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KILKENNY
R95 XF97**

**ELECTRICAL GENERAL SPECIFICATION
REVISION T1**

TABLE TO CONTENTS

1. GENERAL REQUIREMENTS.....	14
1.1 Standards and Regulations	14
1.2 Co-operation	15
1.3 Co-ordination.....	15
1.4 Sub-contractors.....	15
1.5 Allocation of Responsibility	15
2. CABLE SUPPORT, TRUNKING AND CONDUIT	17
2.1 Cable Tray.....	17
2.1.1 General	17
2.1.2 Standard Medium Duty.....	17
2.1.3 Heavy Duty.....	18
2.1.4 Light Duty	18
2.1.5 Bonding	18
2.1.6 Installation of Tray and Workmanship	18
2.2 Cable Basket.....	19
2.2.1 Ladder rack.....	19
2.2.2 Cable Cleats, Ties, Saddles and Clips.....	19
2.3 Trunking.....	20
2.3.1 General	20
2.3.2 Surface Steel Trunking	20
2.3.3 Fixings	20
2.3.4 Fittings.....	20
2.3.5 Partitions and Covers.....	20
2.3.6 Joints.....	20
2.3.7 Screws, Nuts, Washers	21
2.3.8 Cable supports	21
2.3.9 Underfloor/Flush Floor Steel Trunking	21
2.3.10 Lighting Trunking.....	21
2.3.11 Lighting Trunking Cover.....	22
2.3.12 Dado Trunking (Plastic)	22
2.4 CONDUIT	22
2.4.1 General	22
2.4.2 Metal Conduit.....	22
2.4.3 PVC Conduit	23
2.4.4 Flexible Conduit	23
3. CABLES	24
3.1 Cable Manufacturer	24

3.2 Certification and Markings	24
3.3 Cable Records	24
3.4 Conductor Material.....	24
3.4.1 Flexible Cords.....	24
3.4.2 Wiring and Power Cables	24
3.5 Colour Coding.....	24
3.6 Flexible Cables	24
3.7 P.V.C. Cables & L.S.F Cables	24
3.8 PVC/PVC/SWA/PVC CABLES	24
3.9 XLPE INSULATED ARMOURED LSF CABLES	25
3.10 MICS CABLE	25
3.11 Glanding and Terminating Cables.....	26
3.11.1 Glanding	26
3.11.2 Terminations	26
3.12 Cable Fixing	27
3.13 Cables in Trenches.....	27
3.14 Cables in Trunking and Conduit.....	28
4. EARTHING AND EQUIPOTENTIAL BONDING.....	29
4.1 General	29
4.2 Standards	29
4.3 Existing Installations	29
4.4 Earth Electrodes	29
4.5 Joints and Connections	29
4.6 Test Joints.....	30
4.7 Protective Conductors.....	30
4.8 Main Earth Cable	30
4.9 Main Earth Terminal Connections	30
4.10 Neutral/Earth Connection.....	30
4.11 Clean Earth Bar.....	30
4.12 Test Certificates	31

5. MAIN AND SUPPLEMENTARY EQUIPOTENTIAL BONDING	32
5.1 Identification	32
6. ACCESSORIES	34
6.1 Supplier	34
6.2 Samples	34
6.3 Common Requirements	34
6.4 Interior Light Switches	34
6.5 Pull Cord Switches.....	34
6.6 Exterior Light Switches.....	34
6.7 Luminaire Connections	34
6.8 Isolating Switches	34
6.9 Fuse Connection Units.....	35
6.10 Socket Outlets	35
6.11 Cooker Control Unit.....	35
6.12 Cord Outlets.....	35
6.13 Cable and Appliance Couplers	35
6.14 Telephone and Data Outlets	35
6.15 BNC Sockets.....	36
6.16 Aerial Sockets.....	36
6.17 Low Voltage Isolating Transformer Units.....	36
6.18 Shaver Points	36
6.19 External and internal lighting PIR's.....	36
7. FIXINGS AND GROUNDS.....	38
7.1 General	38
7.2 Standards	38
7.3 Methods and Materials	38
7.3.1 Load Bearing Fixings	38
7.3.2 Size and Quantity of Fixings	38
7.3.3 Build-in or cast-in fixings	38
7.3.4 Screws and Bolts	38

7.3.5	Fixing to Steel or Similar Structure	38
7.3.6	Fixing to Concrete	38
7.3.7	Fixing to Brickwork/Stone	38
7.3.8	Fixing to Stud Partitions and Walls	38
8.	INSTALLATION AND PROTECTION OF ACCESSORIES.....	39
8.1	General.....	39
8.1.1	Mounting Height.....	39
9.	GENERAL REQUIREMENTS.....	41
9.1	LV Switchgear – Standards	41
9.2	IEC Standards	41
9.3	European EN Standards	41
9.4	British Standards.....	42
9.5	Switchboards.....	42
9.6	Final Circuit Distribution Boards	42
9.7	Partially Type Tested Assemblies.....	43
9.8	Form of Separation.....	43
9.9	Clearance and Creepage Distances	43
9.10	Degree of Protection	43
10.	SWITCHBOARDS	44
10.1	Enclosure and Compartmentation	44
10.2	Busbars Compartment.....	44
10.3	Cable Compartments	44
10.4	Outgoer Protective Device Compartments.....	45
10.5	Surge Protection Devices.....	45
10.6	MCCBs and ACBs General requirements.....	45
10.7	Discrimination Study.....	46
10.8	ACBs – Specific Requirements.....	46
10.9	MCCBs – Specific Requirements	48
10.10	Switch fuses	50

10.11 Mains Generator Automatic Load Transfer Systems	50
10.12 ALT – Motorized Breakers or Contactors with By Pass.....	50
10.13 ALT – Fully Integrated Units	51
10.14 Mechanical Interlocking of Switches and Breakers.....	52
10.15 Residual Current Monitors.....	52
10.16 Multi Function Meters	52
11. FINAL CIRCUIT DISTRIBUTION BOARDS	54
11.1 Introduction	54
11.2 Distribution Board Assembly	54
11.3 Busbars	54
11.4 Internal Wiring.....	55
11.5 Main and Sub Main Switches	55
11.6 Final Circuits Shall Protective Devices.....	55
11.7 Contactors and Motor Starters	56
11.8 External Lighting Control	56
11.9 Central Test Units for emergency lighting	56
11.10 Change Over Panels for Dual A&B Supplies	56
11.11 Pan Assembly Type Distribution Boards.....	57
11.12 Consumer Unit Type Distribution Boards	57
11.13 Isolation Transformers:	58
12. E.S.B. METERING.....	59
12.1 Introduction	59
12.2 E.S.B. Metering Compartments	59
12.3 E.S.B. Metering Panels.....	59
13. POWER FACTOR CORRECTION EQUIPMENT:	60
13.1 Introduction:	60
13.2 General Arrangement of Equipment:	60

13.3 Capacitors:	60
13.4 Reactors:.....	60
13.5 Switching:.....	61
13.6 Reactive Power Regulator:	61
13.7 Equipment Enclosure:.....	61
14. REPLACEMENT OF EXISTING SWITCHGEAR.....	62
14.1 Introduction	62
14.2 Load Monitoring.....	62
14.3 Testing of Circuits	62
14.4 Survey drawings	62
14.5 Link Boxes.....	63
14.6 Retention of Existing Wiring	63
14.7 Colour Coding.....	63
14.8 Removal of Obsolete Switchgear	63
15. IDENTIFICATIONS & LABELLING	64
15.1 General	64
15.2 Compartment Labels.....	64
15.3 Busbar Configuration.....	64
Appendix 1 – Typical Switchboard – Form 4 type Construction	66
Appendix 2 – Typical distribution board – Form 2type 2 Construction	68
17. GENERAL METHODS OF INSTALLATION LIGHTING AND POWER ...	69
17.1 General	69
17.2 Cabling	69
17.3 Lighting Installation	69
17.4 General Services	70
17.5 Circuit Labels.....	70
17.6 Standard Cable Sizes.....	71

17.7 Hand Dryers Installation	71
18. LV SWITCHGEAR AND DISTRIBUTION BOARDS	72
18.1 MAIN DISTRIBUTION:	72
18.2 L.V. Switchgear.....	72
18.3 Distribution Boards	73
19. WIRING TO MECHANICAL PLANT AND EQUIPMENT.....	75
19.1 In progress.....	75
19.2 Power Distribution and Control Systems	75
19.3 Equipment Co-ordination	75
19.4 Power Supplies.....	75
19.4.1 Method of Installation.....	75
19.4.2 Local Isolation	75
19.4.3 LV Control Control Wiring	76
19.4.4 Protection of Control Cables	76
19.4.5 Local Ventilation Fans and other Equipment	76
20. EMERGENCY LIGHTING INSTALLATION.....	77
20.1 Emergency Lighting	77
20.2 Conversions.....	77
20.2.1 Emergency Lighting Conversions – LED Fittings.....	78
20.3 Batteries – Self Contained Fittings.....	78
20.3.1 General	78
20.3.2 In the case of a), b) & c) above:.....	80
20.3.3 In the case of d above:	80
20.4 Lamps	80
20.5 LED Status Indicator	80
20.6 Metals and Plastics	80
20.7 Overload and Short Circuit Protection:	80
20.8 Emergency Exit Signs.....	81
20.9 Automatic Test Systems	81
20.10 Light Emitting Diode (LED) Fittings – (Fittings Supplied By The Emergency Lighting Supplier Excluding Exit Signs).....	81
20.11 Manufacturer Labelling of RMCE Specification Emergency Light Fittings & Exit Signs.....	81

20.12	Driver Modules – All Emergency Lighting Luminaires	81
20.13	Lifts	82
20.14	Static Inverter Systems (SIS)	82
20.14.1	System Types.....	82
20.14.2	Main Components.....	84
20.14.3	Construction.....	84
20.14.4	Battery Charger.....	84
20.14.5	Batteries	84
20.14.6	Inverter	85
20.14.7	Protections	85
20.14.8	Monitoring.....	85
20.15	Labelling Of Emergency Lighting Fittings.....	85
21.	DATA COMMS (ICT)	86
21.1	General	86
21.2	Installation Procedures	87
21.2.1	Environmental Considerations	87
21.2.1	Surface Cable Runs	88
21.2.2	Floor Distribution - Cable Bundles	88
21.2.3	Ceiling Distribution - Cable Bundles	88
21.2.4	Trunking and Conduit.....	88
21.2.5	Bend radius: As a general rule the following bend radii apply	88
21.2.6	Power and Communications Cable Segregation	88
21.2.7	Fire Barriers	90
21.3	Terminations/Wiring Sequence	90
21.3.1	Fibre Optic Cable Termination	90
21.4	Cables	90
21.4.1	Cat-6 & Cat 6A	90
21.4.2	Voice Backbone (Copper)	90
21.4.3	Fibre Optic Cables.....	91
21.5	Comms Cabinets.....	91
21.6	Labelling.....	92
21.7	Testing	93
21.7.1	Cat-6 & Cat 6A	93
21.7.2	Fibre Optic Cable	93
21.8	Test Results & Warranty	94
22.	FIRE DETECTION AND ALARM INSTALLATION	95
22.1	FIRE DETECTION AND ALARM SYSTEM:	95
22.1.1	Introduction	95
22.1.2	Standards	95
22.1.3	Working Drawings	95
22.1.4	Protection Category	95

22.1.5	Fire Strategy	95
22.1.6	Control and Indicating Equipment (CIE).....	96
22.1.7	Access to Software	98
22.1.8	Circuit Wiring.....	98
22.1.9	Short Circuit isolators.....	98
22.1.10	Manual Call Points	98
22.1.11	Smoke Detectors – Point Type	99
22.1.12	Heat Detectors	99
22.1.13	Anti-Ligature Smoke Detectors	100
22.1.14	Multi Sensor Detectors	100
22.1.15	Duct Smoke Detectors	101
22.1.16	Aspirating Type Smoke Detection Systems.....	101
22.1.17	Smoke Sampling Pipe Network for Smoke Detector, Aspirating Systems.....	101
22.1.18	Photo-Electric Beam Detection Systems	103
22.1.19	Interface Units	103
22.1.20	Monitoring Of Sprinkler Valves & Plant.....	104
22.1.21	Sounders	104
22.1.22	Strobe lights.....	104
22.1.23	Door Holders	104
22.1.24	Zone Chart	104
22.1.25	Repeat Indicator Panels	105
22.1.26	Automatic Receiving Centre (ARC).....	105
22.2	TESTING AND COMMISSIONING OF FIRE ALARM SYSTEM	105
22.2.1	Introduction	105
22.2.2	Fire Alarm Strategy	106
22.2.3	Control of ventilation systems in the event of fire.....	106
22.2.4	Smoke Fire Damper (SFD) in the event of fire.....	106
22.2.5	Atrium Automatic Smoke Vents (ASV) in the event of fire.....	106
22.2.6	Stair Automatic Smoke Vents ASVs	106
22.2.7	Automatic Opening Vents for smoke control	106
22.2.8	Kitchen and Servery Fire Screens.....	106
22.2.9	Control of Lifts In The Event Of Fire.....	107
22.2.10	Control and Monitoring of Gas.....	107
22.3	DEMONSTRATION OF FIRE ALARM SYSTEM	107
23.	SECURITY SYSTEMS : CCTV ,	
	ACCESS CONTROL & INTRUDER ALARM	108
23.1	CCTV SERVICES INSTALLATION:	108
23.1.1	Standards	108
23.1.2	Wiring & Containment	110
23.1.3	Camera Lens Selection.....	111
23.1.4	Internal camera installation.....	112
23.1.5	External camera installation	112
23.1.6	Monitoring and recording	112
23.1.7	CCTV system equipment.....	113
	Internal Fixed Dome Camera :.....	113
	External Fixed Dome / Bullet Camera :.....	114
	Pan,Tilt Zoom (PTZ) Camera External:	118
23.1.8	AUTOMATIC NUMBER PLATE RECOGNITION (ANPR) SYSTEM:	119
23.1.9	CAMERA POLES:	121

23.1.10 BUILDERS WORKS:.....	121
23.2 ACCESS CONTROL SYSTEM:.....	122
23.2.1 Standards	122
23.2.2 Wiring & Containment	123
23.2.3 Security classification.....	124
23.2.4 Access control system strategy for main building doors	125
Door Access System Type 1	125
Door Access System Type 2	126
Applicable To Both Type1 & Type 2 Door Access Systems.....	127
Door Access System Type 3	129
23.2.5 Intercom System	130
23.2.6 Access control system strategy gates, barriers.....	130
23.2.7 Stainless steel pillar	131
23.2.8 General	131
23.2.9 Automatic Gates	131
23.3 INTRUDER ALARM.....	132
23.3.1 General	132
23.3.2 Wiring.....	134
23.3.3 Installation	134
23.3.4 Commissioning and hand-over	136
23.3.5 System Documentation.....	137
23.3.6 As-Built Drawings:	137
23.3.7 Test Documentation:.....	137
23.3.8 Maintenance.....	138
24. EV CHARGING HARDWARE	139
24.1 Standards.....	139
24.2 AC Standard Charging	140
24.2.1 General	140
24.2.2 Installation	140
24.2.3 Installation Requirements	143
24.3 Fast Charger DC/AC.....	144
24.3.1 General	144
24.3.2 Installation	144
25. OPERATION & MAINTENANCE MANUALS (O&M)	147
25.1 Introduction	147
25.2 Applicable standards.....	147
25.3 O&M retention fund	147
25.4 Approval Procedure	147
25.5 Final Approved Copy of O&M manual.....	147

25.6 Hard Copy Format	148
25.7 Electronic Copy Format.....	148
26. IDENTIFICATION AND MARKING OF ELECTRICAL SERVICES	149
26.1 General	149
26.2 Label and Notices – Materials	149
28. COMMISSIONING	150
28.1 PRE-COMMISSIONING	150
28.2 ELECTRICAL - VERIFICATION AND CERTIFICATION.....	150

1. General Requirements

1.1 Standards and Regulations

The complete installation carried out as part of this contract shall be in accordance with the published documents of the Electro Technical Council of Ireland. In particular the following publications are relevant:

- National Rules for Electrical Installations (4th Edition), Issued 2008;
- Code of Practice for the Design, Selection and Erection of Low Voltage Switchboards for Industrial/Commercial Applications, Issued 2005;
- Code of Practice for Control Systems involving Programmable Electronic Products and Systems, Issued 1995;
- Code of Practice for the Selection and Installation of Low Voltage Generators, 2003;
- National Rules for Electrical Installations in Potentially Explosive Atmospheres, 2nd Edition. Issued 2001;
- Guide to the Selection of Electrical Apparatus for Use in Potentially Explosive Atmospheres. Issued 2001;
- Good Practice Guide on the Management of Electrical Safety at Work. Issued 2009;
- Electricity in the Medical Workplace: An Educational Guide for Users of Electrical Equipment in Medical Practice. Issued 2010.
- The latest document, effective at the date of tender issue shall be considered including all amendments, corrigenda and errata and any other published updates

Where no relevant guidance exists in these publications then the contractor shall refer to in the first instance to the publications of the Institute of Electrical Engineers, BS 7671 and other relevant British Standard or Code of Practice.

The contractor shall comply with all statutory instruments and regulations current at the date of tender.

The Contractor shall test the installation on the completion of the work. Should the installation fail to fulfil the requirements of the above regulation the Contractor shall at his own expense alter, amend and retest until such requirements are met, carrying out the test in the presence of the Engineer or his representative. On completion of the installation a certificate shall be given by the Contractor to the Engineer as described in the Commissioning Section of this document.

Where this specification is at variance with any other tender documents or drawings, the tendering party shall obtain clarification before submitting their tender. Failure to do so will be deemed to imply that the most onerous requirements have been included for.

In the event of the Contractor failing to rectify defects within a reasonable period the Engineer will have the work carried out by others and the costs involved will be charged to the Contractor.

1.2 Co-operation

All contractors engaged in the execution of the work shall co-operate with each other.

1.3 Co-ordination

The electrical contractor shall liaise with other contractors on the site to ensure that all services are co-ordinated. It shall be the duty of the electrical contractor to ensure that he is fully briefed on the extent of both his and other contractors work where such work impinges directly or indirectly on the electrical installation.

1.4 Sub-contractors

The electrical contractor shall be responsible for co-ordinating the work of all sub-contractors in his contract including specialist sub-contractors. The electrical contractor shall appoint a foreman or site manager to co-ordinate all the work in his contract including sub-contractors.

1.5 Allocation of Responsibility

The following table is a summary of the responsibilities attached to this contract:

	Activity	Designer	Installer	Other
1	Design			
	The design of all electrical plant and equipment, circuits, sizing and capacity.	√		
	The design of all specialist plant systems such as follows: Fire Alarms Intruder/CCTV Systems UPS Generators Data and Telephone	√		
2	Agree Work Programme and Information Schedule	√	√	Building Contractor
3	Request for Confirmation of Design. Prior to commencing installation confirmation of all design for that portion of the work shall be sought		√	
4	Main Containment Routes	√		
	Main trunking and tray routes	√		
5	Secondary Containment Routes Not shown on the drawings Generally Trunking equal or less than 50X50, tray equal or less than 150mm, conduit.		√	
6	Ordering Provide orders to suppliers in good time to meet agreed programmes		√	
7	Submit details for changes Document and submit proposed changes to the design for approval		√	
8	Approve Changes	√		
9	Supply Utility			
	Arrange Application for Supply	√		
	Liaise with the Supply Utility		√	
10	Commissioning			
	Arrange and attend commissioning meetings	√	√	
	Produce commissioning method statement and programme to match the agreed programme.		√	
	Approve commissioning strategy	√		
	Provide commissioning information as necessary	√		
	Witness commissioning and tests	√	√	
	Produce commissioning reports including exception reports on original design		√	
	Examine commissioning reports, comment and instruct on refinements as necessary	√		
11	Handover			
	Demonstrate to building managers and users the operation of plant, equipment and services.		√	
	Arrange and witness demonstration of specialist equipment	√	√	
	Assist in the development of an operating and maintenance strategy	√	√	
	Provide record drawings, operating and maintenance manuals		√	
12	Health and Safety File			
	Provide all documentation for inclusion in the safety file	√	√	

2. Cable Support, Trunking and Conduit

2.1 Cable Tray

2.1.1 General

Cable tray shall be perforated and manufactured from cold rolled mild steel to B.S. 1449: Part 1. Cable tray and accessories shall be supplied with a hot dip galvanised finish to B.S. 729. All accessories including bends, vertical and horizontal, intersections, tees shall be purpose made by the manufacturer.

The engineer's approval shall be required for the use of site made bends. Where cable tray detailed on the drawings necessitates site fabrication, full details shall be shown on Fabrication Drawings.

Except where specified or shown otherwise the contractor shall be responsible for the selection of the correct grade of cable tray to meet site conditions and the requirements of this Specification.

Include take-off plates for conduits, trunking etc. Fit holes cut in tray for passage of cables with grommets, bushes or other lining.

Support all cables throughout their length using conduit, trunking and enclosures, cable tray, cable racking, special support systems, cleated or clipped fixing direct to building fabric, or aerial catenary suspension systems, as required.

Ensure tray, racking and special support systems are continuous and firmly fixed to building fabric. Allow space for indicated cables + 30% spare, unless otherwise indicated.

Fixings and supports shall be installed at regular intervals of on adjustable steel brackets, to the engineer's approval. Install fixings at regular intervals to prevent visible sagging when loaded, with maximum spacing 1.2m and 230mm from fittings. Support from building fabric with minimum clearance behind of 20mm,

Cable tray and accessories shall be electrically and mechanically continuous throughout its length and bonded to the earth system.

2.1.2 Standard Medium Duty

Cable trays shall be perforated and manufactured from cold rolled mild steel in accordance with BS 1449: Part 1.

All accessories including bends (vertical and horizontal), intersections, tees, risers and reducing sections shall be purpose made by the tray manufacturer. Only one manufacturer's tray and accessories shall be used on the project.

The thickness of normal cable tray and accessories shall comply with the following requirements:

Width of Cabletray and Accessory	Minimum Thickness
Up to and including 152	1.0
Above 152 up to and including 254	1.2
Above 254 up to and including 457	1.5
Above 457 up to and including 914	2.0

2.1.3 Heavy Duty

Where heavy-duty cable tray is shown on the drawings or where the span between supports and/or cable loading necessitates its use then the thickness of tray and accessories shall comply with the following requirements:

Width of Cabletray and Accessory	Minimum Thickness
Up to and including 457	1.5
above 457 Up to and including 914.	2.0

Heavy duty cable trays shall be manufactured with plain return flanges.

