follows:

- Prime coat to metal surfaces generally: P-32 or P-162.
- Prime coat to zinc-coated steel: P-13/4 or P-13/5.
- Undercoat: U-23.

- Full gloss enamel finish coats, oil and petrol resistant: E-24, two coats.

Two-pack liquid coating

Primer: Two-pack epoxy primer to GPC C-29/7.

Topcoat:

- Internal use: Proprietary polyurethane or epoxy acrylic system.
- External use: Proprietary polyurethane system.

Application: Spray.

Finish: Full gloss.

Air-drying enamel

Internal use:

- Primer: Two-pack epoxy primer to GPC C-29/7.
- Topcoats: 2 coats to GPC E-15/3.

Application: Spray or brush.

Finish: Full gloss.

Stoving enamel

Internal use:

- Primer: To GPC P-65.
- Topcoat: To GPC E-66/3.

Application: Spray or dip.

1.9 INSTALLATION

1.9.1 GENERAL

Installation

General: Install equipment and services plumb, fix securely and organise reticulated services neatly. Provide for movement in both structure and services. The Contractor shall be responsible for the design of equipment such that it fits within the space designated.

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements. Under suspended ground floors, keep services at least 150 mm clear above ground surface, additional to insulation, and ensure access is not impeded.

Lifting: Provide permanent fixtures attached to the equipment, for lifting heavy items of equipment, as recommended by the manufacturer.

1.9.2 SERVICES CONNECTIONS

Statutory authorities' requirements

If the authorities elect to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the authorities. Pay all fees as necessary associated with such works.

Connections

Connect to statutory authorities' services or service points. Excavate to locate and expose connection points. On completion reinstate the surfaces and facilities which have been disturbed.

1.9.3 SYSTEM INTEGRATION

General

Interconnect system elements so that the installations perform their designated functions.

1.9.4 WIRING

General

Concealed wiring: Conceal wiring runs, except within plant areas. Install concealed wiring so that it can be rewired easily and without damage to finishes or materials.

1.9.5 BUILDING PENETRATIONS

Piping sleeves

General: Provide metal or UPVC sleeves formed from pipe sections, for penetrations through building elements.

Sleeve diameter (for non-fire-rated building elements): Sufficient to provide an annular space around the service of at least 12 mm.

Minimum sleeve thickness:

- Metal: 1 mm.
- UPVC: 3 mm.

Sleeve terminations:

- If cover plates are fitted: Flush with the finished building surface.
- In floors draining to floor wastes: 50 mm above finished floor.
- In fire-rated and acoustic-rated building elements: 50 mm beyond finished building surface.
- Elsewhere: 5 mm beyond finished building surface.

Finish: Prime paint ferrous surfaces.

Support

All sub-circuit cabling for power, lighting communications, security and fire detection shall be supported by a catenary wire system from the cable trays located on site. In general, no more than 5 TPS cables shall be grouped on a catenary and no more than 20 security/comms cables shall be grouped on a catenary.

Cable sleeves

Provide UPVC sleeves formed from pipe sections, for penetrations through ground floor slabs and beams and external walls by cables not enclosed in conduit. In addition, for MIMS cables, provide sleeves for penetrations through masonry.

Fire rated building elements

Seal penetrations using a system to AS 4072.1.

Refer to the architectural drawings for the extent of fire rated walls and shafts. Install proprietary fire rated wall boxes for outlets and switches in all fire rated walls. Fire rated wall boxes to be Clipsal Fx57 series or equivalent.

Non-fire rated building elements

Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustic rated, maintain the rating.

Acoustically rated building elements of wet areas and all acoustically rated walls and ceilings indicated on the architectural details.

Seal penetrations around conduits and sleeves. Seal around cables within sleeves. Provide acoustic rated wall boxes where electrical accessories are to be recessed mounted.

Limitations

General: Do not penetrate or fix to the following without approval:

- Structural building elements including external walls, fire walls, floor slabs and beams.

- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings.

Membranes: If approval is given to penetrate membranes, provide a waterproof seal between the membrane and the penetrating component.

1.9.6 OUTLETS WITHIN AREAS WITH ACOUSTICS TREATMENT

Lighting switches, General purpose switched socket power outlets, Voice/Data outlets, TV outlets etc. installed on cavity side of walls are to be complete with acoustic wall box equal to HPM 430.

Individual cables should be sealed with approved acoustic sealants. Bunches of cables shall be drawn through a 5mm thick, 600mm long PVC conduit packed with acoustic insulation such as fibreglass, polyester and rockwool. Seal around the conduit by filling with a non-shrinking grout.

1.9.7 FIXING

General

If equipment and services are not suitable for fixing to non-structural building elements, fix directly to structure and trim around holes or penetrations in non-structural elements.

Fasteners

Use proprietary fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

1.9.8 MARKING

General

General: Mark equipment, electrical wiring, conduits and ducts, to provide a ready means of identification.

Conduits and ducts: To AS 1345, as applicable.

Labels

The Contractor shall allow for the labelling of all items of electrical equipment throughout the installation. Equipment shall include all general purpose outlets, permanent connections, light switches, telecommunication outlets, circuit breakers, contactors etc.

Labelling of standard bakelite outlets and switches shall be in the form of adhesive type labels behind a clip-on face plate. All other equipment shall be engraved traffolyte labelling.

Bakelite labelling (i.e.: GPO's etc.) shall clearly identify the origin DB of the sub-circuit plus its circuit breaker number.

The Contractor shall submit details of the labelling method to the Superintendent for approval prior to proceeding.

Minimum lettering heights

Equipment nameplates: 40 mm.

Warning notices: 7 mm.

Automatic controls and electrical equipment: 5 mm.

Isolating switches: 5 mm.

Inside electrical enclosures: 3.5 mm.

Other: 3 mm.

Location

General: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Exposed locations: Use durable materials.

Fixing

General: Use mechanical fixing. Do not penetrate vapour barriers.

Contents

General: Match terminology of work-as-executed drawings.

Electrical

Mark operable control devices, indicators, isolating switches and outlets to provide a ready means of identification.

1.10 COMPLETION

1.10.1 GENERAL

Contractor's submissions

Within 2 weeks after practical completion, submit 3 copies of designated documents.

Warranties

General: Name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Commencement: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

1.10.2 RECORD DRAWINGS

General

Submit record drawings. Show dimensions, types and location of equipment and cables, in relation to permanent site features. Show the "as installed" locations of building elements, plant and equipment. Show off-the-grid dimensions where applicable. Include relationship to building structure and other services, and changes made during commissioning and the maintenance period.

Include diagrammatic drawings of each system showing wiring, and Proprietor items of equipment. In addition to providing a hard copy of "as-installed" drawings the Contractor shall further provide the drawings electronically on disk in “AutoCAD 2008” format or later.

Format

Use the same borders and title block as the contract drawings. The title block shall contain the Contractor’s details.

1.10.3 OPERATION AND MAINTENANCE MANUALS

General

General: Submit operation and maintenance manuals for the installation.

Authors and compilers: Use personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Subdivision: By installation or system, depending on project size.

Referenced documents: If referenced documents or technical sections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Format

A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:

- Pagination: Number pages consecutively.

- Cover: Identify each binder with typed or printed title "*OPERATION AND MAINTENANCE MANUAL*", to spine. Identify title of project, volume number, volume subject matter, and date of issue.
- Ring size: 50 mm maximum, with compressor bars.
- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.
- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs.
- Drawings: Fold drawings to A4 size and accommodate them in the binders so that they may be unfolded without being detached from the rings. Provide with reinforced punched binder tabs.

Contents

Include the following:

Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.

- Table of contents: For each volume. Title to match cover.
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, Sub-Consultants, contractor, subcontractors and names of responsible parties.
- Installation description: General description of installation.
- System's Descriptions: Technical description of the systems installed, written to ensure that the principal's staff fully understand the scope and facilities provided. Identify function, normal operating characteristics, and limiting conditions.
- System's Performance: Technical description of the mode of operation of the systems installed.
  Equipment descriptions:
    - Name, address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
    - Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.
    - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
    - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Operation Procedures:
    - Manufacturer's technical literature as appropriate.
    - Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
    - Control sequences and flow diagrams for systems installed.
    - Legend for colour-coded services.
    - Schedules of fixed and variable equipment settings established during commissioning and maintenance.
    - Procedures for seasonal changeovers.
- Maintenance Procedures:
    - Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
    - Detailed recommendations for preventative maintenance frequency and procedures which should be adopted by the principal to ensure the most efficient operation of the systems installed.
    - Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures.
- Provide logical step-by-step sequence of instructions for each procedure.
    - Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when

replacements are required. Include complete nomenclature and model numbers, and local sources of supply.
    - Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40,000 hours.
    - Instructions for use of tools and testing equipment.
    - Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.
- Certificates:
    - Copies of manufacturers' warranties.
    - Certificates from authorities.
    - Product design and installation certification.
- Drawings:
    - Record drawings, full size.
    - Each service to be presented on a separate layout.
    - Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications.

Timing and quantity

Draft manuals: Submit 2 draft manuals 8 weeks before the date for practical completion to enable the principal's staff to familiarise themselves with the installation. Include provisional record drawings and preliminary performance data.

- Format: As for the final manuals, with temporary insertions for items which cannot be finalised until the installation is commissioned and tested.

Revised draft manuals: Submit revised draft manuals 2 weeks before commissioning.

Final drafts: Submit for review after completion of commissioning and no later than 2 weeks before the date for practical completion. If available, include certificates from authorities, and warranties.

Final copies: Submit 3 sets of final volumes within 2 weeks after practical completion. Incorporate feedback from review and from training of principal's staff, including preparation and insertion of additional data.

Revisions: Submit 3 sets of loose leaf amendments for insertion in the manuals, incorporating feedback from the maintenance period, within 2 weeks after completion.

1.10.4 TRAINING

General

Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents with the principal's staff in detail.

Format: Conduct training at agreed time, at system or equipment location.

Operation

Immediately after practical completion, explain and demonstrate to the principal the purpose, function and operation of the installations.

Maintenance

Immediately after practical completion, explain and demonstrate to the principal the purpose, function and maintenance of the installations.

Demonstrators

Use qualified manufacturer's representatives who are knowledgeable about the installations.

1.10.5 SPARES

Cables

At each ceiling-mounted accessory, provide 2 meters spare cable attached to the accessory.

1.10.6 COMMISSIONING

Reports

Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

Notice

Give sufficient notice for inspection to be made of the commissioning of the installation.

Starting up

General: Co-ordinate schedules for starting up of various systems and equipment. Give 5 working days' notice before starting up each item.

Checks: Before starting, verify that each piece of equipment has been checked for control sequence, circuit protection or for other conditions which may cause damage.

Tests: Verify that tests, meter readings, and specified electrical characteristics agree with those required by the manufacturer.

Wiring: Verify wiring and support components for equipment are complete and tested.

Manufacturers' representatives: Have authorised manufacturers' representatives present on site to inspect, check, and approve equipment or system installation prior to starting up, and to supervise placing equipment and operation.

Report: Submit a report demonstrating that equipment has been properly installed and is functioning correctly.

Circuit protection

Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

1.10.7 COMPLETION TESTS

General

Carry out acceptance tests and final tests.

Functional checks

Carry out functional and operational checks on energised equipment and circuits and make adjustments for the correct operation of safety devices.

Residual current devices: Verify earth leakage tripping times and currents.

1.10.8 CLEANING

General

At practical completion, clean the following:

- Luminaires. Relamp luminaires used during construction.
- Insides of switchgear and controlgear assemblies.

Switchgear and contactors, and other electrical contacts. Adjust as necessary.

1.10.9 MAINTENANCE

General

General: During the maintenance period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.

Emergencies: Attend emergency calls promptly.

Maintenance program

Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

Site control

Report to the principal's designated representative on arriving at and before leaving the site.

Maintenance records

General: Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.

Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

Certificates: Include test and approval certificates.

Service visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of the principal's designated representative.

Referenced documents: If referenced documents or technical sections require that log books or records be submitted, include this material in the maintenance records.

Certification: On satisfactory completion of the installation, submit certificates stating that each installation is operating correctly.

SUPPLY AUTHORITY REQUIREMENTS: Provide the works required by the Supply Authority to complete the installation, including the installation of equipment supplied by the Authority.

SECTION 2 - SCOPE OF WORKS AND DRAWINGS

2.1.1 MAIN SCOPE OF WORKS

The work to be carried out under or in relation to this Contract is as set out below, and as may be further described elsewhere in this Specification and Architectural drawings. All works shown on drawings and given in the specification are to be done, regardless of implicit inclusion in this scope of works section.

Unless specified otherwise all equipment and materials installed under this Contract shall be new.

The Contractor shall co-ordinate the specified work with other services and trades.

The work covered by this specification comprises the supply, installation, commissioning, testing, placing into service, warranty on installation, and maintenance of the electrical services and shall include but not be restricted to the following:

2.1.2 GENERAL

- Advise of any discrepancies between electrical services specification, electrical services drawings and architectural room layout sheets by way of RFI, during the tender period and during construction.
- Provision of planning and preparation for the works.
- Provision for coordination with other disciplines.
- Provision for installation of all outlets, equipment and fittings in accordance with architects details. Advise of any discrepancies between electrical services documentation and architects documentation by way of RFI.
- Provision of general penetrations other than the major service core riser penetrations and horizontal penetrations from service core to the building areas. Fire sealing of penetrations. Provision of sleeves on band beams as noted.
- Provision of cable baskets, cable trays, conduit systems and other support systems for lighting, communications and security cabling.
- Provision of clear and comprehensive labelling of all outlets, equipment and wiring systems.
- Provision of product data sheets.
- Provision of samples.
- Provision of Acceptance Test Procedures.
- Provision of test results for each item of plant and equipment and for all systems.
- Provision of Quality Assurance manuals for approval prior to commencement of the works, customised to this project.
- Provision of testing and commissioning of the complete installation.
- Provision of detailed “Shop Drawings” and “For Construction” drawings, fully coordinated with all services and Architectural drawings, wiring schedules and schematics for the complete project in compliance with this specification, the BCA and the relevant standards.
- Provision of 12 month warranty and preventative maintenance for the complete installation.
- Provision for training of building staff on the usage and maintenance of equipment and systems

2.1.3 DETAILED SCOPE OF WORKS

The electrical contractors shall allow for site visits and undertake a thorough investigation to confirm existing site conditions.

The works covered by this specification comprises the documentation, certification, supply, installation, commissioning, testing, placing into service, warranty on installation, maintenance, quality assurance and certification of electrical, communications, security services, smoke alarm and BOW systems, and shall include but not be restricted to the following:

- The Contractor shall thoroughly inspect the areas of work prior to submission of their tender;
- Diversion of existing in-ground electrical services currently serving the Memorial Gates from the existing Hospital. Refer to Drawings for further details and extend of works;
- Provide new overhead consumer mains to the new private power pole and further underground to main switchboard complete with conduits as nominated on the drawings;
- Provide generator link connection box to the new main switchboard complete with conduits as nominated on the drawings;
- Provide new communication lead-in cable to the new communication rack complete with conduits as nominated on the drawings;
- All external underground conduits, trenching, pits, back filling, etc. as shown on the drawings;
- Provide a new Form 3bih, 30kA Fault Current Level (or as instructed by local Authorities), bottom connected main switchboard with Energy Authority current-transformer metering. Provide fused surge protection at the service entry equal to Erico TDX200 with earth connections to the manufacturer's specification. Install a digital bi-directional multi-function meter capable of displaying (for each phase) kWh, current maximum demand, max and min maximum demands including date and time of these occurrences, instantaneous current, and voltage and power factor.
- Provide all new submains, cables, cable supports and underground conduits. Maintain minimum spacing of 150mm for paralleled power and communications cables;
- Provide new electrical and communications cabling trays for cabling reticulation from MSB and Communications Rack to the office area via ambulance plant room and office corridors;
- Current Transformers metering provision for new incoming main supply;
- Liaise with the builder to provide slab penetrations as required to all distribution board cupboards. Penetrations shall be sized to allow cable trays to rise to floors above/ below. The same applies for all comms cupboards & all other slab penetrations where cable trays rise from floor below.
- Liaise with builder for all structural penetrations of conduits. All penetrations shall be vermin proofed, waterproofed (fire rate penetrations as required);
- Allow to provide new underground conduits, cable supports and cables etc. to all externally located services (including pole lighting, security services –card readers and the like);
- Provide power outlets and permanent electrical connections along with sub-circuit cabling;
- Where workstation outlets are shown on the architectural drawings, provide all soft wiring and workstation-mounted outlets. Provide a starter plug to connect into a starter socket provided locally. Provide all data outlets on workstations and connect all data outlets directly to patch panels in communications room communications racks (i.e. hard-wire communications cabling). Data & power outlets on modular furniture (workstations) shall be staggered;
- Provide power outlets and permanent electrical connections along with sub-circuit cabling;
- Provide & install floor boxes &/ or service poles with all outlets;
- Provide in slab conduits to adequately pull electrical & comms cabling and/ or co-ordinate with the builder to provide core holes to reticulate cables to all floor boxes. Co-ordinate this work onsite prior to commencement;
- Provide and install a modular rack-mounted UPS system to service the Comms room of the ambulance station;
- Provide and install smoke alarms and heat alarms with the interface to security & mechanical system;

- New internal light fittings along with sub-circuit cabling;
- New emergency and exit lights and associated sub-circuit cabling;
- New external lighting and associated sub circuits and control;
- New communication services including racks, MDF, backbone cabling, UTP horizontal structured cabling.
- Provide & install Communications earthing system (CES).
- New MATV system and associated MATV antenna;
- New security and access control system and all associated cables and components as well as patch leads from the data points to the equipment;
- Supply and install new Airkey Receiver systems, as specified;
- Sundry minor works as specified herein.
- Provide Paramedic Activation Speaker system capable of integrating in phone system;
- Allow for the supply & installation of 10- off additional DGPO's (inc. cabling) + 5 additional 20A circuit breakers + 5- off additional dual data outlets including cabling back to communications rack, into the contract. Any unused portions shall be re-inburst to the client for the full amount.
- Contractor must complete & submit all portions of the Tender Schedule & Schedule of rates. Completed schedules shall be returned back to the client & electrical consultant.
- All supports, brackets, drilling, penetrations, fire stops and other building works associated with the above.
- Provide acoustic boxes to outlets in acoustically rated areas.
- All other minor works as described elsewhere in this specification or as indicated on the drawings.
- All other minor works as deemed necessary to ensure a fully functional system;
- Testing, commissioning and programming of all systems installed under this contract;
- Preparation and submission of operating and maintenance manuals;
- 12 months Maintenance and defects liability warranty **for all services**;
- "As Installed" drawings in Auto CAD 2010 format

2.2 DESCRIPTION OF WORKS

2.2.1 ELECTRICAL GENERAL

Provide shop drawings for the final cable tray and catenary layout for approval before installation.

Service poles to workstations will be two channel (comms and power), 100mm x 100mm, anodised to the architect's preferred colour and provided with all accessories for installing through a tiled ceiling.

Power cables from starter sockets and data cables rising from floor to table or wall to workstations will be fully protected to avoid kicking and tangling in feet.

The switching of corridor lights will be by time clock. When turning off, two in three fittings will extinguish first with the remainder extinguishing after 5 minutes. Switching cabling for this is not shown explicitly on the drawings. In parallel with the time clock, distributed momentary action switches will allow for the lights to be turned on for a timed two hours. In parallel to this, motion detectors at strategic locations will allow for the lights to turn on for 5 minutes in response to motion.

With the exception of cleaner's outlets, no more than 16-off 10A GPO outlets will be placed on any 20A circuit.

Within kitchenettes and beverage bays, boiling water units will be placed on their own 20A circuit and no more than four GPO outlets will be placed on any single 20A circuit.

Minimum circuit rating will be 20A unless noted otherwise.

Minimum cable size for 20A single phase circuits will be 2c 2.5mm2 Cu PVC/PVC + E up to 30m, 2c 4mm2 Cu PVC/PVC + E up to 50m, and 2c 6mm2 Cu PVC/PVC + E up to 70m. Other cables will be selected to suit circuit rating and length.

All cabling (of all types) will be supported. Where trays to suit are not shown catenary may be provided or direct fixings may be used. Adhesive direct fixings will not be used without a 20 year replacement warranty being provided by the contractor. Cables within ceilings will be supported and will not drape over ceiling tiles.

Allow for the removal of electrical systems and cabling from areas to be demolished. Reuse may be considered where the cabling is appropriate and in excellent condition (with no degradation or damage).

Power outlets throughout will adequately service each area and will be provided to comply with the Engineering Guidelines, Australasian Health Facilities Guidelines and good engineering practice.

Motion detection shall be used for lighting control in store rooms, bathroom/toilet areas, staff facilities rooms and the like – providing an over-ride off switch at each location. Motion detectors controlling lighting are to be of the 'fail-on' type. That is, a failure is to cause all lighting to remain on. With override 'On' set.

Project works will comply with NSW Health's 'Protecting People and Property' standard.

At the end of the works provide proper labelling to all distribution boards (and circuit schedules), power outlets and telecommunications infrastructure (note the NSW Health Guideline has specific requirements for labelling that are to be observed).

Where a distribution board has separate power and lighting sections, lighting circuits will be installed in the lighting section and power circuits installed in the power section.

2.2.2 EARTHING

Where applicable, supply and install an MEN Earthing system to earth effectively the main switchboard, all distribution boards, fixed and general purpose outlets, luminaries and all other equipment as required by the SAA Wiring Rules and Energy Australia.

All metallic cable support systems including cable trays, skirting ducts, wall studs, roof trusses, steel covers, removable escutcheon panels housing electrical and communication cabling shall be earthed in accordance with AS/NZS 3000.

Where the cable support systems are not electrically connected, a suitably sized earth cable with crimped lug ends is to be installed between the 2 support systems to form a continuous electrical bond.

The earth cables with crimped lug ends are to be secure to the cable support system with bolts and nuts. Spot welds and compression type applications will not be acceptable.

All stud walls where GPO are mounted on shall be earthed to avoid the risk of electrocution.

2.2.3 ENERGY METERING (SUB METERING)

Private energy digital metering shall be provided to the incoming supply to the main switchboard Meters will, as a minimum, be digital 'smart' type 3 phase meters with LCD display.

Meters shall, as a minimum, monitor maximum demand, Amps, Volts, Hz, kVA, kVAr, kW, kWh, Power Factor and harmonics and shall be compatible with a High Level interface to the BMS (Ethernet RJ45).

Energy Meters shall be Schneider PM3550 meters capable of being interfaced to a BMS and capable of operating standalone.

Allow to coordinate and provide a double data out to all electrical, mechanical switchboards for the future connection to the BMS. BMS and connection by others.

The following loads shall be provided with dedicated private KWh energy meters that comply with NMI standards and NCC Section J and high level interface for connection to future Energy Management System;

- Air-conditioning plant including heating plant
- Common area lighting & power

- Central hot water supply
- Central kitchens

2.2.4 SUBMAINS

Submains shall originate from the main switchboard and shall utilise copper conductors.

Cables shall be sized for the building fit out and 20% spare capacity.

Neutral conductors shall be sized for 100% of the active phase current.

Non-essential services cabling shall be XLPE/PVC type.

All Essential services (Safety Services as defined by AS/NZS 3000) shall utilise Fire rated cables

Horizontal reticulation of sub-mains shall be via cable trays. All cabling shall be spaced on the cable so as to avoid de-rating as per AS3008.

2.2.5 DISTRIBUTION BOARDS

All new distribution boards shall be surface mounted, front connected circuit breaker type, wall mounted, inside smoke sealed, fire resistant cupboard in located on the locations nominated on the layout drawings.

All distribution boards shall be sheet metal enclosed fitted with doors, and located in dedicated riser cupboards. Circuit breakers will be minimum 10 kA din-rail miniature type. Boards shall be NHP Concept Plus 2 DIN-T DB's or an approved equivalent.

New Distribution boards shall be sized to allow 25% spare pole capacity or have 72 Poles (Whichever is the greater)

Combination RCD/MCB's shall be provided in accordance with AS/NZS 3000 and 3003, as applicable.

All new distribution boards shall be split chassis to allow separate metering of lighting, power and mechanical loads as per the NCC section J8.

2.2.6 GENERAL SUB-CIRCUIT CABLING

Final sub-circuit cabling shall be minimum 2.5 mm^2 V75 wiring, with a maximum circuit utilisation of 65%.

Horizontal distribution of final sub-circuit cabling shall be by means of cable trays in ceiling spaces. Wiring shall be tied to tray throughout its entire length.

Lighting circuits will have the capacity of 20% additional connected load to accommodate revised lighting layouts.

Reticulation of wiring within all areas shall be concealed where possible. All exposed cabling shall be painted to the colour predetermined by the architect

All final sub circuits cabling shall be sized to ensure the voltage drop on that run to be 2.5% or less. The contractor will be required to upsize cables are required for long runs to accommodate the voltage drop requirements.

2.2.7 EQUIPMENT CONNECTIONS

Equipment connections shall be provided to the following items of equipment, including items provided by others:

I. Motor Control Centres & A/C units

II. Access control system including data gathering panels for card readers, intruder detection equipment

III. Miscellaneous electrical systems

IV. Entrance gates and roller doors

V. Automatic doors

VI. Hot water unit equipment

VII. Boiling water units

VIII. Hydraulic services control panels

IX. All other permanently installed equipment

2.2.8 LIGHTING

All luminaires shall be subject to approval before orders are placed. The builder and contractor shall note this is a requested hold point by PM. Refer to drawings and schedule of luminaires on the drawings.

Luminaires are described and specified in the drawings. Please note lighting schedule is provided for reference.

Lighting layouts shall be coordinated with all other services.

All lighting to be energy efficient LED technology and generally installed to comply with the maximum power density limits specified in section J of the NCC.

Lighting levels for front of the house to be higher than AS 1680 requirements to enhance the amenity for residents in accordance with NSW Health design standards.

All lighting to be LED technology with electronic drivers. Minimum requirement for light fittings include:

- Warranty: > 5 Years
- Commercial quality, economy range
- Available in stock in Australia or lead-time < 6 weeks
- Minimal colour shift (<= 2 McAdam Ellipse Steps)
- Low glare (< UGR 19)
- LED lamp life > 50000 hours
- Quality metal work and paint finishes.

Light fittings to each location shall be equal or better in performance and quality to any luminaires specified in the luminaire schedules unless approved by PM.

Provide all mounting and support equipment including the associated accessories required to accommodate recessed mounting of light fittings.

2.2.9 LIGHTING CONTROL

The Electrical Contractor shall provide all necessary switching and circuitry to facilitate the lighting control for the development. For front of the house areas lighting control system will be provided. Centralised lighting control and override will be located in kitchen area. The controls are to be installed in a lockable cupboard with staff access only.

Ultrasonic or microwave or presence detectors (Steinel or similar quality) to be installed in frequently occupied spaces to turn off lighting when area is not in use. Locations to include store rooms, plant rooms, utility rooms and staff amenities and where specified on the drawings.

Motion detectors controlling lighting are to be of the ‘fail-on’ type. That is, a failure is to cause all lighting to remain on. With override ‘On’ set.

In order to maximise the use of daylight, light fittings within internal perimeter to be controlled with photoelectric sensors. Daylight sensing controls are to dim light fittings where possible to soften transitions.

Colour temperature shifting and day / night lux control for circadian rhythm regulation required in commercial areas. The control system shall be automated and gradually changing.

2.2.10 EMERGENCY AND EXIT LIGHTING

Emergency lighting and illuminated exit lighting shall be in accordance with the AS/NZS 2293 and the BCA / NCC. All emergency lighting shall be single point with 2 hour test timer relay on each distribution board to ensure general lighting is not disrupted during testing. All exit and emergency lighting to be the LED type with integral lithium battery backup facilities.

Throughout all internal areas provide emergency and exit lighting to AS2293. Allow for all the wiring and control devices required for a single point testing system from the MSB as per AS2293 requirements.

2.2.11 **UNINTERUPTABLE POWER SUPPLY**

Provide a new 3kVA rack-mounted UPS in new Communications Room. Allow for an autonomy of 60 minutes at full load.

2.2.12 COMMUNICATIONS

All data cabling and outlets will comply strictly with the current Health ICT Structured Cabling Standard, ie. NSW Health Cabling Standards, NSW Ambulance “How to build an ambulance station” document, ICT Cabling Brief NSW Ambulance Stations V1.1 and NSW RAIR ICT Group 1 document.

The contractor will obtain the latest version of this document at tender time and will engage subcontractors as necessary with sufficient competence and knowledge to comply with this standard.

Data cables to all outlets, including those mounted on workstations, will be cabled in a single un-joined length and to be Cat 6A F/UTP. Cables will reticulate to the comms room as shown on the drawings. Allow for Cat 6A F/UTP termination at both ends and testing to confirm compliance with Cat 6A F/UTP cable requirements. All work will comply with the NSW Health ICT standards, NSW Ambulance RAIR ICT Group 1 document, NSW Ambulance Security Specification and NSW Ambulance “How to build an ambulance station” document

WAPs will be provided by the Client but installed by this contractor. WAPs locations are to be as per NSW Health Wi-Fi standards.

Cables to WAPs shall be provided with 5-6m tails to allow local movement. Once installed, signal strength measurements will be taken and WAPs relocated locally to provide optimal signal. The contractor will allow for this.

Data installations (patch panels, cabling, outlets, communications racks, etc.) shall be Panduit/Siemon/R&M. Installers shall be certified to provide, and will provide, 25 year installation warranty of the structured cabling system and installation.

2.2.13 SECURITY

2.2.13.1 ACCESS CONTROL

Provide new Electronic Access Control System Integriti from Inner Range.

Provide electric strikes, magnetic locks, RFID card readers, etc. as nominated in this specification, architectural room layout sheets, NSW Ambulance Security Specification and NSW Ambulance “How to build an ambulance station” document

Selection of electric strikes, card readers, keypads and other security devices are to be aligned with NSW Ambulance Security Specification and NSW Ambulance “How to build an ambulance station” document.

Magnetic locks will be monitored. Each access controlled door will be provided with an appropriate reed switch to convey the door position to the Integriti system.

Where a card reader is located on one side of the door, the door will be free handle egress from the other side. Where a push-to-exit is shown the door will be programmed to be free-handle-egress during business hours but push-to-exit after hours.

Where a card reader is shown on both sides of the door, there will be a break-glass to exit to allow exit in the event of a failure of the EACS. All access controlled doors on emergency egress routes will release on fire trip regardless of the state/health of the EACS. Emergency egress routes are identifiable by the exit signs over the doors.

Duress push buttons will be the two-finger press type and will be concealed beneath the desk/table where shown on a desk/table. Provide a locational cue below the desk/table to allow to find and operate the duress alarm easily.

Push-to-exit buttons on emergency egress doors (where exit lights are shown on the door) will not be reliant on the functioning of the access control system to function (i.e. will release locks directly with a fail-safe run-on timer). Alternatively a break glass door release will be provided.

2.2.13.2 INTERCOMS

Provide audio intercoms in all the building perimeter doors, which shall be connected to the PABX system. Additional intercoms shall be provided to the pedestrian and vehicle gates to access the site.

Any head-end equipment (if required) will be installed in the local services cupboard. Intercoms will have the ability to transfer to SIP handsets when they are not answered after a specified time. System shall allow for a door-release button by the VOIP phone system.

Refer to NSW Ambulance Security Specification and NSW Ambulance “How to build an ambulance station” document for further details.