2.1.4 Light Duty

Light duty tray over 100mm shall not be installed. All light duty cable tray shall require the express permission of the engineer or as detailed in the drawings or particular specification. Fixing centres shall be at 400 mm maximum.

2.1.5 Bonding

Cable tray and accessories shall be electrically and mechanically continuous throughout its length and bonded to the earth system. Tray carrying LV cables shall be bonded to earth with green/yellow PVC insulated stranded copper, single core cable. Tray carrying HV cables shall be bonded to earth with copper strip with a minimum cross-section of 50mm².

2.1.6 Installation of Tray and Workmanship

Sections of cable tray and accessories shall be jointed in accordance with the recommendations of the manufacturers or alternatively by using mushroom-head roofing bolts, nuts and washers.

Any damage caused to the tray, accessories and finish during cable installation and prior to Practical Completion shall be made good using either a zinc rich epoxy primer or equal alternative with a generous overlap on the existing sound metal coating. The jointing screws, nuts and washers shall all be galvanized or sheradized steel, brass shall not be used.

Cable trays shall be cut along a line of plain metal and not through perforations. Burrs or sharp edges shall be removed prior to the installation of tray sections or accessories. Holes cut in cable tray shall be suitably bushed with grommets complying with BS 1767. In either case the cut or damaged metal shall be made good by the contractor by first treating the surfaces with a suitable rust-proofing agent, similar to that used in its original manufacture and then applying finishes comparable to the remainder of the surface.

Fixings and supports shall be formed from sections of purpose made racking with purpose made accessories.

Fixings and supports shall be installed at regular intervals of 1000mm and not more than 150mm from all bends, tees, intersections and risers. Midspan joints between cable tray sections shall be avoided and they shall be positioned as close as practicable to the tray fixing or support.

A minimum clear space of 25mm shall remain behind all installed runs of cable tray.

Cables shall be installed on trays in a single layer, leaving 25% of the tray width spare for future use.

Cable trays shall preferably be installed such that they offer direct support to cables without the use of cleats or saddles. Purpose made straps, cleats, or saddles shall be employed, however, to maintain a neat and regular disposition of cables. Where trays do not directly support cables, e.g. vertical try, then load bearing cable cleats or saddles shall be employed and securely fixed to the tray. All cable cleats, saddles and straps shall comply with the cable manufacturer's recommendations and shall be compatible with the cable tray finish and cable sheath or serving.

When horizontal runs of cable tray cross building or structural expansion joints, then the tray shall be cut between supports installed on either side of the expansion joint. The tray sections shall then

be jointed with bolts, nuts and washers installed in elongated holes permitting a lengthwise movement of + 10mm from the initial fastening position. Vertical runs of cable tray shall not be installed such that they straddle vertical expansion joints of the building structure.

2.2 Cable Basket

Cable basket shall only be installed as indicated on drawings or with the express permission of the engineer.

Basket tray to have 50mm square grid and side walls.

Light duty to be 25mm sides, medium duty 50 mm sides and heavy duty 75 mm sides. For under floor basket tray three independent supports legs shall be provided along each standard section of tray, where legs are required. Support leg depth as indicated. Every section shall have at least one connection point screwed to the floor. Accessories and fittings shall be as manufacturers standard items. Include take-off plates for conduits, trunking etc.

2.2.1 Ladder rack

Proprietary system of channel sections or tube with return lip and compatible jointing and fixing accessories.

2.2.2 Cable Cleats, Ties, Saddles and Clips

For cables supported on horizontal tray use ties for each circuit. Use tie manufacturer's special tensioning tool where available. Crop off tie ends.

For cables on inverted horizontal or vertical tray use cleats bolted to tray for paper, plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables. Use cleats sized to grip cables firmly without undue pressure or strain on cable, but preventing slipping.

For cables on vertical or horizontal rack use proprietary fixings for plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables. Use cleats sized to grip cables firmly without undue pressure or strain on cable, but preventing slipping.

For cables on vertical or horizontal rack use proprietary fixings for plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables.

For sub-circuit wiring on continuous flat surfaces of wood, plaster, brick etc. Use polypropylene surface fixing clips with pre-fixed hardened steel pin for PVC insulated and sheathed cables and sheathed or bright mineral insulated cables. Use round or flat twin pattern as appropriate, manufactured specifically for cable being fixed. Use one hole 'P' clips or two way saddles of bright copper for unsheathed mineral insulated cable. Use PVC covered for sheathed mineral insulated cables.

Space cleats, ties, saddles and clips as Appendix 1 of Guidance Note 1 'Selection & Erection' published by the IEE.

2.3 Trunking

2.3.1 General

The Contractor shall be responsible for co-ordination with other trades and for working to any trunking layout drawing.

Surface mounted trunking runs shall be horizontal and vertical and where these requirements are not met then the trunking shall be run parallel to the building lines.

Set out cable trunking as indicated on the drawings, making due allowance for any diagrammatic presentation. Provide all necessary offsets, bends, tapers, transformation pieces etc., whether or not these are detailed. Manufacturer's standard fittings shall be used for all connections and changes of direction.

Where trunking passes through walls, floors and ceilings, non-combustible, non-metallic fire barriers shall be installed in the trunking.

A protective conductor of no more than 2.5mm sq. shall be installed throughout the trunking installation.

2.3.2 Surface Steel Trunking

Material Steel trunking to BS 4678 Part 1. Gauge of Metal Table 1 BS 4678. Trunking of each type shall be from one manufacturer. Partitions and covers shall be of the same material as the trunking. Use only trunking manufactured with inward return edge flanges and fitted with flange couplers, which ensure that when the cover is removed a minimum of 80% of the nominal trunking or compartment width is available for access.

Resistance against ingress of water and solid foreign bodies shall be rating IP31 to BS EN 60529 for internal use.

Colour to be Manufacturers standard or to BS 4800 standard as scheduled.

CLASS	PROTECTION TO BS 4678 PART 1
Class 2	Electroplated zinc having a minimum thickness of zinc coating of 0.0012mm inside and outside with additional coating of stoved or air-drying paint, applied at least to the external surface.
Class 3	Hot dip zinc coated steel to BS EN 10142 or BS EN 10143 and BS EN 10147

2.3.3 Fixings

Use purpose made brackets to fix to structural steel or suspension rods. Provide external fixing lugs where specified protection for the installation is IP44 or greater.

2.3.4 Fittings

Use bends, tees and angles of similar gauge, type and finishes as trunking body and supplied by same manufacturer. Use standard fittings where possible. Where site fabricated fittings are necessary ensure they are comparable in construction and finish with system. Obtain prior approval in writing before site fabricating any fittings or special accessories.

2.3.5 Partitions and Covers

Ensure partitions are electrically continuous with the body of the trunking or provide a connector for a circuit protective conductor. Ensure gap between partitions and lids maintains segregation of circuits.

2.3.6 Joints

Use purpose made jointing pieces fixed with screws into captive nuts. Ensure screws do not protrude through the nuts. Ensure rigidity of trunking is maintained across joint. Ensure external dimensions of trunking are maintained and not reduced by more than 4% across joints between

trunking lengths and/or fittings. Use purpose made fittings of the same manufacture where trunking connects to switchgear and distribution boards.

Provide flanges for connection of flush floor trunking to vertical trunking to maintain the cross sectional area of compartments with 50 mm minimum radius.

Maintain electrical continuity at each joint by a copper link, (tinned copper for galvanized trunking), fixed on outside of trunking, secured by screws, nuts and shake proof washers. Screws must not project through the nut. Make provision for continuity to be achieved without need to remove paint from ferrous metal where trunking has a painted finish.

2.3.7 Screws, Nuts, Washers

Do not use self-tapping screws. Use cheese or round head screws except where provision is made for the use of counter-sunk heads. Screws, nuts and washers to be made of brass or steel zinc coated.

2.3.8 Cable supports

Provide horizontal trunking with removable cable retainers or bridges to retain cables in-situ. Provide vertical trunking with pin racks to support cables at 3000 mm maximum spacing. Use insulated pins or insulation sleeved pins on pin racks.

2.3.9 Underfloor/Flush Floor Steel Trunking

Trunking material Sheet steel trunking to BS 4678 Part 2. Gauge of Metal Table 1 BS 4678. Degree of Protection Class 3. Provide flanges for connection of vertical trunking and temporary blanking plates. Maintain cross sectional area of compartments with 50mm minimum radius for connections to vertical trunking.

Secure covers by steel cam locking devices for use with a removable tool. Provide cork gasket or equivalent between cover and flange for sound deadening.

Supply trunking bodies complete with flanged connections for service outlet boxes with screwed levelling device. Ensure securing devices on recessed covers are accessible without removing applied floor finish.

Trunking and connectors shall be manufactured generally in accordance with B.S. 4678: Part 1. Trunking and fittings shall have removable lids extending over the entire length. The lids to be of the same thickness of material as that of the trunking as a minimum.

Where trunking is run in floor trenches it shall be continuously hot dip galvanised plain sheet steel to comply with BS 4678, part 1.

The number of cables to be installed in the trunking shall be such that a space factor of 45% is not exceeded.

The fixings and spacing of fixings shall conform to the manufacturer's instructions.

Where more than one circuit is run in the same trunking, or more than one service, the cables for each circuit or service shall be bound together at 1.2m intervals with PVC tape suitably coloured.

The trunking shall be manufactured by Electrofast or equal and approved.

2.3.10 Lighting Trunking

Where specified the lighting trunking shall be manufactured from 1.2 metres, galvanised, sheet steel.

The trunking shall be 50mm x 50mm in size and shall be complete with all necessary couplings, blank ends and all accessories.

The trunking and suspension brackets shall be of a design to allow the trunking lid to be removed without disturbing the suspension bracket.

2.3.11 Lighting Trunking Cover

Provide cover strip to prevent ingress of foreign materials, locate cabling in place and act as closure strips between luminaries. Use trunking cover strip clipped into place in trunking body. The Cover strip is to match lighting trunking body or high quality colourfast extruded plastic as scheduled. Colour and shade to BS 381 and/or BS 4800 as indicated.

Trunking to be manufactured by Electrofast or equal and approved.

2.3.12 Dado Trunking (Plastic)

Dado trunking shall be supplied and installed using proprietary manufacturers bends, accessories , covers and lid.

Trunking shall be white in colour unless otherwise stated and shall be either :

a) Schneider Prima 60 Plastic Three Compartment Dado Trunking. 190mm x 62mm. Colour White

b) MK Prestige 3D Plastic Dado Trunking. 170mm x 57mm Colour White Provide cover strip to prevent ingress of foreign materials, locate cabling in place and act as closure strips between luminaries. Use trunking cover strip clipped into place in trunking body. The

2.4 CONDUIT**2.4.1 General**

The Contractor shall be responsible for co-ordination with other trades and for working to any conduit layout drawings.

Surface mounted conduit shall be run horizontal or vertical. Where this requirement can not be met then conduit shall be run parallel to the building lines.

No conduit smaller than 20mm shall be installed.

The maximum number of cables drawn into any one conduit shall not exceed 80% of those allowed by the relevant regulations IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations.

A protective conductor of 2.5mm sq. minimum shall be installed throughout the conduit installation.

2.4.2 Metal Conduit

All conduit, bends and couplers shall comply with BS 4568: Part 1. The conduit shall be heavy gauge screwed. Internally screwed couplers shall be made from steel.

Conduit fittings and components shall comply to BS 4568: Part 2 and be suitable for use with screwed conduit.

Inspection elbow and bends, tees and manufactured bends will not be allowed.

Particular attention shall be paid to the continuity of all conduits and fittings to avoid high resistance between joints and connections. Continuity tests shall be made at the completion of the conduit installation and details of the test results shall be entered in the Inspection Certificate.

Conduit shall be supported in accordance with current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations. Where conduit is connected to surface mounted equipment or accessories it shall be additionally supported within 150mm of each side of the item.

Where bends and sets occur the conduit shall be fixed at a distance of 150mm on each side of such diversion. Unless otherwise indicated on the drawings all concealed conduit work shall be installed on the "loop-in" system.

The inner radius of any conduit bend shall not be less than 2.5 times the external diameter of the conduit. Where conduit has to be bent it must be bent without altering its section.

Conduit buried in concrete shall have a minimum depth of 25mm cover over its entire length. Conduit buried in a plaster shall have a minimum cover of 15mm over its entire length.

Conduits in chases shall be held in place by purpose made crampets.

All fixings shall be by means of spacer bar saddles using either slotted or keyhole pattern type saddle tops.

Throughout the course of the Contract, all conduits and accessories shall be effectively protected against the ingress of plaster and other building materials.

The Contractor shall ensure that conduits are free from dampness and moisture before any wiring is installed therein and shall swab them dry if there is any doubt or if such should prove necessary.

No cables shall be installed until such time as the relevant part of the building is reasonably weathered and free from major water ingress.

No cables shall be inserted until the conduit and boxes are fixed and the plastering complete. No greater pull than 15kg shall be exerted.

2.4.3 PVC Conduit

All rigid PVC conduit and conduit fittings shall comply with BS 4607. Concealed conduit shall be medium and surface conduit shall be heavy classification.

Conduit, fittings and accessories shall be of the same manufacturer.

All conduit joints shall be in accordance with the manufacturers installation recommendations. Screwed PVC conduit shall not be used.

No inspection elbows, bends or tees will be allowed. All bends shall be made using the correct size spring.

Surface mounted conduit shall be fixed by means of PVC spacer bar saddles. Conduits shall be supported at regular intervals in accordance with current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations. A separate 2.5mm sq. earth shall be used throughout the installation.

2.4.4 Flexible Conduit

Flexible conduit shall be constructed by means of two leaded steel layers covered by black PVC, and a minimum size of 20mm.

Connectors shall be aluminium or zinc plated steel.

The conduit shall be Kopex supplied by Irish Industrial Supplies or equal and approved. A separate 2.5mm sq. earth shall be run in the flexible conduit.

3. CABLES

3.1 Cable Manufacturer

Use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with manufacturer's name, size, description, BS number, classification, length, grade and date of manufacture.

3.2 Certification and Markings

Mark all types of cable with CENELEC cable certification marking or if included in British Approvals Service for Electric Cables (BASEC) in accordance with BASEC regulations.

3.3 Cable Records

Keep records of cable drum numbers and supporting information, mark information on record drawings, indicating precise location of each length of cable, and submit copies of manufacturer's cable test certificate.

3.4 Conductor Material

3.4.1 Flexible Cords

All flexible cords shall have tinned copper conductors and be rated for 600/1000V operation unless otherwise indicated.

3.4.2 Wiring and Power Cables

All wiring and power cables shall have copper conductors unless otherwise indicated. All cables shall have a voltage rating and performance characteristics suitable for the application. For multicore cables the conductors shall be circular up to 16mm² and shaped over 16mm² unless otherwise indicated. LSF means Low Smoke and corrosive gas emission compound.

3.5 Colour Coding

Cables for different phases, neutral, and protective conductors shall be distinctively coloured as shown in E.T.C.I. Regulations.

3.6 Flexible Cables

Flexible cable used shall, in all cases unless otherwise specified, be to B.S. 6500 heat resistant type suitable for temperature up to and including 2000F. All flexible cables shall be manufactured by an approved manufacturer and shall comply with approved I.E.E. regulations in all respects.

3.7 P.V.C. Cables & L.S.F Cables

P.V.C. insulated cables shall be 600/1000 volt manufactured in accordance with B.S. Specification No. 6004. The conductors shall be high conductivity tinned copper.

L.S.F. insulated cables shall be 600/1000 volt manufactured in accordance with IS EN 50525-3. The conductors shall be high conductivity tinned copper.

3.8 PVC/PVC/SWA/PVC CABLES

Where indicated PVC/PVC/SWA/PVC cables shall be installed as outlined below. The cables shall comprise copper stranded conductors insulated with PVC enclosed in PVC sheath and covered with steel wire armour which shall be covered with a PVC sheath.

The cables shall comply with B.S. 6346. Cables shall be of 600/1000 volt grade. The cables shall be installed in strict compliance with the manufacturers requirements and bends in the cables shall be of the minimum radius of 8 times the overall diameter of the cable.

All runs of cable inside the building shall be supported on cable tray/ladder or securely fixed to the walls at high level and to steelwork with approved cable clamps, on Unistrut brackets and in all instances the spacing of supports shall comply with the cable manufacturers recommendations.

All cables shall be terminated in the makers glands. Termination of the cable core shall be by means of makers compression termination lugs in accordance with the makers instructions. The cable armouring shall be carefully made off in the makers gland at each entry to switchfuses etc.

Bonding to the metal work for the earthing shall be by proprietary earth tags.

Where necessary separate earth wire shall be installed alongside the PVC/PVC/SWA/PVC cable to comply with the E.T.C.I. Regulations.

3.9 XLPE INSULATED ARMoured LSF CABLES

Cables shall be armoured and LSF sheathed. Multi-core cables shall be steel tape or single wire armoured and single core cables shall be aluminium strips armoured. Generally multi-core cables shall be XLPE/LSF/SWA/LSF and single core XLPE/SWA/LSF.

The cables shall comply with BS 5467: 1989 and shall be of 600/1000 volt grade.

Cable installation, support, glanding, termination etc as per PVC/SWA/PVC above and manufacturer's guidelines.

3.10 MICS CABLE

Where specified MICS cable shall be installed as outlined below. The cable shall be 660 volt grade with seamless copper sheath and powered mineral insulated high conductivity copper conductors in compliance with BS 6207. 750V heavy-duty cables shall be used for sizes over 2.5mm² to 25mm². Outer sheath colours shall be:

Red	-	Fire Alarms
White	-	Emergency Lighting
Orange	-	Other Services

All wiring where MICS cable as specified shall be carried out in two or four core cable not less than 1.5 sq. mm cross sectional area.

All MICS wiring shall be carried out in strict accordance with the makers instructions and to the approval of the engineers. All sealing glands shall be made with the makers cold type seal. Where cables are fixed to brick or concrete suitably sized rawplugs shall be used.

Immediately after cutting, each cable end shall be sealed, either by the permanent seal or by being dipped in bituminous compound.

Termination for cables shall comply with BS 6081, and shall be made off strictly in accordance with the manufacturer's recommended procedures.

All cables shall terminate using only screw-on pot type seals incorporated in the universal ring type glands and shall be adapted to suit the various boxes, switches, etc. All cables shall be effectively sealed using only the makers sealing compounds. Sealing pots and glands shall be marked with the appropriate cable reference. All terminations, fixings, and accessories and all tools used shall be made by the same manufacturer as the cable itself.

All sheathing shall be electrically continuous across all joints and earthed in accordance with the current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations.

All cables shall be securely fixed at sufficient intervals with brass saddles and screws. In no case shall saddles be placed at intervals greater than 300mm. Where cables pass through floors, walls or ceiling they shall be protected by a short length of galvanised steel conduit of suitable size, correctly bushed.

MICS cables installed in under-floor or similar ducts, on galvanized tray, on a dampstone, brick, or concrete surface, or elsewhere in damp or corrosive conditions, or where specifically called for in this Specification, or on the drawings, shall be provided with an overall extruded orange sheath.

Terminations of PVC or similar sheathed MI cables shall be protected by the correct size of plastic gland shroud. Any exposed metal sheath remaining after the installation of the cable gland shall be wrapped with PVC tape, as supplied by the cable manufacturer, before fitting the gland shroud.

Bending radius for M.I.C.C. with copper sheath is 6 times the diameter.

Cable clips and saddles shall be purpose-made by the cable manufacturer. The use of bare or PVC covered copper strip for site fabrication of saddles or clips will not be permitted. Clips with single hole fixings may be used when installing single cables. Where two or more cables are grouped together then saddles with two hole fixings shall be employed. Plain copper sheathed cables shall be held with bare copper clips or saddles; PVC or similar sheathed cables shall be held with PVC covered clips or adjustable nylon saddles. The type of fixings employed shall be consistent throughout the installation.

Connections between cables shall be by means of mechanical connectors of approved type. Every connector shall be easily accessible and shall not have a resistance greater than that of the equivalent length of the largest conductor to which the connector is fixed.

All cables shall have their conductors tested for insulation resistance immediately prior to terminating the cable end. Tests shall be carried out with a 500V 'Megger' insulation tester, or similar instrument, to prove the integrity of the insulation between cores and the cable sheath.

MICS shall be as manufactured by BICC or equal and approved.

3.11 Glanding and Terminating Cables

3.11.1 Glanding

Only glands specifically manufactured to suit the cable shall be used.

Armoured cables shall be brass. Shrouds shall be used in all instances. MICS glands shall be as supplied by cable manufacturer.

IP rating shall be as specified but not less than

Holes cut in gland plates, adaptable boxes and other equipment shall be correctly sized for the gland to be installed such that minimum of free play exists between the gland body and the cut metal. Paint or other finishes around the hole periphery shall be removed and the metal thoroughly cleaned before the gland is installed.

Large single-core cables shall be terminated in the manner recommended by the manufacturer to reduce losses due to eddy currents or circulating currents.

Where glands are installed on non-conducting materials then earth tail seals or sheath earth bond clamps shall be employed. The earth tail or clamp shall be bonded to the appropriate earth terminal or bar.

3.11.2 Terminations

Ensure all joints and terminations are made by appropriately qualified cable jointers, using jointing materials, components and workmanship recommended by the cable manufacturer and the jointing accessory manufacturer. Install cable glands in accordance with BS 6121 Part 5. Cold pour resin and heat shrink joints in accordance with BS 6910 Part 2.

Cut all cable ends immediately prior to jointing or terminating. Seal cables left unconnected for more than 24 hours to prevent the ingress of moisture. Seal plastic sheathed cables using proprietary shrink on end caps. Seal lead sheathed cables by a plumbed dressed lead cap with an air space to allow conductor movement.

Strip cables to bring out the cores and expose conductors, for the minimum length required for connection, to leave no exposed length of conductor after termination. Ensure that strands are not damaged when stripping cable cores. Twist strands together. Do not reduce number of strands. Secure all strands at terminations.

At connections to equipment and switchgear without integral cable clamping terminals, use compression or solder type lugs for bolted terminal connections, of correct bore. Form all compression connections to components using tools that cannot be released unless the correct

degree of compression has been achieved. Install and inspect compression and mechanical connectors, to BS 6360, on conductors in accordance with BS 7609.

Bolt core termination with lugs to equipment using washers or proprietary shake proof devices. Provide separate bolted connection for each core.

For auxiliary and sub-circuit wiring do not bunch more than three cores at clamping terminals or bolted connections. Individual stranded cores should be twisted together and folded back to form a "U" where entering screw or clamp type terminals.

Mark cable conductor phasing, or other core identification, at each end of all cables, and at all joints, maintaining consistency of marking with any existing system.

Connect all cores, including multicore cable spare cores, at all joints and terminations. Bond any unused cores of multicore cables to earth at both ends, unless otherwise indicated.

3.12 Cable Fixing

Cables fixed to the building structure or to cable tray shall have clips or saddles spaced at the following regular intervals as a minimum:

Overall Diameter of Cable (mm) (excl. P.V.C. Sheath).	Horizontal & Vertical Fixing Centres (mm)
Up to 7.5 inclusive	450
Above 7.5 up to 12.5 inclusive	600
Above 12.5	750

Cable saddles and clips shall be fixed to the building fabric or to cable tray as follows:

- (i) Building fabric - brass roundhead screws and fibrous or approved plastic plugs.
- (ii) Galvanized trays in damp or wet conditions - zinc coated roundhead screws, nuts and washers.
- (iii) All other cable trays - brass roundhead screws, nuts and washers.

3.13 Cables in Trenches

See work section P30. Cable trenches to be by others but supervision of all works is to be carried out by electrical contractor. Insure that all PVC cable marker tapes are installed in accordance with the following table (also in work section P30):

WIDTH	Up to 600mm	600-1000mm	1000-1400mm	1400-1800mm
DEPTH Up to 500mm	1 tape at 200mm below ground level in the centre of the trench	2 tapes at 200mm below ground level horizontally spaced 400mm apart	3 tapes at 200mm below ground level horizontally spaced 400mm apart	4 tapes at 200mm below ground level horizontally spaced 400mm apart
DEPTH 500- 800mm	1 tape at 200mm and 1 tape at 500mm below ground level in the centre of the trench	2 tapes at 200mm and 2 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	3 tapes at 200mm and 3 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	4 tapes at 200mm and 4 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart

Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material. Cover newly laid cables with 100mm of bedding material.

When using a power winch ensure tension on the cable is taken by element of the cable designed for that purpose, that is armour or conductor cores as appropriate and not plastic sheath, metal sheath or core insulation.

During hand pulling cable ensure no kinks are formed and that flaking when used is done in the correct direction.

Do not allow cable to twist during installation. Use swivels to connect pulling bond to cable stocking or equivalent fitting.

Check drum is suitable for jacking before commencing installation. If drum or reel is unsuitable for jacking, flake cable in correct direction in maximum size turns from drum or reel before commencing installation. Use skilled labour to supervise all unreeling, flaking or running of cable from a drum.

Lay cables in the formation shown, ensure spacing is not reduced below that indicated.

Bind trefoil groups at 1m intervals. Bind any associated earth or protective conductor to its cable or trefoil group at 1m intervals.

Ensure installation radii and permanent bending radii are not less than those recommended by the manufacturer.

Do not lay cables that are not suitable, are not waterproofed or mechanically protected in the ground.

3.14 Cables in Trunking and Conduit

Throughout the course of the Contract, all trunking, conduits and accessories shall be effectively protected against the ingress of plaster and other building materials.

Cable trunking to be clear of debris, in particular metal swarf, prior to the installation of any cabling.

The Contractor shall ensure that all trunking and conduits are free from dampness and moisture before any wiring is installed therein and shall swab them dry if there is any doubt or if such should prove necessary.

No cables shall be installed until such time as the relevant part of the building is reasonably weathered and free from major water ingress.

No cables shall be installed until the trunking and conduit system is complete, outlet boxes are fixed and the plastering complete. No greater pull than 15kg shall be exerted.

4. EARTHING AND EQUIPOTENTIAL BONDING

4.1 General

To provide systems for the transfer of electric current to earth, to protect personnel, buildings, structure, plant and equipment in the case of an electrical fault within the supply system and from interference from electro-magnetic fields and electro-static forces.

4.2 Standards

All necessary earthing and equipotential bonding shall be done in accordance with the IS 10101 National Rules For Electrical Installations supply requirements.

4.3 Existing Installations

Check earth continuity conductors and loop impedance values of existing installation. Report defects and elements not in accordance with IS 10101 National Rules For Electrical Installations before connecting new or modified installations to existing supply.

4.4 Earth Electrodes

Earth electrodes shall be molecularly bonded copper clad steel rods driven vertically into the ground. Threads shall be properly rolled so that the copper cladding is unbroken throughout. Couplings shall be of silicon aluminium bronze and shall be fully threaded to allow metal-to-metal contact of the rods. Couplings shall be counter-bored and of sufficient length to completely cover and protect the threaded portion of the rods to minimize corrosion.

Driving heads for the rods shall be high tensile steel and shall be fully threaded to ensure head-to-rod contact. Driving shall be accomplished by using a purpose made power hammer. Each rod shall be fitted, after driving, with a conductor clamp.

Where the ground is unsuitable for copper clad steel rods, other types of earth electrodes complying with BS 6651 may be used. Where building elements are to be used as the earth electrodes they shall be tested during construction to ensure the resistance is low enough to make suitable electrodes. A formal record will be kept of the resistance readings taken.

Appropriate sealing methods shall be used where rods or conductors pass through concrete into earth. Pre-cast concrete inspection pits and puddle flanges or, in tanked structures, more elaborate seals as described in BS 6651, shall be cast in at the time of construction. Permanent waterproofing and sealing shall be accomplished after installation and testing of the earth rods or conductors.

Earth pits shall be pre-cast concrete with reinforced covers. When fully embedded in concrete, earth pits may be of galvanised steel construction or moulded plastic bodies with galvanised steel frames and lids. Pits shall be installed so that they are flush with the finished floor or ground level.

Covers shall be removable for inspection and testing of the earth electrode and shall be inscribed 'Lightning Protection Earth'.

Drilled earth bars shall be fitted in pits where the number of connections exceeds one looped conductor (interconnecting electrodes) plus one external connection. The drilled earth bars shall be copper, not less than 50mm x 6mm and mounted on insulators.

Where natural earth electrodes are used, such as sheet steel piling, reinforced concrete raft or pile foundations or other suitable structures, provision shall be made during construction to ensure suitable electrical connection to such electrodes. If parts of the structure are also to be used as natural down conductors then electrical continuity between the elements used as down conductors and those used as earth electrodes shall be ensured during construction in consultation with the Engineer and the Structural Contractor.

4.5 Joints and Connections

Use proprietary cast gunmetal accessories, fixings, clamps and couplings with phosphor-bronze bolts, nuts and washers.

Provide waterproof protection at joints subject to moisture.

4.6 Test Joints

All test joints shall be accessible for testing at the time of installation and for future routine tests.

Test joints shall be provided at the bottom of each down conductor so that the integrity of the earth electrodes can be tested separately. Where natural building elements are used as down conductors then test joints shall be provided at the top of the building to measure the resistance to earth.

4.7 Protective Conductors

Use insulated cable generally - PVC Single core to BS 6004 or XLPE Single core to BS 7211 as appropriate.

Armouring and/or metallic sheathing of armoured cables may be used within the IS 10101 National Rules For Electrical Installations but in new installations provide separate cable as standard. Integral copper conductor is preferable in multicore cables and shall be used wherever possible.

Provide protective conductors sized in accordance with IS 10101 National Rules For Electrical Installations.

All expressed metalwork on the roof and on the outside of the building shall be bonded to the lightning protection system. Interior metalwork shall be bonded if it is close enough to elements of the lightning protection system to risk the danger of flashover. The need for bonding shall be assessed by the calculation method given in BS 6651.

In life installations only, the continuous rigid metal structure shall be bonded to the lightning conductor and to adjacent structural steelwork and such bonding shall be confined to the top and bottom of the continuous rigid metal structure. The guide rails are not part of the structure for this purpose but shall be bonded as exposed conductive parts.

4.7.1 Main Earth Terminal

Provide earth bar at incoming electrical service position. Bond earth terminals and metallic structure of switch and control gear and plant. Connect all earth terminals to each other.

4.8 Main Earth Cable

Cable as protective conductor above sized as per regulations. Provide Mechanical protection throughout. Provide mechanical moisture seals as appropriate where structure or membrane is broken.

4.9 Main Earth Terminal Connections

Connect separately each main earth conductor and main equipotential bonding conductor to main earth terminals.

Terminate circuit protective conductors on switchboard earthing bar.

Terminate conductors with compression type lugs suitable for bolting direct to bar or solder lugs suitable for bolting direct to bar.

Extend separate protective conductor from main earth terminal to main switch/switch panel served by incoming main cable

Provide terminations on each main earth bar as appropriate for all main connections.

4.10 Neutral/Earth Connection

Provide neutral/earth connection at main distribution board.

4.11 Clean Earth Bar

Where specified provide clean earth bar.

Materials and installation similar to above.

4.12 Test Certificates

A test certificate shall be provided on completion of the installation to certify that Inspection and Testing have been carried out in accordance with the Standards.

The test certificate shall contain the resistance measurement of each earth electrode and earth termination network, of each down conductor and of the building as a whole. In addition to resistance measurements, the certificate shall contain the following information for each reading:

- (i) the date and time
- (ii) the weather conditions
- (iii) the type of soil
- (iv) the condition of the soil (e.g. wet, dry, average). Any measures taken to reduce soil resistance. Details of the reference earth used for testing.

5. MAIN AND SUPPLEMENTARY EQUIPOTENTIAL BONDING

Bond in accordance with IS 10101 National Rules For Electrical Installations to main earth terminal all extraneous conductive parts of the installation. Ensure that all of the following services are bonded for each building or equipotential zone:

- Main water pipes.
- Main gas pipes.
- Fuel oil pipes.
- Air ductlines.
- Heating pipework.
- Chilled water pipework.
- Exposed metallic parts of building structure.
- Thermal insulation metallic cladding.
- Metallic cable sheaths of all cables except.
- Lightning protection systems.

Bond all simultaneous accessible conductive parts with supplementary equipotential bonds to protective conductor system. Ensure that all of the following areas are bonded:
Bathrooms and shower rooms.

- Boiler houses.
- Calorifier rooms.
- All other plant rooms.
- Wet and damp process areas.
- Kitchens and laundries

5.1 Identification

Use numbered and/or lettered plastic cable sleeves to indicate circuit numbers and phases of corresponding phase conductors on all cables.

Ensure conductors are connected to earth bar in same sequence as phase and neutral conductors.

Identify at substation, switchboard and building earth bars each protective, bonding and earthing conductor.

Label earth bar "SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE" with wall mounted laminated plastic tablet engraved in 10mm high red letters on white ground.

Provide a permanent label durably marked in letters 4.75mm minimum height "SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE, in visible position, at each bonding conductor connection to extraneous conductive parts.



6. ACCESSORIES

6.1 Supplier

Unless otherwise indicated source all accessories from the same manufacturer.

Unless otherwise specified all accessories shall be MK Albany Plus MCO. Industrial type outlets shall be MK unless otherwise specified. The contractor must submit any alternatives for approval prior to installation.

6.2 Samples

Where indicated submit samples of proposed materials and equipment for approval before work is started. Label each sample with name, catalogue number and services in connection with item.

6.3 Common Requirements

All enclosure box to BS4662 for recessed and to BS5733 for surface. For interior use these shall be IP30 and for exterior IP 54 or as specified. All coverplates to be overlapping unless otherwise specified.

Enclosure material and finish to match conduit system. Enclosures to be recessed unless otherwise specified.

6.4 Interior Light Switches

These shall be BS 3676 Part 1., grid type, and shall incorporate rocker bars unless otherwise specified.

Rating of all the switches to be 15A. Mounting to be on an adjustable steel grid. All switches shall have a snap action microgap mechanism. Multiswitch units shall be used as appropriate. Switches on differing phases shall be mechanically separated.

MK MCO or similar and approved unless otherwise specified.

6.5 Pull Cord Switches

To BS3676 Part 1 rating of all the switches to be 16 A for lighting circuits and 40-45A for showers, fans etc as specified. All switches shall have a snap action microgap mechanism and a neon indicator lamp.

MK MCO or similar and approved unless otherwise specified.

6.6 Exterior Light Switches

To BS 3676 Part1 switch type shall be either rocker bar with sealed-in plastic membrane or rotary disc or lever operating through sealing gland. Rating of all switches shall be 15 A. Action shall be two positions, unless otherwise stated. Enclosure pattern shall be weatherproof and shall be surface, unless otherwise stated. Enclosure material shall be galvanized cast iron or impact resistant moulded plastic. Neon etc shall be as indicated on the drawings.

MK or similar and approved unless otherwise specified.

6.7 Luminaire Connections

Rating shall be 5A minimum. Load carrying captive cord grip type plug/socket and clip-on cover to BS 5733, BS 546 or BS 5733 Load Supporting BS 7001 (3 or 4 pin as appropriate).

Load carrying capacity to match connected luminaire.

Coverplate finish white moulded plastic.

MK Klix or similar and approved unless otherwise specified.

6.8 Isolating Switches

Provide isolating switches for fixed appliances, with utilization category and making capacity as indicated. These shall be to BS 3676 Part 1 or BS EN 60947-3. Mounting to be on an adjustable steel grid. Engrave front plate to indicate equipment served. Switch type toggle.

Neon indicator with red lens.

Cord outlet with cord grip.

MK or similar and approved unless otherwise specified.

6.9 Fuse Connection Units

To BS 1363 Part 4. Printed label to indicate equipment served. Units shall be switched unless indicated otherwise. Fuses to BS 1362 sized as indicated.

Cord outlet and cord grip.

MK or similar and approved unless otherwise specified.

6.10 Socket Outlets

Standard 13A socket-outlet to BS 1363. MK or similar and approved unless otherwise specified. Socket outlets shall be single or twin and switched unless indicated otherwise.

Industrial socket-outlets, BS EN 60309-1. All 110V, 230V and 430V volt industrial outlets shall be IP44 rated indoors and IP67 rated for outdoors. Conduit entry to the outlets shall be to suit each particular application. All industrial outlets shall be from the MK Commando Range similar and approved unless otherwise specified.

6.11 Cooker Control Unit

Standard

Cooker unit to BS 4177.

The rating shall be 45A double pole with neon indicator light.

MK or similar and approved unless otherwise specified.

6.12 Cord Outlets

BS 5733

BS EN 61058-2-1.

Engrave front plate to indicate equipment served. Rating shall be 20A for all outlets except cooker and for cooker and for cooker outlets 45A. Pole configuration to be DP&E.

Terminal block sized for cables.

For cooker 2 x 10mm², for all other 2 x 2.5mm²

MK or similar and approved unless otherwise specified.

6.13 Cable and Appliance Couplers

BS 4343:1968

BS EN 60309-2 (BS 4343:1992)

Industrial couplers, BS EN 60309-1, Bs EN 60320-2, Bs 196.

MK or similar and approved unless otherwise specified.

Material polycarbonate male and female type connectors.

Colour coding as follows:

25V, Violet

50V, White

110 – 130V, Yellow

220 – 240V Blue

380 – 415V Red

500 – 750V, Black.

Degree of protection to BS EN 60529

Internal – IP 44

External – IP 67

6.14 Telephone and Data Outlets

Refer to Data and Telephone Specification.

For jack socket to BS 6312 Part 2 or RJ 45, LJU.

6.15 BNC Sockets

Circuit configurations as indicated on drawings. Connections shall be crimp terminals. The impedance of the outlet shall be 75. The mounting shall be insulated unless otherwise indicated. Connections shall be insulation displacement type unless otherwise indicated.

Ancillaries shall be dust caps for sockets unless otherwise indicated.

6.16 Aerial Sockets

Standard BS3041 Part 2

Circuit configurations (single or dual or TV and/or FM) as indicated on drawings. Connections shall be insulation displacement type unless otherwise indicated.

Ancillaries safety isolation to BS 6330 for communal aerial systems.

6.17 Low Voltage Isolating Transformer Units

Standard EN 60742 (BS 3535 Part 1) and BS 3535 Part 2.

The configuration shall be single phase, double wound. Rating – Input 230V/Output power 1500VA, unless otherwise indicated on the drawings.

Type	Output voltage	Description
V1	110V	For power tools in plantrooms with plug and socket to BS 4343
V2	24V	For portable lights in plantrooms
V3	110/24V dual	For power tools and portable tools and portable lights in plantrooms

Plug and socket for 110V

Plug and socket for 25V

Switch primary supply

Centre tapped secondaries

Secondary side fusing.

6.18 Shaver Points

Provide shaver points, internally switched by plug insertion to BS 4573, BS EN 60742 (BS 3535 Part 1) and BS 3535 Part 2.

Engrave input and output voltages and 'SHAVERS ONLY'. Rating 20VA.

Double wound single-phase transformer 230/230V and 110V to BS EN 60742 and BS 3535 Part 2.

Internal overload protection.

6.19 External and internal lighting PIR's

Internal PIR types and locations to be used

Type 1

Location Covered: All areas except corridors unless otherwise specified

Type: LUXOMAT PD4-M-2C-DUO-FC (Flush)

Setting: Off Delay 25min – Photocell Zero

Type 2

Location Covered: Corridors unless otherwise specified

Type: LUXOMAT PD4-M-1C-C-PS-SM MK K4031

Setting: Off Delay 15min



External PIR types

7. Fixings and Grounds

7.1 General

The Electrical contractor shall be responsible for the fixing of all equipment supplied as part of electrical contract including specialist panels and boards supplied by other contractors and specialist suppliers.

7.2 Standards

Fixings shall comply with BS 3974 Part 1. Expanding anchors or similar fixings shall comply with BS 5080.

7.3 Methods and Materials

7.3.1 Load Bearing Fixings

All load bearing fixings shall be type tested and certified.

7.3.2 Size and Quantity of Fixings

Generally the largest bolt or screw size to fit the diameter of the hole of the item to be fixed. Ensure that all holes are used.

7.3.3 Build-in or cast-in fixings

Mark out and provide all assistance necessary.

7.3.4 Screws and Bolts

Generally sheradized for dry areas. In damp areas brass screws and galvanised bolts shall be used. In exposed or wet areas stainless steel screws or brass as appropriate and and stainless steel bolts should be used. Galvanised and stainless steel items shall not be in contact with each other.

7.3.5 Fixing to Steel or Similar Structure

Obtain prior approval both for fixing and method.

7.3.6 Fixing to Concrete

Avoid reinforcement. Generally fdo not fix to within 100mm of edge of concrete without approval.

7.3.7 Fixing to Brickwork/Stone

Fix directly onto brick or stone. Do not fix to mortar or any unsound material.

7.3.8 Fixing to Stud Partitions and Walls

Advise Main/Building contractor on the provision of grounds.

Where equipment is light such as battery wall clocks and the like toggle type fixings may be used.

8. Installation and Protection of Accessories

8.1 General

Ensure that all cable terminals suitably sized for cable.
Ensure all metal parts are bonded to earth.

Ensure there is no physical or electrical damage to accessories when they are removed from their packaging and during installation.

Provide masking covers for surface mounted accessories to protect surface from paint.

Where accessories are flush mounted install front plate after painting is finished.
Align accessories horizontally and vertically, as indicated. Where accessories are grouped, mount horizontally in line and parallel to each other and equidistant.

Fix cover plated to boxes with brass fixing screws.

8.1.1 Mounting Height

Mount electrical accessories in accordance with the following table, unless otherwise indicated. Measurement to be to centre line of equipment, unless otherwise stated, from either finished floor or worktop. If specified height coincides with top of tiling mount above tiling with a clear gap of 50mm. Where located below a worktop mount 100mm below underside of worktop.

Accessory	Location	Height mm	Mounting Height for Access from Wheelchair
Lighting switch		1100	1000-1200
Socket outlet	General	450	800
	Kitchen	1400	800
	Above worktop	200	150
	For disabled use	1000	
	Plantroom	1400	800
	External	1400	800
Shaver socket outlet		1400	800
Fused connection unit controlling	Radiant heater: - wall	1800	800
	Radiant heater: -focal point	200	800
	Tubular heater	200	800
	Clock	2200	
Cooker control unit		1400	150 above worktop
Cooker connection unit		600	600
Safety isolating transformer		1400	
Room thermostat		1600	900-1200
Telephone outlet		200	800
Radio/TV outlet		200	800
Pushbutton		1400	800
Fire alarm manual call point		1200	800
Bell or buzzer		2200	

In car parks and garages comply with appropriate petroleum regulation for mounting heights of socket outlets.

Accessory	Location	Height mm	Mounting Height for Access Wheelchair from
Lighting switch		1400	1000-1200
Socket outlet	General	200	800
	Kitchen	1400	800
	Above worktop	200	150
	For disabled use	1000	
	Plantroom	1400	800
	External	1400	800
Shaver socket outlet		1400	800
Fused connection unit controlling	Radiant heater: - wall	1800	800
	Radiant heater: -focal point	200	800
	Tubular heater	200	800
	Clock	2200	
Cooker control unit		1400	150 above worktop
Cooker connection unit		600	600
Safety isolating transformer		1400	
Room thermostat		1600	900-1200
Telephone outlet		200	800
Radio/TV outlet		200	800
Pushbutton		1400	800
Fire alarm manual call point		1400	800
Bell or buzzer		2200	

In car parks and garages comply with appropriate petroleum regulation for mounting heights of socket outlets.

For wheelchair access the following pull cord lengths are recommended: -

Ceiling mounted switches	Cord pulls to extend to 1000mm above finished floor level.
	Alarm pulls to extend 500mm above finished floor level and be coloured red.
Shower circuit switch	Pull cord to isolating switch to extend to 1000mm above finished floor level.

9. General Requirements

9.1 LV Switchgear – Standards

All switchgear supplied on RMCE projects shall be designed, constructed and tested in strict accordance with the IS 10101 National Rules For Electrical Installations and the current version of the relevant standards listed below.