2.2.13.3 CCTV CAMERAS

Internal data outlets for future CCTV system installation shall be provided. Future CCTV cameras shall be to monitor the perimeter of the building. No allowances shall be considered for CCTV within the building.

2.2.14 GENERAL

All systems installed, including security, Emergency Lighting, Intercoms and MATV will be thoroughly tested and proven to work. Allow for detailed programming of each system to the user’s requirements. Allow to engage accredited subcontractors as necessary to ensure that the programming is done correctly.

Where an accreditation is not given out, the programmer shall have greater than 5 years demonstrated experience with that system.

Provide as-builts in hard-copy and softcopy (pdf and Revit format).

Provide 12 months warranty of all components from handover.

Provide a 12 month defect and liability period with on-site remediation of any issue. Urgent issues will be attended to within 24 hours.

2.3 INTERFACING WITH OTHER SERVICES

2.3.1 GENERAL

The Contractor shall review the mechanical, hydraulic, vertical transportation, AV and fire services documentation before installing cabling and co-ordinate the final equipment loads to satisfy themselves as to the extent of power supplies and interfacing. The electrical Contractor shall confirm all final mechanical, hydraulic & fire services equipment loads prior to installation and notify the design team of any discrepancies.

2.3.2 IN CONNECTION WITH MECHANICAL SERVICES

a) Supply and install sub mains cabling complete with adequate tails for termination by mechanical contractor to mechanical services switchboards/equipment. Testing of sub-mains shall be by electrical services. Provide a 5 metre submain tail for the all submains

b) Interlock kitchen hood operation with the outside air ventilation fans.

c) Provide a fire trip connection from the Residential Fire Control Panel to the mechanical services switchboard MSSB.

d) Supply and install circuit breaker, isolator and associated cabling to the External Air Conditioning Condenser Unit serving the communications room form the Battery-backed Distribution Board DB-B.

2.3.3 IN CONNECTION WITH HYDRAULIC SERVICES

a) Supply and install sub mains cabling complete with adequate tails for termination by hydraulics contractor to hydraulics services switchboards/equipment. Testing of sub-mains shall be by electrical services. Provide a 5 meter submain tail for the all submains

b) Supply and install power supplies to BWU’s and the like and time switches in distribution boards where required for control of BWUs

2.3.4 IN CONNECTION WITH BUILDERS WORK

Concrete

a) Chasing, coring, cutting and making good provided as part of electrical services work

b) Placing, casting in and protection of conduct sleeves and conduits provided as part of electrical services work.

c) Bases and plinths for equipment excluding steel fabricated bases provided as part of the Electrical Services equipment.

Masonry

a) Chasing, coring, cutting and making good provided as part of electrical services work

Internal Walls/Ceilings

a) Cut outs and trimming of openings for light fittings to be provided as part of Electrical Services Works.

Doors

a) Cut outs in doors and trimming of openings for electric locks and security sensors to be provided as part of Electrical Services Works

Ceilings

a) Co-ordination of penetrations

b) Mounting and support equipment including all associated accessories required for the mounting of light fittings, emergency lights, speakers, smoke and thermal detectors, indicating and warning lights and the like to be provided as part of Electrical Services Works.

2.4 ASSOCIATED WORKS

a) Works associated with Electrical, Communications, security and dry fire Services but carried out by other trades under separate Contracts comprise unless otherwise noted:

2.4.1 IN CONNECTION WITH MECHANICAL SERVICES

a) Supply, installation and testing of Mechanical services switchboards/equipment

b) Termination of electrical Submains to mechanical distribution boards

2.4.2 IN CONNECTION WITH HYDRAULIC SERVICES

a) Supply, installation and testing of Hydraulic switchboards

b) Supply and installation of BWU’s and the like

c) Termination of electrical Submains to hydraulic distribution boards and control panels

2.4.3 IN CONNECTION WITH BUILDERS WORK

Hoisting and Lowering

a) Available on request subject to booking.

Scaffolding

a) Use of building scaffolding subject to reasonable access requirements. Allow for the cost of hire and erection of any special scaffolding.

2.4.4 PERMANENT WORKS

Demolition

a) Services decommissioning, disconnection from supply, capping and sealing.

b) Services demolition and removal other than electrical services affecting the works

Masonry

a) Plant enclosures and service risers

Structural Steel

a) Lifting beams, building structure for securing electrical components

Metalwork

a) Platforms and walkways for maintenance to equipment

Roofing

a) Openings underflashings and overflashings.

External Walls

a) Metal louvre grilles complete with bird mesh for air intakes and exhausts

Doors

a) Access doors and hatches for maintenance.

Physical Security

a) Electrically operated gates and associated controls and safety devices.

b) Automatic doors and associated controls, battery backup and safety devices.

2.4.5 ADDITIONAL SERVICES

In addition to the supply and installation of services as shown on the drawings and nominated elsewhere within this specification, the Contractor shall allow for the supply and installation of the following additional services at the Authorised Principal's Representative (APR) discretion.

- Double GPO's 10-off
- Single phase 20A permanent connections 5-off
- Dual data outlets connections including cabling 5-off
- Emergency Lights 5-off
- Exit signs 5-off
- Smoke Alarms 6-off
- Heat Alarms 6-off

2.4.6 TEMPORARY ELECTRICAL SUPPLY

Arrange with the Supply Authority to provide a temporary electrical supply (Contractor to provide) as required during the construction stage of the work. The temporary electrical supply and all associated equipment and wiring shall be removed on completion of the work.

Provide and install all necessary equipment, wiring and connections etc. as required. This shall include temporary lights under decks, on cranes, framework and wet areas to suit the construction programme.

The temporary electrical supply, equipment, wiring, etc. shall comply with the requirements of the Supply Authority, Workcover Australia and all other relevant code and Authority requirements.

Pay all costs involved.

2.4.7 GENERAL DRAWINGS

Drawings associated with this electrical installation and to supplement this specification are as follows:

R25-EL-DRG-0000	COVER SHEET AND DRAWING LIST
R25-EL-DRG-0001	ELECTRICAL LEGEND OF SYMBOLS & GENERAL NOTES
R25-EL-DRG-0002	ELECTRICAL SERVICES SITE PLAN
R25-EL-DRG-0100	LIGHTING AND FIRE DETECTION LAYOUT – LOWER GROUND LEVEL
R25-EL-DRG-0101	LIGHTING AND FIRE DETECTION LAYOUT – GROUND LEVEL
R25-EL-DRG-0200	POWER, COMMUNICATIONS AND SECURITY LAYOUT – LOWER GROUND LEVEL
R25-EL-DRG-0201	POWER, COMMUNICATIONS AND SECURITY LAYOUT – GROUND LEVEL
R25-EL-DRG-0202	POWER, COMMUNICATIONS AND SECURITY LAYOUT – ROOF PLAN
R25-EL-DRG-0300	SINGLE LINE DIAGRAMS AND SCHEMATICS

SECTION 3 - ELECTRICAL SUPPLY

3.1 GENERAL

3.1.1 CROSS REFERENCES

General

Comply with the *General requirements* section.

3.1.2 RELATED SECTIONS

Refer to the Wiring & Accessories section

3.1.3 STANDARDS

Consumer Mains: To AS/NZS 3008

Submains: To AS/NZS 3008

Earthing/Wiring: To AS/NZS 3000

NSW Services Installation Rules

3.2 QUALITY

3.2.1 INSPECTION

Give sufficient notice so that inspection may be made of the following:

- Earthing
- Consumer mains and submains

3.2.2 WORKSHOP DRAWINGS

General

Submit workshop drawings for the following:

- Main Switchboard and Distribution Boards

3.2.3 CERTIFICATION

General

Submit certification for the following

- Lightning protection system.
- Compliance with all relevant Australian Standards and the BCA.

3.3 LV EXTERNAL SERVICES

Contractor shall submit a separate Application For Connection (AFC) to the authority with the proposed PV & Battery Storage design noted in the drawings.

The contractor shall allow for all negotiations with Essential Energy, approvals and payment of connection fees, etc. as required.

SECTION 4 - CONSUMER MAINS & SUBMAINS

4.1.1 CONSUMER MAINS

The Contractor shall liaise with the supply authority for the connection of the site's Consumer Mains to Supply Authorities grid. Allow for all trenching, re-connection of interrupted services, liaison with all relevant parties (e.g. RTA, local council) and the payment of their fees etc. as necessary to install the consumer mains.

Cables shall be run so that no derating applies. If derating is unavoidable representation should be made to the Electrical Consultant for the works. Depth and layout of the conduits should comply with required relevant standards and, in particular, AS3000 and AS3008.

Prior to commencement of any work, obtain specific information from Supply Authority regarding termination details and prepare detailed drawings for approval by the Supply Authority and the Superintendent.

The Contractor shall supply and install consumer mains and all required submains for correct services operation.

The contractor shall allow employing suitably accredited service providers as necessary to carry out the installation at service mains works.

4.2 SUBMAINS

Supply and install submains to the mechanical switchboard, PV system, portable generator connection link and other loads.

Cables shall be run so that no de-rating applies. If de-rating is unavoidable ensure the cables and conduits are sized accordingly.

When installing submain cabling, ensure the following minimum requirements:

- All submain cabling shall be reticulated on appropriately sized cable ladder tray within building.
- Submain cabling shall be reticulated in such a manner so as to ensure that no derating of the cabling takes place.
- That the reticulation of all such cabling shall be co-ordinated with all other services in the region. Submain size and type is to be identified at each end in the form of engraved labelling on the distribution boards
- Verify all final proposed loads and advise the Principal prior to installation of the submains.
- All 3 phases shall be evenly balanced for both submains and consumer mains.
- All submains shall utilise stranded copper conductors.
- All terminators shall be fitted with compression lugs.
- Submain cabling shall be installed in tre-foil or quatre-foil

SECTION 5 - MAIN SWITCHBOARD

5.1 GENERAL

5.1.1 GENERAL

General

The electrical Contractor shall design, supply and install Form 3Bih Main Switchboards as specified here-in and within the drawings.

Comply with the General services requirements section and this section.

Supply and install a new site main switchboard. Refer to the main switchboard single line diagram for the general requirements including metering and surge protection.

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

The main switchboard shall be manufactured to fit the space provided; equivalent to Modulec (preferred). Consult a board provider before submitting tender to pre-empt possible issues. These must be raised in the tender submission.

Provide a laminated and framed single line diagram in the main distribution switchroom/cupboard indicating the switchboard general arrangement and the cable sizes used consumer mains and for all submain cables.

Allow for installation of supply authority metering and associated equipment on the switchboard. Provide any power outlets, phone connections required by the supply authority.

5.1.2 STANDARD

General

To AS/NZS 61439.1.

5.1.3 INTERPRETATIONS

Definitions

Custom-built assemblies: Low voltage switchgear and control gear assemblies manufactured to order.

Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.

Abbreviations

TTA: Type tested assemblies.

NTTA: Non-type tested assemblies.

PTTA: Partially type tested assemblies.

5.1.4 DESIGN

Layout

Position equipment to provide safe and easy access for operation and maintenance. Consider functional relationships between items of equipment in the laying out of equipment on the assembly.

Design

The main switchboard shall be designed to fit within the allocated space. The switchboard shall be designed with a minimum 30% spare space and capacity.

Fault levels

Fault level shall be to a minimum of 30KA or as indicated by Supply Authority.

- Allow to coordinate with Supply Authority for exact fault levels.

- The switchboard shall be designed to comply with Form 3x construction.

Degree of protection

Provide IP 42 protection to the switchboard

Mounting

The switchboard must be of a metal cubicle type, floor mounted.

Connection

Cable entries: Bottom and top

Cable exit: Bottom and top

5.1.5 AUTHORITIES

Statutory authority's equipment

General: Install equipment supplied by the statutory authority, and provide wiring to complete the installation. Contractor to submit MSB shop drawings for approval by the authorities prior to issuing to the consultant.

Tariff meter compartment: Install the statutory authority's tariff metering equipment in a separated, sealed meter compartment.

5.2 QUALITY

5.2.1 INSPECTION

Notice

Give notice so that inspection may be made at the following stages:

- Factory assembly completed, with busbars exposed and functional units assembled.
- Assembly installed and connected.
- Acceptance.

5.2.2 PRE-COMPLETION TESTS

Type tests

To AS/NZS 61439.1.

Testing facility: Accredited by NATA or registered with the Association of Short-Circuit Testing Authorities (ASTA).

Production tests

Carry out the following tests:

- Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment.
- Dielectric testing: NTTAs and PTTAs: 2.5 kV R.M.S. for 15 s.
- Functional testing: Operate mechanical devices, relays, programmable logic controllers and logic controls, protection, interlocking and alarm equipment.
- Protection relays: Primary current injection tests or, if approved, secondary current injection tests, to verify time/current characteristics and settings.

Site tests

Carry out secondary current injection tests on adjustable trip circuit breakers after installation and before energisation, to verify time/current characteristics and settings.

5.2.3 CONTRACTOR'S SUBMISSIONS

General

Submit type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data.

Calculations

General: Submit detailed certified calculations verifying design characteristics of cascading and discrimination of functional units.

Standard: To AS 3865 and IEC 890.

Type test data

General: Verify that type tests and internal arcing-fault tests, if any, were carried out at not less than the designated fault currents at rated operational voltage.

Alterations to TTAs: Submit records of alterations made to assemblies since the tests.

Shop drawings of custom-built assemblies

Submit shop drawings showing:

- Types, model numbers and ratings of assemblies.
- Component details, functional units and transient protection.
- Detailed dimensions.
- Shipping sections, general arrangement, plan view, front elevations and cross-section of each compartment.
- Projections from the assembly that may affect clearances or inadvertent operation, such as handles, knobs, arcing-fault venting flaps and withdrawable components.
- Fault level and rated short circuit capacity characteristics.
- IP rating.
- Fixing details for floor or wall mounting.
- Front and back equipment connections and top and bottom cable entries.
- Door swings.
- External and internal paint colours and paint systems.
- Quantity, brand name, type and rating of control and protection equipment.
- Construction and plinth details, ventilation openings, internal arcing-fault venting and gland plate details.
- Terminal block layouts and control circuit identification.
    - Single line power and circuit diagrams.
    - Details of mains and submain routes within assemblies.
- Busbar arrangements, links and supports, spacing between busbar phases, and spacing between assemblies, the enclosure and other equipment and clearances to earthed metals.
- Dimensions of busbars and interconnecting cables in sufficient detail for calculations to be performed to AS 3008.1 and AS 3865.
- Internal separation and form of separation and details of shrouding of terminals
- Labels and engraving schedules.

5.3 CUSTOM BUILT ASSEMBLIES

5.3.1 CONSTRUCTION

General

Provide rigid, ventilated, insect-screened enclosures consisting of panels, doors, or both, giving the designated enclosure, separation and degree of protection.

TTAs and PTTAs

Use construction methods verified by required tests to at least the nominated fault level and temperature-rise limits and internal arcing-fault containment and venting.

NTTAs

Fabricate from sheet metal of rigid folded and welded construction. Obtain approval for non-welded forms of construction.

Layout

Compartments: Separate shipping sections, subsections, cable and busbar zones, functional unit modules and low voltage equipment compartments using vertical and horizontal steel partitions which suit the layout and form of separation.

Equipment mounting heights above floor to the centre line of the equipment:

- Toggles and handles of circuit breakers, fused switch units and isolators:
  - Wall mounted assemblies: 500 – 900 mm.
- Control switches, indicating lights, meters and instruments on doors:
  - Wall mounted assemblies: 1 – 1.7 m.
- Push-button emergency switching devices: 800 – 1600 mm.

Equipment on doors: Set out in a logical manner in functional unit groups, so it is accessible without the use of tools or keys.

Enclosures

Steel enclosures:

- General: Minimum 2.0 mm thick zinc-coated sheet steel, coating class Z200.

Insect proofing

Cover ventilation openings using non-combustible and non-corroding 1 mm mesh.

Equipment mounting panels

General: Strong enough to support the weight of mounted equipment. Construct using minimum 3 mm thick metal or non-metallic board with heavy metal angle supports or plates bolted or welded to enclosure sides.

Front accessible cable zones: 450 mm minimum width.

Equipment fixing

Spacing: Provide sufficient thermal, mechanical and electrical clearance between equipment to ensure proper functioning. Provide 50 mm minimum clearance between

- Busbars for lifts, fire services and building emergency services; and
- General installation services, busbars and equipment.

Mounting: Use bolts, set screws fitted into tapped holes in metal mounting panels, studs or proprietary attachment clips. Provide accessible equipment fixings, which allow equipment changes after assembly commissioning.

Installation: For lightweight equipment, use combination rails and proprietary clips.

Earth continuity

Effectively bond equipment and assembly cabinet metal frame to the protective earth conductor. Strip painted surfaces and coat with corrosion resistant material immediately before bolting to the earth bar. Provide serrated washers under bolt heads and nuts at painted, structural metal-to-metal joints.

Lifting provisions

For assemblies with shipping dimensions exceeding 1.8 m high x 600 mm wide, provide fixings in the supporting structure and removable attachments for lifting.

Supporting structure

Provide concealed fixings or brackets to allow assemblies to be mounted and fixed in position without removing equipment.

Floor-mounting

Provide mild steel channel plinth, galvanised to class Z600, with toe-out profile, nominal 75 mm high x 40 mm wide x 6 mm thick, for mounting complete assemblies on site. Drill M12 clearance holes in assembly and channel and bolt assemblies to channel. Prime drilled holes using zinc rich organic binder to GPC-C-29/16.

Provide a further 500mm accessible cable zone at the base of the switchboard for future cable access.

5.3.2 CABLE ENTRIES

General

Provide cable entry facilities within assembly cable zones for incoming and outgoing power and control cabling. Provide sufficient clear space within each enclosure next to cable entries to allow incoming and outgoing cables and wiring to be neatly run and terminated, without undue bunching and sharp bends.

Cover and gland plates

Cover plates: Provide 150 mm maximum width cover plates butted together and covering the continuous cable entry slot.

Gland plates: Provide removable gland plates fitted with gaskets to maintain the degree of protection.

Materials: 1.5 mm thick steel, 5 mm thick composite material or laminated phenolic. Use 6 mm thick brass for MIMS cables and cable glands.

Covers

Maximum dimensions: 900 mm wide and 1.2 m^2 surface area.

Fixing: Fix to frames using at least 4 fixings. Provide corrosion-resistant acorn nuts if the cover exceeds 600 mm in width. Rest cover edges on the cubicle body or on mullions. Do not use interlocked covers.

Handles: Provide corrosion-resistant “D” type handles.

Escutcheons

For doors enclosing circuit breakers, provide escutcheon plates as barriers between operating mechanisms and live parts.

Escutcheon plates

General: Provide plates or removable covers with neat circuit breaker toggle cut-outs allowing interchange ability of 1, 2 and 3 pole circuit breakers. Provide corrosion-resistant lifting handles or knobs. Provide unused circuit breaker toggle cut-outs with blanking in-fill pole covers. Fixings shall be chrome plated acorn nuts.

Maximum dimensions: 900 mm wide and 1.2 m^2 surface area.

5.3.3 FACTORY FINISHES

Extent

Apply protective coatings to internal and external metal surfaces of assembly cabinets including covers, except to stainless steel, galvanised, electroplated, or anodised surfaces and to ventilation mesh covers.

Finish coats

Thermoset powder coating or two-pack liquid coating.

Paint colours

Standard: To AS 2700.

Colours:

- Indoor assemblies: Manufacturer’s standard colour.
    - Removable equipment panels: Off white Y35.
    - Assembly interior: White.
    - External: Coordinate with the principal the external colour

5.4 BUSBARS

5.4.1 BUSBARS

General

Provide main circuit supply busbars within assemblies, extending from incoming supply terminals to the line side of protective equipment for outgoing functional units and for future functional units.

Standards

To AS 3768, AS 3865 and IEC 890.

Definitions

Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.

Main circuit supply busbars: Busbars connecting incoming functional unit terminals, or incoming busbars where no main switches are included, to outgoing functional unit terminals or outgoing functional unit tee-offs.

Tee-off busbars: Busbars connecting main busbars to incoming terminals of outgoing functional units.

Material

Hard-drawn high-conductivity electrolytic tough pitched copper alloy bars, designation 110.

Temperature rise limits – active and neutral conductors

Maximum rated current temperature rise limits: 65 ± 1.5°C by type test or calculation to AS 3768 or IEC 890.

Maximum short-circuit withstand current temperature rise limits: 160°C by calculation to AS 3865.

Cross section

Rectangular with radiused edges.

Supports

General: Sufficient to withstand thermal and magnetic stresses due to maximum prospective fault currents.

Material: Non-hygroscopic insulation capable of holding busbars at 105°C.

Phase sequence

For main busbars and connections to switching devices, set-out phase sequence for phases A, B and C, from left-to-right, top-to-bottom and back-to-front when viewed from the front of the assembly.

Colour coding

General: Provide 25 mm minimum width colour bands permanently applied to busbars at 500 mm maximum intervals with at least one colour band for each busbar section within each compartment.

Active busbars: Red, white and blue respectively for the A, B and C phase.

Neutral busbar: Black

MEN link: Green-yellow and black.

Protective earth busbar: Green-yellow.

Restrictions: Do not use adhesive type colour bands.

Busbar systems

Use multi-pole proprietary busbar assemblies or busbar systems, which have been verified for short circuit capacity and temperature rise-limits by type tests.

Current carrying capacity

Active conductors: Take into account thermal stresses due to short circuit current, assuming magnetic material enclosures located indoors in well-ventilated rooms and 90oC final temperature.

Neutral conductors: Size to match incoming neutral conductor current carrying capacity.

Protective earth conductors: Size for at least 50% of the rated short circuit withstand current for 100% of the time duration.

Tee-off busbars current rating

For individual outgoing functional units: Equal to maximum frame size rating of the functional unit.

For multiple functional units: Equal to the diversity factors of AS 61439.1, based on frame size rating.

MEN links

MEN links > 10 mm^2 in section: Bolted removable busbar links stamped "*MEN LINK*", located in the incoming compartment, between neutral and earth busbars.

Busbar links

For current transformers, provide removable busbar links < 450 mm long.

Cable connection flags

General: Provide and support busbar flags for equipment with main terminals too small for cable lugs. Use flags sized to suit cable lug termination, with current rating of at least the maximum equipment frame size.

Phase isolation: Provide phase isolation between flags where the minimum clearance distances phase-to-phase and phase-to-earth are below the component terminal spacing.

Future extensions

Pre-drill the main circuit supply busbar for future extensions and extend busbar droppers into future functional unit locations.

Jointing

Use high tensile steel bolts, washers and nuts, with lock nuts or locking tabs. Do not use tapped holes and studs or the like for jointing current carrying sections.

5.5 MAIN SWITCHES

5.5.1 SWITCH ISOLATOR

Standard

To AS/NZS 60947.3.

Type

Poles: 3.

Rated current: To suit unit installed in enclosure.

Rated fault capacity

Short circuit making capacity: At least the fault level at assembly incoming terminals.

Breaking capacity: At least the rated full load current.

Utilisation category

At least AC-22.

Rated duty

Uninterrupted in non-ventilated enclosure.

Operation

Independent manual operation including positive "*ON*/*OFF*" indicator.

Locking

Provide for padlocking in the "*OFF*" position.

5.5.2 TRANSFER SWITCHES

Standard

To AS 3947.6.1.

Type

3 pole or 4 pole type with supervisory circuits which interact with the generator controller, PLC system and synchronisation electronics.

Load side connections

Segregate from incoming side.

Circuit breakers

Comply with *Moulded case and miniature circuit breakers*, in the *Circuit breakers* subsection. Do not use non-auto circuit breakers.

Interlocks

Interlocks will not be required as the generator and mains busbar will be connected for less than one second.

5.6 CIRCUIT BREAKERS

5.6.1 MOULDED CASE AND MINIATURE CIRCUIT BREAKERS

General

Circuit breakers shall be equipped with combined inverse thermal and instantaneous magnetic overload trip features and shall have quick make/break trip free operating mechanisms. NHP or better shall only be used.

Mounting

Mount circuit breakers so that the "*ON/OFF*" and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.

Utilisation category

Partial or full discrimination: Type B.

Adjustable current settings

General: If trip current adjustment control is exposed with covers in position, provide for sealing to prevent tampering.

Labels: Provide labels indicating trip settings.

5.7 LINKS

5.7.1 NEUTRAL AND EARTH LINKS

Terminals

Provide terminals for future circuits.

Links

Assembly capacity > 36 poles: Provide neutral and earth links at the top and bottom of the circuit breaker section.

Assembly capacity < 36 poles: Provide links at the point of entry of incoming supply cables.

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral and earth links.

Labels: Provide labels for neutral and earth terminals.

Cables > 10 mm^2

Provide bolts or studs.

5.8 INTERNAL WIRING

5.8.1 WIRING

Cable type

Provide 0.6/1 kV copper cables. Use V-90HT insulation where directly connected to active and neutral busbars.

Cable interconnections

General: For the main circuit supply, provide cable interconnections as follows:

- Use 1.5 mm^2 (minimum) internal cables, with minimum V75 insulation rating with stranded copper conductors rated to AS/NZS 3008.1. Use cables with current ratings suitable for the internal assembly ambient air temperature and for temperature rise limits of equipment within the assembly.
- Run cables clear of busbars and metal edges.
- Provide cables capable of withstanding maximum thermal and magnetic stresses associated with relevant fault level and duration.
- Run cables neatly. Provide slotted trunking sized for future cables or tie at 150 mm maximum intervals using ties strong enough to withstand magnetic stresses created at the specified fault current. Do not use adhesive supports.
- Ensure wiring for future equipment can be installed without removal of existing equipment.
- Identify power and control cables at both ends using neat fitting ring type ferrules agreeing with record circuit diagrams. Mark to AS/NZS 4383.1.
- Terminate control cables and motor control circuits in tunnel terminals or, if necessary, use suitable palm type lugs and correct crimp tool.
- For equipment mounted on hinged doors run cables on the hinge side to avoid restricting the door opening. Bundle cables using spiral wrap PVC.
- If recommended by device manufacturers, provide shielded wiring.

Adjacent circuit breakers: If suitable proprietary multi-pole busbar assemblies are available to link adjacent circuit breakers, do not use cable interconnections.

Cables > 6 mm^2

Terminations:

- Tunnel terminals: Single cables.
- Other connection points or terminals: £ 2 cables.

Doors: Do not run cables to hinged doors or removable panels.

Supports:

- Spacing at enclosure: < 200 mm from a termination.
- Spacing generally: < 400 mm.
- Strength: Capable of withstanding forces exerted during fault conditions.

Single core cables rated > 300 A: Do not use ferrous type metal cable saddles.

Marking: Terminate marked cables for connection to external controls in correspondingly marked terminals within the assembly.

Control and indication circuits

General: Provide conductors sized to suit the current carrying capacity of the particular circuit.

Minimum size: 1 mm^2 with 32/0.2 stranding.

Cable colours

Colour code wiring as follows:

- A phase: Red.
- B phase: White.
- C phase: Blue.
- Neutral: Black.
- Earthing: Green-yellow.

5.9 MEASUREMENT ACCESSORIES

5.9.1 CURRENT TRANSFORMERS (METERING)

Standard

Provide CT provisions for Authority and Private metering.

5.9.2 INSTRUMENTS AND METERS

Standards

Indicating instruments: To AS 1042.

Install maximum demand indicators as detailed in Section 5 electrical services Appendix 1.

Electricity meters: To AS 1284 Parts 1, 3 & 4

Transducers: To AS 1384.

General

Install a power meter that provides instantaneous voltage, current, power factor, real power, accumulated power, maximum demand to Schneider PM3550 or similar.

Transducers

If necessary for transducer operation, provide auxiliary supply. Connect outputs to dedicated rail-mounted isolating type terminals.

Accuracy

Indicating instruments and accessories: Accuracy class 1.5 or lower class index number except Class 3 for thermal maximum demand indicators.

Electricity meters: Class 0.5.

Power factor meters, phase angle meters and synchroscopes: 2 electrical degrees maximum error.

Transducers: Class 0.5.

Mounting

Flush mount meters on hinged panels. Wire with multi stranded flexible cables.

Protection devices

Meter potential protection devices: Group together behind associated meter cover or hinged door, preferably next to current transformer test links.

Labels

If associated exclusively with one phase, label meters "*RED*", "*WHITE*", or "*BLUE*" as applicable.

Ammeters

Type: Moving iron type oil dampened for motor starter circuits.

Overscale: For ammeters subject to motor starting currents, overscale to at least 5 x full load current.

Selector switches: 4-position type with positions designated "*R/W/B/OFF*". Mount under or next to relevant ammeters.

Maximum demand indicators

Built into power meter.

Accuracy class

Instantaneous: Class 1.5.

Maximum demand: Class 3.

Voltmeters

Type: Moving iron.

Selector switches: 7-position voltage transfer type for measurement of phase-to-phase and phase-to-neutral voltages with off. Mount under or next to relevant voltmeters.

5.9.3 INDICATOR LIGHTS

Standard

To AS/NZS 60947.5.1.

Degree of protection

At least that of the assembly/operating face.

Incandescent indicators

Type: Incandescent oil tight type minimum 22 mm diameter or 22 x 22 mm.

Lamps: Changeable from front of panel without removing the holder.

Lamp rating: 1.2 – 5 W.

Press-to-test

Compartments/subsections with < 5 indicating lights: Provide each indicating light with a fitted integral press-to-test lamp actuator.

Compartments/subsections with > 5 indicating lights: Provide a common press-to-test lamp push-button.

5.9.4 SURGE PROTECTION

Provide Surge Diverters within the Main Switchboard. The Surge Diverters shall be connected between the Main Switchboard active and neutral busbars and the MEN earth link.

The unit shall utilise Metal Oxide Varistors individually fused and shall incorporated an external clean contact to provide an individual phase segment failure. The unit shall also have a local digital display indicating percentage active per phase.

Unit specification:

Operating voltage	250 VAC
Surge withstand	ANSI C62.41 Cat A, B, C
	AS1768 Cat A, B, C
Surge rating:	8/20 us pulse response 200KA
Performance:	< 750V clamp voltage for 3KA Cat C
	< 950V clamp voltage for 20KA Cat C
Alarms:	Local digital display
	External clean contact C/O on one segment failure.

Max Conductor: 16mm^2

The surge diverters shall be factory fitted to the Main Switchboard and shall be model SD3-200 by Erico or an approved equal.

5.10 INSTALLATION

5.10.1 ASSEMBLY INSTALLATION

Fixing

Before making interpanel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

5.10.2 ASSEMBLY ENTRIES

Cable entries

General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Use the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables rated > 300 A: Pass separately through non-ferrous gland plates. Do not use metal saddles.

Cable enclosures

Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports

Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

5.11 MARKING

5.11.1 MARKING

General

Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters. Labels should be traffolyte where possible with adhesive that is non-degrading in high temperatures. Alternatives to be approved by the Supervisor.

Identifying labels

Provide labels fixed to access panels, doors, covers and escutcheon panels and internal equipment, indicating the relevant section and component.

Minimum lettering heights

Main assembly designation: 25 mm.

Distribution assembly designations: 15 mm.

Small proprietary distribution boards: 10 mm.

Main switches: 10 mm.

Outgoing functional units: 8 mm.

Identifying labels (on outside of cabinet rear covers): 4 mm.

Danger, warning and caution notices: 10 mm for main heading, 5 mm for remainder.