9.2 IEC Standards

- IEC 60038 - EC Standard Voltages
- IEC 60255 - Electrical Relays
- IEC 60269 - Low voltage fuses
- IEC 60439 - Low voltage switchgear and control gear assemblies
- IEC 60670 - General requirements for enclosures for accessories for household and similar fixed electrical installations
- IEC 60715 - Dimensions of low-voltage switchgear and control gear. Standardised mounting on rails for mechanical support of electrical devices in switchgear and control gear installations.
- IEC 60721 - Classification of environmental conditions
- IEC 60831-1 - Shunt power capacitors of the self-healing type for AC systems having a rated voltage up to and including 1000 V - Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation
- IEC 60898 - Electrical accessories. Circuit breakers for over current protection for household and similar installations.
- IEC 60947 - Standards for low-voltage switchgear and control gear
- IEC 60947-2 - Circuit Breakers
- IEC 60947-3 - Switch, Disconnectors, Fuses
- IEC 60947-4-1 - Magnetic Starters
- IEC 60967-6-1 - Automatic Transfer Switches
- IEC 61009 - Residual current operated circuit breakers with integral over current protection for household and similar uses (RCBOs)
- IEC 61378 - Converter Transformers
- IEC 61439 - Low-Voltage switchgear and control gear assemblies
- IEC 61642 - Industrial AC networks affected by harmonics - Application of filters and shunt capacitors
- IEC 61643 - Surge protective devices connected to low-voltage power distribution systems
- IEC 61921 -Power capacitors - Low-voltage power factor correction banks
- IEC 62020 - Electrical accessories. Residual current monitors for household and similar uses (RCMs)Bottom of Form
- IEC 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

9.3 European EN Standards

- EN 50274 Low-voltage switchgear and control gear assemblies. Protection against electric shock. Protection against unintentional direct contact with hazardous live parts
- EN 60715 Dimensions of low-voltage switchgear and control gear. Standardized mounting on rails for mechanical support of electrical devices in switchgear and control gear installations
- EN 60947-2: Circuit-breakers
- EN 60947-3: Switches, disconnectors, switch-disconnectors and fuse-combination units
- EN 60947-4-1: Contactors and motor-starters. Electromechanical contactors and motor-starters
- EN 60947-5-8:2006 Control circuit devices and switching elements
- EN 60947-7-1: Ancillary equipment. Terminal blocks for copper conductors
- EN 60947-7-2 Ancillary equipment. Protective conductor terminal blocks for copper conductors

- EN 60947-7-3: Ancillary equipment. Safety requirements for fuse terminal blocks
- EN 61008 - Residual current operated circuit breakers without integral over current protection for household and similar uses (RCCB's)
- EN 61009 - Residual current operated circuit breakers with integral over current protection for household and similar uses (RCBOs)
- EN 61095 Electromechanical contactors for household and similar purposes
- EN 61439-1: Low-voltage switchgear and control gear assemblies. General rules
- EN 61439-2: Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies
- EN 62026-1: Low-voltage switchgear and control gear. Controller-device interfaces (CDIs). General rules
- EN 62026-3 Low-voltage switchgear and control gear. Controller-device interfaces (CDIs). DeviceNet
- EN 62208: Empty enclosures for low-voltage switchgear and control gear assemblies. General requirements

9.4 British Standards

BS 6423: Code of practice for maintenance of electrical switchgear and control gear for voltages up to and including 1 kV

BS 6518: Specification for low voltage switchgear and control gear for industrial use. Control switches. Position switches 42.5 x 80. Dimensions and characteristics

BS 7767: Method for assessing the short-circuit withstand strength of partially type-tested assemblies (PTTA)

9.5 Switchboards

For the purpose of this specification a switchboard is deemed to be either of the following:

- A main distribution board
- A sub main distribution board

In all cases these switchboards will generally feed major loads such as final circuit distribution boards, HVAC control panels, lifts, chillers etc. Unless other wise noted on the drawing switchboards shall be sheet steel type multi-compartment enclosures to Form 4 Type 2 as described elsewhere in this specification.

Form 2 Type 2 sheet steel cabinet enclosures, as described elsewhere in this specification, may also be used for the Main Distribution Board in smaller installations subject to the following:

- The supply is single phase or 3 phase whole current metered.
- The incoming protective device does not exceed 125 Amps.
- There are no downstream sub main distribution boards in the building.

9.6 Final Circuit Distribution Boards

Final Circuit Distribution Boards are fed from switchboards and typically feed light, sockets and small power final circuits. In some cases they may be an integral part of a switchboard. They shall be Form 2 Type 2 sheet steel cabinet type enclosures as described elsewhere in this specification.

Where the total number of outgoing circuits is less than twelve a metal clad type consumer unit will suffice for the Final Circuit Distribution Board.

9.7 Partially Type Tested Assemblies

All LV switchgear assemblies for supply on RMCE jobs shall meet the requirements for “Partially Type Tested Assemblies” in accordance with EN 60439 – 1 and as summarized below.

The assembly shall be derived from a Type Tested Assembly. Deviations from the tested configuration are only permitted provided they can be verified by calculation or equivalent methods.

As a means of demonstrating design compliance with the Standard, manufacturers must have available Type Test documentation for the original design and any calculations relating to modified elements.

The Assembly shall consist, as far as practical, of a series of standard elements configured to suit a particular application.

Customization should be restricted to situations where it cannot be avoided, e.g. facilities for terminating over size cables, use of an alternative tested component, etc.

All components and devices shall be fully Type Tested to their respective product standards. Documentation shall be available for examination.

Combinations of Type Tested components and devices installed in an otherwise untested Assembly are not covered by this definition and the Standard.

9.8 Form of Separation

Forms of separation shall be as defined in EN 60439-1 and as summarized below.

- Main and Sub main Distribution boards - Form 4 Type 2
- Final Circuit Distribution boards - Form 2b

The requirements are summarized in the relevant sub sections which follow.

9.9 Clearance and Creepage Distances

Clearance and creepage distances shall be determined in accordance with EN 60439-1 based on the following criteria.

- Pollution Degree 3: For normal indoor applications
- Pollution Degree 4: For external / damp applications
- Voltage Category 4
- Inhomogeneous Electric Field

9.10 Degree of Protection

The degree of protection of the enclosure shall be in accordance with IEC 60529 and as summarized below.

- Local Distribution Boards – Minimum IP 43 – preferred IP 54
- Main Distribution Boards – Minimum IP 54
- External Distribution Boards – Minimum IP 65

10. Switchboards

10.1 Enclosure and Compartmentation

The form of separation for Switchboards i.e. Main or Sub Main Distribution Boards shall be shall be Form 4 Type 2 as described in EN 60439-1 and as summarized below.

- Busbars shall be separated from the functional units.
- The functional units shall be separated from each other.
- Cables shall be terminated within the functional unit and glanded at the top, bottom or side of the cable chamber.
- Separation shall be achieved by metallic partitions in all cases.

Switchboards shall be of metal clad construction using a proprietary modular switchgear enclosure system such as Logstrup, Cubic or Elsteel.

The assembly shall be a multi-compartment distribution board comprising 1.5 mm sheet steel panels and rolled steel frame construction. The assembly shall have a bake-on powder spray finish in the manufacturer's standard colour. It shall have an ingress protection rating of at least I.P. 54.

The layout of the switchboard shall generally follow the following format as indicated in Appendix 1:

- Main incomer section for mains and generator supplies and multi function meters as required
- Main Horizontal busbars fully accessible
- Secondary Vertical busbars fully accessible
- Outgoer protective device compartments – vertically stacked adjacent to secondary busbars.
- Separate compartment doors shall be provided for each outgoer
- Cable compartment – Full Height adjacent to outgoer protective device compartments.

Glanding plates shall be supplied at top and bottom. It shall be suitable for over duct floor mounting.

10.2 Busbars Compartment

The switchboard busbars shall be of bare copper mounted in their own compartment. The complete system shall have an ASTA certified short circuit rating of 50kA for 3 sec at 400V.

The entire busbar assembly shall be a fully type tested system and the manufacturers shall supply short circuit test certificates for the system

The busbars and all associated connections shall be fully accessible from the front or top or bottom without having to remove switchgear.

A sheet of perspex or equivalent material shall be located behind the metal covers of the busbar compartment to enable safe inspection with a thermal imaging camera.

The busbar configuration shall be indicated on the busbar compartment covers as described later in this specification.

10.3 Cable Compartments

Cable compartments shall be provided in all switchboards beside and/or between the various vertical rows of outgoing protective devices. They shall be wide enough to ensure that cables can be terminated

easily and that cable-bending radii for the cables specified on the schematic drawings are not exceeded.

Each compartments shall be fitted with an earth busbar. Neutral bars shall not be permitted in this compartment. Neutral connections shall only be made onto a solid neutral link in the outgoer compartment.

10.4 Outgoer Protective Device Compartments

Each outgoing protective device compartment in the switchboard shall be door interlocked so that the switch or circuit breaker must be 'off' before the door can be opened. The interlock must be defeatable by insertion of a 2 mm diameter pin or equivalent.

Each compartment of the switch board shall be labelled to indicate the following:

- Function of compartment – e.g. Supply to Distribution Board G1
- Size and type of outgoing cable - e.g. 5X16 mm² XLP SWA PVC
- Max size of Fuse e.g. – Max Fuse 63A or where an MCCB is used Max thermal and magnetic settings - e.g. – Max trip Setting - $I_n = 63A$, $I_m = I_n \times 2.5$

These labels shall be supplied by the LV switchgear manufacturer and fitted on site on completion of the works.

10.5 Surge Protection Devices

Surge Protection Devices (SPDs) shall be installed in switchboards and distribution boards as described below to suppress over voltages and transients due to network disturbances and or lightning strikes.

Class 1 SPDs shall be fitted to each main switchboard at supply the intake point to each building. Class 2 SPDs shall be fitted downstream at each local distribution boards. These units shall be rail mounted within a dedicated compartment of the switchboard or distribution board.

SPDs shall be of Furuse manufacture or equal and shall comply with IEC 61643.

Where there is Lightning Protection System Specialist employed on the project The SPDs shall be supplied by that specialist and handed over to the switchgear manufacturer along with installation instructions.

10.6 MCCBs and ACBs General requirements

This section of the specification covers general requirements for Moulded Case Circuit Breakers (MCCBs) and Air Circuit Breakers (ACBs). Specific requirements in relation to each type is given below.

Unless otherwise indicated on the schematic drawings - ACBs – shall be used as main incoming protective devices for mains and generator supplies for ratings above 630 Amps.

MCCBs and ACBs shall be installed in appropriate cubicles in the Switchboard, with the appropriate busbars or cable connections as recommended by the manufacturer. Dimensions and ventilation of the cubicle shall be sufficient to dissipate the heat generated by the breaker at its nominal rated current.

Adequate space shall be provided above the breakers for the inspection and eventual replacement of the arc-chutes. Terminal blocks of the auxiliary circuit's terminals shall be easily accessible from the front of the breaker.

Where MCCBs and ACBs are indicated in the schematics they shall be of the same manufacture throughout. They shall provide protection against overloads, short-circuits, and, earth fault protection where indicated on the schematics.

All MCCBs and ACBs shall meet the following requirements in terms of their making, breaking and withstand capacities

- The Thermal Rated Current (Ith) shall be at least equivalent to the nominal current of the circuits they have to protect,
- The Service Breaking Capacity (Ics) shall be at least equivalent to the maximum presumed three-phase short-circuit current which may occur on their outgoing terminals.
- The Rated Making Capacity (Icm) shall allow the breakers to be closed on the maximum presumed three-phase short-circuit current which may occur on their out-going –terminals
- The short-circuit current withstand capacity (Icw) for 1 second shall be at least equal to the current corresponding to their Service Breaking Capacity Ics.

Internal accessories such as under voltage release coils, shunt trip coils etc shall be field installable and conveniently located behind the front accessory cover for easy replacement.

All MCCBs and ACBs in the switchboard shall be provided with duplicate volt-free contacts to provide “open”/“closed” and “trip” status signals to the BEMS.

All MCCBs and ACBs shall be provided with ancillary components to achieve the operational and control functions as specified or as required. These would typically power closing, under voltage releases and shunt trips as required to achieve the design intent as indicated on the schematic drawings.

All ACBs and MCCBs shall be fitted with electronic trips. Standard thermal and magnetic types shall not be acceptable.

Restricted Earth Fault (REF) relay protection shall be provided on all main circuit breakers to monitor earth leakage between the customer's MV/LV transformer and the main LV breaker. This shall be provided whether indicated or not on the schematic.

With this protection scheme the medium voltage breaker shall be tripped once the REF setting is reached. The MV breaker should not be tripped under long, short or instantaneous over current faults.

10.7 Discrimination Study

The switchgear manufacturer shall select the circuit breaker trips to ensure full discrimination is achieved throughout the entire installation. Using the breaker manufacturers software and cable sizes and lengths to be confirmed by the contractor he shall submit computer calculations to indicate the prospective fault levels throughout the installation along with verification that full discrimination has been achieved.

10.8 ACBs – Specific Requirements

All ACBs shall comply with EN 60947-2 and EN 60947-3. All their electrical and operating characteristics shall be expressed in accordance with these standards. The reference ambient temperature shall be 40°C.

Unless other wise stated all ACBs shall be withdrawable.

The operating mechanisms of the circuit breakers shall be of the “stored-energy quick-make” and “free-trip” type. They shall ensure “positive on” and “positive off” indications.

All settings shall be programmable on the field, without the use of any external device. A means of connection shall be provided for an external test device, allowing for periodical tests of the status of the electronics of the trip unit.

They shall be provided with independently powered tripping units such that the breaker does not trip due to under loading.

To avoid unauthorized tampering, the trip unit shall be sealable once adjusted (key-lock, or seal), behind a transparent door or plate, allowing the settings to be visible.

“Long Time” Protection against overloads shall be based on an inverse time/current characteristic adjustable between 0.4 and 1.0 times the rated current I_n .

A “pre-alarm” device shall be provided, to allow eventual load-shedding before an over-load trip occurs. A “thermal memory” shall be provided, adjustable to the type of load to be protected.

To allow discrimination with down-stream breakers, a delayed short-circuit protection shall be provided, with thresholds adjustable by steps, and ranging from 1.5 to 12 times I_r . The delay of this protection shall be adjustable from 0.1 to 1 second.

An instantaneous short-circuit protection shall also be provided, over-riding the delayed short-circuit protection, with its threshold adjusted to the current corresponding to the maximum breaking capacity of the ACB.

Where indicated on the schematic drawings ACBs shall also be equipped, with trip units to provide “Restricted earth fault (REF), Unrestricted earth fault (UEF) or Stand-by-earth fault protection (SEF). UEF and SEF relays shall include an I^2t sensing device, allowing for an adjustable delay in the tripping time, to ensure discrimination with other down-stream ACB's.

A specific “over-ride” protection, independent of the trip unit, shall ensure the trip when closing the ACB onto a short-circuit. This “over-ride” trip shall be unoperative if the short-circuit occurs with the breaker already in its closed position.

The electronic trip unit shall be self-protected, and ensure the tripping of the ACB in case of its malfunction. It shall enclose an “excess temperature” device and signal, which shall trip the breaker if the temperature inside its installation cubicle reaches a temperature, which may damage the ACB or the trip unit.

ACBs shall be equipped with both a local indicator and an auxiliary contact indicating “springs charged” when its closing mechanism is ready for operation.

The trip unit shall have LED indicators or LCD display to indicate the following:

- In-service
- Over-load pre-alarm (current $1.1 I_r$, 60% of thermal memory consumed)
- Tripped on “Long Time” - overload
- Tripped on “Short Time” - short circuit or inrush
- Tripped on “Instantaneous” protection
- Trip unit malfunction.

ACBs shall be equipped with a minimum of three volt free auxiliary contacts, operating simultaneously with the ACB and rated for 10 Amp and 250 VAC.

The trip unit shall provide 3 out-put signals, indicating:

- Pre-trip alarm - “Load-shedding required” alarm
- Tripped on external fault (overload or short-circuit)

An LCD display on the ACB shall indicate the following

- The current flowing through the ACB (phase by phase)
- The number of mechanical operations of the ACB
- A record of up to the last 16 trips

The trip unit shall have at least 4 inputs for external tripping signals, allowing the ACB to be remotely tripped. In addition the trip unit shall be able to communicate bidirectionally, via an RS485 serial connection and MODBUS protocol.

All ACB shall be equipped with a stored energy spring closing mechanism. The springs required shall be charged by means of a charging handle. The ACB shall be closed by means of green push-button marked "ON" and opened by means of a red push-button marked "OFF"

Where automatic closing is required e.g. as part of an automatic load transfer or load restoration system, an electrical motor shall charge the springs within 5 seconds.

In order to allow quick replacement and adaption to a different voltage, closing coils and trip coils shall be easily accessible from the front of the ACB, and require no tools for its replacement.

Unless otherwise agreed with the engineer in writing all ACBs shall be withdrawable type so that the circuit breakers can be replaced without the need to power down the busbars. They shall be mounted on telescopic slide rails with limit stops and shall incorporate a racking mechanism capable of horizontally isolating the circuit breaker from the busbars and enabling it to be withdrawn from the housing for inspection and maintenance. The carriage shall incorporate a location latch and withdrawal limit stops.

The moving part of withdrawable ACBs shall have 4 positions inside its fixed part:

- "Inserted", with main and auxiliary circuits connected.
- "Test", with main circuits isolated, and auxiliary circuits connected
- "Withdrawn", with main and auxiliary circuits disconnected
- "Extracted" (only for dismounting)

Except in the "Inserted" position, shutters will automatically close the access to the live parts of the mains at the rear of the ACB. "Test" and "Withdrawn" Positions shall not require the opening of the cubicle door.

The ACB shall automatically go into its "tripped" position and open its contacts, and remain open, as long as the withdraw handle is inserted in the withdraw mechanism.

The extraction handle for the withdrawable mechanism shall be stored in a convenient space inside this fixed part of the ACB.

All control and auxiliary circuit wiring shall be automatically connected / disconnected upon inserting/ withdrawing the moving part of the ACB. A plug and socket arrangement shall be provided for the isolation of the control and auxiliary circuits.

The fixed part of the ACB shall have a memory device, storing all the parameters of its movable part, downloading them automatically into the replacement ACB as soon as it is placed into the movable part and reaches the "test" position.

To ensure highest safety for the operating personnel, the ACB shall be equipped with a key to lock the ACB in its withdrawn position, the insertion of the key being necessary to move the movable part into its "inserted" position. A padlocking device shall also be provided to lock for the shutters closed.

10.9 MCCBs – Specific Requirements

Moulded case circuit breakers (MCCBs) shall be of compact and modular design complying with EN-60947-2 standard.

Unless otherwise agreed with the engineer in writing all MCCBs shall be plug-in type so that the circuit breakers can be replaced without the need to power down the busbars.

MCCBs shall typically range in standard IEC frame ratings from 125A up to 1600A. The frames shall be available in three interrupting capacities as follows:

-
- N - Normal
 - H - High
 - L - Very High

All MCCBs shall be fitted with interchangeable trip units with a choice of trip functions and features. The interchangeable trip units shall be available in three varieties as follows:

- Thermal-Magnetic
- Electronic
- Electronic with LCD display

MCCB with non-interchangeable trip units shall not be acceptable unless agreed in writing with the engineers.

Thermal Magnetic trip units shall not be acceptable unless agreed in writing with the engineers.

10.10 Switch fuses

Where switch fuses are indicated on the schematic drawings they shall be the fused switch disconnecter type using either B.S. 88 or NH type HRC fuses. The complete switch fuse assembly shall comply with EN 60947-3.

Switch fuses shall be single or triple pole double break with a separate solid neutral. The switch shall provide reliable position indication.

Fuse links shall be stationary and fully isolated when the switch is in the OFF position to allow safe changing of fuses.

A Door interlocking facility in the ON position shall be provided. It shall be possible to defeated the interlock to facilitate inspection without isolation of the load. Padlocking with up to 3 padlocks in OFF position shall be possible.

10.11 Mains Generator Automatic Load Transfer Systems

Automatic Load Transfer (ALT) Systems for transfer of the load from one "Mains" to "Generator" shall be one of the following types as specified on the schematic drawings.

- Motorized breakers or contactors with by pass facility.
- Fully integrated units.

In each case they shall comprise mechanically and electrically interlocked switching devices as indicated to prevent both devices being closed at the same time.

In each case indicator lamps or equivalent shall be provided to indicate each of the following conditions:

- Mains Available
- Mains on Load
- Generator Available
- Generator on Load

Auxiliary Volt-free changeover contacts shall be provided within the unit for relaying of the following conditions to a BMS or other alarm monitoring facility system:

- Mains Available: This should indicate that the mains is present and within acceptable limits.
- Mains on Load: This signal should be taken from an auxiliary contact of the mains switching device.
- Generator Available: This should indicate that the alternator output is present and within acceptable limits.
- Generator on Load: This signal should be taken from an auxiliary contact of the generator switching device.

10.12 ALT – Motorized Breakers or Contactors with By Pass

Automatic Load Transfer (ALT) System shall be provided as indicated on the drawings. They shall comprise contactors or motorized breakers as indicated to. The essential components of the ALT are typically as follows:

- Mains contactor or motorized breaker
- Generator contactor or Motorized breaker
- Under voltage trip – (UVT) - mains breaker
- Under voltage trip – (UVT) - generator breaker
- Phase failure relay (PFR)
- Timer - Mains available
- Timer -Generator available

- Timer - generator start/stop
- Indicator lamps
- By pass switch.

The automatic changeover contactor or breakers shall be 3-pole for 3-phase supplies or single pole for single-phase supplies. Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with EN 60947-4.

The mains under voltage unit shall continuously monitor the mains supply voltage (phase to neutral) on all three phases and initiate auto-starting of the engine should this voltage fall below the pre-set level on one or more phases.

The mains under voltage sensing level shall be precisely adjustable between 80% to 100% of nominal voltage. Differential adjustments shall be provided on each of the three phases, which shall be independent of each other and of the voltage level adjustment.

It shall be possible to set the differentials to within 5 volts of the pre-set voltage level and they shall have an adjustable range of at least 10 volts.

The mains under voltage unit shall be wired in such a way that the mains contactor or breaker will open immediately upon activation of the unit.

The ALT system shall be provided by-pass switch assembly to facilitate by pass of mains or generator. The switch by-pass assembly shall comprise 5 No 3 pole switches on a common operating shaft. The switches shall be 6 position, rotary actuated, with each switch closed at only one position in the full 360° as indicated in the table below.

Switch Position		Switch Functions and Status				
		1	2	3	4	5
		Mains Bypass	Mains Input	Gen Input	Gen Bypass	Mains / Gen Output
NORMAL	0°	Opened	Closed	Closed	Opened	Closed
OFF	60°	Opened	Opened	Opened	Opened	Opened
MAINS BYPASS	120°	Closed	Opened	Opened	Opened	Opened
OFF	180°	Opened	Opened	Opened	Opened	Opened
GEN BYPASS	240°	Opened	Opened	Opened	Closed	Opened
OFF	300°	Opened	Opened	Opened	Opened	Opened

10.13 ALT – Fully Integrated Units

The Fully Integrated (ALT) system shall comprise two electrically and mechanically interlocked motorized back to back load break switches. The system shall have three 3 stable positions (I, 0, II) i.e. Source 1, Off, Source 2 with manual override in both the mains and generator positions.

It shall have an integrated voltage sensing kit, programmable controller and an autonomous power source. It shall be a fully pre-engineered system and shall require only assembly, programming and connection to mains, generator and load on site. The system shall have integrated changeover logic for Normal/generator Backup applications.

The unit shall be supplied to site with the following components fully assembled on a back plate to replace the existing motorized MCCBs.