Other labels including equipment labels within cabinets: 3 mm.

Label colours

Generally: Black lettering on white background.

Main switch and caution labels: Red lettering on white background.

Danger, warning labels: White lettering on red background.

Fixing

General: Fix labels securely.

Method: Select from the following:

- Screws and double-sided adhesive.
- Fixed in extruded aluminium sections fixed to panels using rivets or countersunk screws.

Aluminium labels: Use aluminium or monel rivets.

Restrictions: Do not use self-tapping or thread-cutting screws.

Set-out

Align horizontally and vertically with adjacent labels.

Labels on assembly exteriors

Manufacturer's name: Required.

Assemblies: Label with essential markings.

Designation labels: For other than main assemblies, provide designation label stating source of electrical supply. Identify separate sections of enclosures.

Assembly controls: Label controls and fault current limiters, including the following:

- Circuit designation for main switches, main controls and submains controls.
- Details of consumers mains and submains.
- Incoming busbar or cable rating to first tee-off.
- Fuse link size.

Labels on assembly interiors

General: Provide labels for equipment within assemblies. Locate so that it is clear which equipment is referred to, and lettering is not obscured by equipment or wiring.

Moulded case circuit breakers: If circuit breaker manufacturer's markings are obscured by operating handle mechanisms or motor operators, provide additional markings open to view on or next to the circuit breaker.

Danger, warning and caution notices

Busbars: If polymer membrane coating is used without further insulation, provide warning notices on the front cover near the main switch or local main switch, and on rear covers, indicating that busbars are not insulated.

Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.

Stand-by power: Provide warning notices stating that assemblies may be energised from the stand-by supply at any time.

Custom-built assemblies: For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energising assemblies.

Positioning: Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units, and behind the front cover of functional units. Provide circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

5.11.2 CIRCUIT SCHEDULE

Schedule cards

General: For general light and power distribution boards, provide schedule cards of minimum size 200 x 150 mm, with typewritten text showing the following as-installed information:

- Submain designation, rating and short-circuit protective device.

Mounting: Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers.

Single-line diagrams

Custom-built assemblies: Provide single-line diagrams.

Format: Non-fading print, at least A3 size, showing the as-installed situation.

Mounting: Enclose in a non-reflective glazed metal frame and wall mount close to assembly.

5.12 COMPLETION

5.12.1 SPARES

Tools

Accessories: Provide one set of racking tools for circuit breakers, and special installation, operation and servicing tools.

Indicator lights: Provide 3 spare lamps and one lamp extractor per 10 indicating lights. Locate in spares cabinet.

5.12.2 COMPLETION TESTS

General

Carry out the following tests:

- Electrical operation.
- Dielectric.

5.12.3 MAINTENANCE

General

General: Carry out the following:

- Monthly inspections and maintenance work to maintain the assembly, including battery systems.
- Rectify faults, make adjustments, and replace consumable and faulty materials and equipment within 24 hours of notification.

Standard: To AS 2467.

5.12.4 ACCESSORIES

The following accessories shall be provided by the Contractor.

- an authorised sign giving instructions, with illustrations, upon the treatment of persons suffering from electric shock;

Glass fronted frame in which operating instructions and single line diagram are mounted.

SECTION 6 - METERING

6.1 REFERENCED DOCUMENTS

Details of documents referenced and applicable to this section of the specification are as follows:

Australian/New Zealand Standards

AS 2897-1986	*Power capacitors - Shunt - Rated voltages above 660 v a.c.*

Other Standards

AS 1284.1-2004	*Electricity metering - General purpose induction watt hour meters*
AS 60044.1-2003	*Instrument transformers – Current Transformers*
IEC 60893-1 Ed. 2.0 B (2004)	*Insulating materials - Industrial rigid laminated sheets based on thermosetting resins for electrical purposes - Part 1: Definitions, designations and general requirements*

6.2 SUB METERING

a) Provide 400/230V, kilowatt-hour tariff meters. Meters must conform to the National Metering Code for sale of electricity.

b) Provide provision for 400/230V kilowatt-hour metering at each level.

6.3 ELECTRONIC 'SMART' METERS

a) Supply and install electronic single or polyphase meters as indicated on drawings. Meters shall be suitable for mounting with distribution switchboards or in a common enclosure. Each meter shall:

- Accommodate a range of tariffs without requiring additional consumer's mains to be run to switchboards.

6.4 ENERGY METERS

a) Meters shall be suitable for mounting within and tenancy switchboards in a common enclosure as indicated on drawings. Meters shall be Schneider PM3350 meters or equivalent

6.5 SOLAR SMART ENERGY MONITOR

a) Contractor shall supply and install a Smart Monitor from Solar Analytics as indicated on the drawings. The meter shall monitor the total energy consumption from the consumer mains and the total energy generation from the PV system.

b) The monitoring system shall be supplied, configured, installed, commissioning and tested by the contractor. The contractor shall also supply and install the adequate CTs from Solar Analytics for the purposes mentioned in Section 6.5.

c) The contractor shall also include the payment of the 1-off subscription fee for the monitoring system. Refer to PV Section for further details.

SECTION 7 - EARTHING

7.1 GENERAL

a) Refer to 'Communications' Specification

7.2 REFERENCED DOCUMENTS

Details of documents referenced and applicable to this section of the specification are as follows:

Australian/New Zealand Standards

AS/NZS 1768-2007	*Lightning protection*
AS 2067-1984	*Switchgear assemblies and ancillary equipment for alternating voltages above 1 kV*
AS/NZS 3000-2000	*Electrical installations (known as the Australian/New Zealand Wiring Rules)*
AS/NZS 3008.1.1-1998	*Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions.*
AS/NZS 3080-2003	*Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)*

b)

7.3 MAIN EARTHS

7.3.1 GENERAL

The contractor shall supply and install a new MEN System to comply with AS/NZS 3000:2018 and Local Supply Authority as follows:

The main earthing conductor shall be connected to an earthing electrode, which shall be installed to the requirements of the Supply Authority. The earthing electrode shall be in one piece and consist of a solid steel core rod bonded to an outer casing of electrolytic copper. The rod shall be of minimum length 2.4m and minimum diameter 19mm.

Should the electrode be installed in rock and electrode shall be installed in a hole of minimum dimensions 50mm diameter and 2.5mm deep drilled into the rock. The vacant space around the electrode shall be packed with a mixture of Bentonite, clay and gypsum.

The main earthing conductor shall be connected to the earthing electrode by means of an approved earthing clamp. The connection shall be carried out in a pit or core hole.

The Contractor shall also install bonding conductors to connect the earth bar from the main switchboard to the incoming cold water supply pipe where it enters the site. The connection shall be made at a suitable bolted flange connection in the pipework. To this end, the Contractor shall liaise with the Hydraulics Contractor to ensure that provision is made for the connection and that the connection is made in a manner suitable to the Supply Authority.

The main earthing and bonding conductors shall be sized as required by the SAA Wiring Rules and shall comprise PVC insulated copper cables in conduit.

Alternatively, the existing earth electrode on site may be reused if it can be proven to comply with AS/NZS 3000:2018 in all respects. Provide documentation to support the conclusion.

The existing earthing conductor on site may be reused if it can be proven to comply with AS/NZS 3000:2018 in all respects. Provide documentation to support the conclusion.

7.4 EARTHING TERMINAL BARS

a) Terminations shall comprise cable lugs bolted to terminal bar with stainless steel nuts bolts and locknuts.

b) Provide a tinned copper earthing terminal bar mounted on standoff insulators and predrilled for 25% additional terminations.

c) Label each cable terminating on the terminal bar and number stamp each termination.

7.5 SWITCHBOARDS

a) Effectively earth all metal work in the vicinity of the switchboards. Do not earth equipment via the neutral bus or the neutral earth connection.

b) Where items of equipment (push buttons, instruments or switches) are mounted on doors:

I. Bond the doors to the main body of the cubicle via a tinned copper braided flexible cable sufficient in length to allow the door to open 180 degrees.

II. Attach the braided cable at each end by studs at least 5mm in diameter and 12mm in length.

III. Securely weld the studs to each anchoring point prior to painting.

IV. Use flat brass washers and lock washers beneath a brass nut for securing ends of the cable.

7.6 CABLING ACCESSORIES & APPLIANCES

7.6.1 EARTHING

a) Earth lighting fittings, socket outlets and fixed wiring to appliances by means of the earth conductor which forms part of the respective circuit cabling.

b) Use a separate earthing conductor for each circuit.

c) Run earthing conductors back to the earth bar within the switchboard from where the supply originated.

d) Number each earth bar terminal and record on Circuit Schedules.

e) Earth all metallic cable support systems including cable trays, skirting ducts, wall studs, roof trusses, steel covers, removable escutcheon panels housing electrical and communication cabling.

f) Earth all metal door frames fitted with a switch, electric lock etc.

g) Where cable trays, troughs, ladders etc. support cables that penetrate a fire wall or separation, maintain earthing continuity of the support system through the penetration.

7.7 EARTHING OF ACCESSIBLE EQUIPMENT

a) Provide earthing in accordance with AS/NZS 3000 Section 5.

7.8 EARTHING CONDUCTORS

7.8.1 CABLE SIZES

a) In general select earthing connections in accordance with AS/NZS 3000.

b) For lifts, moving walkways, variable speed drives or any permanently connected devices with high earth leakage select earthing conductors in accordance with AS 62103. The minimum earth size shall be greater than or equal to the associated active conductor or minimum AS3000 size conductor whichever is greater.

7.8.2 COMMUNICATION EARTH

a) Provide earthing to AS/NZS 3080 and the Australian Communications Authority Standards and regulations and as detailed on drawings.

SECTION 8 - DISTRIBUTION BOARDS

8.1 GENERAL

8.1.1 GENERAL

General

Provide Distribution boards within the electrical cupboards as shown on the drawings. Co-ordinate with mechanical services to provide power to MSSB boards. Reticulate sub-mains on cable tray vertically through the cupboards.

Provide single circuit RCDs on all circuits excepting those serving cooktops, water heaters/boilers, fire safety services, UPSs and motors over 1kW.

The distribution boards shall be manufactured to fit the space provided; equivalent to Modulec or NHP. Consult a board provider before submitting tender to pre-empt possible issues. These must be raised in the tender submission.

8.1.2 STANDARD

General

To AS 61439.1

8.1.3 INTERPRETATIONS

Definitions

Proprietary assemblies: Low voltage switchgear and control gear assemblies available as a catalogue item, consisting of manufacturer's standard layouts and equipment.

Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.

Abbreviations

TTA: Type tested assemblies.

NTTA: Non-type tested assemblies.

PTTA: Partially type tested assemblies.

8.1.4 DESIGN

All distribution boards shall have a minimum of 60 poles to suit the No. of circuits plus 30% spare capacity.

All distribution boards shall have separate chassis for lighting & power as required by the BCA section J8.3. Install Rapidtest RCD testers to each distribution board. Commission as required.

The main switch shall be rated at minimum 160A. Circuit breakers will be minimum 10 kA din-rail miniature type. Boards shall be NHP or approved equivalent.

Position equipment to provide safe and easy access for operation and maintenance. Consider functional relationships between items of equipment in the laying out of equipment on the assembly.

Moulded case circuit breakers rated up to 100 A, connected to circuits for lighting, general purpose outlets and small single or multi-phase electrical accessories: Mount any number of circuit breakers within a Form 1 separated subsection, provided the circuit breakers are mounted on an approved multi-pole busbar chassis assembly, concealed with an escutcheon panel.

8.2 QUALITY

8.2.1 INSPECTION

Notice

Give notice so that inspection may be made at the following stages:

- Assembly installed and connected.
- Acceptance.

8.2.2 PRE-COMPLETION TESTS

Site Tests

Visual and functional inspection.

8.2.3 CONTRACTOR'S SUBMISSIONS

Product data for proprietary assemblies

Submit design drawings showing the following:

- General assembly;
- Types and model numbers of items of equipment;
- Overall dimensions;
- Fault level;
- IP rating;
- Rated current of components;
- Number of poles and spare capacity;
- Mounting details;
- Paint colours and finishes;
- Access details;
- Schedule of labels.
- **Shop drawings of custom-built assemblies**

8.3 PROPRIETARY ASSEMBLIES

8.3.1 GENERAL

Modifications

Carry out modifications as necessary to suit single line diagram included.

8.3.2 REQUIREMENT

Provide removable escutcheon plates with neat cut-outs for circuit breakers. Each escutcheon shall be secured by a minimum of 4 fixings each consisting of an M8 plated stud fixed to the cubicle and fitted with a serrated star washer and a chromium plated acorn nut. Lockable distribution boards shall be fitted with a chromium plated lever-type handle.

8.4 BUSBARS

8.4.1 BUSBARS

General

Provide main circuit supply busbars within assemblies, extending from incoming supply terminals to the line side of protective equipment.

Where noted, provide split chassis to distribution boards to allow for separate metering for lighting & power circuits.

Standards

To AS 3768, AS 3865 and AS 4388.

Definitions

Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.

Material

Hard-drawn high-conductivity electrolytic tough pitched copper alloy bars, designation 110.

Temperature rise limits – active and neutral conductors

Maximum rated current temperature rise limits: 65 ± 1.5°C by type test or calculation to AS 3768 or AS 4388.

Maximum short-circuit withstand current temperature rise limits: 160°C by calculation to AS 3865.

Cross section

Rectangular with radiused edges.

Supports

General: Sufficient to withstand thermal and magnetic stresses due to maximum prospective fault currents.

Material: Non-hygroscopic insulation capable of holding busbars at 105°C.

Phase sequence

For main busbars and connections to switching devices, set-out phase sequence for phases A, B and C, from left-to-right, top-to-bottom and back-to-front when viewed from the front of the assembly.

Colour coding

General: Provide 25 mm minimum width colour bands permanently applied to busbars at 500 mm maximum intervals with at least one colour band for each busbar section within each compartment.

Active busbars: Red, white and blue respectively for the A, B and C phase.

Neutral busbar: Black

MEN link: Green-yellow and black.

Protective earth busbar: Green-yellow.

Restrictions: Do not use adhesive type colour bands.

Busbar systems

Use multi-pole proprietary busbar assemblies or busbar systems, which have been verified for short circuit capacity and temperature rise-limits by type tests.

Current carrying capacity

Active conductors: Take into account thermal stresses due to short circuit current, assuming magnetic material enclosures located indoors in well-ventilated rooms and 90^{O}C final temperature.

Neutral conductors: Size to match incoming conductor current carrying capacity.

Protective earth conductors: Size for at least 50% of the rated short circuit withstand current for 100% of the time duration.

Tee-off busbars current rating

For individual outgoing functional apartments: Equal to maximum frame size rating of the functional apartment.

For multiple functional apartments: Equal to the diversity factors of AS 61439.1, based on frame size rating.

MEN links

MEN links > 10 mm^2 in section: Bolted removable busbar links stamped "*MEN LINK*", located in the incoming compartment, between neutral and earth busbars.

Fault current limiters

Rate busbars connected to fault current limiters to 100% of the indicated fault current limiter circuit breaker frame size or fuse base rating.

Busbar links

For current transformers, provide removable busbar links approximately 450 mm long.

Cable connection flags

General: Provide and support busbar flags for equipment with main terminals too small for cable lugs. Use flags sized to suit cable lug termination, with current rating of at least the maximum equipment frame size.

Phase isolation: Provide phase isolation between flags where the minimum clearance distances phase-to-phase and phase-to-earth are below the component terminal spacing.

Jointing

Use high tensile steel bolts, washers and nuts, with lock nuts or locking tabs. Do not use tapped holes and studs or the like for jointing current carrying sections.

Busbar insulation

Active and neutral busbars and joints: Select from the following:

- Polyethylene: At least 0.4 mm thick with dielectric strength of 2.5 kV r.m.s for 1 min, applied by a fluidised bed process in which the material is phase coloured and directly cured onto the bars.
- Close fitting busbar insulation mouldings at least 1 mm thick.
- Heat shrink material: Use only on rounded edge busbars.

Damaged insulation: Repair damaged insulation before energising.

8.5 MAIN SWITCHES

8.5.1 SWITCH-ISOLATOR

Standard

To AS 3947.3.

Type

Poles: 4.

Rated current: To suit apartment installed in enclosure.

Rated fault capacity

Short circuit making capacity: At least the fault level at assembly incoming terminals.

Breaking capacity: At least the rated full load current.

Utilisation category

Circuits consisting of motors or other highly inductive loads: At least AC-23.

Other circuits: At least AC-22.

Rated duty

Uninterrupted in non-ventilated enclosure.

Operation

Independent manual operation including positive "*ON/OFF*" indicator.

Construction

General: Either

- Totally enclosed; or
- with full and direct shrouding to fixed live parts of switches and fuses, so that insertion of a screwdriver does not cause faults between phases.

Shrouding: Effective over range of air break switch positions.

Incorporate the following:

- Earthing terminal.
- Neutral link mounted within apartment.
- Contact position clearly indicated whether cover is in place or not. For fuses mounted in withdrawable carriage ensuring isolation from supply before access to fuses is possible, secondary indication may be omitted.

8.6 CIRCUIT BREAKERS

8.6.1 MOULDED CASE AND MINIATURE CIRCUIT BREAKERS

Standard

Fault capacity ≥ 10 kA: To AS 3858.

To be of NHP Terasaki or Cutler-Hammer manufacture and suitable for the fault level present. Do not cascade breakers to use reduced fault level breakers.

Miniature circuit breakers

Fault capacity ≥ 10 kA, current rating < 100 A: Use miniature overcurrent circuit breakers.

Mounting

Mount circuit breakers so that the "*ON/OFF*" and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.

Utilisation category

Non-discrimination: Select type to match application. Use minimal margin that avoids nuisance tripping.

8.7 LINKS

8.7.1 NEUTRAL AND EARTH LINKS

Terminals

Provide terminals for future circuits.

Links

Assembly capacity > 36 poles: Provide links at the point of entry of incoming supply cables.

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral and earth links.

Labels: Provide labels for neutral and earth terminals.

Cables > 10 mm^2

Provide bolts or studs.

8.8 INTERNAL WIRING

8.8.1 WIRING

Cable type

Provide 0.6/1 kV copper cables. Use V-90HT insulation where directly connected to active and neutral busbars.

Cables > 6 mm^2

Terminations:

- Tunnel terminals: Single cables.
- Other connection points or terminals: 2 cables.

Supports:

- Spacing at enclosure: 200 mm from a termination.
- Spacing generally: 400 mm.
- Strength: Capable of withstanding forces exerted during fault conditions.

Marking: Terminate marked cables for connection to external controls in correspondingly marked terminals within the assembly.

Control and indication circuits

General: Provide conductors sized to suit the current carrying capacity of the particular circuit.

Minimum size: 1 mm^2 with 32/0.2 stranding.

Cable colours

Colour code wiring as follows:

- A phase: Red.
- B phase: White.
- C phase: Blue.
- Neutral: Black.
- Earthing: Green-yellow.

8.8.2 TERMINATIONS

Submains, light and power circuits

Connect direct to the circuit breaker terminals.

Other circuits

Connection to circuits 16 mm^2: Provide DIN-type tunnel terminal blocks.

Tunnel terminals: Provide insulated sleeve ferrules to flexible cables terminated in tunnel terminals.

Identification: Identify cables at both ends using neat ring-type ferrules.

Type: Screw-tightened, clip-on, 35 mm DIN-type, flexible, non-flammable and, as a minimum, suitable for the insertion of a screwdriver blade.

Location: Locate terminals to provide ready access to outgoing terminations.

Mounting rails: Screw or rivet mounting rails to assembly at < 500 mm centres. Provide sufficient length to accept a further 20% terminals or 3 terminals, whichever is the greater.

- Arrangement: Terminate internal wiring to one side of the terminal block, leaving the other side for outgoing circuits.
- Grouping: Provide separate terminal groups for final sub-circuit and control wiring. Provide oversized barriers between each group of terminals having different voltages and terminal size.
- Terminals for power wiring: 3 phases or single phase and neutral.
- Control terminals: In alphabetical or numerical order of wire identification, with the lowest number or letter next to the power terminals.
- Shipping breaks: Provide terminal blocks for interconnecting wiring on each side of shipping breaks.

8.9 SWITCHGEAR ACCESSORIES

8.9.1 RESIDUAL CURRENT DEVICES

Integral type

General: Incorporate earth leakage in circuit breaker protection operation.

Mounting: Comply with Moulded case and miniature circuit breakers, in the Circuit breakers subsection.

Tripping

Residual current classification: Type II.

Maximum tripping current: 30 mA.

8.10 CONTROLGEAR

8.10.1 CONTACTORS

Standard

A.C. contactors: To AS 1029.1 or AS 3947.4.1.

Type

Block type, air break, electro-magnetic.

Poles

3.

Minimum rated values

Rated operational current: Full load current of the circuit protective device.

Rating: 16 A.

Mechanical endurance: 10.

Contacts life: 1 million operations at AC-3.

Auxiliary contacts

General: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 240 V A.C.

Utilisation category: AC-1.

Slave relay: If the number of auxiliary contacts exceeds the number which can be accommodated, provide a separate slave relay.

Mounting

Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Interconnection

Do not connect contactors in series or parallel to achieve ratings.

8.11 RESIDUAL INSTALLATION

8.11.1 ASSEMBLY INSTALLATION

Fixing

Before making interpanel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

8.11.2 ASSEMBLY ENTRIES

Cable entries

General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Use the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Cable enclosures

Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports

Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

8.12 MARKING

8.12.1 MARKING

General

Provide labels including control and circuit equipment ratings, functional apartments, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply.

Identifying labels

Provide labels fixed to access panels, doors, covers and escutcheon panels and internal equipment, indicating the relevant section and component.

Minimum lettering heights

Main assembly designation: 25 mm.

Distribution assembly designations: 15 mm.

Small proprietary distribution boards: 10 mm.

Main switches: 10 mm.

Outgoing functional apartments: 8 mm.

Identifying labels (on outside of cabinet rear covers): 4 mm.

Danger, warning and caution notices: 10 mm for main heading, 5 mm for remainder.

Other labels including equipment labels within cabinets: 3 mm.

Label colours

Generally: Black lettering on white background.

Main switch and caution labels: Red lettering on white background.

Danger, warning labels: White lettering on red background.

Fixing

General: Fix labels securely.

Method: Select from the following:

- Screws and double-sided adhesive.
- Fixed in extruded aluminium sections fixed to panels using rivets or countersunk screws.
- Aluminium labels: Use aluminium or monel rivets.

Restrictions: Do not use self-tapping or thread-cutting screws.

Set-out

Align horizontally and vertically with adjacent labels.

Labels on assembly exteriors

Manufacturer’s name: Required.

Assemblies: Label with essential markings.

Designation labels: For other than main assemblies, provide designation label stating source of electrical supply. Identify separate sections of enclosures.

Assembly controls: Label controls and fault current limiters, including the following:

- Circuit designation for main switches, main controls and submains controls.
- Details of consumers mains and submains.
- Incoming busbar or cable rating to first tee-off.
- Fuse link size.

Labels on assembly interiors

General: Provide labels for equipment within assemblies. Locate so that it is clear which equipment is referred to, and lettering is not obscured by equipment or wiring.

Moulded case circuit breakers: If circuit breaker manufacturer's markings are obscured by operating handle mechanisms or motor operators, provide additional markings open to view on or next to the circuit breaker.

Danger, warning and caution notices

Busbars: If polymer membrane coating is used without further insulation, provide warning notices on the front cover near the main switch or local main switch, and on rear covers, indicating that busbars are not insulated.

Fault current limiters: In assembly sections containing fault current limiter fuses provide caution notices fixed next to the fault current limiters, stating that replacement fuse links are to match as-installed fuse link ratings, make and characteristics. Provide separate label stating fault current limiting fuse ratings.

Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.

8.12.2 CIRCUIT SCHEDULE

Schedule cards

General: For the main switchboard and general distribution boards, provide schedule cards of minimum size 200 x 150 mm, with typewritten text showing the following as-installed information:

- Submain designation, rating and short-circuit protective device.
- Light and power circuit numbers and current ratings, cable sizes and type and areas supplied.

Mounting: Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers.

8.13 COMPLETION

8.13.1 COMPLETION TESTS

General

Carry out the following tests:

- Electrical operation.

8.13.2 MAINTENANCE

General

General: Carry out the following:

- Monthly inspections and maintenance work to maintain the assembly.

- Rectify faults, make adjustments, and replace consumable and faulty materials and equipment within 24 hours of notification.

Standard: To AS 2467.

8.14 MARKINGS

8.14.1 LABELLING

General

The Distribution Boards unit is to be labelled with engraved laminated traffolyte material. Text should include the following information:

e.g.: Main Switch Board

Manufactured by _____ (include full address and contact details)

Serial Number/Job Ref Number _____

Rated Voltage, Frequency & Current: _____

Degree of Segregation: _____

Degree of protection: _____

Rated fault current: _____

Standard followed to build the DB: _____

8.15 COMPLETION

8.15.1 MAINTENANCE MANUALS

General

Maintenance manuals shall contain at least the following:

Copy of all as-installed drawings including construction and single line diagrams;

All technical data necessary for the efficient operation and maintenance of PFC unit;

Names, addresses and telephone numbers of installation Contractor and equipment manufacturer;

Technical description of the systems installed. Identify function, normal operation and limiting conditions;

Manufacturer's technical literature of equipment installed under this contract;

Operation procedures including:

- Safe start up, running and shutting down procedures.

Maintenance procedures including:

- Regular and preventative maintenance requirements.

Certificates including:

- Copies of manufacturers warranties
- Supply Authority Certification
- Testing and commissioning reports
- Product certification

SECTION 9 - LUMINAIRES AND LIGHTING

9.1 GENERAL

For proposed lighting and luminaire schedules refer to the legend drawing,

9.1.1 RELATED SECTIONS

Refer to the following sections:

- *Emergency evacuation lighting*, for emergency luminaires and exit signs;

9.1.2 PROPRIETARY EQUIPMENT

General: The requirements of this specification for lamps, ballasts and luminaire control equipment over-ride the specifications inherent in the selection of a particular make and model of luminaire.

9.1.3 MINIMUM ENERGY PERFORMANCE STANDARDS (MEPS)

General: To AS/NZS 4783.2 and AS/NZS 4782.2.

Self-ballasted lamps: To AS/NZS 4847.2 (Int).

9.1.4 STANDARDS

Standards

Luminaires: To AS 3137.

Radio interference limits: To AS/NZS 4051.

Light Levels: To AS1680.

9.1.5 INTERPRETATIONS

Definitions

Proprietary luminaires: Luminaires available as a catalogue item.

9.1.6 SCOPE

Supply & install new internal light fittings along with sub-circuit cabling, necessary brackets & lamps. Where shadowing by or interference with ducts and trays is an issue, liaise with the Authorised Principal's Representative (APR) to relocate and/or suspend the light fittings.

Provide motion control to the locations shown. Ensure motion control covers all areas within the specified rooms by optimising location. Locate motion detector to ensure lights activate on opening of an entry door. Use only re-trigger able motion sensors which fail closed. Assess onsite for exact mounting location whilst co-ordinating with architectural plans to avoid obstruction of furniture etc.

Supply & install new external lighting along with sub-circuit cabling, lamps, cable containment & relevant mounting hardware (poles, footings & the like). Provide power to all special signage. Provide lighting shields to external lights (as part of fittings if possible, but specifically added if necessary) to ensure light into neighbouring private areas is minimised. Allow to supply & install all timers, Photo electric cells.

Provide a photo-electric switch and multi-channel time switch for the operation of timed lights. Ensure one independent timer channel per external circuit.

Trench cables to AS/NZS 3000 to reticulate power to external lights. Use one channel of the multichannel timer (above) as well as the photo-electric switch output for the operation of external lights. Provide re- triggerable motion sensors on all levels & in all levels of fire stairs.

9.2 QUALITY

9.2.1 SAMPLES

Submit samples of each proposed luminaire for approval by the project manager.

9.2.2 NOISE

The Contractor will extract a guarantee from the lighting supplier (for office lighting) and the switch manufacturer that lights, ballasts and dimming switches will not make perceptible, audible noise.

9.2.3 SUPPORT

The Contractor will extract a guarantee from the lighting suppliers of parts support for ten years.

9.3 LUMINAIRES

9.3.1 COMPLETE

Lamps

Provide luminaires complete with lamps and accessories.

9.4 ACCESSORIES AND CONTROL EQUIPMENT

9.4.1 EARTH LEAKAGE

General

All light fittings shall have a residual earth leakage current of less than 0.5mA per fitting at all frequencies. Connect a maximum of 30 light fittings to a 30mA RCD protected circuit. Use only RCDs/RCBOs that incorporate a high frequency filter to eliminate high frequencies from ballasts as a source of tripping.

Switchgear Protection

All lighting circuits shall be protected at the switchboard by combination 30mA RCD / circuit breakers. Protection devices shall be surge current resistant short delay RCDs, tested for a surge strength of 250A. Lighting circuits shall be loaded to a maximum of 75% of the circuit breaker trip current rating.

9.4.2 WIRING

Flexible cords

General: Provide recessed luminaires with an external ≥ 1.5 m length of 0.75 mm^2 3-core V75 (minimum) PVC/PVC flexible cord, connected to a 10 A 3-pin moulded plug to AS/NZS 3112.

Other fittings flexible cord cross sectional area: ≥ 1 mm^2.

Internal Wiring

General: All internal wiring within light fittings shall be high temperature rated – suited to the temperatures within the fitting. Where continuous light fittings are installed, all pass through wiring shall be high temperature rated. Cables must be retained so as not to come into contact with hot components.

External Wiring

General: Keep all external wiring as far away from light fittings as is practical. Holes for wiring entering a fitting shall have protected edges. No sharp edges will be accepted.

9.4.3 DRIVERS

Number of drivers: Provide separate drivers for each lamp.

Blocking Inductors

If required by the Supply Authority, provide blocking inductors to Authority approval.

9.5 LED LIGHTS

9.5.1 GENERAL

Light fittings are to be commercial grade quality from established Australian based suppliers with purpose built LED lamps and separate drivers. (BC or ES lamp socket arrangements with retrofitted LED globes are not permitted).

High efficiency LED lamps with high colour rendition, greater than CI 85 in order to make high uniformity of lighting to minimise light and dark transition. Light sources to be positioned above eye level.

LED drivers to be of the electronic type with low EMF emission in accordance with IEC standards to ensure that there is no interference with hearing aids or audio equipment.

9.6 INSTALLATION

9.6.1 GENERAL

General

Mount luminaires on proprietary supports using battens, trims, noggings, roses and packing material, as necessary.

9.7 LIGHTING CONTROL

Programmable controls

General: Where programmable controls are specified, refer to the “Programmable Lighting Control Systems” section. Where programmable controls are provided at a location that is not at the entry door, provide a pushbutton at the entry door that will extinguish/restore sufficient lighting for easy movement throughout the area.

Allow for programming of all controllers to provide scenes and operation suited to the area. Obtain scene setup criteria from Authorised Principal’s Representative (APR) if not outlined elsewhere within the contract documentation.

Manual controls

General: Provide manual control of luminaires into groups, zones and to individual devices as documented. Where banks of lighting are not aligned parallel to any projection screen, confirm switching with Consultant before installation.

9.7.1 ACCESSORIES

Lighting outlets

Pin arrangement: Standard: 3 flat pin with looping terminal. Fix to soffit where possible.

Lighting switches (<= 4 gang)

General: Provide light switches as documented.