- Two back to back load break switches with bridging bars
- Motorized module
- Power supply and AMF and control module
- Handle, key and interlocking accessories.
- Door protective surround.

- Auxiliary contacts for remote alarm monitoring – See below
- Door mounted remote interface unit.
- Plug-in optional modules.
- Voltage sensing and power supply kit.

The switchgear specialist shall include for full programming of the motorized changeover switch. He shall agree all necessary set points and time parameters with regards to voltage and frequency with the engineer.

The Automatic Load Transfer (ALT) system shall be rated as indicated on the schematic drawings and shall be from the Socomec ATyS6e range.

10.14 Mechanical Interlocking of Switches and Breakers

Where indicated on the schematic drawings, mechanical interlocking of switches and breakers in the switchboard shall be provided using an approved key operated mechanical interlock system such as Castell FS Interlock or equivalent.

The system shall be specifically designed for the control of electrical switchgear and must not be defeatable by removing covers or otherwise to operate the switch or breaker actuator internally. The lock and key shall be manufactured in stainless steel.

Where a switchboard is fed from two transformers a mechanical interlock system shall be incorporated between each main incomer and the bus-section switch to prevent parallel operation of the transformers. This shall be achieved by means of a “two key three lock” mechanical interlocking system as described above.

A Key exchange unit shall be supplied where the interlock system extends beyond a simple “two key three lock” arrangement. The key exchange system shall be configured to trap and release keys in a pre-determined sequence, depending on the operating requirements of the safety interlocking system.

10.15 Residual Current Monitors

Residual Current Monitors (RCMs) shall be provided where indicated on the drawings. These non-switching devices shall continuously monitor and indicate the level of the residual current in the earthed systems (TN and TT Systems). A prewarning shall be actuated (by an LED bargraph indicator) as soon as the set residual current is exceeded. These monitors shall be rail mounted within a dedicated compartment of the switchboard. They shall be of Bender manufacture or equal and shall comply with IEC 62020.

The unit shall be provided with a volt free alarm output for remote monitoring.

10.16 Multi Function Meters

Multi function meters shall be fitted as indicated on the schematic drawings to provide digital indication of true RMS values of phase and line voltages, phase currents and real, apparent and reactive power.

The meters shall be recessed into the relevant outgoer compartment door. They shall have LCD display and individual direct access key for the following functions:

- Instantaneous and max currents values.
- Voltages and frequency.
- Active, reactive and apparent power (instantaneous and max values)
- Power factor.
- Energy over a specified period.

It shall be possible to centrally read these parameters on a PC or a PLC through an RS485 link using JBUS/MODBUS protocol. The Meters shall be also be provided with pulsed outputs for monitoring of energy usage and maximum demand values by the Building Energy Management System (BEMS).

The Multi function meters shall be from the Socomec DIRIS A20 range or equivalent.

Current transformers (CTs) shall be located in the relevant outgoer compartment and shall be securely fixed to the back plate. The nominal secondary current of all current transformers shall be 5 Ampere and shall have accuracy class 1 designation. Current transformers shall be protected to avoid damage from open circuit. Insulation shall be of the encapsulated resin type.

All control wiring shall be connected via DIN rail terminals and shall be complete with a terminal designation chart fixed to the inside of the terminal cover.

11. FINAL CIRCUIT Distribution Boards

11.1 Introduction

This section generally refers to final circuit distribution boards which are fed from the main switchboard or a sub main distribution board. These final circuit boards typically feed lights, sockets and small power final circuits.

11.2 Distribution Board Assembly

The form of separation for Final Circuit Distribution Boards shall be Form 2 Type 2 as described in EN 60439-1 and as summarized below.

Function units are not required to be separated from each other i.e. typically modular devices mounted side by side.

Main busbars feeding individual distribution board sections e.g. lighting, power etc shall be within their own compartment partitioned from the functional units by metallic or other fire retardant material.

Submain busbars serving rows of MCBs, RCBOs etc shall be separated from functional units by means of proprietary insulated covering on the busbars.

Main busbars feeding individual distribution board sections e.g. lighting, power etc shall be within their own compartment partitioned from the functional units by metallic or other fire retardant material.

Distribution boards may form part of a "switchboard" as previously described or they may stand alone. Where they do form part of a switchboard the enclosure shall be of the same design as the main switchboard. Bolt on cabinets shall not be acceptable.

For stand alone type distribution boards the enclosure may be formed from the same metal work system used for the switchboards or alternatively a cabinet type enclosure may be used as described below.

Cabinet type enclosure shall be of sheet steel construction minimum thickness 1.5 mm, electrolytic galvanized with raised doors and sealing profile. Glanding plates shall be supplied at top and bottom. It shall be suitable for surface wall mounting. The cabinet shall have a bake-on powder spray finish in the manufacturer's standard colour. It shall have an ingress protection rating of at least I.P. 54.

The interior shall consist of a supporting frame, top hat rails etc. It shall be fitted with touch/flash guards manufactured from sheet steel or other heat resistant self-extinguishing materials of proprietary manufacture.

11.3 Busbars

All final circuit distribution boards shall be provided with a main busbar section. Multiple loops from the main isolator or looping from isolator to isolator shall not be acceptable.

The busbars shall be of tinned copper mounted in their own compartment. The bars shall be predrilled and fitted bolts to accept up to 25 mm² tails. The busbar assembly shall be a fully type tested system and the manufacturers shall produce short circuit test certificates upon request.

Sub main busbar serving rows of MCB etc shall be pre-insulated comb busbar type in three pole format so that three single pole MCBs can be replaced by a triple pole MCB or vice versa.

11.4 Internal Wiring

The minimum size conductor between the protective device and the outgoing terminals in the distribution Board shall be as follows.

- Lighting Section 2.5 mm²
- Socket Section 2.5 mm²
- Small Power Section 4.0 mm²

11.5 Main and Sub Main Switches

The main switch for each distribution board shall be a rotary padlockable double break type with neutral link to EN 60947-3.

Sub-switch fuses for each section shall be similar with HRC fuses where indicated or where required for back up protection of the downstream MCBs.

Covers shall be interlocked so that the switch or circuit breaker must be 'off' before the cover can be removed.

11.6 Final Circuits Shall Protective Devices

All final circuits shall be protected by MCBs or RCBOs as described in the following paragraphs.

MCBs shall comply with EN 60947-2 and shall be minimum 6kA rated and shall be 'Type B' characteristic unless otherwise specified.

Unless otherwise noted on the drawings the following shall apply in respect of outgoing protective devices.

- Lighting circuits 10 A type 'B' SP MCBs.
- Sockets etc 20A X 30 mA Type 'B' SPN - A Class RCBO

Residual Current Devices RCDs include the RCBOs and RCCBs as described below. Unless otherwise specified on the schematic drawings all RCDs shall be 30 mA sensitivity.

RCBOs (Residual current operated circuit-breaker with integral over current protection) shall comply with EN 61008 - These devices are used for the majority of applications where RCD protection is required.

RCCBs (Residual current operated circuit-breaker without integral over current protection) conforming to EN 61009 shall not be used unless otherwise agreed in writing.

The following is a summary of the different type of RCDs types and where they may be used.

Type AC RCDs ensure tripping for residual AC currents, whether suddenly applied or slowly rising. RCBOs of this type shall not be accepted unless agreed in writing with the engineer.

Type A RCDs ensure tripping for residual AC currents and pulsating DC currents, whether suddenly applied or slowly rising. Unless otherwise specified all RCBOs shall be of this type.

Type B RCDs ensure tripping for residual AC currents, pulsating DC currents and smooth DC currents, whether suddenly applied or slowly rising. These shall only be used where specifically called for on the schematic drawings

All of the above shall be manufactured by Schneider or ABB .

11.7 Contactors and Motor Starters

Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with EN 60947-4.

Each motor starter shall be complete with MCB, contactor and thermal overload, selected to provide Type 2 co-ordination.

Each motor starter control circuit shall be complete with "run and trip" indicator lights and a "hand - off - auto" switch.

Each duty / standby control circuit shall also be complete with a 1 / 11 duty select switch.

Indicator lights shall be multicell LED type and shall be provided for panel live, Run & Trip status of all motors, Boiler lock out, Air flow failure, Fire interlock etc.

11.8 External Lighting Control

All external lighting distribution boards shall be fitted with an astronomical time switch which shall automatically switch on and off the lighting contactor at dusk and dawn. The units shall incorporate a digital time switch to enable programming of times to override the astronomical control element and switch off the lighting in advance of dawn.

All astronomical time switches shall be of modular design, with change-over contacts rated at 16 Amps resistive, with manual over-ride facility and 150 hours battery reserve as per Theben Selekt range unless specified otherwise in the particular specification.

11.9 Central Test Units for emergency lighting

Central test units (CTU) shall be provided within each of the lighting distribution boards for all self-contained emergency lighting systems. They shall have the following features: -

- 'On/off' control switch.
- ' ½ Hour / 3 Hour' selector switch.
- 'Emergency Lighting on Test' indicator.
- 'Test Complete' indicator.
- Interposing relays.

When the system is in test mode a 220 Volt signal shall energize one or more interposing relays to break the feeds to emergency points and shall automatically reset after the selected test period.

The interposing relays shall be multipole normally closed relays or contactors rated at 10 Amps minimum.

11.10 Change Over Panels for Dual A&B Supplies

Change Over Panels (COPs) shall be provided as indicated on the drawings to enable automatic transfer of critical loads from the A to the B supply or vice versa. The essential components of the ALT are as follows:

- Contactors
- Phase failure relay (PFR)
- Timer
- Indicator lamps
- Source select key switch.

They contactors shall be mechanically and electrically interlocked to prevent both devices being closed at the same time. They shall be 3-pole for 3-phase supplies or single pole for single-phase supplies. Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with EN 60947-4.

The PFR unit shall continuously monitor the mains supply voltage (phase to neutral) on all three phases and initiate the load transfer should the supply voltage fall below the pre-set level on one or more phases.

LED type Indicator lamps shall be provided as follows:

- Supply A Available
- Supply A on load
- Supply B Available
- Supply B on load

When one of the two supply fails the load will automatically transfer to the other supply. When both supplies fail the load will automatically transfer to the first supply that becomes available.

A Source Select Key Switch shall allow either the A or B supply to be selected manually.

11.11 Pan Assembly Type Distribution Boards

This type of distribution shall be only used where it is specifically called for on the schematic drawing.

Pan Assembly units metal clad distribution board complete with 100A or 250A main switch as required. They shall be designed for surface mounting or for flush mounting using flush mounting kit.

The Busbar ratings shall be 250A for TPN boards and 125A for SPN boards. The busbar system shall have a distributed neutral allowing 2 or 4 pole switching at any outgoing way. They shall be designed, manufactured and tested to EN 60439-3.

They shall have an ingress protection IP31 to EN 60529. They shall be epoxy powder coated in the manufacturer's standard colour. They shall be from the "Isobar 4" range as manufactured by Schneider, ABB or equal and approved.

11.12 Consumer Unit Type Distribution Boards

Other than domestic application i.e. within the confines of a private residence Consumer Unit type Distribution Boards shall not be used.

Consumer units shall have IP40 degree of protection and shall be double insulated. They shall comply with IEC 60670 governing insulating enclosures for modular switchgear.

Consumer units shall be available in the colour of RAL 9016 white. Consumer units shall be for domestic or commercial locations, complete with a single door – transparent tinted. They shall be available in single, two – or three – tier models as required.

The base of each consumer unit shall be equipped with a special system of shrouding for the wall fixing holes, with integral plastic elements which shall ensure insulation substantially superior to that required by the standard.

Terminal bars (neutral and earth) shall be installed in the upper and lower areas of the consumer units. The terminal bars shall snap directly onto the base requiring neither screws nor tools and shall be installed in pairs (two terminals above and two below).

Moulded pre-cuts shall be provided inside the cover, the dimensions of which correspond to those of the trunkings most widely available commercially. Conduit fixture achieved by means of flanges supplied, which are fixed to the base of the consumer unit provided with moulded knockouts for conduits of up to 40mm in diameter.

In two-tier or three-tier consumer units (from 24 to 54 modules) it shall be possible to withdraw the chassis for wiring. The consumer unit shall also have a facility for inclining the frame to ease the task of connecting the incoming and outgoing cables.

The main circuit breaker shall be double pole and complete with Type 2 surge protection. All MCBs shall be minimum 6KA rated and shall be 'Type B' characteristic unless otherwise specified. Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with EN 60947 - 4. All control wiring shall be connected via DIN rail terminals and shall be complete with a terminal designation chart fixed to the inside of the cover.

The consumer units shall be manufactured, by one of the following, Schneider or ABB Manufacturing or equal and approved. Consumer units shall be of metal construction.

11.13 Isolation Transformers:

Isolating transformers shall be dual wound, centre tapped to earth on the secondary side, 1:1 ratio, (230 V: 230 V). The KVA rating shall be as indicated on the drawings.

Primary and secondary over current protection shall be provided. The secondary over current protective device shall be a double pole MCB with shunt trip facility.

Earth leakage protection shall be provided by means of a suitable sensor which shall operate the shunt trip on the secondary MCB. A test button shall also be provided.

The transformer and its associated protective devices shall be housed in a suitable ventilated metal enclosure.

12. E.S.B. Metering

12.1 Introduction

It shall be the responsibility of the switchgear manufacturer to comply fully with all requirements of the latest version of the National Code of Practice for Customer Interface as published by the ESB.

12.2 E.S.B. Metering Compartments

Where indicated on the schematics the main switchboard shall contain separate compartments for WC meters and / or metering CTs. Sized in accordance with the National Code of Practice for Customer Interface.

12.3 E.S.B. Metering Panels

E.S.B. Metering switchboards shall be built in accordance with the current edition of the National Code of practice for Customer Interface.

For large commercial developments e.g. multi tenant occupied RMCE office blocks with multiple CT meters or mixed WC / CT meters the panel shall be compartmented to Form 4 Type 2 and shall generally comply with the Switchboard Section of this specification

For smaller developments with multiple WC meters the panel shall be compartmented to Form 2 Type 2 and shall generally comply with the Distribution Board section of this specification

13. POWER FACTOR CORRECTION EQUIPMENT:

13.1 Introduction:

Power factor correction equipment shall comply with and conform to the current issues of the relevant I.E.C. and European Standards as follows.

IEC 60831-1 - Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V - Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation.

IEC 61642 - Industrial a.c. networks affected by harmonics - Application of filters and shunt capacitors.

IEC 61921 -Power capacitors - Low-voltage power factor correction banks

13.2 General Arrangement of Equipment:

Specific details of the power factor correction equipment shall be as indicated on the schematic drawings. Power factor correction equipment shall comprise capacitors and reactors assembled in a sheet steel enclosure together with switchgear, relays, protective fuses, reactive power regulators and main isolator.

The complete assembly shall be connected so as to automatically control the switching 'in' and 'out' of the capacitors to maintain the load power factor at the specified level and filter out unwanted harmonics.

13.3 Capacitors:

The capacitor unit shall comprise a suitable number of capacitor elements to achieve the required KVAR output.

The capacitor dielectric shall be zinc metalised polypropylene film to provide low losses and shall have self-healing characteristics and shall be liquid free.

Each element shall incorporate a secondary set of solid foil electrodes together with an individual element fuse link to ensure safe disconnection at the end of normal working life.

The capacitor elements shall be incorporated in a steel container with inert non toxic granular filling to surround every element. Aluminium cooler plates shall be provided to effect heat dissipation from the elements to the container.

The capacitors shall comply with the requirements of IEC 60831, Part 1 and Part 2.

13.4 Reactors:

Reactors shall be connected in series with capacitors to form a series resonant circuit, tuned so as to act as a low impedance source to the range of harmonic currents likely to prevail in the installation. Reactors shall be formed using copper conductor coils wound on laminated iron cores.

The switchgear specialist shall include for carrying out a power quality analysis on site to determine the range of harmonics on the network He shall include for doing this when the building is fully occupied.

Based on this information he shall determine the tuning frequency of the harmonic filters and select the series reactors accordingly.

He shall use a high quality power analyser and produce a report outlining his findings and recommendations before manufacture of the harmonic filters commence.

For the purpose of tendering the following harmonic distortion shall be assumed.

- 3rd – xx%
- 5th – xx%
- 7th – xx%
- 11th – xx%
- 13th – xx%

13.5 Switching:

Capacitor units shall be switched by contactors controlled by a KVAR regulator. Each switched stage shall incorporate soft start cascade switched contactor sections not exceeding 25 KVAR at 415 V, each equipped with inrush limiting devices in order to significantly reduce the inrush transients associated with power capacitor energisation. Each stage of correction shall be protected by HRC fuses.

Exact ratings and interconnecting of contactors, switchfuses, cables, etc. shall be in accordance with the power factor equipment supplier's recommendations and drawings.

13.6 Reactive Power Regulator:

The reactive power regulator shall be a microprocessor-based multi-step regulator, digital display, mounted on a hinged door of the sheet steel enclosure and shall have the following features:-

- Automatic CT polarity retrieval (to be disabled when required).
- Automatic frequency selection 50 Hz or 60 Hz.
- Settings for inductive and capacitive current.
- Setting for inductive and capacitive target power factor (cos-phi).
- Setting for operation delay.
- Operation delay shall shorten automatically with heavy over compensation.
- Plug-in connectors at rear panel.
- Separate alarm relay with volt free contact.
- Manual operation facility.
- Protective momentary no voltage reset function.
- Watchdog for eliminating possible interference problems.

13.7 Equipment Enclosure:

The complete automatic power factor correction system shall be housed either within a separate cubicle of the main switchboard or in a separate sheet steel assembly.

The capacitors shall be housed in a lower compartment, the volume of which shall be advised by the capacitor manufacturer/supplier subject to a minimum of 1000 cm³ per KVAR.

Filtered air extract and intake grilles shall be provided at the top and bottom respectively of the capacitor compartment cover to give adequate ventilation.

A thermostatically operated extract fan shall be provided to draw air across the capacitors if required.

14. Replacement of Existing SWITCHGEAR

14.1 Introduction

This section of the specification covers requirements in relation to replacement of existing distribution boards or switchgear in buildings as may be required.

Prior to commencing the replacement of existing distribution boards the contractor shall survey the board and its associated circuits to determine the full scope of works required.

14.2 Load Monitoring

All loads served by the distribution board should be monitored using a power analyzer capable of providing the following information on a phase by phase basis.

- KW – Real Power.
- KVA – Apparent Power.
- KVAR – Reactive Power.
- Power factor.
- % Harmonic Distortion – Current.
- % Harmonic Distortion – Voltage.

The information recorded should be saved as spreadsheet files with the peak demand values highlighted in each case. Each file should be clearly identified by name of the distribution board or load as described above. A copy of the recordings should be forwarded to the engineer for analysis and recommendations.

14.3 Testing of Circuits

The contractor shall carry out the following tests on each existing circuit associated with the distribution board. Tests shall be carried out as outlined in the latest edition of the IS 10101 National Rules For Electrical Installations:

- Insulation Resistance Tests
- Earth Continuity
- Line Earth loop impedance.

He shall carry out a full visual inspection of the entire installation. He shall open up and inspect each distribution board, marshalling boxes, lighting and socket points etc relative to the contract works and examine the wiring and connections within. All defective parts of the installation shall be photographed and presented to the engineer for further instruction.

Recording of Survey Information

The survey information shall be recorded onto circuit designation charts using typed spread sheets with clear unambiguous information in the format indicated below. A separate chart shall be provided for each distribution board.

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14.4 Survey drawings

Using the survey drawings provided the contractor shall mark up the circuit references for all circuits associated with the replacement distribution board. These shall include lighting and emergency points, socket outlets, small power points serving water heaters, hand driers, PSUs for security systems etc. This information must correlate with the circuit designation charts referred to above

These drawings shall be handed back to the RMCE for production of record drawings in electronic format.

14.5 Link Boxes

The replacement distribution board shall be designed to pick up all existing sub mains and final sub Circuit wiring in so far this is practically possible. Where it is not possible to extend existing wiring to the new the contractor shall supply and install metal clad link boxes with DIN rail terminals labelled with suitable warning notices. E.g. "Joint Boxes for Circuit N°s G5 112 – 31R and G5 112 – 3B. Switch off MCBs to isolate supplies".

14.6 Retention of Existing Wiring

Where existing final circuit wiring serving lighting, sockets and power services is to be retained the following parameters shall not exceed without further consultation with the engineer.

- 1.5 mm² lighting circuit – 6 Amp type B MCB
- 2.5 mm² lighting circuit – 10 Amp type B MCB
- 2.5 mm² radial socket circuit – 16 Amp type B / A TYPE RCBO
- 4.0 mm² radial socket circuit – 25 amp type B / A TYPE RCBO

14.7 Colour Coding

All existing cables to be reconnected to the replacement distribution boards shall be fitted with coloured heat shrink sleeving to meet new colour coding requirements of the current IS 10101 National Rules For Electrical Installations.

Where it is not practical to sleeve cables the contractor shall install warning notices on all replacement distribution boards using red/white/red triplex engraved labels. A sample label should be submitted for approval on the basis of the following wording – **"Warning: Circuits wired from this Distribution Board contain the following mixed wiring colours"**:

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14.8 Removal of Obsolete Switchgear

The contractor shall include for the disconnection, taking down, removal from site and disposal of all obsolete switchgear, electrical fixtures, cable management systems and cabling from the site in accordance with the current WEEE (Waste Electrical and Electronic Equipment) directive 2002/96/EC. The contractor is deemed to be familiar with these regulations and should include for full compliance within his tender submission. Any Switchgear assemblies or components which may be of use to the RMCE in the future shall be retained.

15. Identifications & Labelling

15.1 General

All LV switchgear shall be clearly and permanently marked to indicate the following:

- Name of manufacturer
- Nominal voltages and frequency
- Rated currents
- Serial number or other identification of the equipment
- Date of manufacture

The suggested label schedule shall be submitted to the Engineer for his approval prior to manufacture.

Danger labels shall also be provided for on interlocked covers enclosing exposed conductors stating 'Danger 400 volts' in block capitals.

Where there are two or more incoming supplies, this shall be clearly indicated at each point of isolation.

15.2 Compartment Labels

Suitably engraved Traffolyte labels, white/ black/ white, 100 x 50mm minimum size, shall be screw fixed on the front of each compartment of the switch board to indicate the following:

- Function of compartment – e.g. Supply to Distribution Board G1
- Size and type of outgoing cable - e.g. 5X16 mm² XLP SWA PVC
- Max size of Fuse e.g. – Max Fuse 63A or where an MCCB is used Max thermal and magnetic settings - e.g. – Max trip Setting - $I_n = 63A$, $I_m = I_n \times 2.5$

These labels shall be supplied by the LV switchgear manufacturer and fitted on site on completion of the works.

15.3 Busbar Configuration

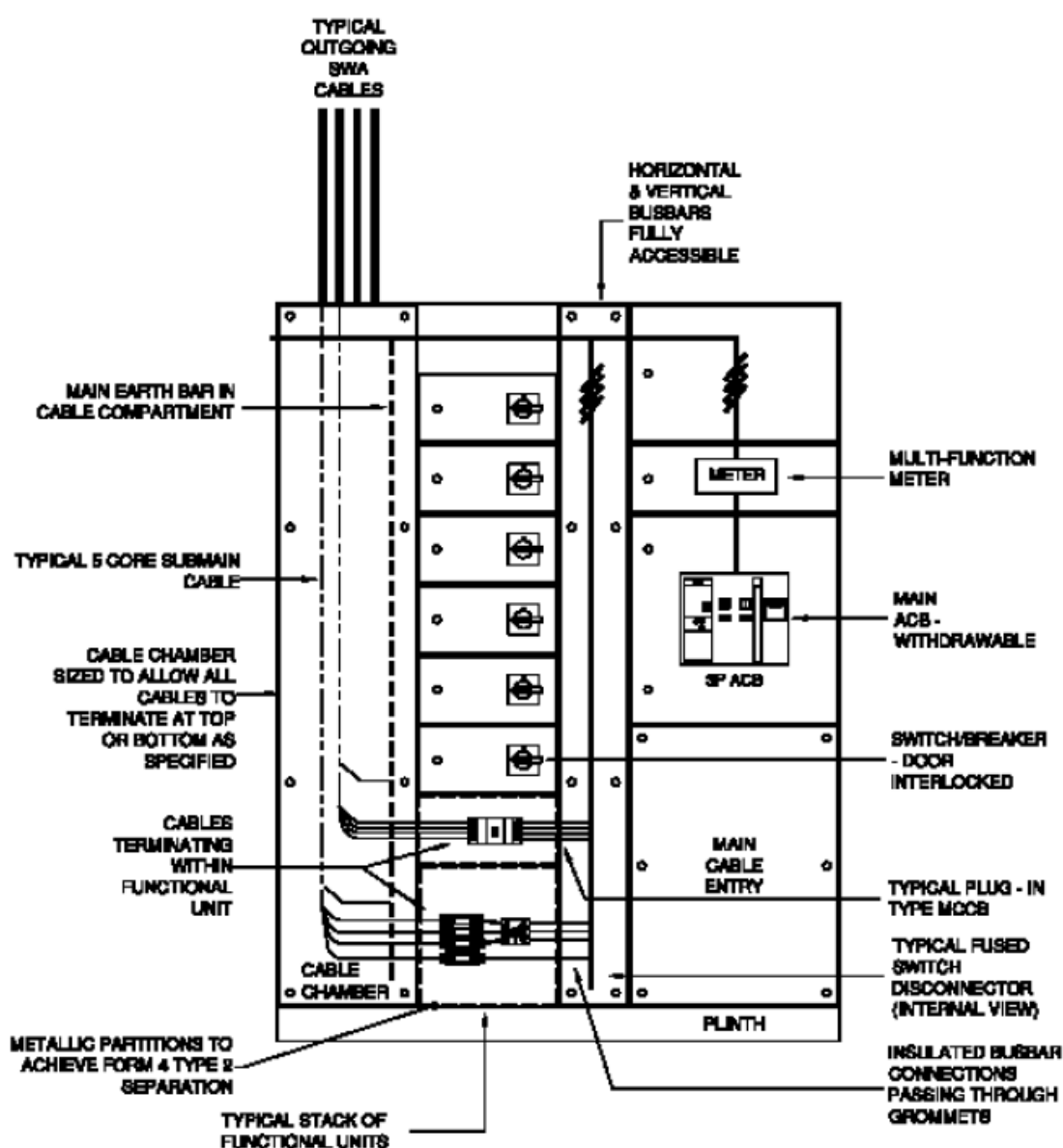
The busbar configuration shall be indicated on the busbar compartment covers using adhesive triplex labelling material minimum 10mm wide throughout. The following colour coding system shall be used or a variation of this depending on the complexity of the system;

Essential Services	–	Red
Non-essential Services (Mains Only)	–	Green
UPS Services	–	Orange



Appendix 1 – Typical Switchboard – Form 4 type Construction

APPENDIX 1: EXTERNAL FRONT VIEW OF TYPICAL SWITCHBOARD (MAIN OR SUB MAIN DISTRIBUTION BOARD) TO FORM 4 TYPE 2 CONSTRUCTION

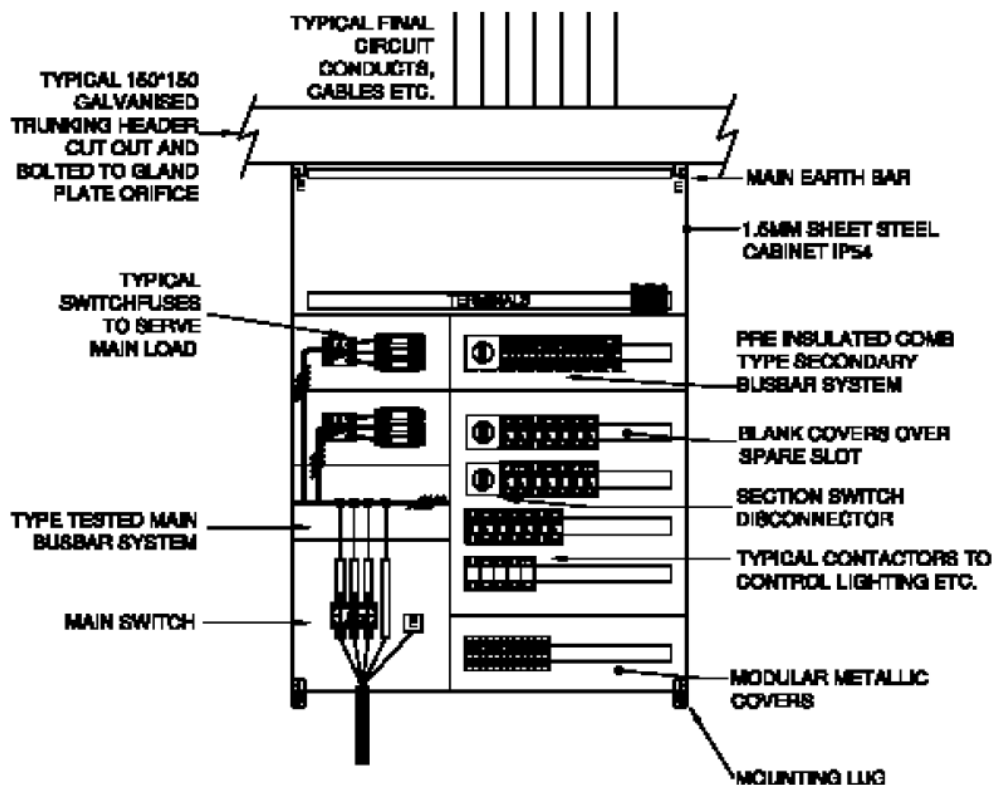


Distribution boards over 100kVA shall be Form 4 / Type 2 (functional units separated from each other and busbars, cables glanded elsewhere, terminals associated with functional units to be

located in the same compartment as the functional unit. Separation by metallic or non-metallic rigid barriers)

Appendix 2 – Typical distribution board – Form 2type 2 Construction

APPENDIX 2: INTERNAL FRONT VIEW OF TYPICAL FINAL CIRCUIT DISTRIBUTION BOARD ETC TO FORM 2 TYPE 2 CONSTRUCTION



All sub-distribution boards shall be Form 2b / Type 2 (functional units and terminals separated from busbars but not from each other – separation by metallic or non-metallic rigid barriers) , except for din rail mounted protective devices (switchgear) where type 1 separation may be used (separation by insulated coverings)

17. GENERAL METHODS OF INSTALLATION LIGHTING AND POWER

17.1 General

The following descriptions of the methods of installation are intended for guidance in tendering and carrying out of installation work on the electrical systems in buildings. Job specific tender documentation will in most cases describe the method of installation. Refer to Particular Specification and Description of Work for these job specific requirements.

17.2 Cabling

Type 1

Galvanised steel trunking and conduit with pvc cables generally routed in voids and where necessary on the surface.

Type 2

Armoured cable on galvanised steel tray.

Type 2.1

XPLE LSF Armoured cable

Type 2.2

PVC/SWA/PVC Cable

Type 3

Unarmoured cable on galvanised steel tray.

Type 3.1

NYY cable on galvanised steel cable tray or ladder.

Type 3.2

NYMJ on galvanised steel tray and locally in galvanised steel tubing.

Type 4

Cable fixed directly to the building.

Type 5

Buried directly in the ground. This method of installation shall only be used for armoured cable with a waterproof oversheath.

Type 6

Formed concrete duct or void designed exclusively for the purpose of accommodating cabled services.

Type 7

Radox or similar screened composite cable in straight lengths of galvanised steel tubing. The tubing shall not be provided at the bends the radius of the cable at the bends to meet with the manufacturers guidelines as per British Standards.

17.3 Lighting Installation

The lighting installation shall be in cabling method Type 1.

The installation will generally be in ceiling voids where permanent access is provided. Where such access is not provided see below for installation details. From the local distribution board circuits – phase, neutral and earth, including emergency lighting circuits - shall be terminated at local terminal boxes (Klippon or similar). The connectors shall be din-rail mounted and shall provide connections to local switching and light fittings. The terminal boxes shall be arranged in a modular fashion to match building layout or similar regular pattern.

Galvanised tubing to luminaire connection point with the final flex connection to the luminaire through a Klux socket. There shall be one Klux unit per luminaire.

The maximum length of flex which shall be 2000mm. No flexible cables shall pass through or be routed in partitions without the express written instructions from the engineer.

Switch drops shall be in galvanised tubing or in the case of stud partitions may be in armoured cable or armoured flexible conduit as appropriate. The maximum length of flexible conduit measured from the ceiling level to the rigid conduit or trunking system shall be the sum of the ceiling void depth plus 250mm.

In situations where permanent access to the ceiling void is not provided care must be made to ensure access to all cable joints. In such circumstances a loop-in conduit system or a Type 2 method of installation as described above – armoured cable on cable tray – shall be required. All cable terminations and lighting connection points shall be within reach of ceiling openings as may exist for recessed light fittings and the like.

Where the installation is recessed in concrete or blockwork/rendering the installation shall be entirely in galvanised steel conduit.

17.4 General Services

The general service installation such as socket outlets and wiring to fixed appliances shall be as described for lighting as in the case of ceiling voids, partitions including specific limitations and restrictions as detailed.

Raised Floor Installations

In proprietary raised floor voids the cabling system shall be one of the following systems:

- a) Type 2 installation as described above to local plug-in units or proprietary busbar units. Armoured flexible cables from plug-in units to floor mounted service outlet boxes. Flexible cables shall be glanded.
- b) Type 3.2 Installation wired directly into service outlet boxes. NYMJ cables shall be glanded with PG glands. The maximum distance for a cable to be run unsupported shall be 400mm.

Ceiling Voids and Partitions

The standard method of installation shall be **Type 1** or **Type 2.1** unless otherwise specified.

Drops to outlets shall be in galvanised tubing or in the case of stud partitions may be in armoured cable or armoured flexible conduit as appropriate. The maximum length of flexible conduit measured from the ceiling level to the rigid conduit or trunking system shall be the sum of the ceiling void depth plus 250mm.

In situations where permanent access to the ceiling void is not provided care must be made to ensure access to all cable joints. In such circumstances a Type 2 method of installation as described above – armoured cable on cable tray – shall be preferable. All cable terminations of ceiling openings as may exist for recessed light fittings and the like.

17.5 Circuit Labels

See also “IDENTIFICATION OF ELECTRICAL SERVICES” SECTION

Each outlet for lighting, socket outlet, fused spur, floor box, etc shall be labelled indicating the distribution board or sub-board from which it is fed and the circuit number.

e.g. A socket labelled in the following manner: **SB7/12** would indicate that the socket is fed from circuit 12 on sub-board 7.

Labels shall be engraved “Traffolyte” save in circumstances that the outlet is concealed in a ceiling or floor void where self adhesive paper may be used.

Outlets feeding appliances shall have such appliance indicated on the label.

All labels shall consist of black text on a white background unless otherwise stated.

17.6 Standard Cable Sizes

The following table lists standard default minimum cable sizes for internal wiring. The contractor is advised to seek confirmation of cable sizes not specified in the job specific documents.

Service	Length	Max No. Outlets	Max Loading	Cable Size	Protective Device
Lighting	<35 metres	8		1.5sq	10amp C Type MCB
	>35 metres	8		2.5sq	10amp C Type MCB
Sockets	<35 metres	10		2.5sq	20amp B Type RCBO
	>35 metres	10		4sq	20amp B Type RCBO
Hand Dryers	<35 metres	1		4sqsq	16amp B Type RCBO
	>35 metres	1		6sqsq	16amp B Type RCBO

17.7 Hand Dryers Installation

The contractor shall supply and install hand dryers as detailed on the drawings. Hand dryers shall be mounted 1200mm above the finished floor level except in the case of a disabled toilet where the mounting height shall be 900mm. Hand dryers shall be wired in via a recessed 13amp switched fused connection outlet with indicator light. The connection outlet shall generally be located 300mm above the finished top level of the hand dryer or adjacent to the hand dryer. There will be no more than one hand dryer per circuit. All hand dryers shall be automatic and shall be selected one of the following:

- Flowsave T3 Automatic
- Redring AD30 Automatic
- World Dryers MR48 Automatic

18. LV SWITCHGEAR AND DISTRIBUTION BOARDS

18.1 MAIN DISTRIBUTION:

The Electrical Specialist shall include for the installation of a main distribution board and attendance on E.S.B. for the installation of metering as shown on the relevant drawings.

The Electrical Specialist shall also include for the installation of the sub-distribution boards as indicated on the drawings and documents.

18.2 L.V. Switchgear.

- 18.2.1 Switchboards shall be of metal clad construction including all external housing and doors and internal dividers and guards. The assembly shall be a multi-compartment switchboard of 1.5mm sheet steel construction and shall be compartmented to Form 4 Type 3, IP55 rated with each compartment clearly labelled. Partition fillets shall be of sheet steel manufacture. It shall be of cubicle design with separate compartment doors for each out goer.
- 18.2.2 Glanding plates shall be supplied at top and bottom. It shall be suitable for over duct floor mounting. The assembly shall have a bake-on powder spray finish in the manufacturers standard colour. It shall have an ingress protection rating of at least I.P. 54.
- 18.2.3 The busbars shall be of bare copper mounted in their own compartment. The busbars and all associated connections shall be fully accessible throughout without having to remove switchgear. The busbar assembly shall be a fully type tested system and the manufacturers shall produce short circuit test certificates upon request.
- 18.2.4 Cable compartments shall be provided between the various vertical rows of switchfuses. They shall be wide enough to ensure that cables can be terminated easily and that cable-bending radii are not exceeded. Each one shall be fitted with an earth busbar.
- 18.2.5 Each compartment shall be door interlocked so that the switch or circuit breaker must be 'off' before the door can be opened.
- 18.2.6 Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with IEC 251.
- 18.2.7 The main switchboard shall contain separate compartments for E.S.B. WC meters and / or metering CTs and the switchboard manufacturer shall be responsible for meeting all E.S.B. metering requirements prior to construction of the board.
- 18.2.8 The main switchboard and all remote area switchboards shall be equipped with surge protection units to suppress over voltages and transients due to network disturbances and or lightning strikes. These units shall be rail mounted within a dedicated compartment of the switchboard. They shall be of Furze manufacture or equal and shall comply with the latest relevant BS / IEC standard and fused at 60A. HBC
- 18.2.9 All ACBs, MCCBs and MCBs shall be of the same manufacture throughout. All main air circuit breakers shall be fully withdrawable. Sub-main MCCBs shall be fixed type. All MCBs shall be minimum 10 KA rated and shall be 'Type C' characteristic unless otherwise specified.
- 18.2.10 Isolation of main boards and of individual sub-boards shall be as follows:
 - 1.3.10.1 Up to 250Amp switches and switch fuses
 - 1.3.10.2 250 Amp to 400 Amp MCCB'S to IEC 157-1, BS4752
 - 1.3.10.3 400 Amp and above MCCB's to IEC 157-1 with rated prospective short circuit current @40 KA and tested to IEC 157-1 PL Category.

- 18.2.11 Automatic load transfer contactors for ESB and generator supplies shall be mechanically and electrically interlocked and shall be provided with key interlocked by-pass switches. Auxiliary switch on main MCCB/ACB will be utilized to stop the generator from starting on opening of the MCCB/ACB.
- 18.2.12 Switchfuses shall be HRC type using either B.S. 88 or NH type fuses. Switches shall conform to IEC 408. Switchfuses/fuse switches shall be single or triple pole double break as indicated with a separate neutral link in each compartment.
- 18.2.13 Earth fault relay protection shall be provided on all main circuit breakers. Each main circuit breaker shall be provided with independently powered tripping units.
- 18.2.14 The switchgear manufacturer shall select the circuit breakers to ensure full discrimination is achieved throughout the entire installation. He shall submit computer calculations to indicate the prospective fault levels throughout the installation along with verification that full discrimination is achievable.
- 18.2.15 Each switchboard shall be fitted with energy meters to provide digital indication of phase and line voltages, phase currents and real, apparent and reactive power and max demand. Meters shall be provided with pulsed outputs for monitoring by the building energy management system (BEMS).
- 18.2.16 All main and sub-main breakers in the switchboards shall be provided with duplicate volt-free contacts to provide 'open', 'closed' and 'trip' status signal to the BEMS and a remote mimic panel (for later use)
- 18.2.17 All control wiring shall be connected via DIN rail terminals and shall be complete with a terminal designation chart fixed to the inside of the terminal cover.
- 18.2.18 Switch boards shall be of the type as manufactured by those companies listed in Appendix A of this document.

18.3 Distribution Boards

- 18.3.1 The Electrical Specialist shall include for the supply and installation of distribution boards to serve individual areas as indicated on the drawings.
Distribution boards serving individual areas etc shall be custom-built low voltage switchgear assemblies manufactured in accordance with IEC 439, Form 2 and the IS 10101 National Rules For Electrical Installations.
- 18.3.2 The housing shall be sheet steel minimum thickness 1.5mm, electrolytic galvanised with raised doors and sealing profile. Glanding plates shall be supplied at top and bottom. It shall be suitable for surface wall mounting. The cabinet shall have a bake-on powder spray finish in the manufacturers standard colour. It shall have an ingress protection rating of at least I.P. 54.
- 18.3.3 The interior shall consist of a supporting frame, top hat rails etc. It shall be fitted with touch/flash guards manufactured from sheet steel of proprietary manufacture.
- 18.3.4 The main switch for each board shall be a rotary padlockable double break type with neutral link to IEC 408. Sub-switchfuses for each section shall be similar with HRC fuses. Covers shall be interlocked so that the switch or circuit breaker must be 'off' before the cover can be removed.
- 18.3.5 All protective devices for final sub-circuits shall be din-rail mounted. Integral busbar arrangements shall not be accepted. All lighting circuits shall be protected by 10 Amp type 'C' SP MCBs. Sockets etc shall be protected by means of 20 Amp x 30 mA SP&N type A RCBOs. Type AC RCBOs shall not be accepted. Security equipment and miscellaneous power supplies shall be protected by 16 Amp type 'C' SP MCBs ratings as indicated.

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- 18.3.6 Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with IEC 251.
- 18.3.7 All motive power distribution board sections serving extract fans shall be fitted with motor circuit breakers incorporating both magnetic release and an adjustable thermal overload release to give individual short circuit and overload protection of each motor circuit. The Engineers shall advise the overload ratings of these motor breakers.

19. WIRING TO MECHANICAL PLANT AND EQUIPMENT

19.1 In progress

The following information is intended for guidance in tendering and carrying out of installation work on the electrical systems in buildings where specific information is not supplied elsewhere in the tender documentation. Refer to Particular Specification and Description of Work or Drawings for any job specific requirements.

19.2 Power Distribution and Control Systems

Heating and Ventilation equipment shall generally be supplied and controlled from Control Panels supplied by the Mechanical Contractor.

19.3 Equipment Co-ordination

The mechanical contractor shall be responsible for taking the coordination of electrical services to mechanical plant. The electrical contractor shall liaise with the mechanical contractor on the wiring and commissioning of the mechanical equipment. He shall seek full descriptions of the equipment early in the construction contract including electrical loadings and other electrical special requirements or characteristics, locations, etc.

19.4 Power Supplies

19.4.1 Method of Installation

Unless otherwise specified these shall be as **Type.1** or **Type. 2.1** methods of as described in the power distribution section. External wiring shall be in **Type 2.1** unless otherwise specified.

19.4.2 Local Isolation

All items of equipment shall be provided with local isolators appropriately rated unless otherwise stated. Isolators shall be as follows unless specific ratings are specified elsewhere.

Isolators shall be MK or equal and approved **unless otherwise stated**. Isolators shall be supplied suitable for three phase **unless otherwise stated**.

Description of Plant	Default Rating	Comment
Heating Pump	10A	
Air Handling Supply Air fan	20A	
Air Handling Return Air fan	10A	
Toilet Extract Unit	10A	Separate supply to Twin fans
Oil Fired Heating Burner	10A	
Gas Fired Heating Boiler	10A	
Domestic Cold Water Booster Pump	20A	
Domestic Hot Water Booster Pump	20A	
Fire Hose Reels Booster Pump	20A	
Hot water Circulating Pump	10A	Single Phase only

19.4.3 LV Control Control Wiring

(Building Energy Management Systems)

Cable runs up to 30 meters to single control units such as valves and actuators may be wired in combined cable for both signal and e.l.v. For cable runs in excess of this the e.l.v. supply shall be run separately taking account of volt drop.

Equipment	Location	Height mm	Cable	Comment
Temperature Detector	Pipe	NA	Beldon 9502	
	Wall mounted	1400	Beldon 9502	
	Plantroom	1400	Beldon 9502	
	External	1400	Beldon 9502	
Humidity Detectors	Duct	NA	Beldon 9502	
	Wall mounted	1400	Beldon 9502	
Combined Temperature Detector and Local Control Adjustment	For disabled use	1200	Beldon 9502	
Pressure Sensor	Duct/Pipe	NA	Beldon 9502	
Air Quality Sensor	Duct		Beldon 9502	
	Wall		Beldon 9502	
Damper Actuator			Beldon 9502	
Heating Control Valve			Beldon 9502	

19.4.4 Protection of Control Cables

The electrical contractor shall provide for the mechanical protection of all control cables both internally in the building and externally by way of metal covers on cable trays, metal conduit, or armoured cable trays as appropriate.