Type: Unless noted otherwise, light switches 4 gang or less to be Clipsal C2000 series (or approved equivalent) with integral label windows.

Standard: To AS/NZS 3133.

Switch Mechanisms: Rating to be minimum 15 A, 250 V A.C. and rated for reactive load switching. Mechanisms shall be white for circuits connected to standard mains power supplies. Mechanisms shall be red for circuits connected to generator supplies.

Labelling: Provide typed ’Dymo’ adhesive labels to the fixed plate behind the snap-on covers, to indicate the distribution board designation and circuit breaker number. Provide printed labels (using Clipsal software templates) behind transparent cover plate label windows to indicate the switch function. Prior to installing switch function labels, submit schedules of proposed labelling for approval.

Lighting switches (> 4 gang)

General: Provide light switches as documented in architectural room data sheets and NSW Ambulance Principal Project Requirements (PPR) documentation.

Type: Unless noted otherwise, light switches greater 4 gang to be of the recessed flat plate stainless steel type with engraved labelling to indicate the switch function

Standard: To AS/NZS 3133.

Switch Mechanisms: Rating to be minimum 15 A, 250 V A.C. and rated for reactive load switching. Mechanisms shall be white for circuits connected to standard mains power supplies. Mechanisms shall be red for circuits connected to generator supplies.

Labelling: Provide typed 'Dymo' adhesive labels to the fixed plate behind the stainless steel plate, to indicate the distribution board designation and circuit breaker number. Provide engraved labelling to the front of the stainless steel plate indicate the switch function. Prior to engraving the stainless steel plates, submit schedules of the proposed labelling for approval. Engraving will be in letters 4mm high.

Provide floor layout, with colour coded areas and laminated, of the area being controlled by the respective switch panel.

Lighting switches (general)

Labelling: All light switches greater than three gang will have engraved labelling that clearly indicates which area and which light bank is controlled by which switch. Engraving will be in letters 4mm high.

Where a light switch is also to control a separate device (such as a fan) that is not on the same lighting circuit, a double-pole light switch will be provided. The double pole light switch will be rated for the switching of separate phases where necessary.

Double switched lamps will be connected to 4-pin sockets using four core flex and plug.

Weatherproof and Impact Resistant Lighting Switches

General: Weatherproof and impact resistant lighting switches shall be installed in all plantrooms, switchrooms, external areas, and other areas as noted. Weatherproof is considered to be IP56 or better.

Key switches

General: Provide key lockable switches where documented.

Type: Key lockable switches to be Clipsal 56 series (or approved equivalent).

Run-on timer switches

General: Provide run-on timer switches as documented in architectural room data sheets and NSW Ambulance Principal Project Requirements (PPR) documentation.

Type: Run-on timer switches shall be of the push button electronic type. Pneumatic types are not permitted

Delay: Adjustable to 20 minutes.

Dimmer switches

General: Provide integral dimmer/switch units as documented in architectural room data sheets and NSW Ambulance Principal Project Requirements (PPR) documentation. For programmable dimmers, refer to the "Programmable Lighting Control Systems" section.

Type: Manual dimmer controllers shall be the rotational pot type integrated into the light switch – with a separate switch for on/off. Where push-button dimming is used as requested in drawings, provide engraved labelling 'Press for on/off. Hold for dimming'.

Installation: Locate any associated remote electronic control units in accessible locations. Acceptable locations include behind the light switch plate, accessible ceiling spaces or switchboard cupboards

Compatibility: Ensure dimmable ballasts of the light fittings are compatible with the dimming system used. DALI may be substituted for DSI provided that the functionality remains the same and there is no additional cost to the Client.

Proximity switches

General: Provide proximity switches as documented in architectural room data sheets and NSW Ambulance Principal Project Requirements (PPR) documentation.

Standard: To AS/NZS 60947.5.2.

Daylight switches

General: Provide photo electric (PE) switch units as documented in architectural room data sheets and NSW Ambulance Principal Project Requirements (PPR) documentation. PE switch should be integral to the light fitting unless otherwise documented. Precise location will take into account local shadowing, ceiling profile and ceiling fittings. Precise location and settings will take into account the surfaces below the PE cell and the range of reflections that may apply to the surface (e.g. an office desk may be covered in white paper of black folders).

Performance: Adjustable between 50 and 1000 lux.

Time delay: > 2 minutes.

Illumination differential: > 50 lux.

Motion detector switches

General: Provide movement detectors which cover designated areas as documented in architectural room data sheets and NSW Ambulance Principal Project Requirements (PPR) documentation. Generally, a motion detector will activate lights before an occupant enters the area controlled by the detector.

A detector controlling lighting within a room without a door will not be activated by motion in the corridor outside. It will activate lighting only when the occupant has crossed the threshold.

Where a motion detector is shown to control two separate circuits, provide a double pole motion detector switch.

If a motion detector switch is to serve double duty as a lighting controller and security detector, the switch must have two poles with an independent timer for each pole. Switching of each pole must be silent.

Fail Safe: Generally provide fail safe motion detector switches. Such a motion detector switch will, on a malfunction or failure of the switch to operate, default to the 'on' position.

Timer: Incorporate 'on' timer adjustable between 1 and 5 minutes minimum and 30 minutes and 2 hours maximum. The Contractor will allow to return to site after two months of occupation to adjust all timers to the Client's specification.

Standard: To AS 2201.3.

Type:

Where used in an office or other location where occupants are expected to be seated, the motion detector must be suited to the purpose. In particular, it must detect slight motion to remain activated (e.g. high sensitivity infra-red with dual technology microphonics/ultrasonic. Dual technology as a MINIMUM. Model: Steinel 3000 series or approved equal to meet coverage as required by the drawings).

Where installed in toilets, precise location must enable the detector to observe motion within cubicles. Again use high sensitivity or dual technology ultrasonic/infra-red.

Manual time delay switches

General: Provide manual time delay relay switches as documented.

Type: Run-on timer switches shall be of the push button electronic type. Pneumatic types are not permitted

Duration: Adjustable between 5 minutes and 15 minutes.

Indicator light: Required. Activated when artificial illumination is 'off'.

Automatic time switches

Where a Building Management and Control System is present, lighting time switching shall be preferably be done by providing additional outputs to the UPS and programming the BMS as appropriate.

Where time switching is to be achieved by a stand-alone timer, all light switching should be performed by a single, multichannel timer with low-loss contactors provided to enable load switching. The multi-

channel timer will have independent operation of each channel and will, unless otherwise stated, be a seven-day timer with switchable increments of 5 minutes or less.

The multi-channel timer will have in-built daylight savings correction.

If the outputs of the multi-channel timer are insufficient for all circuit switching, provide additional linked multi-channel timers.

9.8 LAMPS

9.8.1 LED LAMPS

Provide photometrics and longevity statistics for proposed lamps.

Lamp Caps

All lamp holders shall be bayonet type socket.

9.9 INSTALLATION

General

General: Install all luminaires to the manufacturer's requirements. Including recommended spacing of insulation and recommended support points.

9.9.1 SUPPORTS

General

General: Install luminaires on proprietary supports by means of battens, trims, 68olypha, roses and packing material.

Suspended luminaires

Rods: Steel pipe suspension rods fitted with gimbal joints.

Chains: Electroplated welded link chain.

Levelling wire: Stainless steel.

Levelling: Adjust the suspension system length so that the lighting system is level and even.

Horizontal tolerance: ± 3 mm between luminaires within the one space.

Luminaire movement: where a luminaire is exposed to possible air movement over $2ms^{-1}$, provide a mechanism (such as an additional wire) to eliminate sway of the fitting.

Surface mounted luminaires

General: Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.

Fixing: Provide 2 fixings at each end of fluorescent luminaires. A single fixing at each end in conjunction with 1.6 mm backing plates may be used for narrow luminaires.

Surface mounted fittings will be mounted hard against the surface, with no gaps.

Recessed luminaries

General: Install recessed luminaries in trimmed openings in the suspended ceiling.

Fittings with trims: Recessed fittings with trims will be mounted with no gap between the trim and the ceiling or wall.

Trimless fittings: Care will be taken with trimless fittings to ensure an acceptable appearance of the plasterwork or timber work. Liaise with the building trade to ensure a satisfactory appearance.

Alignment and spacing: Where a line of recessed fittings is documented, fittings are to be evenly spaced and in one straight line. Co-ordinate with mechanical, fire and hydraulic trades before the start

of work to ensure that this happens. The Contractor may be asked to relocate fittings at his/her own cost if this requirement has not been observed.

Standard: To AS 2946.

Poles and pole-mounted luminaires

General: All poles will be provided with footings sufficient for the height and size of the pole. Consult the manufacturer for details.

Provide all rag bolts and ancillary fittings necessary for the installation of the pole.

Any fixtures or additions to the pole will not compromise the poles internal IP rating and corrosion resistance and will be in accordance with the manufacturer's instructions.

Bollards

General: All bollards will be provided with footings sufficient for the height and size of the bollard. Consult the manufacturer for details. The Contractor will be required to replace the footing where it is possible for a person to push the bollard over.

Bollards will be examined for water ingress at the end of the defects liability period. If there is evidence of water ingress, the bollard will need to be removed and seals for cable entries re-established. Seals for the diffuser will also need to be re-established.

9.9.2 WIRING CONNECTIONS

Recessed luminaires

General: Connect recessed luminaires to a plug / socket outlet.

Lighting tracks

General: Locate associated low voltage transformers within 600 mm of the track.

Buried cables

Buried cables between external pole and bollard lights will be in conduit and installed to AS3000:2007. Underground cable joins are not permitted. Where possible, install beneath footpaths or other permanent structures. Garden beds or areas where digging is expected must be avoided. Co-ordinate burial with landscaping trade to ensure clearance beneath swales, dish drains and the like.

External lighting will be broken into sections and wired in a 'star' fashion to each section to minimise voltage drop. It would rarely be acceptable to have a single cable running around the entire perimeter of a building for external lighting. A more acceptable solution would be to break the perimeter into two sections and wire the two sections in a star fashion.

9.9.3 SPECIALISED LIGHTING

Indoor Carpark entry lighting: Where high light-level fittings are provided at car-park entries to comply with AS1680 requirement for transition lighting, this lighting will be PE cell controlled to turn off at night to leave remnant lighting sufficient for general car park operation.

Security lighting: Where security lighting is provided to operate over-night (under PE cell control), a key-switch will be provided to over-ride the PE cell control (over-ride on and over-ride off). The key switch will be labelled with engraved labelling and will not require access to a cupboard to operate. Confirm suitable location on site.

9.9.4 HANDLING

General: Do not handle lamps or reflectors with bare fingers. Use clean cotton gloves when handling luminaire lamps and reflectors. If fingerprints are found on some reflectors, the Contractor will be required to check all reflectors and clean as necessary.

9.9.5 COMPLETION

General

Prior to practical completion carry out the following:

- Verify the operation of all luminaires.
- Adjust aiming and controls for all luminaires under night time conditions.
- Clean all luminaires using the manufacture's recommended techniques to avoid scratching.
- At completion, luminaires shall be free of fingerprints, dust dirt, insects and paint splash.
- In addition, the contractor must allow for 5% spare lamps per fitting and submit to the superintendent for storage prior to handover. (Minimum 2-off spares for a fitting type, if there is less than 20 fittings of a particular fitting on the project).

9.9.6 REPLAMPING

Replace any lamps used during construction with new lamps at practical completion. Any light fitting connected to an energised circuit and fitted with a lamp greater than 2 weeks out from practical completion is deemed to be used during construction. Provide evidence of re- lamping by retaining the old lamps and presenting receipts for the purchase of the new lamps.

9.10 INTELLIGENT LIGHTING REQUIRMENTS

9.10.1 SYSTEM DESCRIPTION

Provide contactors if motion detector's manufacturers recommended switching capacity is exceeded by load. Use day lighting control where appropriate.

Allow to set motion sensitivity levels of all areas. Allow to adjust acoustic sensitivity levels of acoustic sensors to reject noise typical of the location. Allow to set timer to suit location.

Motion detectors controlling lighting are to be of the 'fail-on' type. That is, a failure is to cause all lighting to remain on. With override 'On' set.

Motion detectors must use re- triggerable timers. No other timers will be accepted.

Corridor lighting shall be configured to be 100% during 7am – 7pm. After 7pm, corridor lighting shall be controlled by corridor function, i.e. when no movement is detected, lighting shall switched off.

Provide a system that allows for the above functionality. Provide 24 hour lighting plus dedicated 24 hr lighting circuit as shown on the drawings.

Where lighting control is affected by a BMS, provide a shop drawing of the connections to this system.

SECTION 10 - EMERGENCY EVACUATION LIGHTING

10.1 GENERAL

10.1.1 CROSS REFERENCES

General
Comply with the General services requirements section.

Provide a single point emergency lighting system to AS2293 requirements within the MSB. Provide local testing facility in the new local distribution board along with all luminaires, exit signage and all necessary components for a fully functioning system.

Related sections

Refer to the following sections:

- Wiring and accessories, for cabling requirements.
- Luminaires, for general information.

10.1.2 STANDARDS

General

Design and installation: AS 2293.1.

Inspection, tests and maintenance: AS 2293.2.

10.2 QUALITY

10.2.1 CONTRACTOR'S SUBMISSIONS

Product data

Submit manufacturer's data for each type of luminaire and exit sign including tables indicating the maximum luminaire spacing for a given mounting height.

Type test data

Submit the following:

- Photometric data and temperature test reports for each type of luminaire and exit sign.

10.3 COMPONENTS

10.3.1 SINGLE-POINT SYSTEM

General

Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.

Common test switches: Provide a common test switch on the local distribution boards which disconnects main supply to the luminaries and tests for discharge performance. After testing, this switch must automatically revert to normal operating mode.

10.3.2 EMERGENCY LIGHTS

Be of the self-contained type.

Provide a charge indicator LED (Light Emitting Diode) showing mains supply available and charging circuit status.

Include integral batteries, inverter, charger and change-over device. Individual test switches, LED indicators and markings in accordance with AS2293.3.

Be manufactured, designed for a 10 year expected lifetime including the LED/Lamp driver and the LED/lamps.

Incorporate Lithium cells with the an expected life of ten (10) years and a guaranteed life of 4 years when operated in accordance with manufacturer's directions in the proposed emergency or exit luminaire.

Be classified by an approved Authority in accordance with AS2293 Part 3. The classification shall be clearly marked on the luminaire label.

Be tested in accordance with AS2293.3 with respect to Thermal/Duration, and Photometry resulting in a classification. Be tested to comply with EMC Standard AS / NZS CISPR 15:2011

10.3.3 EXIT SIGNS

In all areas exposed to weather, vandal prone areas & workshops, IP56 rated exit signs shall be provided.

Incorporate the general requirements of emergency luminaires and exit signs as detailed in this specification.

Be the permanently maintained type utilising LEDs with expected lifetime of 100,000 hours to L70/B50. This must be in line with the LED manufacturers' data.

Incorporate Pictograph and/or "EXIT" lettering and directional arrows as detailed in the Schedule or as determined on site.

Have screen printed legends, including arrows where required, and shall be green and white pictograph (or green letters on black background).

Be tested in accordance with AS2293.3 with respect to Thermal/Duration, Colour/Luminance/Format and Photometry resulting in a classification.

10.3.4 GENERAL

Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.

Warranty: Emergency and Exit lighting units must have a written guarantee providing for four year fitting replacement from the date of supply.

10.3.5 BATTERIES

Type: Lithium Iron Phosphate nanotechnology batteries capable of operating each lamp at its rated output continuously at least 2 hours during completion tests and 1.5 hours during subsequent tests.

Battery life: The design life of the batteries and their application in the emergency and exit luminaire shall be ten (10) years at a cell temperature of 45°C. Battery packs must incorporate battery protection (for over voltage in charge, low voltage protection and over current in discharge) and must be labelled with date of manufacture, ampere hour (Ah) rating and replacement part number.

Marking: Indelibly mark each battery with its date of manufacture.

Batteries for single point Emergency luminaries must be L10 Lithium nanotechnology batteries or other approved manufacture. The design life of the batteries and their application in the emergency and exit luminaire shall be ten (10) years at a cell temperature of 45°C. Battery packs must incorporate battery

protection (for over voltage in charge, low voltage protection and over current in discharge) and must be labelled with date of manufacture, ampere hour (Ah) rating and replacement part number.

10.4 INSTALLATION

10.4.1 GENERAL

Power supply to single-point systems

Provide a 240 V active supply to each luminaire and exit sign to monitor, the nearest local house lighting final sub-circuit.

10.5 COMPLETION

10.5.1 COMMISSIONING

General

General: Carry out tests, including out-of-hours tests, to demonstrate the emergency and evacuation system's performance. Include the following:

- Test components for correct function and operation.
- Demonstrate illumination performance on site, to at least the level stated in the manufacturer's performance specification for that device.
- Test operation of battery discharge test and control test switch functions, including discharge and restoration.
- Demonstrate system functions under mains fail condition.
- Demonstrate operation of the battery and charger including a full discharge/recharge over the designated time.

Mains supply

Before commissioning, ensure mains supply has been continuously connected for at least 24 hours.

Single-point systems
Simulate mains supply failure to each general lighting final sub-circuit and verify the correct operation of luminaires and exit signs for a continuous period of 2 hours. Then restore normal supply and verify the operation of the indicator lights on each luminaire.

10.5.2 COMPLETION TESTS

Single-point systems

Carry out the 6-monthly procedures before practical completion and again before the end of the maintenance period.

10.6 MAINTENANCE

General

Emergency evacuation lighting: To AS 2293.2.

Interval: Carry out the 6-monthly procedures before practical completion and again before the end of the maintenance period.

Provide appropriate log book for entering test performance of Emergency and Exit lights.

SECTION 11 - TELECOMMUNICATIONS

11.1 GENERAL REQUIREMENTS

11.1.1 GENERAL STANDARDS

AS/NZS 11801.1: Generic cabling for customer premises General requirements.

AS 3084: Telecommunication services pathways and spaces for commercial buildings.

AS/CA S008 Requirements for customer cabling products

AS/CA S009 Installation Requirements for customer cabling (Wiring Rules)

EIA/TIA 568

EIA/TIA TSB-36

EIA/TIA TSB-40

NSW Health Infrastructure Engineering Services Guidelines – 2016

NSW Health Infrastructure ICT Cabling Standard – Rev 3.0 July 2018

NSW Health Wi-Fi Standard

NSW Ambulance – RAIR Group 1 ICT Standard

NSW Ambulance – Electronic Security System – Standard Specification – Rev 3 Jun 2019

NSW Ambulance – How to Build an Ambulance Station – Rev 2.0 July 2021

11.2 SCOPE OF WORKS AND DRAWINGS

11.2.1 SCOPE OF WORKS

The scope of the contract telecommunications works as detailed within this specification, associated drawings, the architectural room data sheets and the NSW Ambulance Principal Project Requirements document, include, but not be limited to, the following.

- Supply, installation and termination of Panduit/Siemon/R&M RJ 45 telecommunications outlets and associated Cat 6A F/UTP cabling back to the new telecommunication cabinets located in the communications room;
- Provide 800Wx1000Dx42RU Communication Racks from Panduit/Siemon/R&M & all inclusions as shown in the drawings.
- Provide Panduit/Siemon/R&M structured cabling, cable management and patch panels.
- Provide Panduit/Siemon/R&M communication services including patch panels, backbone cabling and UTP horizontal structured cabling. Comms cable may be supported on catenary (maximum of 24 cables per catenary) or cable trays.
- Provide Panduit/Siemon/R&M cable management units.
- Manufacturer shall provide a warranty certificate for 20 years as per NSW Health ICT guidelines
- Provide lead-in cable, allow for trenching + comms conduits for phone connections etc. from the pit nominated by NBN/Telstra to the Main equipment room.
- Provide one P50 spare white telecommunication conduit running same route as lead-in communication cable.

- Pay all NBN/Telstra fees and charges.
- Provide and MDF/TPF in the communications room. Provide surge protection on each used copper pair comms cable entry equivalent to HSP10-K230. Provide sufficient surge protection for 30% additional (spare) pairs. Terminate lead-in cable onto MDF.
- Provide cabinet mounted floor distributors in the ground floor TER. Each distributor shall use 19inch cabinet mounted RJ45 patch panels.
- Provide 2-off 20A vertical power rails (PDUs) per rack. Each PDU to have 20 outlets.
- Provide inter-cabinet cabling, tie cables and voice cables between cabinets and MDF.
- Supply of all patch leads and fly leads.
- Install & supply wiring for alarm bells, thermal sensors and alarm panels.
- Supply & install thermal sensors & alarms.
- For cable runs greater than 90m, provide fibre converters as necessary at either end where specified.
- Grounding & bonding (inc. protective earth & telecoms reference earth)
- Ensure segregation is kept to comply with S-009 segregation requirements between LV power, ELV cabling etc. Provide GPO shrouds to the rear of the faceplate as required where the minimum cable distances between data & power cannot be achieved;
- Tie cabling between the new patch panels and local telephone frame;
- Testing, commissioning and training;
- All other minor works as deemed necessary to ensure a fully functional system;

11.3 TELECOMMUNICATIONS INSTALLATION

11.3.1 OUTLETS AND ASSOCIATED CABLING

Provide outlets and cabling to at least the accompanying drawings. Provide comprehensive labelling of each outlet with outlet number within the **window ID of the outlet**.

The Contractor shall supply and install shuttered universal telephone/data outlets as specified on the drawings.

The building wiring shall be terminated to the rear of the RJ 45 jack by the use of insulation displacement connections forming a gas tight joint.

The Contractor shall ensure that a minimum separation from a noise source (i.e.: power cabling) shall be 300mm.

Each multiple outlet shall be capable of accepting installation of four individual RJ 45 sockets along the long/horizontal axis fitted flush on a faceplate. Any unused socket positions shall be fitted with suitable blanking pieces. Unless specified otherwise, all pairs must be terminated. All cables must be labelled at both ends.

Each RJ 45 outlet shall be wired back to the telephone/data patch panel in the allocated telecommunication cabinet on the corresponding floor via unshielded twisted pair (UTP) cables. All such cabling shall be category CAT 6A F/UTP. All cables to be less than 90m. For the unlikely event of runs greater than 90m, provide fibre converters as necessary.

Allow 0.5m slack of cable behind each faceplate.

Do not use nylon cable ties for fixing/gathering cables. Use only soft ties with Velcro fastening.

The Contractor shall provide detailed technical specifications of the performance of the proposed cable to be used. The Contractor shall ensure that the cable complies with the following minimum specifications:-

Cable type- All cables are to be unshielded twisted pair type 4 pair cable of Cat 6A F/UTP performance.

A. Gauge- 24 AWG (except for 8 wire RJ 45 jumper cables).

B. Characteristic Impedance- 95-105 ohms at 1 MHz

C. Attenuation- Less than 2.5 dB (A) per 100 meters at 1 MHz (for 4 pair cables).

D. Resistance - Less than 8.5 ohms per 100 meters

The complete structured cabling system shall meet the CATEGORY 6A F/UTP performance criteria of TSB-36 and TSB-40.

11.3.2 RACKS/CABINETS

The contractor shall provide Equipment cabinets to comms rooms as shown on drawings & as per below. Any discrepancies to the drawings & to the list below shall be brought to the attention to the consulting engineer prior to any pricing or installation.

Provide UTP patch panels at each cabinet sufficient to terminate all terminating cables. Provide Fibre Distribution Enclosure (FDE) with connectors for each cabinet, as required for termination of all optical fibre.

Provide horizontal and vertical cable management for all cables where required.

11.3.3 PATCH & FLY LEADS

The Contractor shall allow to provide sufficient copper and fibre optic patch leads and fly leads to allow connection of all RJ45 and RJ11 outlets installed under this contract.

All patch leads and fly leads shall be Cat 6A F/UTP compliant.

11.4 CABLE PATHWAYS

- No UTP cable run shall exceed 90m in length
- Each cable run from the patch panel to the data outlet shall be one continuous length. No splicing or joining in any form shall be allowed.
- UTP cables shall not be run in parallel with power cable of any kind and cable routes should avoid devices such as fluorescent lights, plant equipment, etc.
- All wiring shall be installed in a neat and tidy fashion with all physical site disturbances and damages attributable to the contractor being made good by the contractor.
- Work area cabling shall be supported within the roof space of the building.
- Minimum bend radius figures specified by the cable manufacture shall be strictly observed.
- All wiring inside panels or enclosures shall be grouped and fixed in location by Velcro.
- All points of entry, supporting frames shall be free of burrs or other obstructions so as to prevent damage to the cable insulation or conductors
- Cabling shall be installed on cable tray or catenary, Catenary bundles shall not exceed 20 cables.

11.5 TESTING AND COMMISSIONING

11.5.1 TESTING

- All tests shall be recorded and presented as part of the “as installed” documentation.

On completion of the works, all acceptance tests are to be carried out prior to the cabling being placed into service.

All twisted pairs and fibre cable cores shall be tested. Any failure shall result in a re-termination and re-test, and/or a replacement cable and re-test.

All materials, equipment, instruments, tools, and labour required to prepare the installation for carrying out the tests and for recording the results shall be supplied by the Trade Contractor, including consumable and expendable items.

The Project Manager + consulting engineer may request the demonstration of the functionality of any of the links. The communications contractor shall supply the Engineering Consultant (JHA) with a copy of a calibration certificate for all test equipment as per AS/NZS 61439.1 using certified equipment. Testers shall be calibrated and serviced within the past 12 months.

All test equipment shall have the latest version of software installed to produce soft and hard copies of the results. Any test made with leads that exceed the maximum number of tests shall be considered invalid. Testing shall not commence until the cabling infrastructure has been fully installed and terminated. Testing shall be done in an environment as close as possible to operational conditions. All results shall be downloaded into the database system provided by the field tester manufacturer.

All test equipment used shall be “in-calibration”. The tester may require a warm-up period, and the self-calibrate feature is to be activated on a daily basis or prior to a batch test of cables.

All twisted pair (UTP/FTP/STP etc.) and fibre (MM/SM) test results shall be independently verified for compliance by an approved CSO NATA inspection body (AS/NZS 61439.1), prior to project closure.

The test data to be verified shall be provided to the NATA inspection body in the cable tester equipment native format and additionally a fibre test reporting sheet will be completed for each fibre cable.

11.6 TEST CONDITIONS

Single Mode Optic Fibre Cable

All fibres, connectors and patch cords shall be cleaned prior to inspection, testing and commissioning, using isopropyl alcohol and a lint-free tissue or equivalent, or compressed air, and then inspected using a microscope of at least 400x incorporating an infra-red filter as per AS/NZS 61439.1.

The cleaning process is to be repeated for each removal and re-insertion.

The core and inner cladding are to be free from blemishes, pits, chips, scratches or cracks. Any signs of these shall result in the connector being cleaned or reterminated, etc., to remove the blemishes.

All test equipment used shall be “in-calibration”, and the equipment model number, serial number and date of last calibration shall be documented on the test results.

It is important that the test equipment used, and associated procedures used, be compliant with the class being tested; otherwise, compliance with AS/NZS and ISO cannot be guaranteed.

The tester may require a warm-up period and the self-calibrate/reference feature is to be utilised prior to testing fibres.

All fibre cabling, test equipment and test procedures shall comply with the AS/NZS and ISO Standards as listed at the beginning of this document.

Test all permanent link fibres in both directions and at both wavelengths (1310 and 1550 nm) with a Light Source Power Meter (Optical Attenuation) and at both wavelengths in a single direction with an OTDR trace. Test results shall include Length, Propagation delay, Attenuation, Continuity and Polarity, and, traces. The one-jumper Zero method shall be used in accordance with:

- Relevant clause of ISO/IEC 14763-3
- Relevant test method of IEC 61280-4 (Part 4-2 for Single Mode)

All Reference Cords & Field Calibration cords shall be Qualified.

Launch and Tail Reference Cords for SMF LSPM testing shall be 1m to 5m each and have a Reference Connector at one end.

Field Calibration Cord shall not exceed 2m in length and have Reference Connectors at both ends.

Reference Connectors shall be the same type of connectors as the cabling to be tested.

Reference Connectors shall have an attenuation of < 0.20 dB for SMF.

Test results shall include all link parameters specified in AS/NZS 61439.1, and:

- Test equipment details
- Company and testing officer
- Date

- Instrument model and serial number, and the date of the last calibration
- Instrument firmware version numbers
- Building name, floor naming convention, cable and outlet number
- Cable type, manufacturer, part number, batch number, refractive index
- Fibre core size and class, number of cores, lengths, and wavelengths tested
- Fibre performance level
- Direction of test, attenuation (insertion loss), and return loss
- Connector/splice loss (if applicable)
- Design loss calculations
- Visual inspection of all ends
- Length
- Propagation delay
- Continuity and polarity
- OTDR traces at both wavelengths

All test results are to be provided in electronic format only. The preferred format is the manufacturer-supplied native database, including charts and fibre traces that can be viewed with its own software or printouts, and, Microsoft (MS) Excel spreadsheet format.

A link is defined as a single section of cable with a terminator at each end.

Excessive Event Reflection

An OTDR will be used from the Main TER Equipment cabinet end of the link to test for excessive reflection due to faulty products or installation practices. The OTDR test shall incorporate both a lead launch spool greater than the length of the fibre under test and a trail spool (patch cable) of greater than 30 metres in length.

Telephone cabling

Voice Frequency cable shall be tested for conductor continuity and correct pair termination and sequence on all pairs.

UTP Network Cabling

The test results shall meet all the requirements outlined in the specifications AS/NZS 61439.1 for the category of cable specified for installation.

Testing Results are required in an electronic format. Summary formats are unacceptable. Complete details of all tests are required. Appropriate reader software and user guides are to be supplied with the electronic results.

Test equipment and procedures to be compliant with AS/NZS 61935 standard.

Star-pass (*pass/*fail) function, plot data and 3db and 4db rules to be enabled.

Cable testers shall be fully charged and calibrated before testing.

Test CAT 6 cable to Aust Cat 6, Class E 1 gigabit permanent link to 250 MHz bandwidth including all Power Sum (PS) results using a minimum of Level III (3) or level IV (4) accuracy cable tester. Fluke DSP4300, DTX1200 or DTX1800 (level IV).

Cable test ID is “AS/NZS 61439.1 PL Max Class E”. PL = Permanent Link, some cable testers refer to ISO11801 instead of AS/NZS 61439.1.

Test CAT 6A F/UTP cables to Aust Cat 6_A, Class E_A 10 gigabit channel performance to 500 MHz bandwidth including all Power Sum (PS) results using a minimum of Level IV (4) accuracy cable tester (Fluke DTX1800).

Test from the rack patch panel to wall outlet, using the manufacturer specified permanent link adapters and personality modules. Ensure the correct cable NVP is selected for cable under test.

Report results in manufacturer’s native application format such as Fluke Networks LinkWare database format, Agilent DataScope or LANTEK Reporter.

Marginal passes (star * passes) shall NOT be accepted.

Test results shall include all link parameters specified in AS/NZS 61439.1, and the following:

- Test equipment details and owner;
- Company and testing officer;
- Current time and date;
- Instrument model and serial number, and the date of the last calibration;
- Instrument firmware version numbers;
- Cable ID with site name, rack naming convention, cable and outlet number;
- Cable type, manufacturer, part number, NVP;
- UTP test performance level used for test.
- Wire Map
- Length
- Propagation delay
- Delay Skew
- Insertion Loss (Attenuation)
- Return Loss
- NEXT and PS NEXT,
- ACR-F and PS ACR-F
- ACR-N and PS ACR-N
- ELFEXT and PS ELFEXT
- DC loop resistance

11.6.1 COMMISSIONING

The Contractor shall demonstrate that the voice/data system complies with requirements of the drawings and specification and operates in a satisfactory manner including the following as a minimum:

- Arrange acceptance tests to be carried out in the presence of the Authorised Person for the Principal to demonstrate satisfactory operation of the system;
- The Authorised Person for the Principal may request verification of any of the previously performed tests;
- Carry out the tests on cable pairs selected at random by the Authorised Person for the Principal; Provision of all test equipment and provision of a list of all proposed test equipment to be utilised in the commissioning tests.

NOTICE
Give sufficient notice that commissioning of the integrated voice/data system is to commence.

Minimum notice required: 14 working days.

Cabling type

All new multicore backbone telephone cabling shall have the following technical specifications

No of pairs	-	as nominated on drawings
Wire Size	-	24 AWG
Performance Criteria	-	Category 3
Characteristic Impedance	-	100 Ohms +/- 15%
Jelly filled, external grade		

SECTION 12 - MATV SYSTEM

12.1 GENERAL

The Contractor shall supply and install a fully functional MATV system to re all commercial analogue and digital channels & service all outlets as nominated on the drawings and complying with AS 1367 and AS 1417. The system shall consist of, but not be limited to, the following components:

- Single roof mounted digital antenna (UHF and VHF);
- MATV outlets at locations nominated on the drawings. Exact location and height to be confirmed.
- Mast, rigging and support hardware, head end equipment including UHF/VHF signal duplexer/amplifier, feeder cabling from head end equipment to distribution amplifiers, active and passive components including distribution amplifiers, filters and splitters, distribution cabling, MATV outlets, earthing system (common to both FTA and MATV systems, wiring termination & labelling and records.
- Cabling to all outlets as nominated on drawings
- Labelling at each outlet and schedules provided at splitter locations
- Testing and commissioning.

These are to be installed in the mains comms room.

Allow for power supplies and install power sockets as necessary.

As a minimum requirement the system shall be capable of receiving all free-to-air digital and analogue channels available in the area. Adjust aerial to eliminate reception problems.

12.2 SYSTEM DESIGN

Prior to the commencement of any on site works the Contractor shall undertake on-site measurements of field strength levels and determine the optimum location of services to suit.

Prior to the commencement of the installation the Contractor shall submit for the Superintendents approval full design figures and schematics of the system and proposed location of equipment.

12.3 PERFORMANCE

At each outlet, the picture received on a domestic TV receiver shall not be noticeably different from the picture received when the receiver is connected directly to the aerial, and shall be free from discernible cross-modulation, inter-modulation, ringing, noise or other distortion.

The output level difference between outlets shall be less than 10dB.

12.4 CABLING

Install all cabling within communications riser or conduit within the building structure using the most direct route and keeping clear of other services.

Cables shall be run continuously from splitters/amplifiers to the terminating point without intermediate joints or connections unless otherwise approved.

All MATV vertical trunk cabling shall be reticulated in low loss quad-shield RG11 and/or RG 6 cable to suit the site conditions. The bending radius of all cabling shall not be less than the cable manufacturer's recommendations.

All MATV vertical trunk cabling shall be reticulated in low loss quad-shield RG11 and/or RG 6 cable to suit the site conditions. The bending radius of all cabling shall not be less than the cable manufacturer's recommendations. Leave coils of cables (refer to drawings for lengths) above the COMS room left neatly above the ceiling on level 1 for future roof mounted antenna.

Provide 6mm green/yellow earth cable to bond the antenna, active equipment etc. as shown on detail drawings.

12.5 AERIAL

Supply and install combined digital UHF, VHF aerial which gives adequate gain, directional characteristics and polarisation for the nominated services.

The balun transformer utilised at the aerial shall be of an approved type, completely weather proofed with no exposed terminals.

The aerial shall be positioned and orientated such as to minimise reception of reflected signals and gain optimum signal performance.

The aerial shall be adequately fixed to the roof via galvanised rigging, brackets etc. as necessary to ensure a secure installation. Aerial location shall be approved by the 81olyphaser prior to installation and all cable penetrating roofs, or floors shall be sealed with approved weather proof sealants or deck tights etc. to be used on roofs.

The antenna shall be earthed separately.

12.6 AMPLIFIERS

The Contractor shall supply and install individual channel amplifiers for each broadcast channel. All amplifiers shall be sized to ensure adequate picture quality and signal strength at each outlet apartment. All amplifiers shall be housed within the first floor communications cupboard.

Frequency response of amplifiers shall be flat to within + or – dB for each channel.

Amplifier gain shall be sufficient such as to provide a minimum of 2mV across 75 Ohm at each outlet.

12.7 SPLITTERS AND T-OFFS

Taps, splitters, and the like shall be of the transformer or directionally coupled type. Connections for splitters and T-offs must be via 75Ohm F-type connectors.

12.8 OUTLETS

All TV outlets shall have 75 Ohm F-type cable sockets for MATV. Flush mounted on faceplates which match GPOs. Fix components on a printed board assembly fitted with a clamp and screw for the co-axial cable termination.

Install attenuators to provide the specified isolation between outlets.

All MATV cabling shall be installed uninterrupted between TV socket and MATV splitter.

Outlets locations to be aligned with the architectural room data sheets and the NSW Ambulance Principal Project Requirements document.

12.9 TESTING AND COMMISSIONING

Carry out tests required by regulatory authorities and tests necessary to demonstrate compliance with the performance and other requirements of the specification.

The Contractor shall provide all equipment, apparatus and materials necessary to perform the tests, including field strength meter and portable TV receiver.

SECTION 13 - ELECTRONIC ACCESS CONTROL AND SECURITY MONITORING SYSTEMS

13.1 GENERAL

The technical documents have been prepared on the basis of a performance specification.

The Contractor shall design, supply, install and commission a new security system throughout the building, based on the **Integrity system by Inner Range**.

The security system shall interface with the smoke alarm system, communications system and intercom system

Submit the system shop drawings for approval prior to installation and procurement.

The installation of the security system shall be undertaken by a recognised company which specialises in security work and which has a minimum of 5 years' experience in this type of work. The Contractor shall submit details of the proposed security system installation personnel at the time of tender.

13.1.1 GENERAL REQUIREMENTS

General Standards

Australian Communications Authority	TS 008/9	ACA Standards for cabling requirements
ABCB	BCA-2005	Australian Building Code of Australia
Institute of Electrical and Electronics Engineers	IEEE 802.3 IEEE 802.5	Broadband applications
Standards Australia	AS/NZS 1102.103:1997	Conductors and connecting devices
Standards Australia	AS 1345 – 1995	Identification of the contents of pipes, conduits and ducts
Standards Australia	AS 2053	Conduits and fittings for electrical installations
Standards Australia	AS 2201.1 – 1998	Systems installed in client's premises
Standards Australia	AS 2201.2 – 2004	Monitoring centres
Standards Australia	AS 2201.3 – 1991	Detection devices for internal use
Standards Australia	AS 2201.4 – 1990	Wire-free systems installed in client's premises
Standards Australia	AS 2201.5 – 1992	Alarm transmission systems
Standards Australia	AS 2834 – 1995	Computer accommodation
Standards Australia	AS/NZS 3000	Wiring rules
Standards Australia	AS/NZS 61439.1	Telecommunications installations – Generic cabling for commercial premises
Standards Australia	AS 3768 – 1990	Guide to the effects of the temperature on electrical equipment
Standards Australia	AS 3084:2003	Telecommunications installations – Telecommunications pathways and spaces for commercial buildings
Standards Australia	AS 3011	Electrical installations – Secondary batteries installed in buildings
TIA/EIA	TSB36	Specification for unshielded twisted pair cables

TIA/EIA	TSB40	Transmission specifications for unshielded twisted pair cables connecting hardware
Building Code of Australia	NCC 2019	National Construction Code
NSW Occupational Health and Safety Act		
ACMA Cabling and Conduiting Requirements		
Manufacturer recommendations for individual equipment		
NSW Health Infrastructure	ESG 2016	Engineering Services Guidelines
NSW Health Infrastructure	Rev 2.0 Nov 2015	ICT Cabling Standard
NSW Health Infrastructure	PPaP Standard	Protecting People and Property Standard
NSW Ambulance	Rev 3 Jun 2019	Electronic Security System
NSW Ambulance	Rev 2.0 July 2021	How to Build an Ambulance Station

13.2 SCOPE

The scope of works for this section shall include the following:

- The design, supply, installation, commissioning, configuring, programming, testing, training of staff and maintenance warranty period of all security related services covered in this security access control & security monitoring section. Refer to NSW Ambulance Electronic Security System Specification for details.
- Drawings, operator and maintenance manuals.
- Access Control and Alarm System consisting of a P.C. and associated software, printer, programmer, access panels door control and data gathering hardware including card readers, code pads, Mortise locks and magnetic locks, door strike/ mortise lock connections, intruder detectors, reed switches, press buttons and associated alarm equipment, as specified.
- Liaise with door/door hardware provider as necessary.
- Intercom Systems
- Security System to be Integriti from Inner Range with HID Signo 40 PIN/Proximity Reader Combo and HID Signo 20 mini mullion card readers. All other components to be compatible with Integriti Inner Range Technology.
- All cabling and associated conduits for the above systems.
- All power supplies for all equipment.
- Any works and sundry items to ensure a fully operational and functional electronic security installation.
- Other works as described in the specification.
- Installation warranty for at least 12 months.
- Provide a fully functional assist push button systems for public WC & all Access WC's. Located waterproof push buttons as nominated on the drawings connected to an audible + visual acknowledgement panel with reset facility.
- Provide slim-line iClass smart-cards compatible with the security and access control system.
- Provide gate & roller shutter motor controllers and logic controllers as required linked to access control system;
- High frequency vehicle entry transmitters for ambulance. Provide High freq. Radio frequency remote transmitters along with HF access control panel receivers to integrate to the security system. Neatrol systems second generation Airkey's. See section. Allow for the, supply, installation, programming, commission, training & all relevant work for a fully functioning remote vehicle entry system.
- Ensure all external accessible fittings such as intercoms, card readers and fittings within areas occupied by offenders or are located outside are vandal resistant.
- Allow for all other security and access control items shown on the drawings or as obviously required for a fully functioning system;

13.3 CARD READERS

HID Signo 20 mini mullion readers will be used. The controller and readers will be configured to support the NSW Ambulance standard smartcards format and 26-bit Wiegand format.

Back to back Card readers shall be offset a suitable distance to maintain integrity of card reader operation and avoid cross reading.

The ACID system shall monitor each individual card reader and provide an alarm if the card reader is off-line, providing information on which card reader has stopped operating and its location.

Card readers shall be mounted at a height of 1.0 to 1.1 metres from the floor, unless otherwise specified with access wiring entering the device from the rear.

Operator code pads shall be mounted at a height of 1.2 to 1.5 metres from the floor, unless otherwise specified with access wiring entering the device from the rear. Code pads are to be fully compatible with the main control panel and must be able to carry out basic and desirable functions to enable full utilisation of the security panel. They must be user friendly, supply information regarding panel status to the operator, be robust, offer up to date technology and have “Plain English” displays. They shall provide back lit or LCD and audible output.

Each card reader shall be robust construction capable of being surface mounted, have tamper protection and be vandal resistant. Where externally mounted or mounted in wet areas, it must be IP65 rated.

Cardholder Management

Cardholder Records

The card reader system shall provide the capability for operators to define Cardholders with the following identification and operating parameters:

- Cardholder name (first, middle, last)
- Cardholder address
- Card number
- PIN code (6-8 digits)
- Access Group
- Cardholder phone number and extension number
- Validation period using start and void dates
- 64 user defined cardholder fields, e.g. mobile number, email address, staff number, etc. The
- system shall provide the capability to use these fields in filtering reports

The system shall support up to 64 user defined data fields, which may be used to store information for each cardholder. Each field may be of a type: alphanumeric text, numeric, date, toggle (Yes/No). The Security System shall provide standard menu items, which shall allow the operator to define these cardholder database fields at any time.

Card Number and Card Format

Each cardholder shall be assigned with one proximity card only. When enrolling a card into the card reader system, an operator shall be notified if the card number is already in-use. The access card shall serve as the means to uniquely identify a cardholder and for a cardholder to gain access through authorized doors defined in the Access Group assigned to him/her.

Each card number shall have specific card ID number, which uniquely define a card number.

In order to prevent duplication, the system shall alert operators if a card number has already been used by another cardholder.

Addition and Deletion of Cards

It shall be possible to add and delete cards from a workstation by operators with sufficient system access level. Allow to provide this facility at the reception and staff room.

When adding cards, it shall be possible to nominate an individual card or a numerical range of cards to a cardholder or a range of cardholders. The newly added data shall be automatically downloaded to respective Intelligent Security Controller once they are online with the System Server.

When deleting cards, it shall be possible to delete an individual card or a numerical range of cards. Cards shall not be deleted from the system database unless the card data have been completely removed from the database of all the connected intelligent security controllers.

Card data deletion shall not imply the removal of cardholder data and associated transaction records from the system database. Deletion of card data shall only invalidate a cardholder from using a particular card.

The cardholder data and associated transaction records shall be retained for retrieval in the future if required.

Door Operations

The card reader system shall allow card readers to be configured to operate in either of the following modes:

- Free access mode: door is unlocked, no card is required for entry.
- Secure access mode: door is locked, a successful card attempt is required for valid entry. Door re-secures after access attempt.
- Dual Authorization/Escort mode: Access is granted when two different but legitimate cards are presented within a given time frame. The first cardholder shall be an authorized escort. The time frame shall be programmable from 0 – 30 seconds.
- Lock-up mode: the system shall enable an operator to set a particular door into lock-up mode. Under such a mode, the reader(s) associated to the door will no longer process cards presented to it even the cards are valid.

It shall be possible to control the access mode assigned to each door by either manual (operator) command, based upon time schedules or based upon triggered events. Each change of access mode shall be logged to the database and shall be available for report generation.

Anti-passback

The system shall provide the Anti-passback feature to prevent unauthorized persons from entering in the protected areas by using access cards being passed back to them from cardholders who have already entered into the protected areas. Once a cardholder enters into the protected areas, he/she must first exit from the protected areas before using the same card to re-enter into those areas.

The system shall support three Anti-passback modes:

- Soft Anti-passback mode: the person will be allowed access. However, an Anti-passback alarm will be raised at the operator workstation to alert the operator that an anti-passback violation has taken place at a particular door. The system shall log the anti-passback violation against the particular access card.
- Hard Anti-passback mode: the person will not be allowed access. As well an anti-passback violation will be logged against the particular access card.
- Timed Anti-passback mode: A person will only be allowed access after a user pre-defined time has expired. The transaction records will be logged in the system database.

This Anit-passback feature shall not be limited among doors connected to the same Intelligent Controller only. Instead, this feature shall be applicable to doors globally across the whole system.

Archiving

The system shall provide facilities allowing operators to archive system, programming, transactions and events data from its database to an external medium. During archiving, it shall not affect the normal operations of the System. Options shall also be available allowing operators to set up a time schedule for automatic archiving or just manually. Once data is archived, it shall not be possible to alter or modify it.

13.4 PIN/ PROXIMITY READERS

HID Signo 40K/Prox readers will be used. The readers will be capable of accepting a six-digit PIN for individual card holders. Unless otherwise specified by Superintendent, the readers will be configured in OR configuration – an authorised PIN or proximity smartcard can be presented to authorise access.

13.5 CONTRACTOR'S DESIGN

The Contractor must submit the design drawings and design description of the systems to the Principal's Authorised Person for comment prior to site installation.

13.6 EQUIPMENT LOCATIONS

Refer to the architectural room data sheets and the NSW Ambulance Principal Project Requirements document for locations of equipment. Final location of equipment is subject to the room configuration and the position of building services. Co-ordinate with other trades as necessary. Note, client sign off is required on all camera locations and lens focal length selection.

13.7 ENVIRONMENTAL LIMITATIONS

The equipment selected and installed must be suitable for the site's environmental conditions.

Failure to indicate a limitation must not relieve the Contractor of the responsibility for ensuring that the equipment must function properly in the manner intended.

13.8 240V POWER CIRCUITS

Note: Dedicated GPOs for security panels will be installed in the Communications Base building Room and other areas by the Electrical Trade where security equipment is required – refer electrical drawings.

Any other security equipment requiring power supply circuits must be installed from the distribution board/s for the areas in question, by the Contractor.

All 240V installations required to complete the work must be done in accordance with AS 3000. These circuits must be separate and dedicated to security services only.

13.9 WORKMANSHIP

All electrical wiring work must be carried out by or under the constant personal supervision of a person holding a Qualified Supervisor Certificate issued by the Department of Fair Trading.

The Contractor and all persons working under his supervision, where directly working on the security installation and commissioning must be licensed under the Security (Protection) Industries Act, (and subsequent amendments) and the Contractor must supply all such license numbers (in writing) to the Principal's Authorised Person at the first site meeting.

13.10 CLARIFICATION OF DOUBT

If there is any doubt as to the meaning of any provision of the Specification, clarification must be obtained in writing. If ambiguity occurs between the Electronic Security clauses and the Electronic Security Tender Drawings – then the requirements in the drawings shall be deemed to be correct.

13.11 CONFIDENTIALITY

The Contractor shall keep confidential, all of the Confidential Information and may be required to sign a confidentiality agreement.

The Contractor shall use any Confidential Information solely for the purposes of performing its obligations under the Contract and will only disclose the Confidential Information following approval from the Principal's Authorised Person.

This approval may be granted or withheld at the Principal's absolute discretion and in each case being persons who have a need to know.

13.12 PASSWORDS

Title to all materials including intellectual property rights and program passwords will upon coming into existence, vest immediately and absolutely with the Principal. Contractor to supply all master codes, passwords and installer codes to the Principal's Authorised Person in a discrete format.

If required by the Principal, the Contractor will assign, and ensure that the key personnel assign to the Principal all existing and future Property Rights in all Materials.

These details shall take the form of electronic and hard copy records of the current program and associated information inclusive of all codes, passwords etc. required to access **and manage /maintain** the system.

SECTION 14 - VEHICULAR ACCESS CONTROL VIA HIGH FREQUENCY TRANSMITTERS

A high frequency transmitter receiver is required to be interfaced to the new security access control system at Ambulance Station to allow for remote control of electronic gate(s) and roller shutters

The following details the specific operation of the Gates and roller shutters, along with the necessary interfacing details proposed.

14.1 RADIO FREQUENCY TRANSMITTERS – NEATROL AIRKEY SYSTEM (SECOND GEN)

In addition to the master intercom + door release buttons, the gates & roller doors mentioned above shall also have the ability to be controlled by high frequency radio frequency transmitters which will be carried by each officer driving an authorized ambulance or general duty staff stationed at the Ambulance station. The high frequency radio transmitters shall integrate to the security access control system.

HF Radio frequency transmitters shall be supplied from Neatrol Systems, model Airkey AK2TX4. (Second generation) or similar.

It shall be integrated into the security access system via the Neatrol system access control receiver compatible to the security access control system to be installed.

Allow for 40 individual 4- button RF Neatrol Air Key transmitters.

All transmitters are uniquely coded with their own identification tag and are assigned access levels using the Security System, the same way as normal swipe cards. The airkey will also be programmed to allow to act such like a access card being held in front of the card reader/

Provide the compatible Air Key Remote Control Receivers to accommodate all channels & to integrate to the access control system. (At least 2 –off 4 channel Air Key remote control receivers). Ensure to provide the correct Neatrol Air Key transmitters & receivers (protocol, bit) to be fully compatible with access control system.

Image: Neatrol 4 button Air Key Transmitter

14.1.1 BUTTON SCHEDULE:

- Roller Shutter #1
- Roller Shutter #2
- Spare
- Spare

Label Air Key buttons with the assigned access gate as appropriate behind transmitters casing.

14.1.2 FEATURES OF NEATROL AIRKEY:

- Rugged IP65 rated dust proof and water resistant housing with full silicone gasket.
- 69 bit encrypted data transmission guarantees security.
- Each transmitter is uniquely coded and cannot be replicated.

- Self-learning receiver technology stores up to 340 unique transmitters.
- Convenient size allows attachment to key-ring or under dash placement with 89olyph.
- Easy to add new transmitters with the push of a single button.
- 433.92MHz crystal locked transmitter frequency immune from interference caused
- CB radio etc.

All transmissions immune from code grabbing and code scanning techniques

SECTION 15 - CCTV GENERAL REQUIREMENTS

15.1 GENERAL

As requested by the client, no CCTV cameras are to be provided and installed. However, data outlets for future provision of CCTV cameras are required to be supplied and installed as per the architectural room data sheets and the NSW Ambulance Principal Project Requirements document.

Preferably, these outlets are to be terminated in the building ceiling. Future CCTV cameras allowances should be to monitor the external perimeter of the building. No provisions are to be considered for CCTV cameras inside the building.

Where these outlets are located in external areas, the data outlet(s) plate shall be IP rated for outdoors accordingly.

Cabling for the CCTV cameras to follow Section 11 of this specification.

SECTION 16 - RADIO ANTENNA SYSTEM

16.1 LIGHTNING PROTECTION

All antennas installed in RAIR buildings shall have lightning protection in accordance with Australian Standards and, in the case of the UHF Ambulance Radio, the recommendations of the Radio Telecommunications group in NSW Ambulance (see below for recommended products). Refer also to the appendixes of this specification that includes the NSW Ambulance Wireless Communication Standard and the “How to Build an Ambulance Station”.

Lightning protection shall be connected to earthing rods in the comms room.

16.2 FREE TO AIR TV

Free to Air TV antenna shall be installed by the builder as a Group 1 item. A distribution splitter shall be provided so that a signal can be provided to multiple points. For a Small site, this shall be at least a 2 way splitter. For Medium and Large sites, this shall be a minimum of a 4 way splitter. A mast amplifier shall also be provided if necessary within the region.

The structured cabling may be used to distribute FTA TV, however adapters will need to be provided.

16.3 CELLULAR / MOBILE DATA

Where mobile phone usage is not satisfactory, a commercial indoor coverage booster product should be implemented from the mobile service provider. This is a Group 3 item. Ambulance will determine the necessity for this (by measurement of indoor signal strength) and the areas in the station that will have coverage.

Where 4G cellular is necessary for data then it shall be provided by a mast and an appropriate antenna for the area (which in most cases will be a yagi antenna), and a cable to the comms room rack. If this is provided by NSW Ambulance after handover (e.g. Group 3) – then the building design shall permit access and ability to install this.

16.4 UHF AMBULANCE BASE STATION RADIO

If this is provided by NSW Ambulance after handover (e.g. Group 3) – but the building design shall permit access and ability to install this.’

Also, the contractor shall allow for ø80mm communications conduit pathway at high level from the antenna location to the comms room.

The builder shall provide waterproof seals or Dektite pipe flashing system to any roof penetration for cabling reticulation.

The builder shall avoid roof penetrations for the antenna mast installation and supports to minimise the risk of water leaks.

16.5 PROVISION OF UHF ANTENNA AND CELLULAR ANTENNA AS A GROUP 1 ITEM

Where the UHF Antenna and Cellular Antenna is to be provided as a Group 1 item, the following requirements shall be met:

1. Three separate 1-meter height antenna masts shall be provided and spaced by 1m in a triangular formation.
2. The antennas must be mounted with the correct polarisation, and the cellular antenna shall have the correct azimuth (and directed to a local Telstra base station)
3. The UHF dipole shall be mounted so that the antenna drain-hole is at the bottom
4. N type connectors shall be used for any external coax connections and these shall be waterproofed
5. Lightning protection to be PolyPhaser IS-B50LN-C2, and is to be mounted to the equipment rack bonded to the building earth. The RF tail from the lightning protection is to be RG58 coaxial cable terminated with a BNC connector to the radio location in the rack

6. The UHF Base Antenna is to be a RF Industries SMD4-67 (200 – 520 MHz)
7. The cellular yagi antenna is to be a RF Industries YW15-6989 (high gain 700 – 800 MHz)
8. 3-off CNT400 (50 ohms) coaxial cables shall be used for the UHF & 2xHWAN Base Antennas
9. CELLFOIL LOW LOSS RG58 TYPE RFI CAT No 9006 50 OHM LSZH coaxial cable shall be used for the cellular yagi
10. The RF connection at the antenna is to be sealed with self-amalgamating tape such as 3M Scotch 23 or RF industries Silicon One Tape to prevent water ingress
11. All coaxial cable is to be secured to the mast with cable ties to prevent movement. Leave a 2m tail in a weatherproof bag and terminated with an “N male” connection.
12. In the comms room, contractor to leave a 2m coaxial tail coiled and terminated with a “FME female” terminal
13. Cabling reticulation to be via ø80mm communications conduits at high level from the antenna location to the comms room and avoid using 90° elbow conduits. Provide a Dektite pipe flashing system or similar to any roof penetration.

Items may not be substituted by equivalents without specific approval of Ambulance.

16.6 OTHER

All rooftop antennas shall be located such that it is the minimum cable distance to the RF equipment (in the comms room).

All rooftop antennas and rooftop cabling shall use best practices for wind, solar, water and bird protection. This includes installation of loops in external cabling to prevent water running into the building, use of waterproof and solar resistant tape, drain holes in antennas and masts.

All RF joints must be crimped with appropriate tools to web appropriate level of RF performance.

Refer to “How to build an ambulance station” document & associated appendixes B & C of this document for further details.

SECTION 17 - CABLE SUPPORT AND DUCT SYSTEMS

17.1 GENERAL

17.1.1 CROSS REFERENCES

General

Conform to the *General requirements* work section.

Related work sections

Conform to associated worksections as follows:

Electrical general requirements.

17.1.2 STANDARDS

General

Cable trunking systems: To AS/NZS 4296.

Conduits and fittings for electrical installations: AS/NZS 2053 Parts 1, 2, 3, 4, 5, 6, 7 and 8.

17.1.3 DESIGN

General

17.2 QUALITY

17.2.1 SUBMISSIONS

Shop drawings

Provide shop drawings showing the following:

- Cable routes.
- Cable tray and trunking routes.
- Underground conduits and pits.
- Invert levels for underground conduits.
- Depth of burial for cables and conduits.

Technical data

Provide technical submissions with at least the following information:

- Design basis and performance parameters.
- Layout of cable supports and enclosures on the current architectural background coordinated with the structure and other services.
- Pit locations with construction grid references.
- Invert level or depth of burial for underground enclosures.
- Samples.
- Accurate records of installed underground enclosure systems.

17.3 MATERIALS

17.3.1 CONDUITS

Minimum sizes

Metallic and non-metallic conduits: > 20 mm.

Galvanized water pipe: Medium or heavy, to AS 1074.

Rigid conduits

Provide straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings.

Set out

If exposed to view, install conduits in parallel runs with right angle changes of direction.

Inspection fittings

Locate in accessible positions.

Draw cords

Provide 5 mm² Polypropylene draw cords in conduits not in use.

Draw-in boxes

General: Provide draw-in boxes at intervals < 30 m in straight runs and at changes of level or direction.

Underground draw-in boxes: Provide gasketted covers and seal against moisture.

Galvanizing

Provide galvanized mild steel wiring enclosures and support systems if installed in locations exposed to the weather, pollution, or high humidity.

17.3.2 CONCEALED CONDUITS

Routes

Run conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations directly between points of termination, minimising the number of sets. Do not provide inspection fittings.

Conduits in concrete slabs

Route: Do not run in concrete toppings. Do not run within pretensioning cable zones. Cross pretensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location. Space parallel conduits > 50 mm apart.

Minimum cover: The greater of the conduit diameter and 20 mm.

Conduit size: generally 25 mm maximum diameter unless noted otherwise.

Fixing: Fix directly to top of the bottom layer of reinforcing.

Prohibited floor slabs

Do not run conduits in the floor slabs of boiler rooms, plant rooms and tank rooms.

Hollow-block floors

Locate conduits in the core-filled sections of precast hollow-block type floors.

Columns

Conduits in columns:

Maximum 4 per column.
< 25 mm diameter.
Locate conduits centrally in each column.
Bends: Enter columns via ø 150 mm radius bends. Do not use elbows.

Chasing: Do not chase columns.

17.3.3 METALLIC CONDUITS AND FITTINGS

Standard

Metallic conduits and fittings: AS/NZS 2053.7 or AS/NZS 2053.8.

Type

Screwed steel.

Corrosion protection

For steel conduits, paint ends and joint threads with zinc rich organic primer to APAS-2916.

Expansion joints

General: Provide flexible couplings consisting of flexible conduit and fittings, at structural expansion joints; and in long straight runs if the ambient temperature varies by more than 40ºC.

Movement: Provide conduit support saddles close to flexible couplings to permit free movement for expansion and contraction.

17.3.4 NON-METALLIC CONDUITS AND FITTINGS

General

Standards: Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6

Conduits in roof spaces: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

Conduit in slabs: High compression corrugated conduit, restrained at regular intervals to achieve a nominally straight run.

Category A conduit

For direct buried installations requiring the use of Category A conduit, provide protective cover strips and corrugated conduit.

Flexible conduit

Provide flexible conduit to connect with equipment and plant subjected to vibration. If necessary, provide for adjustment or ease of maintenance. Provide the minimum possible length.

Associated fittings

Type: The same type and material as the conduit.

Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, provide prefabricated earthed metal boxes.

Inspection fittings

Provide inspection-type fittings only in accessible locations and where exposed to view.

Joints

Type: Cemented or snap on joints.

Expansion couplings: If encased in concrete, do not provide the bellows type.

17.3.5 DUCTED WIRING ENCLOSURES

Ducting

Provide purpose-made ducts, skirting ducts and floor ducts, incorporating segregation where used for multiple services. Provide rigid supports. Round off sharp edges and provide bushed or proprietary cable entries into metallic ducting.

Accessories

General: Provide purpose-made accessories and covers to match the duct system. Provide screw-fixed covers, or clip-on covers removable only with the use of tools.

Cable support: Except for horizontal runs where the covers are on top, support wiring with retaining clips at intervals of not more than 1000 mm.

17.3.6 CABLE SUPPORTS

General

System: Provide a complete cable support system consisting of trays or ladders and including brackets, fixings and accessories.

Manufacture: Provide proprietary trays, ladders, fittings and accessories from a single manufacturer in the same application.

Cable ladders: Run small cables < 13 mm diameter in cable trays or ducts.

Fixing to building structure

General: Fix supports to the building structure or fabric by means of direct fixing hangers or brackets.

Cable fixing

Provide strapping or saddles suitable for fixing cable ties.

Provide non magnetic straps to MIMS cables.

Bend radius

Provide bends with an inside radius 12 times the outside diameter of the largest diameter cable carried.

Cable protection

Provide rounded support surfaces under cables where they leave trays or ladders.

Access

Provide a minimum of 150 mm free space above and 600 mm free space on at least one side of trays and ladders.

Clearances

From hot water pipes: > 200 mm.

From boilers or furnaces: > 500 mm.

EMI: Locate support systems for electrical power cabling and communication cabling to minimise electromagnetic interference.

Derating

Derate the electrical cables to suit the method of installation.

Catenary systems

Catenary systems may be used within suspended ceiling spaces in lieu of cable tray and ladder systems.

Wire: Provide stainless steel cable and couplings for catenary systems.