In addition external control cables shall be UV protected throughout.

The contractor should note that armoured cable is the preferred option for external cable and that any other protection system shall provide an equivalent level of protection throughout the entire length of the cable.

19.4.5 Local Ventilation Fans and other Equipment

Small local ventilation equipment indicated in electrical layout drawings shall be fed from the local lighting circuit through a local switched fused unit. Control shall be either through the local light switch, through a separate on/off switch, a presence detector or other sensing device. Unless otherwise specified control shall be through a separate local switch. Delay on or off timers if required shall generally be incorporated in the fan.

20. Emergency Lighting Installation

20.1 Emergency Lighting

The entire emergency lighting system shall be designed and installed such that a central test unit (CTU) is capable of testing each emergency luminaire and/or circuit. The CTU shall be capable of providing testing as per IS EN 3217 : 2023

Where an ATS system is installed it shall meet the testing requirements of IS EN 62034.

Emergency lighting completion certificates shall be provided as detailed in IS3217 : 2023

Commissioning and certification of the emergency lighting system shall be carried by the manufacturer the emergency light fittings.

All luminaires shall be so designed such that they may be installed and fixed easily to required surfaces. All luminaires shall provide areas for easy cable access and have internal cable ways if required. All emergency fittings i.e. exit signs, conversions, bulkhead fittings, LED fittings, twin spots, etc. are to be from a single manufacturer and shall be to RMCE specification for emergency lighting.

The manufacture shall be one of the following: NEL, Emcon, Profile, Ventilux or Lighting Solutions.

The emergency lighting system and components shall comply with the latest revision of the following standards:

IS 3217	Irish Standard for Emergency Lighting
IS EN 1838	Lighting Application - Emergency Lighting
IS EN 50171	Central Power Supply Systems
IS EN 50172	Emergency Escape Lighting
IS EN 62034	Automatic Test Systems for Battery Powered Emergency Escape Lighting
IS EN 60598-1	Luminaires General Requirements & Tests.
IS EN 60598-2-22	Particular Requirements Luminaires for Emergency Lighting
IS EN 61347	Lamp Control Gear

20.2 Conversions

All drivers utilised shall be fully enclosed type (either metal or plastic).

All conversions shall wherever possible, be integral to the original luminaire only following specialist assessment, investigation and test, to ascertain the suitability for conversion with regard to electrical, electronic, mechanical, thermal, EMC, LVD, serviceability and safety. In the event that integral conversions cannot be undertaken, due to any of the above reasons, remote conversions are acceptable of the piggyback enclosure type if access to the emergency lighting equipment can be made without removal of the original luminaire from the ceiling, wall or floor. In the event that the piggyback conversion option cannot be undertaken due to the above reason, remote conversions are acceptable of the remote enclosure type if the interconnecting wiring between luminaire and remote gear is suitably protected mechanically and is fire rated as required in the standards. Suitable protection shall be provided by a fully enclosed flexible conduit for routing interconnecting wiring or by an appropriate flex. Cables from the luminaire to the enclosure greater than 1 m in length shall have a min duration of survival of 120 min when tested in accordance with BS 8434-2:2003+A2:2009.

The interconnecting wiring shall be suitability sized in relation to C.S.A. (Cross Sectional Area) for the required load and distance travelled to minimise volt drop between source and load to 3% and is also electrically suitably rated for the required purpose in terms of voltage and high frequency and/or DC characteristic.

All conversions shall not affect the Ingress Protection Classification (IPXX) of the original luminaire, shall not affect the normal operation photometric performance of the original luminaire and shall also not affect the Safety Classification of such luminaire (Class I, II, III).

Overall responsibility of re-certification of the original luminaire following the conversion process specific to the EMC and LV Directive, Ingress Protection Classification, Safety Classification and performance criteria shall be the responsibility of the company undertaking the emergency conversion.

All cables entering and leaving the remote enclosure shall be glanded using glands of the appropriate size and type. Strain relief shall also be provided to the cables entering the lighting fittings. Cable ties or knotting of cables are not considered suitable measures for securing cables or providing strain relief and shall not be used.

All conversions shall be undertaken off site and shall undergo complete performance and safety tests upon completion.

20.2.1 Emergency Lighting Conversions – LED Fittings.

The lumen output from the fitting in emergency mode must be at least 10% of the normal rated output and uniformly across the fitting.

All emergency lighting status indicators shall be mounted in the surround / trim of the fitting or behind the diffuser where the depth of the fitting permits. The emergency lighting status indicator shall be visible from floor level. Where a lighting manufacturer provides fittings with an option for a cut out / blank for mounting the emergency lighting status indicators these shall be used. Where piggy back remote conversions are undertaken the enclosure housing the control gear, batteries etc. shall be fitted with rubber feet of a suitable size and quantity to reduce movement / slippage of the enclosure.

All RMCE Approved Manufacturers for Emergency Lighting shall be capable of providing a Technical Data Sheet for the converted fitting upon request. The data sheet shall confirm at a minimum, for the specific emergency lighting conversion, the following:

- Compliance with: IS. EN.60598-2-22
- Conformity: CE Marking Directive, EMC Directive, LVD Directive, RoHS Directive & WEEE Directive
- Emergency Lighting Lumen Output
- Normal Lighting Lumen Output:
- Fitting Mode of Operation
- Emergency Lighting Duration
- Battery Type

20.3 Batteries – Self Contained Fittings

20.3.1 General

All batteries shall be mounted within fittings and/or remote packs using battery holders to ensure that no part of the battery casing is in contact with the fitting's or remote pack's chassis.

All batteries used in emergency lighting shall be dated with the date of manufacturer.

All fittings shall have reverse polarity protection to protect against damage if batteries are connected incorrectly.

All battery packs used in emergency lighting luminaires shall be fully encapsulated and come complete with battery disconnect male/female connector(s) to aid isolation and service. All chargers and changeover controls shall be fully automatic and failsafe upon power failure or resumption of supply.

Batteries shall be rated for a minimum of four years of normal operation from the date of commissioning. Batteries shall be capable of providing the required duration of 3 hours at the end of the four years. Any batteries that fail within four years of the date of commissioning shall be replaced by the manufacturer at no cost to the RMCE.

The following batteries shall be utilised in emergency light fittings

- a) Sintered Plate Nickel-Cadmium (NiCD),
- b) Nickel-Metal Hydride (NiMH)
- c) Lithium Iron Phosphate (LiFePO₄),
- d) Sealed Lead Acid (SLA)

They shall be Secondary Cell type, rechargeable.

20.3.2 In the case of a), b) & c) above:

Batteries shall be high temperature (rated 0°C to 55°C – Surface Temp) and shall have the rated max temperature indicated on the battery casing.

20.3.3 In the case of d) above:

The operating ambient temperatures for SLA batteries used in emergency lighting shall be as follows:

Charge – 0°C to 30°C

Discharge – 0°C to 30°C

All rechargeable Sealed Lead Acid (SLA) batteries used in self-contained fittings shall be maintenance free and of a sealed leak proof construction. All batteries shall be valve regulated to prevent excess build-up of gas. Valves shall automatically reseal upon venting. All batteries shall be capable of operating in any orientation. However, SLA batteries shall not be mounted permanently inverted.

20.4 Lamps

All lamps utilised as part of the emergency lighting system shall be suitable for the required purpose and be of major brand name manufacture only. All lamps shall be professional long-life variants.

20.5 LED Status Indicator

In all emergency lighting luminaires the LED status indicator light shall be visible while the luminaire operates under normal lighting supply i.e. it shall be possible to see a fitting is an emergency luminaire when it is switched on and operating under normal supply.

20.6 Metals and Plastics

All metals and plastics utilised as part of the emergency lighting luminaires shall be suitable for the required purpose.

20.7 Overload and Short Circuit Protection:

All emergency luminaires shall incorporate separate protection for each incoming supply line, to include the un-switched and switched supplies, integrally, within the luminaire by means of suitable fused terminal block(s) to aid safety, isolation and discrimination functions. LED Emergency Luminaires, of small or miniature form factor, that utilise an internal PCB mounted fuse(s) to provide the required protection may be used to meet this requirement.

All fused terminal blocks for the purpose of connection to the supply network shall be suitable sized for the connection in each terminal of at least 2 No. 1.5mm² cables.

Where the installation of a fused terminal block is not possible due to the size or configuration of the fitting, the approved emergency lighting manufacture may submit such fittings to the RMCE for assessment provided that the fitting has suitable protection for each incoming supply line, un-switched and switched.

20.8 Emergency Exit Signs

All exit signs shall be maintained LED type using only LED's.

Wiring within the exit sign shall not be loose or hanging and shall not be visible when the exit sign is illuminated.

The background colour of the blade shall be green and the running man, arrow and door symbols, shall be white.

All LED's operating when the normal supply is available and in emergency mode, shall be at a ballast of unity. No under-running of LED's is allowable by combination mains/emergency ballasts in normal operation.

All diffusers shall be made from a fire retardant material.

All Emergency Exit Sign shall comply with the requirements of IS 3217 Annex B Type 1 & ISO 7010.

20.9 Automatic Test Systems

Where an ATS system is installed it shall meet the testing requirements of IS EN 62034.

All ATS type S fittings shall be supplied with an externally mounted test button that can initiate a short duration (typically 10 to 30 sec) test of the fitting. Where the form or size of the fitting does not permit the test button to be mounted externally, it may be mounted within the fitting. The RMCE engineer shall be advised of the fitting details prior to undertaking the works.

20.10 Light Emitting Diode (LED) Fittings – (Fittings Supplied By The Emergency Lighting Supplier Excluding Exit Signs)

All LED fittings shall utilise LED's that provide the following minimum efficacy: **70 lumens/Watt – Usable into the Room.**

All LED's shall be rated for operating at 25 deg C ambient room temperature and a Tc(max) 75 deg C

All LED's used, unless otherwise stated, shall be 2700K to 6500K

20.11 Manufacturer Labelling of RMCE Specification Emergency Light Fittings & Exit Signs

Each manufacturer (as listed in 20.1) of RMCE Specification Emergency Light fittings that are to be used for RMCE projects shall fix an identification label to the outside and inside of each fitting (or remote conversion). The label shall be black text on yellow background and shall have the appropriate text, specific to each approved manufacture as agreed with the RMCE: e.g. **RMCE-00-AAA**

The label shall be approx. 25mm x 10mm, securely fixed and of a suitable material. The size of the label may vary depending on the fitting but shall always be clearly legible.

Example placement of labels for various fittings:

- Box Exit Sign – External side & Internal (removable side panel not to be used)
- Remote Conversion – Remote pack external body side & Internal (lid not to be used)
- Integral Conversion – External body side & internal
- Other fittings – External side & internal

Where there are possible issues in relation to the placement of the identification labels the manufacturer shall provide a proposal to the RMCE for consideration.

20.12 Driver Modules – All Emergency Lighting Luminaires

All driver modules used in emergency lighting luminaires shall be fully encapsulated and provide for overload and short circuit protection via fused terminal block(s).

All driver modules shall be continuously rated and suitable for their specific application. All drivers shall have reverse polarity protection to protect against damage to the driver if batteries are connected incorrectly (i.e. reverse polarity).

All driver modules used in emergency lighting luminaires shall be fully encapsulated by metal or plastic can such that no components or conductive surfaces at L.V. or higher tension are accessible upon removal of louver, diffuser and/or gear tray for preventive or remedial maintenance purposes. Twin spot fittings utilising robust enclosures are excluded from this requirement.

All chargers and changeover controls shall be fully automatic and failsafe upon power failure or resumption of supply

20.13 Lifts

Emergency lighting luminaires mounted in the lift shafts and lift cars shall have a DALI Interface, an automatic test function and be suitable fluorescent lamps or LED fittings and be compatible with all electronic ballasts. The DALI test facility shall be specific to each project and shall be specified in the particular specification or drawings for the project. Where a test facility is not specified contact the RMCE engineer responsible for the project.

20.14 Static Inverter Systems (SIS)

The particular specification will detail the requirements relevant to each project.

Below are the general requirements specific to all static inverter systems.

20.14.1 System Types

Typical wiring topologies:

- 1:1 Single Phase In/Single Phase Out
- 3:1 Three Phase In/Single Phase Out
- 3:3 Three Phase In/Three Phase Out

All Static Inverter Systems shall be located in areas of low risk and in ventilated rooms or enclosures that have a minimum 120 min fire rating.

Low Power Systems (LPS): SIS with a rating less than 1.5kW shall be mounted in 120 min fire resistant enclosures with a minimum IP66 classification.

Operation and control of the static inverter shall be from the front panel without the need to open the door(s) except in the case of LPS.

Charger control and inverter control of the SIS shall be microprocessor based.

The static inverter system display shall be a back-lit LCD screen with keypad type operation on systems larger than 1.5kW and LED indicators with pushbutton type operation on LPS.

The system shall provide switching facilities together with self-diagnostic monitoring to give output characteristics and alarms.

The system shall have a minimum of four volt-free contacts to facilitate the remote monitoring of the following alarm conditions:

- Mains Fail
- Battery Fault
- Load Fault

-
- Common

Larger static inverter systems above 1.5kW shall have the following interfaces

- RS232 interface
- and/or
- Simple Network Management Protocol (SNMP) Transfer Control Protocol Internet Protocol (TCP-IP) adapter for connection via LAN to a remote computer

20.14.2 Main Components

The Static Inverter System, as a minimum, shall be comprised of the following main components:

- 1: AC to DC Battery Charger
- 2: DC to AC Inverter
- 3: Automatic Bypass Switches for instantaneous transfer of loads.
- 4: Manual Bypass Switch for routine maintenance.
- 5: Battery Bank must utilise at a minimum 2 No. separately isolatable strings of gas recombination, sealed lead acid, maintenance free, 10 year service life, batteries. The battery bank must be capable of supporting the load, at battery end of life, for the rated duration of the system, typically 3 hours.
- 6: A Manual Central Test Unit or an Automatic Testing System.
- 7: A Remote Alarm Monitoring and Status Indicator Unit.

20.14.3 Construction

- Zinc coated steel panels with powder coating or 316L Stainless Steel panels for electrical control gear and batteries.
- Segregation of electrical control gear and battery compartments with lockable access doors.
- For larger systems, above 1.5kW, fully cladded battery racks shall be utilised.

20.14.4 Battery Charger

The battery charger shall comply with the following requirements;

- Solid state, constant voltage or advanced battery management charging control module
- Capable of recharging its associated Battery Bank to full capacity, following a full discharge, within a period of 24 Hours maximum fully automatically
- Capable of recharging its associated Battery Bank, following a full discharge, to 80% capacity within 12 hours
- Have current limit facility, preventing overcharging or damage to the system in the event of battery failure or fault.
- AC Input protection by MCB.
- Minimum on-load efficiency of 90%
- An overload capability of 120% of the rated maximum load.
- Battery terminals shall be easily accessible from the front of the cabinet for ease of measurement and safety during maintenance.
- Provide deep discharge protection
- Shall be provided with an automatic temperature compensation system.

20.14.5 Batteries

All rechargeable Sealed Lead Acid (SLA) batteries used in in static inverter systems shall be maintenance free and of a sealed leak proof construction. All batteries shall be valve regulated to prevent excess build-up of gas. Valves shall automatically reseal upon venting. All batteries shall be capable of meeting the required duration of 3 hours for emergency lighting at the end of ten years of usage. Any battery that fails within the 10 years from the date of commissioning shall be replaced by the manufacturer at no cost to the RMCE.

The operating ambient temperatures for SLA batteries used in SIS shall be as follows:

Charge – 0°C to 30°C

Discharge – 0°C to 30°C

20.14.6 Inverter

The Inverter shall comply with the following requirements;

- Digital regulation and control electronics.
- The operating principle shall be based on Pulse Width Modulation (PWM).
- The inverter shall provide a high quality sinewave output with a THD of less than or equal to 3%.
- In the event of mains failure, the battery shall provide the supply to the inverter which shall supply the load. Upon return of the mains supply, the system will transfer the load from inverter to mains and the rectifier will supply the battery charger to recharge the batteries.
- When the system is operating on battery, the inverter shall continuously generate and regulate the output power.
- The inverter structure shall allow the different output parameters (voltage, total harmonic distortion, frequency etc.) to be maintained within the tolerances required.
- Output voltage shall be regulated between +/- 6 % of the rated voltage.
- Output frequency shall be regulated between +/- 2 % of the rated frequency.
- The inverter shall be able to handle short-circuit conditions without any damage.

20.14.7 Protections

The system shall be provided, at a minimum, with the following protections:

- Overload protection (set at 120% of rated load).
- AC output earth leakage protection (set at 30mA)
- Deep discharge protection for batteries
- Reverse battery polarity protection
- Battery disconnection protection
- Input and output filters for increased immunity and to limit EMI and RFI emissions
- Thermal pre-alarm automatically triggered before stopping of the inverter or bypass
- Inverter D.C. over and under voltage protection

The system shall be capable of clearing a fault on downstream circuit breakers and continue to supply the load afterwards without manual intervention. Generally, systems shall be capable of clearing a fault through a type 'C' MCB or RCBO.

20.14.8 Monitoring

The unit shall incorporate monitoring facilities for the following:

- DC Battery Monitoring (DC Voltage as well as Battery Charge & Discharge DC Current of Battery)
- AC Load Monitoring (Output AC Voltage and AC Current to Load)

20.15 Labelling Of Emergency Lighting Fittings

Each emergency light/luminaire and exit sign shall be labelled. The label shall be clearly visible from floor level so that a fitting can be clearly identified. The printed text on the label shall be as follows: **floor number / emergency luminaire number.**

e.g **02 / 17** would indicate emergency luminaire number 17 on the second floor.

The electrical specialist shall supply upon completion of the project a logbook for the emergency lighting system for inclusion with the O&M manuals. The logbook shall contain a list of all emergency lighting luminaires for the project by location, label number and type, included also shall be A3 NTS drawings of the building showing the location of the as installed emergency luminaires c/w label numbers

21. DATA COMMS (ICT)

21.1 General

The Contractor shall supply, install and test the data system as detailed in the drawings, specifications & pricing document.

In the installation of Class E/Cat-6 & Class EA/Cat-6A U/UTP networks all equipment supplied shall be from a single manufacturer i.e. cables (copper & fibre), patch panels, jacks, patch cords, ports, outlets etc.

Cables shall be installed in accordance with this specification, manufacturer's recommendations and best industry practices.

The entire installation shall be carried out using a Cat-6 or Cat 6A system and fibre from one of the following RMCE pre-approved manufacturers: **Commscope NETCONNECT** , **Commscope SYSTIMAX** **Leviton (Brand-Rex)** or **Gigamedia**. The installation shall be carried out by an approved installer for the specific system used. The installer shall be trained & certified in the installation, termination and testing of fibre optic and copper cables.

A manufacturer's 20 year system performance warranty shall be provided. The warranty shall include parts, labour & applications.

The Installation is to be carried out in accordance with the following standards including all current amendments and addendums.

Standard	Title
IS 10101	IS 10101 National Rules For Electrical Installations & National Wiring Regulations
IS EN 50173-1	Information technology. Generic cabling systems. General requirements
IS EN 50173-2	Information technology. Generic cabling systems. Office premises
IS EN 50173-3	Information technology. Generic cabling systems. Industrial
IS EN 50173-4	Information technology. Generic cabling systems. Residential
IS EN 50173-5	Information technology. Generic cabling systems. Data centres
IS EN 50173-6	Information technology. Generic cabling systems. Distributed building services
IS EN 50174-1	Information technology. Cabling installation. Installation specification and quality assurance
IS EN 50174-2	Information technology. Cabling installation. Installation planning and practices inside buildings
IS EN 50174-3	Information technology. Cabling installation. Installation planning and practices outside buildings
IS EN 50310	Application of equipotential bonding and earthing in buildings with information technology equipment
IS EN 60825-1	Safety of Laser Products. Equipment Classification, Requirements and User's Guide
IS EN 50600-1	Information technology. Data centre facilities and infrastructures. General concepts
ISO/IEC 11801:2002 + amendments 1 & 2	For Class EA channel and permanent link performance respectively
IS EN 50600-2-4	Information technology. Data centre facilities and infrastructures. Telecommunications cabling infrastructure
ISO / IEC 14763-3	Information technology. Implementation and operation of customer premises cabling. Testing of optical fibre cabling
IS EN 50600-1	Information technology. Data centre facilities and infrastructures. General concepts
IS EN 50600-2-4	Information technology. Data centre facilities and infrastructures. Telecommunications cabling infrastructure

ISO / IEC 14763-3

Information technology.
Implementation and operation of customer premises cabling.
Testing of optical fibre cabling

Prior to works commencing on site the contractor shall advise the RMCE of the proposed approved installer for the system and shall provide copies of all installer training certificates for the system to the RMCE upon request.

21.2 Installation Procedures

Items Particular To All Installations

- Cable runs should be concealed where possible and only run on the surface in areas where user access is restricted.
- Where cables or conduits are installed in plaster or concrete liable to damp conditions, precautions should be taken against corrosion.
- Cables should be labelled at any point where they enter or leave concealment.
- Cable routes should always be parallel with or perpendicular to walls.
- Where cables must pass through walls the holes should be sleeved and the cables must enter and exit these holes at 90 degrees.
- All cable runs must follow pre-defined routes.
- All cable runs must be free from tension along the entire cable length.
- Where cable runs must bear some stress, supports must be used to distribute the strain.
- Where a number of cables need to be run on the surface, trunking or conduit should be installed. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- Excess slack may be neatly coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- Cables shall be dressed and terminated in accordance with manufacturer's recommendations and/or best industry practices.
- Voice jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate. Voice jacks in horizontally oriented faceplates shall occupy the right-most position(s). Modem jacks shall be considered the last voice jack in the sequence. Data jacks shall occupy the top position(s) on the faceplate. Data jacks in horizontally oriented faceplates shall occupy the left-most position(s).
- Cables shall be installed in accordance with manufacturer's recommendations and best industry practices.
- Cables shall not be installed in damp conditions and until such time as the building is properly weathered. Any cable exposed to water shall be replaced by the contractor prior to final acceptance at no cost to the RMCE.
- Cable raceways shall not be filled greater than the IS EN 50174 maximum fill for the particular raceway type; generally do not exceed 50% of the capacity of a raceway. Cable bundles should not exceed the height of the sidewalls of the tray or basket.
- Cables shall be installed in continuous lengths from origin to destination. All cable runs must be free from bridges, taps and splices unless specifically addressed in the tender documents. Where cable splices are allowed, they shall be in accessible locations and housed in an enclosure intended and suitable for the purpose.
- The cabling system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the RMCE. Cable runs are on the basis that no cable length shall exceed 85meters outlet to patch panel; if it likely that 85 meters shall be exceeded then the contractor shall inform the RMCE in time to take corrective action.
- Cables shall be identified by a self-adhesive label in accordance with section T08.5 "Labelling". The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate. Pulling tension on 4-pair UTP cables shall not exceed 110 Newtons for a single cable or cable bundle.