Anchoring: Anchor catenary systems to the structure. Do not fix to any part of a suspended ceiling system.

Design loads: Provide catenary systems designed to support the proposed load of the cables with a spare capacity of 50% loading.

Fixing: Fix cables to the catenary system such that no cable is under stress due to tension or compression. Use proprietary fixings that allow cables to be added or removed without destroying the integrity of the system.

Segregation: Install separate catenary systems for electrical and telecommunications cabling systems.

17.3.7 CABLE PITS

General

Draw-in pits: Sizes given are internal dimensions.

Proprietary cable pits

For pits < 1200 x 1200 mm, provide proprietary concrete or polymer moulded pits.

In-situ construction

For pits > 1200 x 1200 m, either:

- Proprietary cable pits.
- Construct walls and bottoms from rendered brickwork or 75 mm thick reinforced concrete. Incorporate a waterproofing agent in the render or concrete.

Pit covers

General: Provide pit covers to suit expected loads. Fit flush with the top of the pit.

Standard: To AS 3996.

Weight: < 40 kg for any section of the cover.

Lifting handles: Provide a lifting handle for each size of cover section.

Drainage

General: Provide functional drainage from the bottom of cable pits, either to absorption trenches filled with rubble or to the stormwater drainage system.

Absorption trenches: Minimum size 300 x 300 x 2000 mm.

17.3.8 COLUMNS

Definition

Fabricated columns more than 2400 mm high, designed to support accessories outdoors.

Design

General: Provide columns designed, manufactured and tested by a specialist manufacturer.

Dimensions: To AS 1798.

Construction

General: Galvanize columns and fittings after fabrication.

Bases: Provide columns with mounting bases for fixing to reinforced concrete footings.

Accessory mountings: Provide adjustable mountings, to suit accessories, and with provision for rigidly clamping each item in position, once adjusted correctly.

Maintenance access: Provide pole stirrups secured to either side of the column for access to accessories. Locate the first stirrup at least 3 m above ground level.

Electrical connections: Provide a recess at the base of the column for access to cable connections and equipment, fitted with a flush mounted cover. For connections higher than 3 m provide a catenary wire cable support system.

17.4 EXECUTION

17.4.1 UNSHEATHED – INSTALLATION

General

Provide permanently fixed conduit enclosures assembled before installing wiring. Provide draw wires to pull in conductor groups from outlet to outlet, or provide ducts with removable covers.

17.4.2 CABLES IN TRENCHES

Sand bed and surround

Provide clean sharp sand around cables and conduits installed underground.

Sealing ducts and conduits

Seal buried entries to ducts and conduits with waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation.

17.4.3 UNDERGROUND CABLE ROUTES

Survey

Accurately record the routes of underground cables before backfilling. Include on the record drawings.

Location marking

General: Accurately mark the location of underground cables with route markers consisting of a marker plate set flush in a concrete base.

Location: Place markers at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

Concrete bases: 200 mm diameter x 200 mm deep, minimum.

Direction marking: Show the direction of the cable run by means of direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, minimum size 75 x 75 x 1 mm thick.

Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.

Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.

Marker tape

Where electric bricks or covers are not provided over underground wiring, provide a 150 mm wide yellow or orange marker tape bearing the words "*WARNING - electric cable buried below*", laid in the trench 150 mm below ground level.

17.5 SCHEDULES

17.5.1 WIRING ENCLOSURES AND CABLE SUPPORT SYSTEMS

Wiring enclosures and cable support systems schedule

Conduit:
- Minimum size
- Painting - colour and finish
Ducted wiring enclosures:
- Material
- Construction
- Mechanical properties
- Electrical properties
- Finish and colour
- Acid gas emission
- Cover retention method
Skirting duct:
- Size
- Number of channels
- Profile and dimensions
- Material
- Colour
- Finish
Cable support system
Loading capacity:
- Design load
- Minimum safety factor
Exposure:
- Interior
- Exterior
- Special requirements

Fire hazard properties:
- Spread of flame index
- Smoke developed index
- Flammability index
Cable trays:
- Type
- Material
- Finish
- Tray dimensions:
. Usable width
. Usable depth
. Thickness
. Unit length
. Connector type and material
Cable ladders:
- Material
- Finish
- Coating:
- Dimensions:
. Usable depth
. Usable width
. Thickness
. Unit length
- Rung:
. Spacing
. Type
- Connector type and material
Fixing to building structure:
- Hanger:
. Type
. Spacing
. Material
. Bracing
Cable fixing:
- Type
Catenary systems:
- Maximum number of cables permitted to be supported by a catenary system

. Lighting circuits
. Socket outlet circuits
. Telecommunications cabling

17.5.2 UNDERGROUND SYSTEMS

Underground systems schedule

Cable pits
Cable route marker dimensions
Marker tape

SECTION 18 - SEISMIC BRACING / RESTRAINS

18.1 GENERAL

18.1.1 CROSS REFERENCES

General

Conform to the *General requirements* work section.

Related work sections

Conform to associated worksections as follows:

Electrical general requirements.

18.1.2 STANDARDS

AS1170.4 Structural Design Action - Earthquake Actions in Australia

All electrical plant, equipment and supports shall be fixed to the building in accordance with AS1170.4 (including Section 8).

For IL4 buildings (projects with post disaster function), a special study is required to ensure the facility remains 'Serviceable for Immediate Use' post-earthquake and cyclone events (1 in 500 years). Building importance level definition remains the responsibility of the building owner/end-user via a risk assessment mechanism in the NCC.

AS5216 - Post-installed Anchors

All anchors used for seismic bracing shall be rated by the manufacturer for seismic loads

18.2 DESIGN

General Provisions

Arrange all components, other than service items exempted in AS 1170.4 Clause 8.1.4, to resist seismic loads determined in accordance with AS 1170.4

- Securely fix all electrical plant and equipment to the building structure. Do not rely on gravity and/or friction to resist seismic forces.
- Where anti vibrations devices (such as spring mountings) are used, they shall be horizontal and vertical restrained type, to inhibit the development of resonance in the flexible mounting system, and to prevent overturning. If these cannot be used equipment to be fixed or restrained separately to the spring mountings.
- Do not use electrical equipment or components that will be damaged by earthquake conditions. Protect systems against the adverse effects of components such as mercury switches that, although not damaged by earthquake, may malfunction.

18.2.1 Seismic Restraint and Expansion/contraction

- General: Seismic restraint shall be in accordance with AS1170.4 and an associated Seismic Engineering Specialist detail drawing.
- Method of fixing floor mounted equipment shall be in accordance with AS1170.4 and an associated Seismic Engineering Specialist detail drawing.

18.2.2 Description of Work

- Seismic restraints are designed to limit the movement of equipment and to keep equipment captive during a seismic event.

- Non-compliance with seismic restraint requirement shall be corrected by the contractor in an approved manner.
- The work in this section includes, but is not limited to the following:
    - Seismic restraint for electrical systems and equipment.
    - Equipment and conduit buried underground is excluded but entry of services through the foundation wall is included.

Typical Electrical equipment to be restrained is as follows:

- Ducts, cabling and piping distribution systems
- Smoke Control System
- Communications systems
- Lighting Fixtures
- Electrical Distribution Boards

Items not specifically mentioned in AS1170.4 section 8.1.4 are considered to require restraint by "All other components similar to those listed" and may include shelving, items installed in ceiling voids, cranes, building maintenance units, water storage tanks, systems involving hazardous materials, pressure vessels and heat exchangers, solid fuel heaters, water treatment equipment, waste disposal equipment, air handling plant and fans, automatic control systems and BMS, cable trays, ladders, busbars, conduits, plinths, fuel storage systems, batteries and UPS.

- Seismic restraint shall be installed in accordance with AS1170.4. Provide calculations signed by structural engineer licensed in the Australia in which the work is to take place certifying that seismic restraints will act in accordance with the relevant standards stipulated in the specification and will maintain equipment in captive position

18.2.3 Seismic Design Criteria

The following is a list that is needed for seismic engineering and may be obtained from the structural engineer associated with the project.

- Building/Structure Importance level (IL#)
- Earthquake design category (EDC)
- Hazard Design Factor (Z)
- Site sub-soil class
- Probability Factor

18.2.4 Provisions

Comply with the following as a minimum:

Arrange all components to resist the design earthquake loads as determined by the use of AS 1170.4-2011.

Restrain all electrical components against seismic loads including those parts and components identified in Clause 8.1.4, AS 1170.4-2011.

Plant and equipment: Securely fix all electrical plant and equipment to the building structure. Fixings shall have a load-transferring capacity equal to or more than that determined by the use of AS 1170.4-2011.

Fixings: Fix all electrical components to withstand earthquake loads determined in accordance with AS 1170.4-2011 Do not rely on gravity and friction to resist seismic forces.

Anti-vibration mounts: Use horizontally restrained type with a load-transferring capacity equal to or in excess of that determined by the use of AS 1170.4-2011. If this is not possible use snubbers or equipment clips to restraint with free springs.

Components: Do not use components that will be damaged by earthquake conditions. Protect systems against the adverse effects of components such as mercury switches which, although not damaged by earthquake, may malfunction.

Submission: Provide evidence that the fixings and vibration isolation installed comply with the requirements of AS 1170.4-2011. Include the provision of a design certificate with calculations certified, by an experienced and practicing structural engineer.

Material submittals shall include, but not limited to the following information:

• Catalogue cuts and data sheets on specific restraints on other equipment to be utilised, showing compliance with the specification.

• A list of the items of equipment to be restraint, the proposed seismic restraint types and models, and seismic restraint loading.

18.3 SUBMISSIONS

18.3.1 Shop Drawings:

- Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations as well as the integration of vibration isolation.

- Where walls, floors, slabs, or supplementary steel work are used for seismic restraint locations; details of acceptable attachment methods must be included and approved before the condition is accepted for installation. Restrain manufacturer's submittals must include spacing, static loads and seismic loads at all attachment and support points.

- Provide specific details of seismic restraints, vibration isolation and anchors; include number, size, and locations for each piece of equipment.

18.3.2 Seismic Analysis:

- Seismic restraint calculations must be provided for all connections of equipment to the structure.
- Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilised for connections to equipment and structure.
- Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, acting through the equipment centre of gravity. Overturning moments may exceed forces at ground level.

18.3.3 Contractor's Responsibilities

The following is the minimum contractor's responsibility:

- Engage a Seismic Design Specialist to:
    - Conduct a Special Study as required by AS1170.4
    - provide specific engineering design of all seismic/wind restraints.
    - advise appropriate service clearances.
    - perform installation inspections, and
    - provide certification the design requirements have been met.

- Confirm with relevant trades that all walls, ceiling and partitions are engineered for the loads of engineering services elements and ensure that appropriate service clearance requirements have been met.

- Ensure values for all parameters with the Structural Engineer and allow to adjust calculations and equipment selections as required prior to ordering equipment

- Carry out all remedial works due to failure to meet the above responsibilities at no cost.

18.3.4 Document Submittals

Submit the following documentation prior to commencement of work or ordering of equipment

- Design computations for all design items and check as required within this specification including:
- Equipment support seismic computations.
- Seismic restraints design, locations and auditable load calculations
- Adjusted services pathway illustrating minimum service clearances as outlined in specific engineering design and coordination with relevant trades.

18.4 INSPECTIONS AND VERIFICATION

Prior to installation of ceilings, notice shall be given for inspection by Seismic Design Specialist and main contractor of in-ceiling systems, seismic anchors and seismic restraints.

Seismic Design Specialist to provide a Construction Monitoring Report for submittal for installed restraints and braces.

Failure to give notice will result in cutting and patching of coverings for spot checking. Prior to practical completion, Seismic Design Specialist shall issue certification that installation meets design requirements, signed by qualified structural/seismic engineer.

18.4.1 Services Expansion/contraction

Refer to structural drawings for location and details of building expansion joints. Perform, submit, coordinate and provide calculations for all aspects of pipe and duct expansion and contraction including:

- Building expansion joints (movement 75mm in all directions as described)
- Temperature variations across all conditions including construction, operation, building or part building isolation/shutdown under all possible weather conditions
- Anchor locations, forces and construction details. Coordinate with the Managing Contractor and provide all necessary structural support as required.
- Arrange reticulated services and equipment to avoid excessive movement, forces and stress in pipework and ductwork and to eliminate the risk of pipe, duct and equipment connection fractures.
- Provide appropriate lengths of hanger, pipe/duct guides, saddles, rollers, anchors, changes of direction, expansion loops, spring hangers, expansion bellows, etc. as required.
- Acoustic penetrations shall be arranged to allow necessary longitudinal and lateral movement.

Provide design certificate with calculations, certified by an experienced and practicing Structural/Seismic Engineer.
All pipe and duct systems shall accommodate the following building joints expansion:

- Horizontal movement:
- Vertical movement:

18.4.2 Services Clearances

- Minimum clearances for services shall apply as per below table
- These clearances include services and other structural and non-structural elements, including but limited to pillars, ceiling hangers, wall studs, etc.
- Such service clearances need to be allowed for in the design, with pathways adjusted, and any changes communicated to other trades and project management.

The following minimum clearances must be achieved:

Condition being considered	Minimum Clearances	
	Horizontal	Vertical
Unrestrained component to unrestrained component	250 mm	50 mm
Unrestrained component to restrained component	150 mm	50 mm
Restrained component to restrained component	50 mm	50 mm
Penetration through structure such as wall or floor	50 mm	50 mm
Restrained services passing through the ceiling	25 mm	25 mm
NOTE: ceiling hangers and braces are considered to be restrained components for the purpose of this table, hence 150 mm horizontal clearance is required between ceiling hangers and unrestrained services		

18.4.3 Seismic Testing & Component Importance Factors

The Equipment Schedule indicates the Component Importance Factors (I_p) applicable to equipment and the systems associated.

The Equipment Schedule indicates where equipment/plant shall be capability to maintain its integrity and remain operational in the event of earthquake. Such evidence shall be provided by the Manufacturer/supplier.

18.4.4 Equipment Fixing

All equipment mounting and fixing points to be verified as adequate to withstand seismic events nominated in the project documentation, utilising seismic fixings/restraints where required to provide a complete system.

Anti-vibration and acoustic isolations systems shall be fixed with seismically stable isolator mounts or restraints incorporated.

All bracing shall be independent of the main item support (gravity/vertical support system) unless designed by a Seismic Design Specialist. All post-installed anchors for bracing shall meet the requirements of AS5216.

All fixing of equipment to concrete plinths and piers shall be in accordance with seismic requirements from the contractor's Seismic Design Specialist. Plinths shall be designed to withstand seismic loads being imposed by the supported equipment, with adequate depth and

edge distances for anchor capabilities and suitably connected to the structure to transfer the required loads.

IL4 structures fix only to building structural elements or to steel framing fixed to structural elements. Do not fix to masonry infill panels unless specifically designed and certified by a Seismic Design Specialist.

18.4.5 Bracing Location

The Seismic Design Specialist shall provide bracing locations, restraint capacities, suggested brace types and transparency of calculations.

General rules of bracing

Unless exempted, all building services shall be braced:

- when penetrating walls/soffits/floors, unless directed by Seismic Design Specialist.
- both sides of piping, conduit or ductwork at flexible connections
- to avoid collisions between piping, conduit or ductwork and adjacent other non-structural components
- within 600mm of changes in direction, whether it be horizontal or vertical changes (note that offsets of less than 600mm along a run are not considered a change of direction)
- in both directions at the top of all risers where risers exceed 900mm.

18.4.6 Restraint exemption clarification

The exemptions outlined in AS1170.4 Section 8.1.4(b)(x) require specific engineering design knowledge, although the following is noteworthy:

- The exemptions apply to IL2 & IL3 structures only.
- IL4 structures require a Special Study (Specific Engineering Design) before any exemptions apply.
- The exceptions only apply to 'individually supported services'.
- If a straight run of service is exempt at one end and ends non-exempt at the other end, then the whole run should be braced, not just the non-exempt section. The same applies where the hanging distance varies from less than 300mm to more than 300mm in a straight run.
- Where below threshold items are supported on a trapeze or multi service hanger exemption is no longer valid.
- Where a mix of exempt and non-exempt items are within the same support exemption does not apply.
- Exemptions do not apply to the following services:
    - Smoke control systems.
    - Emergency electrical systems (including battery racks).
    - Fire and smoke detection systems.
    - Fire suppression systems (including sprinklers).
    - Life safety system components.
    - Boilers, furnaces, incinerators, water heaters, and other equipment using combustible energy sources or high energy sources, chimneys, flues, smokestacks, vents and pressure vessels.
    - Communication systems (such as cable systems, motor control devices, switchgear, transformers and unit substations).
    - Reciprocating or rotating equipment.
    - Utility and services interfaces.
    - Anchorage of lift machinery and controllers.

- Lift and hoist components including structural frames providing support for guide rail brackets, guide rails and brackets, car and counterweight members
- Escalators
- Machinery (manufacturing and process)
- Lighting fixtures
- Electrical panel boards and dimmers
- Conveyor systems (non-personal)

SECTION 19 - WIRING SYSTEMS

19.1 GENERAL

19.1.1 INTERPRETATIONS

Abbreviation

MIMS: Mineral-insulated metal-sheathed.

19.2 QUALITY

19.2.1 SITE TESTS

Test the insulation resistance before the final connection of equipment and before energisation.

19.2.2 CONTRACTOR'S SUBMISSIONS

Cable routes

If not shown on the drawings in detail, submit details of the following:

- Sub-main cable tray routes and signs.
- Switchboard cupboard layouts including risers.

19.3 WIRING SYSTEMS

19.3.1 SELECTION

General

Use the following systems:

- Cast concrete slabs: Unsheathed cable in heavy duty UPVC conduit.
- Accessible spaces: Thermoplastic insulated and sheathed cables.
- Concealed spaces: Unsheathed cable in UPVC conduit.
- Plastered or rendered surfaces: Cable in UPVC conduit.
- Stud walls without bulk insulation: Thermoplastic insulated and sheathed cables.

19.3.2 INSTALLATION

Standard

Fire or mechanical damage: Classifications to AS/NZS 3013.

Installation methods table

Wall construction	Installation and concealed cabling facilities
Rendered masonry partition	Flush wall box – conduit chased into wall
Double sided face brick partition	Vertically mounted flush wall box with conduit concealed in cut bricks
Face brick external cavity wall	Flush wall box with thermoplastic insulated cables in conduit run in cavity and tied against inner brick surface, or thermoplastic sheathed cables run in cavity
Stud partition	Rewirable

Handling cables

Report damage to cable insulation, serving or sheathing.

Straight-through joints

Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

Cable joints

Locate in accessible positions in junction boxes.

Extra-low voltage circuits

Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

Conductor colours

General: For fixed wiring, use coloured conductor insulation. If this is not practicable, slide at least 150 mm of close fitting coloured sleeving on to each conductor at the termination points.

Active conductors in single phase circuits: Red.

Active conductors in 109 polyphaser circuits:

- A phase: Red.
- B phase: White.
- C phase: Blue.

Tagging

Identify multicore cables and trefoil groups at each end using stamped non-ferrous tags clipped around each cable or trefoil group.

Marking

Identify the origin of all wiring using legible indelible marking.

19.4 POWER CABLES

19.4.1 SELECTION

Cable

General: Use multi-stranded copper cable generally, except for MIMS, to achieve an overall voltage drop of no greater than 7% (where a substation is located on the site).

Minimum size:

- Lighting sub-circuits: 2.5 mm^2.
- Power sub-circuits: 2.5 mm^2.

19.4.2 UNSHEATHED – INSTALLATION

General

Use permanently fixed conduit enclosures assembled before installing wiring. Use draw wires to pull in conductor groups from outlet to outlet, or use ducts with removable covers.

19.4.3 MIMS – INSTALLATION

General

Maintain manufacturer’s seals until joint or termination is made. Remove moisture by heating cable ends.

Seals

Temporary seals: Fit temporary seals to the open ends of cables cut and not immediately used.

Terminations: Fit termination seals at ends of cable runs as soon as the cable has been cut to length, stripped back, and the moisture driven out.

Through joints: Use joints with the same fire-rating as the cable.

Sheath earthing

If MIMS cables enter metal enclosures, earth sheaths to non-ferrous plates secured to the enclosures. Where sheaths terminate at plates, fully insulate, colour code, and fix the conductors to the enclosures.

Bonding

Bond metal sheaths of single core cables in multi-phase circuits using proprietary earth bonding clips or clamps.

Separation

Separate MIMS cables from tough plastic sheathed (TPS) cables and UPVC conduits by at least 25 mm.

Eddy currents

Arrange single core cable entries into non-ferrous metal gland plates to minimise eddy currents.

Vibration

Connections with vibrating equipment: Loop cables in a complete circle next to the point of connection.

19.5 TERMINATIONS

19.5.1 COPPER CONDUCTORS

General

Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, using compression-type lugs of the correct size for the conductor. Compress using the correct tool or use soldering.

Within assemblies and equipment

General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

- Alternative: run cables in UPVC cable duct with fitted cover.

Identification ferrules: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

19.6 WIRING ENCLOSURES AND CABLE SUPPORTS

19.6.1 CONDUITS

Minimum sizes

Metallic and non-metallic conduits: 20 mm.

Galvanised water pipe: Medium or heavy, to AS 1074.

Rigid conduits

Provide straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings.

Galvanising

If installed in damp locations, galvanise mild steel wiring enclosures and support systems.

Set out

If exposed to view, install conduits in parallel runs with right angle changes of direction.

Inspection fittings

Locate in accessible positions.

Draw cords

General: Provide draw cords in conduits not in use. Leave 1 m of cord coiled at each end of the run.

Material: Polypropylene cord, or insulated stranded earth wire, 2.5 mm^2 minimum size.

Draw-in boxes

General: Provide draw-in boxes at intervals not exceeding 30 m in straight runs, and at changes of level or direction.

Underground draw-in boxes: Provide gasketted covers and seal against moisture.

19.6.2 CONCEALED CONDUITS

Routes

Conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations: Run directly between points of termination, minimising the number of sets. Do not use inspection fittings.

Conduits in concrete slabs

Route: Do not run in concrete toppings. Do not run within pretensioning cable zones; cross pretensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location. Space parallel conduits at least 50 mm apart.

Minimum cover: Conduit diameter or 20 mm.

Conduit size: 40 mm maximum diameter.

Fixing: Fix directly to top of the bottom layer of reinforcing where the conduits pass above a single layer of reinforcing.

Columns

General: Do not place more than four 25 mm (maximum) diameter conduits centrally in each column.

Bends: Enter columns via bends with minimum radius of 150 mm.

Chasing: Do not chase columns.

19.6.3 METALLIC CONDUITS AND FITTINGS

Standard

Metallic conduits and fittings: AS/NZS 2053.7 or AS/NZS 2053.8.

Type

Screwed steel.

Corrosion protection

For steel conduits, paint ends and joint threads with zinc rich organic binder to GPC-C-29/16.

Expansion joints

General: Provide flexible couplings consisting of flexible conduit and fittings, at:

- Structural expansion joints; and
- In long straight runs if the ambient temperature varies by more than $40^{O}C$.

Conductivity: Maintain electrical conductivity between the two ends of rigid metallic conduit.

Movement: Provide conduit support saddles close to flexible couplings to permit free movement for expansion and contraction.

19.6.4 NON-METALLIC CONDUITS AND FITTINGS

Standard

Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6.

Conduits in roof spaces

Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

Conduit in slabs

Use high compression corrugated conduit and restrain at regular intervals to achieve a nominally straight run.

Category A conduit

For direct buried installations requiring the use of Category A conduit, use protective cover strips and corrugated conduit.

Flexible conduit

Use for equipment and plant subjected to vibration. If necessary, use for adjustment or ease of maintenance. Provide the minimum possible length.

Associated fittings

General: Use fittings of the same type and material as the conduit.

Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, use prefabricated earthed metal boxes.

Inspection fittings

Use inspection-type fittings only in accessible locations and where exposed to view.

Joints

General: Use cemented or snap on joints.

Expansion couplings: If encased in concrete, do not use bellows type.

19.6.5 CABLE SUPPORTS

System

Provide a complete cable support system consisting of trays or ladders and including brackets, fixings and accessories. Fabricate brackets, racks and hangers using structural steel sections or other materials in sections of equivalent strength. As a minimum the Contractor shall provide ladder/tray throughout the carpark levels and within cupboard risers to support cabling.

Manufacture

Use proprietary trays, ladders and accessories from a single manufacturer in the same application.

Cable trays

Materials:

- Interior: Zinc-coated steel, or steel with two-pack liquid coating, air-drying enamel or stoving enamel finish.
- Exterior: Hot dip galvanised steel.

Minimum steel thickness:

- Trays < 150 mm wide: 1 mm.
- Trays ≥ 150 mm, < 300 mm wide: 1.2 mm.

- Trays ≥ 300 mm wide: 1.6 mm.

Perforations: To Admiralty pattern, reverse stamping.

Cable ladders

General: Use 2 folded steel or extruded structural grade aluminium side rails with cable support rungs between the rails.

Steel ladders: Galvanised.

Rung spacing: 300 mm maximum.

Small cables: Run cables less than 13 mm diameter in cable trays or ducts.

Structural sections:

- Angles and bars: 6.5 mm minimum thickness.
- Rods: 10 mm minimum diameter.

Fixing to building structure

General: Fix supports to the building structure or fabric using direct fixing, hangers or brackets.

Spacing: Space supports at maximum intervals of 1.5 m for trays and 3 m for ladders.

Access

Provide a minimum of 150 mm free space above and 600 mm free space on one side of trays and ladders.

Cable fixing

Provide slats or rails suitable for fixing cable ties, strapping or saddles.

Bend radius

Provide bends with a minimum inside radius of 12 times the outside diameter of the largest diameter cable carried.

Cable protection

Provide rounded support surfaces under cables where they leave trays or ladders.

Cable strapping

Use steel straps on MIMS cables.

Minimum clearances

Hot water pipes: 200 mm.

Boilers or furnaces: 500 mm.

19.7 ACCESSORIES

19.7.1 LIGHTING AND SOCKET OUTLET SWITCHES

Minimum rating

10 A, 240 V A.C.

19.7.2 GENERAL PURPOSE OUTLETS

Pin arrangement

Mount outlets with the earth pins at the 6 o’clock position.

19.7.3 LIGHTING OUTLETS

Pin arrangement

Standard: 3 flat pin with looping terminal.

Emergency lighting: 4 flat pin if self-contained emergency lighting is to be connected.

19.7.4 INSTALLATION

General

Provide flush mounted accessories except in plant rooms or where there aren't any false ceilings.

Surface mounting

Use proprietary mounting blocks.

Restricted location

Do not install wall boxes across junctions of wall finishes.

Marking

Label isolating switches and outlets to identify circuit origin.

19.7.5 OUTLETS AND SWITCHES

All outlets, switches telephone and TV outlets are to be, HPM Excel range.

All power outlets shall be single piece units (i.e. no removable faceplates), to eliminate tampering / misplacement of faceplates.

19.7.6 WET AREA CLEARANCES

The Contractor shall allow for the co-ordination and positioning of services within all wet areas to ensure full compliance with AS/NZS 3000 is maintained.

19.8 UNDERGROUND SERVICES

Note all works associated with the trenching, In-ground conduiting, pits, back filling and making good must be undertaken by the electrical Sub-Contractor.

19.8.1 CABLES IN TRENCHES

Sand bed and surround

Provide clean sharp sand around cables and conduits installed underground.

Sealing ducts and conduits

Seal buried entries to ducts and conduits using waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation.

19.8.2 CABLE PITS

General

Draw-in pits: Pit sizes are to be 600mm x 600mm or as nominated on the drawings.

Precast concrete types with knock outs to suite.

All pits shall be heavy duty rated suitable for heavy vehicle loading.

Incorporate a waterproofing agent in the render or concrete.

Pit covers

General: Provide drop in pit covers to suit heavy traffic loads where necessary and nominated on the drawings. Fit flush with the top of the pit. Pit lids to have lifting slot holes for servicing purposes.

Standard: To AS 3996.

Drainage

General: Provide drainage from the bottom of cable pits, either to absorption trenches filled with rubble or to the storm water drainage system.

Absorption trenches: Minimum size 300 x 300 x 2000 mm.

19.8.3 UNDERGROUND CABLE ROUTES

Survey

Accurately record the routes of underground cables before backfilling.

Location marking

General: Accurately mark the location of underground cables on as built drawings.

19.8.4 SERVICE TRENCHES

Excavation

Excavate for underground services, to required lines, levels and grades. Generally, make the trenches straight between personnel access ways, inspection points and junctions, pits and changes in cable route, with vertical sides and uniform grades.

Spoil: If excavated material cannot be used for filling or backfilling, remove it from the site.

Trench widths

Keep trench widths to the minimum consistent with the laying and bedding of the relevant service and construction of personnel access ways and pits.

Trench depths

General: As required by the relevant service and its bedding method.

Notice: If excavation is necessary below the level of adjacent footings, give notice, and provide necessary support for the footings.

Obstructions

Clear trenches of sharp projections. Cut back roots encountered in trenches to at least 600 mm clear of services. Remove other obstructions including stumps and boulders which may interfere with services or bedding.

Dewatering

Keep trenches free of water. Place bedding material, services and backfilling on firm ground free of surface water.

Excess excavation

If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or grade N20 concrete.

Backfilling

Backfill service trenches as soon as possible after the service has been laid and bedded, if possible on the same working day. Place the backfill in layers < 150 mm thick and compact to the density which applies to the location of the trenches to minimise settlement, and so that pipes are buttressed by the trench walls.

Marking services

Underground marking tape: To AS/NZS 2648.1.

Backfill material

Under roads and paved areas: Coarse sand, controlled low strength material or fine crushed rock.

In topsoil areas: Complete the backfilling with topsoil for at least the top 50 mm.

In reactive clay: In sites classified M, H or E to AS 2870, use an impervious material where trenches fall towards footings.

Elsewhere: Well graded, inorganic, non-perishable material, maximum size 75 mm, plasticity index < 55%. Do not place stones greater than 25 mm within 150 mm of services.

Boring

Subcontractor: If under road boring is required in lieu of trenches, engage a suitably qualified subcontractor to do the work.

Process: Ensure a tight fit to the service pipes. If voids are encountered, fill by pressure grouting.

Unit paving

Provide sand bedding and, if necessary, compacted crushed rock base. Reinstate the paving units.

19.8.5 RE-INSTATING EXCAVATED SURFACES

Grassed Areas

All surfaces that are to be disturbed in any way or form to accomplish the aim of this project shall be re-instated in its original state or better. Remove turf from areas to be excavated and re instate immediately after the excavation works are complete. I t is the electrical contractors responsibility to ensure that the removed turf is not lost or stolen and stored in an appropriate manner that doesn't interfere with the operation of the complex.

Concrete / Road Surfaces

All surfaces that are to be disturbed in any way or form to accomplish the aim of this project shall be re-instated in its original state or better.

A saw cut method is to be employed in areas where the need arises for services to be installed under existing road or concrete surfaces.

A search for all services in the area should be undertaken prior to any excavation works. It is the electrical contractors' responsibility to ensure that the removed waste from road and concrete surfaces are disposed accordingly.

All waste stored on site while work is being executed, shall be stored in an appropriate manner that doesn't interfere with the operation of the complex.

A geotech test shall be provided to ensure that the backfill has achieved 80% compaction every 50metres of the trench.

SECTION 20 - WIRING AND ACCESSORIES

20.1 GENERAL

20.1.1 INTERPRETATIONS

Abbreviation

MIMS: Mineral-insulated metal-sheathed.

20.2 QUALITY

20.2.1 SITE TESTS

Test the insulation resistance before the final connection of equipment and before energisation.

20.2.2 CONTRACTOR'S SUBMISSIONS

Cable routes

If not shown on the drawings in detail, submit details of the following:

- Sub-main cable tray routes and signs.
- Switchboard cupboard layouts including risers.

20.3 WIRING SYSTEMS

20.3.1 SELECTION

General

Use the following systems:

- Cast concrete slabs: Unsheathed cable in heavy duty UPVC conduit.
- Accessible spaces: Thermoplastic insulated and sheathed cables.
- Concealed spaces: Unsheathed cable in UPVC conduit.
- Plastered or rendered surfaces: Cable in UPVC conduit.
- Stud walls without bulk insulation: Thermoplastic insulated and sheathed cables.

20.3.2 INSTALLATION

Standard

Fire or mechanical damage: Classifications to AS/NZS 3013.

Installation methods table

Wall construction	Installation and concealed cabling facilities
Rendered masonry partition	Flush wall box – conduit chased into wall
Double sided face brick partition	Vertically mounted flush wall box with conduit concealed in cut bricks
Face brick external cavity wall	Flush wall box with thermoplastic insulated cables in conduit run in cavity and tied against inner brick surface, or thermoplastic sheathed cables run in cavity
Stud partition	Rewirable

Handling cables

Report damage to cable insulation, serving or sheathing.

Straight-through joints

Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

Cable joints

Locate in accessible positions in junction boxes.

Extra-low voltage circuits

Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

Conductor colours

General: For fixed wiring, use coloured conductor insulation. If this is not practicable, slide at least 150 mm of close fitting coloured sleeving on to each conductor at the termination points.

Active conductors in single phase circuits: Red.

Active conductors in 118 polyphaser circuits:

- A phase: Red.
- B phase: White.
- C phase: Blue.

Tagging

Identify multicore cables and trefoil groups at each end using stamped non-ferrous tags clipped around each cable or trefoil group.

Marking

Identify the origin of all wiring using legible indelible marking.

20.4 POWER CABLES

20.4.1 SELECTION

Cable

General: Use multi-stranded copper cable generally, except for MIMS, to achieve an overall voltage drop of no greater than 7% (where a substation is located on the site).

Minimum size:

- Lighting sub-circuits: 2.5 mm^2.
- Power sub-circuits: 2.5 mm^2.

20.4.2 UNSHEATHED – INSTALLATION

General

Use permanently fixed conduit enclosures assembled before installing wiring. Use draw wires to pull in conductor groups from outlet to outlet, or use ducts with removable covers.

20.4.3 MIMS – INSTALLATION

General

Maintain manufacturer’s seals until joint or termination is made. Remove moisture by heating cable ends.

Seals

Temporary seals: Fit temporary seals to the open ends of cables cut and not immediately used.

Terminations: Fit termination seals at ends of cable runs as soon as the cable has been cut to length, stripped back, and the moisture driven out.

Through joints: Use joints with the same fire-rating as the cable.

Sheath earthing

If MIMS cables enter metal enclosures, earth sheaths to non-ferrous plates secured to the enclosures. Where sheaths terminate at plates, fully insulate, colour code, and fix the conductors to the enclosures.

Bonding

Bond metal sheaths of single core cables in multi-phase circuits using proprietary earth bonding clips or clamps.

Separation

Separate MIMS cables from tough plastic sheathed (TPS) cables and UPVC conduits by at least 25 mm.

Eddy currents

Arrange single core cable entries into non-ferrous metal gland plates to minimise eddy currents.

Vibration

Connections with vibrating equipment: Loop cables in a complete circle next to the point of connection.

20.5 TERMINATIONS

20.5.1 COPPER CONDUCTORS

General

Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, using compression-type lugs of the correct size for the conductor. Compress using the correct tool or use soldering.

Within assemblies and equipment

General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

- Alternative: run cables in UPVC cable duct with fitted cover.

Identification ferrules: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

20.6 WIRING ENCLOSURES AND CABLE SUPPORTS

20.6.1 CONDUITS

Minimum sizes

Metallic and non-metallic conduits: 20 mm.

Galvanised water pipe: Medium or heavy, to AS 1074.

Rigid conduits

Provide straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings.

Galvanising

If installed in damp locations, galvanise mild steel wiring enclosures and support systems.

Set out

If exposed to view, install conduits in parallel runs with right angle changes of direction.

Inspection fittings

Locate in accessible positions.

Draw cords

General: Provide draw cords in conduits not in use. Leave 1 m of cord coiled at each end of the run.

Material: Polypropylene cord, or insulated stranded earth wire, 2.5 mm^2 minimum size.

Draw-in boxes

General: Provide draw-in boxes at intervals not exceeding 30 m in straight runs, and at changes of level or direction.

Underground draw-in boxes: Provide gasketted covers and seal against moisture.

20.6.2 CONCEALED CONDUITS

Routes

Conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations: Run directly between points of termination, minimising the number of sets. Do not use inspection fittings.

Conduits in concrete slabs

Route: Do not run in concrete toppings. Do not run within pretensioning cable zones; cross pretensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location. Space parallel conduits at least 50 mm apart.

Minimum cover: Conduit diameter or 20 mm.

Conduit size: 40 mm maximum diameter.

Fixing: Fix directly to top of the bottom layer of reinforcing where the conduits pass above a single layer of reinforcing.

Columns

General: Do not place more than four 25 mm (maximum) diameter conduits centrally in each column.

Bends: Enter columns via bends with minimum radius of 150 mm.

Chasing: Do not chase columns.

20.6.3 METALLIC CONDUITS AND FITTINGS

Standard

Metallic conduits and fittings: AS/NZS 2053.7 or AS/NZS 2053.8.

Type

Screwed steel.

Corrosion protection

For steel conduits, paint ends and joint threads with zinc rich organic binder to GPC-C-29/16.

Expansion joints

General: Provide flexible couplings consisting of flexible conduit and fittings, at:

- Structural expansion joints; and
- In long straight runs if the ambient temperature varies by more than $40^{O}C$.

Conductivity: Maintain electrical conductivity between the two ends of rigid metallic conduit.

Movement: Provide conduit support saddles close to flexible couplings to permit free movement for expansion and contraction.

20.6.4 NON-METALLIC CONDUITS AND FITTINGS

Standard

Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6.

Conduits in roof spaces

Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

Conduit in slabs

Use high compression corrugated conduit and restrain at regular intervals to achieve a nominally straight run.

Category A conduit

For direct buried installations requiring the use of Category A conduit, use protective cover strips and corrugated conduit.

Flexible conduit

Use for equipment and plant subjected to vibration. If necessary, use for adjustment or ease of maintenance. Provide the minimum possible length.

Associated fittings

General: Use fittings of the same type and material as the conduit.

Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, use prefabricated earthed metal boxes.

Inspection fittings

Use inspection-type fittings only in accessible locations and where exposed to view.

Joints

General: Use cemented or snap on joints.

Expansion couplings: If encased in concrete, do not use bellows type.

20.6.5 CABLE SUPPORTS

System

Provide a complete cable support system consisting of trays or ladders and including brackets, fixings and accessories. Fabricate brackets, racks and hangers using structural steel sections or other materials in sections of equivalent strength. As a minimum the Contractor shall provide ladder/tray throughout the carpark levels and within cupboard risers to support cabling.

Manufacture

Use proprietary trays, ladders and accessories from a single manufacturer in the same application.

Cable trays

Materials:

- Interior: Zinc-coated steel, or steel with two-pack liquid coating, air-drying enamel or stoving enamel finish.
- Exterior: Hot dip galvanised steel.

Minimum steel thickness:

- Trays < 150 mm wide: 1 mm.
- Trays ≥ 150 mm, < 300 mm wide: 1.2 mm.

- Trays ≥ 300 mm wide: 1.6 mm.

Perforations: To Admiralty pattern, reverse stamping.

Cable ladders

General: Use 2 folded steel or extruded structural grade aluminium side rails with cable support rungs between the rails.

Steel ladders: Galvanised.

Rung spacing: 300 mm maximum.

Small cables: Run cables less than 13 mm diameter in cable trays or ducts.

Structural sections:

- Angles and bars: 6.5 mm minimum thickness.
- Rods: 10 mm minimum diameter.

Fixing to building structure

General: Fix supports to the building structure or fabric using direct fixing, hangers or brackets.

Spacing: Space supports at maximum intervals of 1.5 m for trays and 3 m for ladders.

Access

Provide a minimum of 150 mm free space above and 600 mm free space on one side of trays and ladders.

Cable fixing

Provide slats or rails suitable for fixing cable ties, strapping or saddles.

Bend radius

Provide bends with a minimum inside radius of 12 times the outside diameter of the largest diameter cable carried.

Cable protection

Provide rounded support surfaces under cables where they leave trays or ladders.

Cable strapping

Use steel straps on MIMS cables.

Minimum clearances

Hot water pipes: 200 mm.

Boilers or furnaces: 500 mm.

20.7 ACCESSORIES

20.7.1 LIGHTING AND SOCKET OUTLET SWITCHES

Minimum rating

10 A, 240 V A.C.

20.7.2 GENERAL PURPOSE OUTLETS

Pin arrangement

Mount outlets with the earth pins at the 6 o’clock position.

20.7.3 LIGHTING OUTLETS

Pin arrangement

Standard: 3 flat pin with looping terminal.

Emergency lighting: 4 flat pin if self-contained emergency lighting is to be connected.

20.7.4 INSTALLATION

General

Provide flush mounted accessories except in plant rooms or where there aren't any false ceilings.

Surface mounting

Use proprietary mounting blocks.

Restricted location

Do not install wall boxes across junctions of wall finishes.

Marking

Label isolating switches and outlets to identify circuit origin.

20.7.5 OUTLETS AND SWITCHES

All outlets, switches telephone and TV outlets are to be, HPM Excel range.

All power outlets shall be single piece units (i.e. no removable faceplates), to eliminate tampering / misplacement of faceplates.

20.7.6 WET AREA CLEARANCES

The Contractor shall allow for the co-ordination and positioning of services within all wet areas to ensure full compliance with AS/NZS 3000 is maintained.

20.8 UNDERGROUND SERVICES

Note all works associated with the trenching, In-ground conduiting, pits, back filling and making good must be undertaken by the electrical Sub-Contractor.

20.8.1 CABLES IN TRENCHES

Sand bed and surround

Provide clean sharp sand around cables and conduits installed underground.

Sealing ducts and conduits

Seal buried entries to ducts and conduits using waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation.

20.8.2 CABLE PITS

General

Draw-in pits: Pit sizes are to be 600mm x 600mm or as nominated on the drawings.

Precast concrete types with knock outs to suite.

All pits shall be heavy duty rated suitable for heavy vehicle loading.

Incorporate a waterproofing agent in the render or concrete.

Pit covers

General: Provide drop in pit covers to suit heavy traffic loads where necessary and nominated on the drawings. Fit flush with the top of the pit. Pit lids to have lifting slot holes for servicing purposes.

Standard: To AS 3996.

Drainage

General: Provide drainage from the bottom of cable pits, either to absorption trenches filled with rubble or to the storm water drainage system.

Absorption trenches: Minimum size 300 x 300 x 2000 mm.

20.8.3 UNDERGROUND CABLE ROUTES

Survey

Accurately record the routes of underground cables before backfilling.

Location marking

General: Accurately mark the location of underground cables on as built drawings.

20.8.4 SERVICE TRENCHES

Excavation

Excavate for underground services, to required lines, levels and grades. Generally, make the trenches straight between personnel access ways, inspection points and junctions, pits and changes in cable route, with vertical sides and uniform grades.

Spoil: If excavated material cannot be used for filling or backfilling, remove it from the site.

Trench widths

Keep trench widths to the minimum consistent with the laying and bedding of the relevant service and construction of personnel access ways and pits.

Trench depths

General: As required by the relevant service and its bedding method.

Notice: If excavation is necessary below the level of adjacent footings, give notice, and provide necessary support for the footings.

Obstructions

Clear trenches of sharp projections. Cut back roots encountered in trenches to at least 600 mm clear of services. Remove other obstructions including stumps and boulders which may interfere with services or bedding.

Dewatering

Keep trenches free of water. Place bedding material, services and backfilling on firm ground free of surface water.

Excess excavation

If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or grade N20 concrete.

Backfilling

Backfill service trenches as soon as possible after the service has been laid and bedded, if possible on the same working day. Place the backfill in layers < 150 mm thick and compact to the density which applies to the location of the trenches to minimise settlement, and so that pipes are buttressed by the trench walls.

Marking services

Underground marking tape: To AS/NZS 2648.1.

Backfill material

Under roads and paved areas: Coarse sand, controlled low strength material or fine crushed rock.

In topsoil areas: Complete the backfilling with topsoil for at least the top 50 mm.

In reactive clay: In sites classified M, H or E to AS 2870, use an impervious material where trenches fall towards footings.

Elsewhere: Well graded, inorganic, non-perishable material, maximum size 75 mm, plasticity index < 55%. Do not place stones greater than 25 mm within 150 mm of services.

Boring

Subcontractor: If under road boring is required in lieu of trenches, engage a suitably qualified subcontractor to do the work.

Process: Ensure a tight fit to the service pipes. If voids are encountered, fill by pressure grouting.

Unit paving

Provide sand bedding and, if necessary, compacted crushed rock base. Reinstate the paving units.

20.8.5 RE-INSTATING EXCAVATED SURFACES

Grassed Areas

All surfaces that are to be disturbed in any way or form to accomplish the aim of this project shall be re-instated in its original state or better. Remove turf from areas to be excavated and re instate immediately after the excavation works are complete. I t is the electrical contractors responsibility to ensure that the removed turf is not lost or stolen and stored in an appropriate manner that doesn't interfere with the operation of the complex.

Concrete / Road Surfaces

All surfaces that are to be disturbed in any way or form to accomplish the aim of this project shall be re-instated in its original state or better.

A saw cut method is to be employed in areas where the need arises for services to be installed under existing road or concrete surfaces.

A search for all services in the area should be undertaken prior to any excavation works. It is the electrical contractors' responsibility to ensure that the removed waste from road and concrete surfaces are disposed accordingly.

All waste stored on site while work is being executed, shall be stored in an appropriate manner that doesn't interfere with the operation of the complex.

A geotech test shall be provided to ensure that the backfill has achieved 80% compaction every 50metres of the trench.

SECTION 21 - SMOKE ALARM SYSTEM

21.1 GENERAL

21.1.1 CROSS REFERENCES

Related sections

Refer to the following sections:

Wiring and accessories, for cabling requirements.

21.1.2 STANDARD

General

Refer to BCA and AS 3786

21.2 SCOPE

The Electrical Contractor shall supply, install, test and commission an **AS 3786** smoke alarm system complying with the requirements of the Building Code of Australia. If an alternative system is proposed, it should be discussed with the Principal, BCA Consultant and JHA prior to proceeding with the installation.

Provide centralized Smoke Alarm control panel (RFP) similar to Brooks RFP12V2 (with Zone Output Card SUB365) for control and monitoring purposes. All alternatives must be approved by the Superintendent.

Provide control panel battery backup for minimum 72 hours.

Provide Smoke alarms as per design drawings. Smoke alarms to be Brooks EIB650IWX with interface base BAX16 or similar compatible. All alternatives must be approved by the Superintendent.

Provide Heat alarms as per design drawings. Heat alarms to be Brooks EIB603CX with interface base BAX16 or similar compatible. All alternatives must be approved by the Superintendent.

Provide and install wiring from smoke alarms to the RFP.

Exact location of the Smoke alarms shall be shown on the drawings by the Electrical Contractor and submitted for approval to the Principal. Self-contained smoke alarms shall comply with the following performance criteria:

a) Certificate of Compliance by Scientific Services Laboratory (SSL) for testing to AS3786.

b) Dual ionisation chamber system or photoelectric model.

c) First and subsequent alarm indicator.

d) Test button.

e) Alarm pause/"hush" button to silence alarm.

f) Branded to manufacturers trademark to AS3786.

g) Installed to manufacturer's recommendation.

h) Mains operated (hard-wired) 240 volts unit with battery/capacitor backup.

i) Interlinkable features.

j) DC 9 volt alkaline long life battery/capacity with minimum 72 hours standby.

k) Low battery capacity indicator

The Contractor shall supply and install smoke/heat detectors as nominated on the design drawings. Each smoke and heat detector shall incorporate an integral siren alert per level and connected to and

have integral battery backup.

The smoke/heat alarms installed in physically segregated areas shall be linked together to provide a common alarm on activation of any one (1) smoke/heat alarm in the affected area. **These smoke and thermal alarms are to be interconnected to the electronic security system. Upon activation of any of the smoke or thermal alarms security systems alarm would be triggered. If alarm is not resetted in client designated time, offsite security company is to be alerted though signal transmitted by the security system. Provided reset facility at Client designated location.**

Contractor to provide a fire trip signal from the Residential Fire Panel to the Mechanical Services Switchboard.

The smoke/heat alarms shall be constructed such that the main body can be detached from the ceiling mount and replaced if faulty, by the occupant, without disconnection of any wiring or mechanical connection.

The smoke/heat alarms shall be white and must be submitted for review by the Architect prior to the placement of any orders.

The smoke/heat alarm types shall have been used in the industry for at least two (2) to five (5) years in similar applications, and must be serviced, stocked and maintained for at least 7 years after

Practical Completion by the supplier / installer.

The smoke alarm shall be of Brooks manufacture or approved equal.

Contractor to provide a fire trip signal to the mechanical switchboard to shut down the mechanical equipment accordingly. Coordinate with mechanical trade as required.

21.3 QUALITY

21.3.1 CONTRACTOR'S SUBMISSIONS

Submit product data and samples for components.

- self-contained smoke alarms

21.3.2 PERFORMANCE AND GUARANTEE

The performance of installed equipment shall be guaranteed to comply with the specified requirements. All equipment installed shall be suitable for the duty and application and give specified performance within the limits of equipment capacity.

All equipment and systems shall be selected, installed and commissioned to ensure safe, continuous and unattended operation of the specified conditions as follows:

- Temperature range 0°C to 40°C
- Humidity up to 95%
- Altitude 100m

The effect of noise generated by equipment shall not exceed: NR 40

21.4 DETECTION AND ALARM SYSTEMS

21.4.1 AUTHORISED PRODUCTS

Use equipment listed in the SSL Register of Accredited Products - Fire Protection Equipment.

21.4.2 INSTALLATION WIRING

Wiring and connections

Conductor size: 1.5 mm^2 TPI 250 V rated, with red and white insulation.

Sheathing: Red.

SECTION 22 - PUBLIC ADDRESS

22.1 PUBLIC ADDRESS SYSTEM

A Public Address (PA) system will be provided and installed by the Client as part of Group 3 items.

SECTION 23 - HEARING AUGMENTATION

23.1 AUDIO FREQUENCY INDUCTION LOOP SYSTEM

The AV Contractor shall provide and install an Audio Frequency Induction Loop System (AFILS), sometimes referred to as a Hearing Loop, complying with NCC/BCA Clause D3.7 requirements, which shall reinforce audio sources for the hearing impaired.

- The AFILS shall cover 80% of the room.

All Installations are to be done by AFILS specialist qualified staff.

The hearing augmentation system shall be installed and commissioned to ensure performance complies with AS1428.5 and AS60118.4-2007.

The system shall be Univoix PLS-X1 or equivalent. PLS-X1 Univox Loop Amplifier for meeting and class rooms, TV lounges and other small areas. 4.7A RMS at 22Vpp. Integrated Parametric Metal Loss Correction control (selectable knee at 100 Hz, 500 Hz,1 kHz, 2 kHz). Three inputs including XLR, Euro block and dual RCA, Input 2 can be set to override and to accept a 50-100V speaker feed. Integrated System Diagnostics with LED output, Dual action AGC, 10W integrated amp with monitoring speaker output, 3.5mm headphone output, 1/2 RU supplied with rack kit for single or dual mounting. Includes 1 x T-Symbol wall sticker.879.00

23.2 CONTROL SYSTEMS

Control systems consist of two key elements: the user interface; and a master/central controller. Other peripherals such as software, sensors and interfaces may also be included to build out the control system.

A user interface/s as required and detailed in the AV System shall be developed by the AV Contractor and submitted for approval.

Communications between devices should be bi-directional for any RS-232, RS-485 or TCP/IP communication and these protocols shall be utilized over uni-directional protocols, where possible.

All control system names and time shall be configured to ensure accurate logs and simple troubleshooting.

The control system shall be configured, where possible, to ensure the system accurately reflects the state of all devices at all times via the use of accurate device feedback and status enquiries.

SECTION 24 - UNINTERRUPTABLE POWER SUPPLY

24.1 GENERAL

24.2 AIMS

24.2.1 RESPONSIBILITIES

General: supply and install an UPS system to service the Comms room.

The rack mounted ICT UPS unit is the DataGuard Model DG900Pro 3kVA unit with an autonomy of 60 minutes or equivalent top tier brand (Eaton/Schneider/Socomec/Vertiv).

24.3 CROSS REFERENCES

24.3.1 GENERAL

General: Conform to the *General requirements* work section.

24.3.2 ASSOCIATED WORKSECTIONS

Associated work sections: Conform to the following:

- *Electrical general requirements*.
- *Switchboards – proprietary.*
- *Switchboards – custom-built.*
- *Switchboard components.*

24.4 STANDARD

24.4.1 GENERAL

General: To AS 62040.2 and AS 62040.3.

Converters: To AS 60146.2.

Batteries: To AS/NZS 4029.2 or AS 4029.3.

Batteries installation: To AS/NZS 2676 series and AS/NZS 3011 series.

24.4.2

24.4.3 AUTHORITIES

EMC: Comply with the requirements of the Australian Communications Authority.

24.5 INTERPRETATIONS

24.5.1 ABBREVIATIONS

General: For the purposes of this work section the abbreviations given below apply.

EMC: Electromagnetic compatibility.

24.5.2 DEFINITIONS

General: For the purposes of this work section the definitions given below apply.

Uninterruptible power supply (UPS): Battery operated static inverter system.

24.6 TESTS

24.6.1 GENERAL

Standard: To AS/NZS 62040.3.

24.6.2

24.6.3 TEST LOADS

General: Supply reactive test loads including power, control wiring and ancillary equipment.

Function: To achieve the kW, and kVAr and load steps necessary to demonstrate and verify the designated steady state and transient frequency and voltage responses and waveform deviation tests.

24.6.4

24.6.5 FUNCTIONAL UNIT TESTS

Rectifier: Factory tests to AS/NZS 62040.3 and AS/NZS 60146.1.

Inverter: Factory tests to AS/NZS 62040.3 and AS/NZS 60146.2.

Switch: Factory tests to AS/NZS 62040.3 and AS/NZS 60146.1.

Monitoring and control: Factory tests to AS/NZS 62040.3.

Battery: Factory tests to AS/NZS 62040.3 clause 6.6.15, 6.6.16, and 6.6.17.

Battery: Capacity test to AS/NZS 4029.

24.7 PRE-COMPLETION TESTS

Production tests

General: Carry out the following tests:

- Inrush current: Record the instantaneous peak value of inrush current at switch-on.
- Power factor (PF): Record the line-side power factor with a full load rated output at 0.8 PF lagging.
- Overload capacity tests: Comply with the **Overload capacity table**, output at 0.8 PF lagging including operation of static switch after the test period has expired.
- Line voltage drop compensation test: Linearly increase the test current from 0 – 100% of rated output, at 0.8 PF lagging.

Balanced load at no load and full load with 0.8 PF lagging:

- % variation from nominal voltage.
- Phase displacement.
- Crest factor ratio.
- Voltage symmetry.

Unbalanced load: With 25% rated load output unbalance on each phase respectively:

- % variation from nominal voltage.
- Phase displacement.
- Voltage symmetry at 50% unbalance.

Transient voltage regulation with primary input within stated limits:

- Step load change: With a change of 3 even steps of 25%, 50% and 100% rated output at 5 s intervals:
- Transient voltage % variation from nominal voltage at each step.
- Transient phase displacement at each step.
- Transient recovery time for return to steady state tolerance at each step.

Voltage waveform harmonic distortion test:

- Distortion: At 100%, 50% and 0% of rated output, measured between phases and between each phase and neutral at the line and load terminals:
- Total harmonic distortion in a range of 1st to 65th harmonic.
- Individual harmonic distortion in a range of 1st to 65th harmonic.
- The THD of the output supply shall be <4.5%

Frequency regulation tests with primary input within stated limits:

- Slew rate.
- Regulation: For steady state 100% and 50% rated output changes, mains failure or restoration of mains and static bypass changeover, UPS to mains or mains to UPS:
- % variation from nominal frequency when synchronised to reserve.
- % variation from nominal frequency when on interval crystal control.

Minimum Overload capacity

UPS rated capacity	Overload capacity test current	Duration
< 1200 VA	110% of rated output	10 min
≥ 1200 VA, < 6 kVA	125% of rated output 150% of rated output	10 min 1 min
≥ 6 kVA	125% of rated output	10 min 10s

24.8 SUBMISSIONS

24.8.1 SHOP DRAWINGS

General: Include the following:

- The UPS system general arrangement and layout with details of connections, circuit breakers, cable sizes, overall dimensions, weight, location of access doors, cable terminating locations, and necessary clearances.
- Functional block diagram.
- The general arrangement of the remote manual by-pass switch/cabinet and indication/alarm panel with details of installation requirements.
- Type and rating of equipment items.
- Battery layout and associated details.
- Detailed layout of the UPS room showing all relevant equipment and dimensions

24.9 COMPONENTS

24.10 OPERATION

By-pass arrangement

Static by-pass: Provide an automatic, no-break, integral static by-pass switch with automatic reset to transfer the load automatically to the by-pass supply when the UPS output characteristics are outside the designated limits.

External Maintenance by-pass: Provide an external manual by-pass switch to manually transfer the load to the mains supply, bypassing the UPS and the static by-pass switch.

Harmonics

Input total harmonic voltage distortion: < 5%.

Current limiting

Provide inrush current limiting to 125% of the UPS rated load current.

Protection

Discrimination: Provide main circuit breakers, both input and output, within the UPS, which fully discriminate with upstream and downstream circuit breakers.

Components: Provide component protection to minimise damage and downtime in the event of component failure. Include the following as appropriate:

- Fuses.
- Circuit breakers.
- Overloads.
- Thermal sensors.

Output: Provide protection against output overload and short circuit. Ensure that output short circuits will not damage the UPS.

Safety interlocks: Provide interlocks to prevent accidental damage to the UPS during maintenance or normal operation.

The UPS shall comprise of four units, anyone can fail and the remaining three UPSs in that system will continue to provide full load.

24.11 RECTIFIERS / CHARGERS

Input circuit breakers

Type: Moulded case circuit breakers.

Frame size and trip rating: Sufficient to supply the full rated load to the inverter and the battery charging load.

Input current limiters

Limit input current to 125% of the full rated load current.

Battery chargers

Type: Automatic constant voltage type, initial current maximum 10% of one-hour rate of the battery.

Maximum charging current: Adjustable from 0 to 10% of the one-hour rate.

24.12 INVERTERS

General: Provide inverters which synchronise with the A.C. input supply within ± 0.5 Hz.

Free running: By manual switch, or automatically when the A.C. input supply is out of the designated tolerances. Provide controls which ensure that the A.C. input supply is stable and within tolerances for 30 s before automatic return from free running to synchronised running.

24.13 COMPLETION

24.14 SPARES

General

Supply spare parts necessary to maintain the “mean time to repair”.

Packaging

Package and label spare parts for long-term storage within the UPS room.

24.15 COMPLETION TESTS

General

Test run the UPS system continuously connected to the test load, for at least 48 hours. Record line and load voltage, current frequency and temperature measurements.

Test loads

General: Supply reactive test loads including power, control wiring and ancillary equipment.

Function: To achieve the kW, and kVAr and load steps necessary to demonstrate and verify the designated steady state and transient frequency and voltage responses and waveform deviation tests.

Tests

UPS system: Verify the following:

- Correct functional operation, including mains failure and return, and operation of static and remote bypass switches.
- Correct operation or indication of controls, alarms, indicators and instruments.

Batteries and battery charger:

- Charge the batteries for 12 hours at 10% of the one-hour rate.
- Simulate supply failure.

24.16 MAINTENANCE

Call out

Respond to call outs for breakdowns or other faults requiring corrective maintenance during warranty period. Attend on site within 24 hours of notification. Rectify faults, and replace faulty materials and equipment.

SECTION 25 - PHOTOVOLTAIC SYSTEM WITH BATTERY STORAGE

25.1 GENERAL

The contractor is to design, supply and install a photovoltaic Grid connected system including inverters, Solar Panels, Panel mounting hardware, cabling, interlocks, and co-ordination with other trades, commissioning and training for a fully functioning system inclusive of grid connected import export meter installed at the MSB section. Allow to liaise with the Authorities as require for the commissioning of the system.

The contractor is to design, supply and install a grid interactive photovoltaic generating systems as documented, incorporating the following:

- Photovoltaic arrays and necessary support structure.
- Grid connected inverter/(s)
- Balance of System components including DC and AC cabling and switchgear, data cabling, junction boxes, switchboard,
- Conduits, cable tray, mounting brackets, etc.
- Connection to low voltage power system in accordance with the DNSP requirements
- Grid connection application and approval, including all secondary protection requirements require by DNSP
- Bi-directional metering to the requirements of DNSP
- New wall-mounted 1-phase battery storage equipment and associated accessories
- Monitoring system from Solar Analytics with 4G modem module allowing all systems to be monitored remotely via web portal.
- Testing and commissioning
- Training of NSW Ambulance staff in the basic operation, maintenance, and trouble-shooting of the PV system
- Operation and maintenance manual
- All permanent and temporary safety and access equipment necessary for lifting materials and working at heights
- All supports, brackets, drilling, penetrations, fire stops, water proofing and other building works associated with the above

The contractor shall also coordinate with other trades, commissioning and training for a fully functioning system inclusive of grid connected import export meter installed at the MSB section. Allow to liaise with the Authorities as require for the commissioning of the system.

The installation must comply with current versions of:

CEC	CEC Clean Energy Council- Grid Connected Solar PV systems – install and supervise guidelines for accredited installations
CEC	Clean Energy Council- No Battery Storage Grid Connected Solar PV systems – Design guidelines for accredited installers
AS/NZS 5033: 2014	AS/NZS 5033: 2014 Installation of photovoltaic arrays (2014 update)
AS 4777.1	AS 4777.1 Grid connection of energy system via inverters Part 1: Installation requirements
AS 4777.2	AS 4777.2 Grid connection of energy system via inverters Part 2: Inverter requirements (2015 update)

AS 4777.3	Grid connection of energy system via inverters Part 3: Grid protection requirements
AS/NZS 1170.2	Wind Loading
AS/NZS 3000:2018	Wiring Rules
AS/NZS 1768	Lightning Protection
AS/NZS 2053	Conduits and Fittings for Electrical Installation
AS/NZS 3008	Selection of cabling
AS/NZS 1170.2	Structural design actions – Wind actions
AS/NZS 61439	Low voltage switch gear and control gear
AS/NZS 3017	Electrical installations – Testing guidelines
AS/NZS 5139	Safety of Battery Systems for use with Power Conversion Equipment
AS 62619	Safety requirements for secondary lithium cells and batteries, for use in industrial applications
ESAA	ESAA Electricity Supply Association of Australia – Guidelines for grid connection of energy systems via inverters
BCA / NCC 2019 Amendment 1	BCA Building Code of Australia
	Local supply authority renewable energy systems technical guidelines

The proposed model of PV Panels are manufactured **by LG NeON 2 335W** panels with dimensions 1600 (length) x 1000mm (wide) or similar.

The layout must provide a minimum 1000mm egress clearance around the panels to the perimeter edge of the parapet structure. **The proposed size of the PV system is 36.18kW.** This system shall allow to charge the battery storage pack.

The Inverter system proposed shall be Solar Edge or similar, with web-based HLI to enable viewing of energy produced, logging of historical data and for fault/ maintenance purposes. Commission NSW ambulance account to enable the station to view and monitor and display energy statistics on local computers and on digital signage.

Supply and termination of cables to the PV panels shall be provided by the Contractor.

The electrical contractor is to supply and install all cabling, supply suitable inverters compatible with the PV panels on the roof and to size inverters to produce maximum output as per the quantity of panels shown on the roof plan. **A total of 1-off high power 25kW 3-phase inverter and 1-off 5kW 1-Phase Inverter Fronius shall be supplied from Fronius** or equivalent.

A new battery storage device shall be supplied and installed as part of the PV system. Such device will provide battery back-up to the following loads through a new 1-phase load centre DB-B:

- Ambulance Plant Room Roller Shutters: estimated a 1-phase 10Amps each (maximum of 2-off), and allow a 12min autonomy (3-off open-close operation cycles). Refer to the electrical documentation to confirm the number of roller doors to be connected to the DB-B;
- Power supply to Communications Rack: 2x15A 1-ph GPOs (estimated power consumption to be less than 2.5kW), and allow a 60min autonomy as requested by the client
- Single lighting sub-circuit serving the light fixtures in the Admin Room and Comms Room.
- Remaining of the battery storage energy is to be used for self-consumption during high electricity rates (typically from 2pm to 8pm on weekdays)

The battery shall be 1-Phase 14kWh Tesla Powerwall 2 or equivalent. The contractor is to supply and install all associated cabling and accessories to have a fully functional and integrated system. The proposed location for the battery storage and PV inverters are denoted in the drawings.

The Supplier shall be responsible for:

- Ensuring that all components and equipment used are approved for use in Australia, meet relevant Australian Standards, are C-tick approved and are accredited for use in solar PV installations by the Clean Energy Council;
- Ensuring all components, equipment and wiring including cabling, electrical protection, controls, inverters, circuit, breakers, fuses, fire protection fuses and lightning protection are installed in accordance with the provisions of AS/NZS 3000, AS/NZS 5033:2014 and all other applicable Australian Standards;
- The roof mounting positions, cabling reticulation, switch box locations, and any other coordination necessary for the correct, safe and proper installation and commissioning of the PV system;
- All DC and AC wiring to complete the installation including wiring and cabling between the PV panels, inverters, meters and distribution boards, as required.

The Supplier shall:

- Design, engineer, construct and commission the PV and battery storage system in accordance with Australian Standards and best industry practice;
- Adhere to all earthing requirements as outlined in Australian Standards with particular attention to the new requirements under AS 5033:2014;
- Install all PV wiring and components to minimize exposure to detrimental environmental effects where they are protected from ultraviolet radiation, corrosion, abrasion, tension, compression & cutting forces. Plastic cable ties are not to be used as a primary means of support for cables and wiring;
- Undertake a lightning risk assessment in accordance with AS/NZS 1768:2007
- Install connectors that are mated with connectors of the same type from the same manufacturer;
- Install DC switch disconnection devices that are not polarity sensitive and comply with the requirements of AS5033:2014;
- Install DC Circuit breakers that are not polarity sensitive. They must also be rated to interrupt the full load when operated and have a voltage rating greater than the open circuit voltage, VOC;
- Ensure that all equipment and appliances provided under this contract are not capable of causing any interference with any electronic or radio equipment, local or otherwise. Should any item of equipment cause interference to electronic or radio equipment, provide efficient devices to eliminate such interference and install without additional cost to this contract.

25.2 DESIGN AND CONTRACT DOCUMENTATION

25.2.1 PLANNING APPROVALS

The Supplier is required to include any costs associated with obtaining planning approvals for the Local Council and any other consent authority in their RFT response. This includes providing documentation and liaising with a private certifier/Council as required.

25.2.2 PRE-INSTALLATION DOCUMENTATIONS AND SHOP DRAWINGS

Prior to installation of the solar system the supplier shall provide detailed documentation and shop drawings for approval by the project manager, this shall include:

- ‘For construction’ drawings including:
    - Proposed roof panel layout drawings which are fully labelled and scaled in A3 format. This shall include proposed panel orientation, spacing between panel rows and proposed mounting/fixing to the roof structure
    - Single line electrical wiring diagrams clearly stating DC and AC electrical design including string layout, isolator sizing, wiring sizing, solar DB’s and proposed AC connection details
    - Location of proposed inverters and mounting, including a photo of the proposed location and schematic diagrams.

  - Description of proposed AC and DC wiring runs including location of wiring runs, fixing and mechanical protection
  - Detailed descriptions and models of all equipment proposed in the installation including panels, inverters, isolators and monitoring equipment as a minimum

- System output & performance estimation report
- Structural certification of the suitability of the building for the proposed work
- Grid connection approval forms;
- Planning approval letter (if required);
- Fully detailed Scope of works document;
- Project Safety Plan which includes site specific information on project details, first aid representation of the install team, evacuation procedures and locations, site isolation and signage requirements, proposed work areas and access, project roles and responsibilities and WH&S site specific issues;
- Site specific Safe work Method Statement and/or JSA.

25.3 SUBMISSIONS REQUIRED

25.3.1 GRID CONNECTION APPLICATION

Complete and submit “Application for Network Connection of an Inverter Energy System” to the distributor for each site. Forward all relevant notices, arrange for inspections and testing, and pay all fees to the distributor and other authorities as required in connection with the solar PV installation.

The supplier is to include in the contract price any costs associated with secondary protection relay and grid connection studies required by Ausgrid or respective utility according to NS194 for systems larger than 30kW.

The supplier is responsible for managing and organising any meter upgrades or replacements at the site required for the solar installation. The supplier is responsible for ensuring that the required feed in tariff for exported solar is accepted by the retailer prior to practical completion. Paperwork required may include:

- Lodge Solar Connection/Application Form as required by the utility;

25.4 TECHNICAL SPECIFICATION OF THE SYSTEM COMPONENTS

25.4.1 MODULE SUPPORTS

The photovoltaic (PV) modules must be supported on the roof at the location and over the area shown on the architectural drawings/ electrical drawings. The modules must be supported by the adjustable Australian made bracket systems to be flat against the pitched room, which already has a 3.5° inclination towards the north-west.

Supports should be Clenergy PV-ezRack SolarRoof Klip-lok 700 System or similar.

The supports or brackets should be designed to withstand winds to AS1170.2. The supports must connect to the building framework so as to transfer all wind loads directly to the framework and not to sheeting materials. Liaise with the Architect to ensure that this is the case.

The supports must not increase the risk of water penetration through the roof.

Contact of dissimilar metals must be avoided. The supports must be protected against corrosion. Untreated wood or metal will not be accepted.

Cables between rows on the roof will be covered by ramped, galvanised steel checker-plate covers anchored to the roof.

Maintain the manufacturer’s recommended unobstructed stand-off between the rear of the modules and the roof to allow ventilation.

All electrical connections and cables to the modules must be protected from access and exposure to the weather.

Access routes must be maintained to all panels. Each pair of panel rows will have 1m separation for maintenance and circulation. Layout is shown on the roof layout.

All accessible conductive components are to be earthed. All earthing conductors to have a cross-sectional area capable of sustaining the module short-circuit current of at least 6 mm^2. Resistance to earth from any point must be less than 25Ω.

The Contractor is responsible for providing all brackets, fixtures and conduits for fixing the inverter, switches, protective devices and any other equipment associated with the PV system. The Contractor will be bound by the requirements of the general electrical Specification, of which he should obtain a copy. This covers issues such as neatness of wiring etc. In particular, cables should be installed out of sight where possible. This may involve reticulating cables through the centre of structural elements.

25.4.2 PHOTOVOLTAIC MODULES

The PV modules should be UL-listed (meet Underwriter Laboratories Standard 1703 for safety of flat-plate photovoltaic modules) and meet or exceed IEEE Std. 1262 (or equivalent).

Provide shop drawings of layout on roof, including brackets, set out distances ensuring optimum solar exposure.

Panels shall be installed as shown on the electrical drawings. The modules must be guaranteed for continuous undisturbed operation over 10 years.

The modules' nominal combined output must exceed 60kW (continuous) under rated conditions (1000W/m^2 at 25˚C).

Multi-crystalline is to be installed.

There is no preference for either a floating or earthed solution, provided that the protective measures of AS5033 are complied with. The DC section of the system should be entirely double insulated (Class II).

There is no requirement placed on the number of strings of modules, save that the DC voltage cannot exceed 600V and that the voltage levels are compatible with the inverter or any other equipment. Strings will be protected against fault current as per AS5033 section 2. Current protection devices will be located as per AS5033 table 2.2.

The modules must be protected with high transmission, toughened glass capable of withstanding hail damage.

The module temperature should not exceed 75°C with a 40°C ambient.

All works shall be allowed for to enable a fully functioning system inclusive of a minimum 12 months Maintenance and defects liability warranty, Testing and commissioning of all systems installed under this contract, "As Installed" drawings in Auto CAD 2010 or more updated format and preparation of operating and maintenance manuals.

25.4.3 CABLING

The electrical contractor is to allow for all cabling to the Solar panels on the roof. Solar panel to be supplied installed as part of this contract.

All electrical connections and cables to the modules must be protected from access and exposure to the weather.

Cabling losses between the modules and the inverter/s must be kept to 1% or less by selecting appropriate cables and maintaining low join resistances.

Current carrying capacity of the cables must be greater than that of any protective device that protects the cable and at least 125% of the PV short-circuit currents.

All cables must be copper; preferably stranded.

All DC cables and connections should be Class II (double insulated).

All above-roof DC connections must be IP54 or better.

Derrate current carrying capacity of conductors (and allowable temperature rise of insulation) based on expected ambient temperatures. Cables connected to the solar modules should be selected for continuous operation at 60°C. All insulation should be rated for operation at 90°C or higher.

All cables should be reticulated through conduit where practicable. Where cables are exposed to direct sunlight they must be UV resistant. Where conduits are exposed to direct sunlight they must be UV resistant.

Cables between rows on the roof will be covered by ramped, galvanised steel checker-plate covers anchored to the roof.

All cables must be strain-relieved when connected to a fixed point.

For DC cables, use only heavy-duty crimping tools to crimp terminals/lugs. Do not use crimping tools intended for electronic purposes.

An appropriately-sized MOV-based surge arrestor should be located on each DC circuit within 15m of the PV modules. Long DC cables should have additional surge arrestors as per AS5033 section F.2.3.3. The recommended specifications for surge arrestors (AS5033.F2.3.4) should be observed. All accessible conductive components are to be earthed. All earthing conductors to have a cross-sectional area capable of sustaining the module short-circuit current of at least 6 mm^2. Resistance to earth from any point must be less than 25Ω.

All cabling penetrations shall be sealed and co-ordinated with the managing contractor to avoid water penetration through the roof at all costs.

25.4.4 INVERTER

Refer to site plan for exact location of the inverters.

The inverter must be capable of handling the full range of voltages output by the PV cells under all realistic conditions. Assume maximum insolation of 1500W/m^2, module surface temperature range of -10°C to 80°C with 10% margin.

The inverter must be sized to provide the maximum energy over a year at the expected insolation rates. This may mean that the inverter rating be less than the total rating of the PV modules. The Contractor must provide calculations to show his determination of this optimal point. The Contractor must also provide grounding details of the inverter unit.

The inverter/s must track the maximum power point of the PV cells and must switch off when supplied energy is less than the inverter's losses.

The Contractor should program any shutdown/start up sequences to suit the installation.

The inverter should have a "Certificate of Suitability" from the Department of Fair Trading.

Preferably the inverter should power-down when photovoltaic module output is below the inverter's own running current.

The inverter shall include sensors and CT's to sense when there is a loss of mains supply and on the mobile generator incoming supply. The contractor shall allow for programming the inverter in a way that the output to the MSB shall be automatically shut down during power outage and during generator supply. The equipment shall remain in this condition until the power supply is changed back from the generator to the mains supply, and confirm that this is available.

The inverter/s must;

- Synchronise to the mains' phases as per AS4777.
- Incorporate anti-islanding protection in the case of mains failure,
- Provide safe shutdown in the event of mechanical damage to PV modules.
- Provide three phase 415V +/-4% over full load range,
- Provide 50Hz +/- 0.01% over full load range,
- Provide a sine wave with distortion less than 4%.

- Be immune to mains disturbances. Its immunity should meet or exceed the requirements of the "Voltage Tolerance Envelope" published by Technical Committee 3 of the Information Technology Industry Council of America.
- Peak inverter efficiency must be greater than 90%, overall efficiency greater than 85%.
- must comply with AS 1044 for Electromagnetic compatibility,
- be reverse polarity protected,
- Operate throughout the temperature range -5˚C to 50˚C.
- Not create over-voltages when circuit breakers within the main switchboard are turned off.+

25.4.5 BATTERY STORAGE EQUIPMENT

The contractor shall supply, install and commission a battery storage unit similar to **Tesla Powerwall 2** or similar, with associated equipment and accessories to have a **fully functional system.** Part of the energy from the battery would be used for battery back-up in case of a power outage, while the rest will be used for self-consumption.

Refer to site plan for exact location of the battery storage unit and associated equipment.

The battery shall have a DC coupled unit, with a nominal storage DC energy of a minimum of 9.5 kWh with a max DC voltage of 520Vdc. The charge and discharge currents shall be circa 12A @ 420V and 14A @ 350V respectively.

The battery unit shall provide back-up to the following loads for the indicated timeframe:

- Each roller door (as indicated in the drawings) for a 3-off open/close cycle, estimated at 6 minutes per door at 240Vac 10Amps
- Communications Rack supply for 60 minutes, estimated at 240Vac 2.5kW
- Light fixtures in the Admin Room and Comms Room for 60 minutes.

The contractor shall supply and install a 1-phase 12-pole, IP-rated load centre for cabling reticulation from the dedicated battery inverter to the loads described above.

The energy sur-plus shall be used for self-consumption during the peak tariff rates. Contractor to allow the programming of the battery controller to achieve this requirement.

The battery storage unit shall be charged via a dedicated **1-Phase 5kW Inverter from Fronius Hybrid** range or similar. This inverter will be connected to a dedicated **6.03kW PV panels arrangement on the roof** (part of the 36.18kW PV system) described previously.

The inverter and battery must be capable of handling the full range of voltages output by the dedicated PV cells under all realistic conditions. Assume maximum insolation of 1500W/m^2, module surface temperature range of -10°C to 80°C with 10% margin.

The battery and dedicated inverter shall include sensors and CT's to sense when there is a loss of mains supply and on the mobile generator incoming supply. The contractor shall allow for programming the inverter in a way that the output to the MSB shall be shut down during power outage and during generator supply. The equipment shall remain in this condition until the power supply is changed back from the generator to the mains supply, and confirm that this is available.

The batteries and dedicated inverter shall provide back-up to the loads noted above in case of loss of main supply. When the MSB is connected to the generator supply, the battery will change its status to stand-by until a loss of power is detected.

The Contractor should program any shutdown/start up sequences to suit the installation.

The inverter and battery should have a "Certificate of Suitability" from the Department of Fair Trading.

Preferably the inverter should power-down when photovoltaic module output is below the inverter's own running current.

The inverter/s and battery storage unit must;

- Synchronise to the mains' phases as per AS4777.
- Incorporate anti-islanding protection in the case of mains failure,

- Provide safe shutdown in the event of mechanical damage to PV modules.
- Provide three phase 415V +/-4% over full load range,
- Provide 50Hz +/- 0.01% over full load range,
- Provide a sine wave with distortion less than 4%.
- Be immune to mains disturbances. Its immunity should meet or exceed the requirements of the "Voltage Tolerance Envelope" published by Technical Committee 3 of the Information Technology Industry Council of America.
- Peak inverter efficiency must be greater than 90%, overall efficiency greater than 85%.
- must comply with AS 1044 for Electromagnetic compatibility,
- be reverse polarity protected,
- Operate throughout the temperature range -10˚C to 45˚C, and a storage temperature range -30°C to 55 °C
- Natural Convection for cooling. If alternative has a fan-cooling system, please provide noise level certificates
- Not create over-voltages when circuit breakers within the main switchboard are turned off.
- Batteries shall provide back-up to the loads for the timeframe denoted above.
- System must comply with the AS/NZS 5139 & AS 62619 for safety of battery systems

25.4.6 SUNDRY

AC and/or DC disconnect switches may be incorporated into the inverters if desired.

Solar array warning signs (AS5033 figures G1, G2 and G3) are to be affixed to appropriate locations. In addition the main switchboard will be provided with a sign noting that it is supplied from two sources – mains and solar panels – and that both main switches should be disconnected before any work is conducted on the switchboard.

Lettering should be 8mm high.

The Contractor must provide any combiner boxes, fuses, junction boxes etc. as necessitated by the choice of module connection and earthing methodology.

The Contractor must provide waterproof enclosures where necessary. All waterproofed cable entries must be from below.

All junction boxes and connection points for DC wiring must be accessible.

There must be no more than one grounded connection to the DC grounded conductor of the PV system.

All system components must be clearly identified as to type, manufacturer and model number to allow simple replacement in the event of failure.

25.4.7 MONITORING AND COMMUNICATION

The systems will be monitored by Solar Analytics via a Solar Smart Monitor or Inverter Integrated Solution at the discretion of the Contractor.

The monitoring systems will also be configured to monitor the electrical load for the entire site and the battery storage charging status (energy in & out). Systems monitoring will be supplied, configured and installed by the Contractor.

The Contractor will also be responsible for payment of the one off subscription fee for the monitoring service as follows:

a) Smart Monitor Solution 15kW and under – Lifetime subscription
b) 15kW and above – 5 year subscription
c) Inverter Integrated solution – 5 year subscription

The Contractor will:

1. Ensure that all installations are correctly commissioned, tested and that data is displaying correctly.
2. Ensure that all systems are commissioned into the NSW Ambulance, already established with Solar Analytics.
3. Where required due to low signal strength, ensure external antenna are fitted to provide adequate signal strength.

In addition, the Solar Analytics system shall be configured to monitor the Battery System remotely with the following functions:

- Monitoring of total PV array charging the battery output per day, month and year in a graphical and CSV output;
- Monitoring of grid usage and display generation exported vs that used on site;
- Support a variety of environmental sensors including temperature, irradiance, and wind;
- A graphical output to allow detailed monitoring and records of the array output to be analysed by NSW Health Infrastructure and NSW Ambulance remotely,
- Automatic email and/or text alarms when generation falls below set minimum generation or there are irregularities.
- Battery status, remaining charge, autonomy, charge/discharge cycles and use per day, month and year shall be recorded in a graphical and CSV output;

The supplier must set up the Monitoring Platform for the following type of configuration:

- Installer view – to enable NSW Health Infrastructure and NSW Ambulance to monitor all appropriate sites and provide module level monitoring capabilities across the full array.

SECTION 26 - ELECTRICAL SERVICES - TENDER PRICE BREAK UP

Prices for all items listed are to be filled in this schedule by the tenderer and lodged with his tender. The prices shall include all sub-contractor's cost, including overhead and profit. The cost of any material or service to be provided free of charge to the electrical sub-contractor by the builder shall be clearly identified in this schedule.

The builder reserves the right to reject any tender if the prices submitted are considered unreasonable.

26.1 Technical DATA

The Schedule of Technical Data shall be completed and returned with the tender. The Schedule shall include manufacturers, installer's and supplier's names of all equipment, together with figure and model numbers as specified.

Item	Price Excluding GST
Consumer Mains	$
Main Distribution Board	$
Distribution boards & Metering	$
Sub mains cabling	$
Cable trays & Cabling management system	$
Internal lighting and associated sub circuiting	$
External lighting, including lighting controls	$
Power outlets and permanent electrical connections along with associated sub circuiting;	$
Emergency and Exit Lighting	$
Incoming lead-in cables and conduits	$
Temp generator connection provision	$
Photovoltaic System	$
Battery Storage System	$
Underground conduit installation & cable pits	$
Lightning Protection	$
PV System	$
MATV System	$
Security and Access Control System: - Security Head-end Panel - Security Panel (Data Gathering Panels) - Movement Sensors & connections - Alarms, card readers, strobes and their connections	$ $ $ $ $

Item	Price Excluding GST
- Security Backbone cabling - Access Control System	$ $
Intercom system	$
Telecommunications System: - Data Outlets & connections - Cable trays & Cabling management system - New Communications Rack - New Copper Backbone cabling	$ $ $ $ $
Intercom system	$
UPS System - 6kVA UPS - 3kVA UPS - 2kVA UPS	$ $ $ $
Testing and Commissioning	$
As-Installed Drawings and Manuals	$
Maintenance During Defects Liability Period	$
Miscellaneous Work Not Included above Items	$
Provisional Sum for active communications equipment	$
Total Cost Excluding GST	**$**
GST	**$**
Total Cost Including GST	**$**

26.2 SCHEDULE OF PRICES

The following schedule is to be completed as part of the tender return. It is to identify the total cost for each element allowed in the return.

Item	Price Excluding GST
1. Builders Works	$
2. Demolition Works	$
3. Preliminaries and General Conditions	$
4. Workshop Drawings/Installation drawings	$
5. Testing and Commissioning	$
6. O & M Manuals (including Work as executed drawings)	$
7. Principal Training	$
8. Supplies from Local Authorities, including fees	$

9. Supply of Samples	$

26.3 GENERAL POWER

Item	Unit	Additions - Amount Excluding GST	Deletions - Amount Excluding GST
Single general purpose outlet including cabling	Each		
Double general purpose outlet including cabling	Each		
15A outlet including cabling	Each		
Single pole circuit breaker (up to 35A) c/w RCD	Each		
24 pole distribution board	Each		
36 pole distribution board	Each		
48 pole distribution board	Each		
72 pole distribution board	Each		
2.5 mm² twin and earth, TPS cable	Metre		
4 mm² twin and earth, TPS cable	Metre		
1x2Cx4 mm² and earth copper conductor (2 hour fire rated)	Metre		
1x4Cx16 mm² and earth copper conductor (2 hour fire rated)	Metre		
1x4Cx16 mm² XLPE and earth	Metre		
1x4Cx16 mm² XLPE and earth	Metre		
1x4Cx35 mm² XLPE and earth	Metre		
1x4Cx50 mm² XLPE and earth	Metre		
4x1Cx35 mm² XLPE and earth	Metre		
4x1Cx50 mm² XLPE and earth	Metre		
1x4Cx150 mm² XLPE and earth	Metre		
4x1Cx240 mm² XLPE and earth	Metre		
4x1Cx300 mm² XLPE and earth	Metre		
4x1Cx400 mm² XLPE and earth	Metre		
150mm cable tray – galvanised Incl. Supports and fixings	Metre		

Item	Unit	Additions - Amount Excluding GST	Deletions - Amount Excluding GST
300mm cable tray – galvanised Incl. Supports and fixings	Metre		
450mm cable tray – galvanised Incl. Supports and fixings	Metre		
600mm cable tray – galvanised Incl. Supports and fixings	Metre		
900mm cable tray – galvanised Incl. Supports and fixings	Metre		
New surface-mounted floor box	Each		

26.4 COMMUNICATIONS

Item	Unit	Additions- Amount Excluding GST	Deletions - Amount Excluding GST
New Single Data outlet including cabling	Each		
New Dual Data outlet including cabling	Each		
New Triple Data outlet including cabling	Each		
New WAP Data outlet including cabling	Each		
New MATV outlet with 40m of associated cabling	Each		
OS2 Fibre Optic Cabling	m		
10 Pair Tie Cable	m		
20 Pair Tie Cable	m		

26.5 LIGHTING

Item	Unit	Additions- Amount Excluding GST	Deletions - Amount Excluding GST
28W LED Troffer light fitting for office areas, medical store and lockers	Each		
19W LED Downlight for corridors, relief room, kitchen and lounge area	Each		
15W LED IP44 Downlight for amenities	Each		
10W LED Wall-mounted decorative fitting for lounge	Each		
30W LED WP Batten light fitting for Ambulance Plant Room	Each		
50W LED Batten for Comms Room and MSB room	Each		
160W LED Low Bay surface mounted fitting for ambulance plant room	Each		
18W LED External Wall-mounted fitting for building perimeter	Each		
94W LED Pole top light fitting for carpark and driveway with light pole	Each		
New 360 Degree dual tech. Lighting motion detector	Each		
New Light Switch, 2-gang with cabling	Each		
New LED ultrablade recessed exit sign	Each		
New LED cleverfit suspended/surface mounted exit sign	Each		
New LED emergency recessed spitfire	Each		
New LED emergency surface mounted spitfire	Each		

26.6 SECURITY

Item	Unit	Additions- Amount Excluding GST	Deletions- Amount Excluding GST
New Card reader	Each		
New Mortice lock	Each		
New Electromagnetic lock	Each		
New Reed Switch	Each		
New Door Controller	Each		
New external siren	Each		
New desk-mounted Master Intercom	Each		
New wall-mounted Video Intercom	Each		

26.7 SMOKE ALARM SYSTEM

Item	Unit	Additions- Amount Excluding GST	Deletions- Amount Excluding GST
New smoke alarm with intelligent base	Each		
New heat alarm with intelligent base	Each		
New Residential Fire Panel	Each		

26.8 SCHEDULE OF RATES

The following is a schedule of rates which shall be completed by the Tenderer for the purposes of variations only. All rates shall include preliminary costs, GST, attendance and profit. Items of equipment listed are supply and install and include labour costs assuming normal time.

26.8.1 LABOUR

Item	Unit	Additions - Amount Excluding GST	Deletions - Amount Excluding GST
Tradesman, normal time, inclusive of profit, attendance and overheads	Hr		
Tradesman, time and a half, inclusive of profit, attendance and overheads	Hr		
Tradesman, double time, inclusive of profit, attendance and overheads	Hr		

26.9 ELECTRICAL SERVICES - SCHEDULE OF TECHNICAL DATA

The Schedule of Technical Data shall be completed and returned with the tender. The Schedule shall include manufacturers, installer's and supplier's names of all equipment, together with figure and model numbers as specified and offered, included in the tender. For alternative offers of equipment, refer to `Instructions to Tenderers'.

	Item	Manufacturer & Type
1.	**LV Switchboards**	
a)	Distribution Switchboards	.....
2.	**LV Cables**	
a)	Insulated & Sheathed	.....
3.	**Accessories, Outlets and Appliances**	
a)	Accessories and Outlets	.....
b)	Other (list)	.....
4.	**Light Fittings**	
Refer to Luminaire Schedule in Legend		
5.	**Emergency Lighting System**	
a)	Manufacturer	……
6.	**Access Control, Intruder Detection & CCTV System**	
a)	Manufacturer and Type	Integriti from Inner Range
7.	**Telecommunications Cabling**	
a)	Voice Cables	Panduit/Siemon/R&M
b)	Modular Connector Patch Panels	Panduit/Siemon/R&M
c)	Punch Down Modules	Panduit/Siemon/R&M
d)	Cat 6A F/UTP Cable	Panduit/Siemon/R&M
e)	Rack Cabinets	Panduit/Siemon/R&M
8.	**MATV/PayTV**	
a)	Manufacturer and Type	.....
9.	**Photovoltaic System**	
a)	Manufacturer and Type	.....
10.	**Battery Storage System**	
a)	Manufacturer and Type	.....

Signed:

Name:

Position:

Company Name:

Date:

SECTION 27 - APPENDICES

27.1 NSW HEALTH STANDARDS & GUIDELINES

- **NSW HEALTH ENGINEERING SERVICES GUIDELINES.**
- **NSW HEALTH PROTECTING PEOPLE AND PROPERTY.**
- **NSW HEALTH CABLING STANDARD FOR NEW REFURBISHED HEALTH FACILITIES.**
- **NSW-HEALTH-WI-FI-STANDARD.**
- **NSW HEALTH DGN 024 BUILDING IMPORTANCE LEVELS FOR NSW HEALTH PROJECTS.**
- **NSW HEALTH DGN 006 GENERAL DESIGN PRINCIPLES.**

27.2 NSW AMBULANCE STANDARDS & GUIDELINES

- **NSW AMBULANCE RAIR GROUP 1 ICT STANDARD.**
- **NSW AMBULANCE STANDARD ELECTRONIC SECURITY SPECIFICATION.**
- **NSW AMBULANCE ICT CABLING BRIEF NSW AMBULANCE STATIONS V1.1**
- **NSW AMBULANCE "HOW TO BUILD AN AMBULANCE STATION"**

Appendix A - Station Radio Upgrade Project

Appendix B - RF Industries SMD4-67 Side Mount Dipole Antenna Specification

Appendix C - Polyphaser IS-B50LN-C2 Coaxial Surge Arrestor Specification

JHA Consulting Engineers
Level 23, 101 Miller Street North Sydney, NSW 2060
T 02 9437 1000 **E** general@jhaengineers.com.au
www.jhaservices.com
ABN 48 612 666 172

DOCUMENT TRANSMITTAL

Electrical Services	Project Name	RURAL AMBULANCE INFRASTRUCTURE PROGRAM (RAIR) KINGSCLIFF
	Project Number	210067

Date	09	25	29	20	
Month	02	02	04	07	
Year	22	22	22	22	
Sent By	JG	JG	JG	JG	

Distribution List	Company	Number of copies			
Howard Morris	Mace Australia	1	1	1	1
Daniel Beekwilder & Mark Roach	DJRD Architects	1	1	1	1

	Current Set				
Reason For Issue **P** - Preliminary **T** - Tender **C** - Construction **I** - For Information **A** - For Approval		P	T	T	C
Document Format **P** - PDF **D** - DWG **S** - PDF & DWG **H** - Hard Copy		S	S	S	S
Method of Delivery **E** - Email **P** - Post **C** - Courier **H** - Hand Delivered **U** - Upload **M** - Media (USB/CD)		U	U	U	U

Document Title	No.	Current Set	Revision			
Cover Sheet And Drawing List	R25-EL-DRG-0000	1	P1	A	B	1
Electrical Legend	R25-EL-DRG-0001	1	P1	A	B	1
Site Plan	R25-EL-DRG-0002	1	P1	A	B	1
Lower Ground Floor Lighting And Fire Detection Layout	R25-EL-DRG-0100	1	P1	A	B	1
Ground Floor Lighting And Fire Detection Layout	R25-EL-DRG-0101	1	P1	A	B	1
Lower Ground Floor Power And Communications Layout	R25-EL-DRG-0200	1	P1	A	B	1
Ground Floor Power And Communications Layout	R25-EL-DRG-0201	1	P1	A	B	1
Roof Plan Power And Communications Layout	R25-EL-DRG-0202	1	P1	A	B	1
Electrical Schematics	R25-EL-DRG-0300	1	P1	A	B	1
Electrical Services Specification		1		A	B	1

IF NOT ALL DOCUMENTS ARE RECEIVED, PLEASE CONTACT THE SENDER