21.2.1 Environmental Considerations

Cables shall not be exposed to humidity levels or temperatures outside their specified limits; this

includes localised effects such as those from hot air blowers or gas burners.

The installation process shall not degrade the intended environmental performance of the raceway/cable management system.

Where there is a risk of water ingress during installation, the cable ends shall be sealed.

Where cables have been left to lying in water, they shall be removed and rewired at the contractor's expense.

The environmental conditions under which cabling components, inspection and test equipment are stored shall be compatible with the manufacturer's/ supplier's specification

21.2.1 Surface Cable Runs

The cables should be firmly fixed to the surface at a minimum distance of every 300mm.

On vertical cable runs the cables should be firmly fixed to the surface at a minimum distance of every 400mm.

All surface cable runs should use cable tray, lined basket or trunking where possible.

If cable routes are on rough or uneven surfaces the above fixing distances should be reduced. All cables shall be secured using Velcro tie wraps. Plastic cable ties shall not be used.

21.2.2 Floor Distribution - Cable Bundles

Where cable bundles run in a raised floor environment they should be run on cable tray or in lined basket wherever possible.

Max. 24 cables to the bundle.

Adhere to power segregation distances.

Ensure cable bundles are properly supported and sleeved when passing through-holes in walls/floors/ceilings.

Any tray or metallic trunking used must be earthed.

All cables shall be secured using Velcro tie wraps. Plastic cable ties shall not be used

21.2.3 Ceiling Distribution - Cable Bundles

Within a suspended ceiling cable bundles should be properly suspended.

Do not lay cables direct onto the ceiling tiles.

Do not tie cable bundles to the ceiling suspension wires.

Cables should be suspended on a catenary wire if not tray or other supports.

Max. 24 cables to the bundle.

Cables shall not be attached to ceiling grid or lighting support wires. Where light support for drop cable legs are required, the contractor shall install clips to support the cabling. All cables shall be secured using Velcro tie wraps. Plastic cable ties shall not be used

21.2.4 Trunking and Conduit

All metallic conduit or trunking used must be earthed/bonded.

Bushes should be used at all cable exit points.

The ends of all conduit and trunking must be capped or sealed.

Enough space should be left in any trunking or conduit for the addition of new cables.

Where possible a draw wire should be left in suitable routes are available.

21.2.5 Bend radius: As a general rule the following bend radii apply

For UTP use 4 times cable diameter Installed & 8 times the cable diameter at installation.

For Fibre Optic, 50 Pair and greater telephone cables, use 10 times cable diameter.

These radii should be adhered to when there is no specific information available about a particular cable, but, where they exist, manufacturer's specifications should always be followed.

21.2.6 Power and Communications Cable Segregation

All cable runs must be the following minimum distances from power lines:

- 127mm from power lines of <kVA (e.g. fluorescent lighting)
- 305mm from power lines of <2-5kVA
- 610mm from power lines of >5kVA or transformers/motors.

Where this segregation is not possible the communications cables must installed in separate trunking or conduit.

If metallic trunking or conduit is used it must be earthed and bonded in accordance with the IS 10101

Where communication cables must cross power cables, they should do so at 90 degrees and non-conductive spacers should be used at the crossing point.

21.2.7 Fire Barriers

Where any cables pass through a fire barrier the requirements of IS 10101 must be adhered to. Separating distances can be reduced where cables pass through fire barriers as long as it is for no more than 0.5m either side of the barrier.

When cables pass through fire barriers in this way, power and communications cables should be installed in separate metal trunking or conduit.

21.3 Terminations/Wiring Sequence

Cat 6 & Cat 6A outlets and patch panels shall be wired as per the EIA/TIA 568B sequence as shown below, unless otherwise stated.

T568B Sequence

Pin No.	1	2	3	4	5	6	7	8
Colour	White/ Orange	Orange	White/ Green	Blue	White/ Blue	Green	White/ Brown	Brown

The twisted pair of the cable shall be maintained as close to the point of the mechanical termination as possible.

The approved installer must also as part of their works properly ground and bond all installed apparatus, equipment and components to ensure equal potential is maintained through the installation in accordance with IS EN 50174 & IS EN 50310

21.3.1 Fibre Optic Cable Termination

Each fibre optic cable shall be terminated in a 24-port rack mounted enclosure providing protection to the terminated fibres. The fibre optic patch panel(s) shall each be capable of containing 24 LC connectors in a 1U enclosure. The jacks shall be 50 micron, multimode connectors, capable of terminating either 250 micron coated or 900 micron buffered fibres. The connectors shall meet the intermateability requirements of the applicable EN standards.

Optical fibre cables shall be terminated using LC-Duplex connectors that conform to EN 186000 Part 1, by means of fusion splicing using factory terminated pigtailed.

The average loss for all connector pairs shall be less than 0.3dB, including the loss due to splicing.

Fibre slack shall be neatly coiled within the fibre termination panel. No slack loops shall be allowed external to the fibre panel(s).

Each cable shall be individually attached to the respective termination panel by mechanical means. The cables strength member(s) shall be securely attached the cable strain relief bracket in the panel. Each fibre cable shall be stripped upon entering the termination panel and the individual fibres routed in the termination panel.

Each cable shall be clearly labelled at the entrance to the termination panel. Cables labelled within the bundle shall not be acceptable.

Dust caps shall be installed on the connectors and couplings at all times unless physically connected.

21.4 Cables

21.4.1 Cat-6 & Cat 6A

Cabling shall be 23 AWG, 4-pair U/UTP, and shall be certified, as a minimum, to a EuroClass Cca-s1b,d2,a2. Cable jacketing shall be lead-free. Cables shall meet the performance requirements for the relevant standards.

21.4.2 Voice Backbone (Copper)

Internal

The Cable shall consist of 0.5mm diameter annealed copper conductors, PVC insulated, polyester taped with a white sheath and shall be certified, as a minimum, to a EuroClass Cca-s1b,d2,a2. The cable shall comply with CW1308B requirements

External

Cable shall consist of 0.5mm diameter plain copper conductors, colour coded polyethylene insulation, petroleum jelly filled and a black polyethylene sheath. The outer sheath shall be made from tough, durable polyethylene which is also UV and sunlight resistant. The cores are to be bedded in petroleum jelly to protect against the ingress of moisture.

The cable shall comply with CW 1128 / CW 1179 requirements.

Harsh Environments Cables shall consist of 0.5mm diameter plain copper conductors, colour coded polyethylene insulation, petroleum jelly filled, polyethylene bedding, galvanised steel wire armour and a black polyethylene or external grade PVC sheath.

The cable shall comply with CW 1198 requirements.

21.4.3 Fibre Optic Cables

Internal

All Internal Fibre Optic Cables shall be certified, as a minimum, to a EuroClass Cca-s1b,d2,a2

Twelve-core 50/125 OM3 multimode cable shall be utilized to provide backbone connectivity for the data network. The fibre optic cable shall be categorized as OM3 and classed as OF-300 as per ISO 11801. Each fibre shall have a core of 50 microns plus a cladding; plus a coating. Each of the coated fibres shall be surrounded by aramid strength members.

Twelve-core 8/125 OS2 singlemode cable shall be utilized to provide backbone connectivity for the data network. The fibre optic cable shall be categorized as OS2 as per ISO 11801. Each fibre shall have a core of 8 microns plus a cladding; plus a coating. Each of the coated fibres shall be surrounded by aramid strength members.

External

A suitable external multimode OM3 or singlemode OS2 cable shall consist of single loose tubes, gel filled, with a maximum of twelve 50/125 micron fibres per tube. Fibres shall be separated into colour coded groups surrounded by a polyethylene core tube which will be surrounded by water blocking tape plus non-metallic strain relief/strength members with a glass yarn or HDPE Steel Tape Armoured jacket. Attenuation and bandwidth characteristics are the same as those specified for internal fibre optic cables. The fibre optic cables shall be categorised as OM3/ OF-300 or OS2 as per ISO 11801.

21.5 Comms Cabinets

All Comms Cabinets, unless other specified, shall be 19" free standing 800mm wide by 1000mm deep 42u high, metal powder coated black and shall each be equipped with the following:

- Secure lockable front perforated steel front door. Door hinging shall be easily reversed to function as either left hand side or right hand side opening.
- Metal perforated rear door and lift off (lockable) metal side panels.
- 1u height marking on 19" mounting profiles
- Adjustable front and rear 19" mounting profiles
- Open base for cable access. Full height vertical cable management with full height cable management system channels 2No – one each side adjacent to the front mounting profiles
- Sliding Shelves for servers (6 No Per Cabinet) etc
- Patch Panels- Data patch panels for termination of field wiring.(quantity required to be determined by number of Class E/Cat-6 or Class EA/Cat 6A cables)
- 1 U Horizontal Cable Management for every 2U of patch panels
- Cable tidy panels, baying kit, castors, earth straps etc
- All cables shall be secured using Velcro tie wraps. Plastic cable ties shall not be used
- All comms cabinets are to be earth bonded in accordance with the Manufacturer's requirements and the IS 10101 wiring rules.
- Facilitate an Internal equipment mounting depth of 890mm min front to rear

- Jacking Feet (50-80mm) & Transit Castors
- Internal Vertical Tray (300mm) mounted left and right and side sides for cable management – Tray shall be metal and powder coated black
- Roof mounted fans unit.
- Blanking Plates
- Cage Nuts and Bolts
- Static Load rating 1100kG minimum.

Each comms cabinet shall be provided with 1 No 30 amp power distribution unit (PDU). Each PDU shall:

- have 12 No IEC C13 and 2 no C19 outlets and shall be rated to 30amp 240V / AC. Each PDU shall have 2 No Internal fused circuits each rated at 16Amps.
- be fed from the comms room distribution board or UPS (please refer to particular specification or drawings).
- be fed from a separate circuit, no other outlets/equipment shall be fed from this circuit. Only one phase shall be present in each comms cabinet unless otherwise stated.
- be vertically mounted within the comms cabinet.
- have local input current monitoring with LCD display (Voltage, Amps ,Watts)
- be rated to max operating temperature of 60 deg C
- The PDU shall be wired to a 32amp , 230V single phase commando plug

All equipment racks shall be augmented with horizontal and vertical management hardware to properly dress all cables and patch cords. Patch panels shall be wired to T568B. The front of each module shall be capable of accepting labels. Each port shall be capable of accepting an icon to indicate its function.

The following shall be provided in accordance with the number of data outlets associated with the project.

Patch Cords of 1M length. – 1 per number of data outlets (50% Blue & 50% Red)

Patch Cords of 2M length. – Quantity based on 20% of the number of data outlets – (50% Blue & 50% Red)

21.6 Labelling

Each data and voice cable shall be labelled at both the patch panel and outlet end at a distance of approximately 150mm from the terminations.

Each outlet shall be labelled. Outlet labels will be the manufacturer's labels provided with the outlet assembly.

All label printing will be machine generated using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view a distance of approximately 150mm from the terminations.

The Labelling convention will be as follows:-

- Hub Number/Number of Hubs on Site/Patch Panel Row/Position on Patch Panel
- For example 1/1/D2/16 indicated the data outlet in question is connection to hub 1 on row D2 and position 16 of the patch panel. The second digit indicates that there is only a single hub on site.
- The installer should adhere strictly to this numbering scheme (unless otherwise instructed) as it is intended to facilitate accurate cable and outlet identification which will form part of the certification documentation to be delivered upon completion of the project.

21.7 Testing

21.7.1 Cat-6 & Cat 6A

All cables are to be tested in accordance with this document to prove compliance with the relevant standard and best industry practices. If any of these are in conflict, the Contractor shall be responsible in bringing any discrepancies to the attention of the engineer or his representatives for clarification and/or resolution.

Testing shall be carried out using a Fluke Networks DSX Level IV tester with up to date software.

The following tests shall be carried out on each cable:

1 Wiremap	8 NEXT	15 Return Loss@Remote
2 Length	9 NEXT@Remote	16 PSNEXT
3 Propagation Delay	10 ACR	17 PSNEXT@Remote
4 Delay Skew	11ACR@Remote	18 PSELFEXT
5 Attenuation	12 PSACR	19 PSELFEXT@Remote
6 ELFEXT	13 PSACR@Remote	20 POE test for all Cat 6A cables
7 ELFEXT@Remote	14 Return Loss	

Please note: no star passes will be accepted

21.7.2 Fibre Optic Cable

Each cable shall be tested to verify installed cable length. Each fibre strand shall be tested with an optical power meter and light source to verify attenuation. The following attenuation limits for multimode fibre shall apply to all installations. These values must be confirmed by field attenuation testing.

Attenuation Limits for Singlemode & Multimode Fibre Optic Cable are as follows:

OS2 – Single Mode

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
1310	0.40	0.38
1383	0.40	0.38
1550	0.40	0.25

OM3 & OM4 - Multimode

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
850	3.50	2.8
1300	1.5	0.8

All fibre optic cables shall be tested using an Optical Time Domain Reflectometer (OTDR).

In order to achieve a defined launch condition for testing multimode fibre systems, the use of a mandrel as a mode filter shall be used. The mandrel must meet the requirements defined in IEC 61300-3-4 and shall be used with the test cords. IEC 61300-3-4 requires an 18mm mandrel for fibre type 50/125 micron.

21.8 Test Results & Warranty

Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test results and the actual test result achieved. The test equipment by name, manufacturer, model number and last calibration date will also be provided. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be collocated and presented.

A hard copy as well as an electronic copy (pdf format on a pen drive) of all test results and information requested, is to be supplied upon completion to form part of the O&M manuals.

Warranty shall be issued prior to the completion of the O&M manuals

A hard copy and an electronic copy of the manufacturer's system performance warranty shall form part of the O&M manuals.

22. FIRE DETECTION AND ALARM INSTALLATION

22.1 FIRE DETECTION AND ALARM SYSTEM:

22.1.1 Introduction

The main fire alarm panel shall be complete with an autodialler and modem for connection to a central monitoring station. The autodialler shall have a facility to have up to 3 separate different pre-recorded messages. The panel shall have an integral modem as required to facilitate the above.

The fire alarm system shall be designed, installed, commissioned and handed over to conform with the requirements of latest version of IS 3218.

22.1.2 Standards

The equipment supplied and the entire installation shall comply with the latest edition of the following Standards and Codes of Practice:

Building Regulations TGD (B) – Fire Safety

IS 3218:2013 – Code of Practice for Fire Detection & Alarm Systems

EN 54-1 – Fire Detection & Alarm Systems - Introduction

EN 54-2 – Fire Detection & Alarm Systems - Control & Indicating Equipment

EN 54-3 – Fire Detection & Alarm Systems - Sounders

EN 54-4 – Fire Detection & Alarm Systems - Power Supplies

EN 54-5 – Fire Detection & Alarm Systems - Point Heat Detectors

EN 54-7 – Fire Detection & Alarm Systems - Point Smoke Detectors

EN 54-11 – Fire Detection & Alarm Systems - Manual Call Points

EN 54-12 – Fire Detection & Alarm Systems - Optical Beam Smoke Detectors

EN 54-13 – Fire Detection & Alarm Systems - Compatibility of System Components

EN 54-17 – Fire Detection & Alarm Systems - Short-Circuit Isolators

EN 54-18 – Fire Detection & Alarm Systems - Input / Output Devices

EN 54-20 – Fire Detection & Alarm Systems - Aspirating Smoke Detectors

EN 54-21 – Fire Detection & Alarm Systems - Alarm Transmission Equipment

EN 54-23 – Fire Alarm Devices - Visual Alarm Devices

EN 54-27 – Fire Detection & Alarm Systems - Duct Smoke Detectors

EN 54-29 – Fire Detection & Alarm Systems - Multi Sensor Fire Detectors

EN 50200 – Fire Resistant Cabling

ET 101 – National Rules for Electrical Installations

BFPSA – Code of Practice for Aspirating Smoke Detectors Fire Safety Design Strategy for the Complex

22.1.3 Working Drawings

Prior to commencement of wiring, the Fire Alarm Specialist shall prepare schematic wiring details of the fire detection and alarm system and shall submit these to the Engineer for approval. The Electrical Specialist/Installer shall wire the fire alarm system in accordance with the Fire Alarm Specialist's working drawings as approved by the Engineer.

22.1.4 Protection Category

The protection category for the building shall be Category L1 in accordance with I.S. 3218 – 2013 unless otherwise stated.

It shall be the responsibility of the Electrical Specialist/Installer and his selected Fire Alarm Specialist to thoroughly examine the Engineer's proposal to ensure that the layout of equipment, as indicated on the drawings and as detailed in the Specification, complies with the relevant protection category of IS 3218, the Building Fire Strategy and that the wiring details are compatible with the equipment to be supplied. The Fire Alarm Specialist and/or Electrical Specialist/Installer shall inform the Engineer in writing of any discrepancies found.

22.1.5 Fire Strategy

The system shall operate so that on activation of any one smoke detector or alarm call point

22.1.6 Control and Indicating Equipment (CIE)

1. The CIE shall be of the analogue addressable type and shall be of Open Protocol design subject to meeting the requirements specified below. The protocol that shall be used for the fire detection and alarm system is Apollo Discovery.
2. The CIE shall comply with the requirements of EN 54-2.
3. The CIE shall be the central processing unit of the system, receiving and analysing signals from fire sensors, providing audible and visual information to the user, initiating automatic alarm response sequences and providing the means by which the user interacts with the system. The CIE shall be manufactured by Morley or Advanced Electronics .
4. The CIE shall be capable of fully supporting the following protocols:
 - Apollo XP95
 - Apollo Discovery
 - Hochiki ESP
5. The requirements for protection of the programme against unauthorized access, corruption processor monitoring etc. shall comply fully with the requirements of the current version of IS 3218.
6. The CIE shall have a facility to enable the testing of sounders, strobes and alarm notification equipment without activating any fire alarm interfaces.
7. The CIE shall be capable of detecting and indicating changes in detector sensitivity and shall constantly monitor detection circuits and sounder circuits and, in the event of a fault occurring, initiate an alarm. To aid maintenance, facilities shall be provided to scan all the detection devices to determine their operating condition. Details of devices requiring maintenance shall be indicated on the panel.
8. The CIE shall continuously monitor the operation of all devices on the system, and shall be capable of providing the following functional conditions:
 - Fire alarm condition
 - Fault warning condition
 - Disabled condition
 - Test condition
 - Quiescent condition
9. The CIE shall be capable of indicating simultaneously any combination of the above conditions
10. The CIE shall be equipped with an alphanumeric display unit and integral printer which shall automatically display details of the alarm status and the location of detection devices which have entered an abnormal condition. A buzzer shall sound automatically in the event of an alarm and may only be silenced on acceptance of the alarm. An alphanumeric keypad shall be provided to allow access for all programming and maintenance routines. Entry shall be at four levels by means of the appropriate passwords and restrictions.
11. The central processing unit shall continuously store in memory details of alarm conditions. It shall be possible to print the entire memory on request.
12. The FACP shall incorporate a real time clock to enable events to be referenced against time and date.
13. The detection devices shall be suitable for wiring on a loop system with each device on a loop holding a separate address. The panel shall be capable of controlling a number of detection loops and sounder circuits with a minimum of 126 addresses per loop and shall be supplied complete with loop cards as required.
14. The system shall monitor each loop and sounder circuit for open circuits, short circuits and earth faults. The system shall interrogate each address at intervals not exceeding 5 seconds to determine it's status and classify it into 'normal', 'pre-alarm', 'alarm' and 'fault' conditions.
15. Alarms shall be enunciated on the display panel in two ways: -
 - a) The loop and device number shall be on a segment display.
 - b) A real language text message for the location shall appear on an LCD display, minimum 40 characters.
16. The real language text message LCD display shall indicate the time, date, number of alarms active, type of message and an 18 character, minimum, customer-selected message.

17. The CIE shall be complete with an integral printer which shall record all events and panel operations.
18. The CIE shall indicate by address and text message the first alarm in a series of alarms until the first alarm has been reset. Subsequent alarms shall illuminate the appropriate LED indicator and have the printer record this alarm. A scroll button shall be provided to allow scrolling through the addresses and message displays of subsequent alarms. The display shall always revert to the first alarm until it is reset.
19. The CIE shall be complete with control push button to carry out the following functions: -
 - Evacuate
 - Silence Alarm
 - Scroll Display
 - Lamp / Display Test
 - Printer Feed
20. The addressable fire alarm control panel microprocessor shall have event memory to store details, including time and date, of the last 100 events that have occurred. It shall be possible to print out the entire memory upon request.
21. The panel shall have a permanent alphanumeric keypad to allow for full programming and maintenance routines.
22. The CIE shall be fed from a 13amp-fused connection. The spur shall be label "Fire Alarm Panel" using a "Traffolyte" label. The spur feeding the main fire alarm panel shall be fed from the main board; no other devices shall be on this circuit.
23. The CIE shall incorporate a standby battery and charger unit to comply with the requirements of EN 54-4 in relation to maximum alarm load. It shall give 72 hours standby.
24. If the battery and charger for the CIE are contained in a separate cabinet, at least two transmission paths shall be provided. The cables used for the transmission paths shall be correctly sized Enhanced Fire Resistant Cable meeting the requirements of PH120 Classification in accordance with the requirements of EN 50200.
25. The Fire Alarm Specialist shall be responsible for calculation the "maximum alarm load" to ensure compliance with the relevant section of the latest version of IS 3218. The duration of the emergency supply source shall be 48 hours in normal quiescent condition after which sufficient reserve shall remain to power all alarm devices and interface units to meet the requirement of the fire strategy.
26. The housing containing the CIE shall be of metal construction and shall be capable of being surface or semi-flush mounted. It shall complete with cable knock-outs in sufficient quantity to accommodate all likely cabling requirements. The housing shall afford a minimum ingress protection to IP40 and it shall not be possible to open the FACP without the use of a special tool or key.
27. The CIE is to be complete with separate DIN rail mounted connection terminals for field wiring. Field wiring is not to be directly connected to PCBs within the panel.
28. The detection device loops shall be two wire bi-directional starting from and returning to the control panel. The panel shall be capable of addressing a minimum of 99 addressable field devices. Each device shall have a unique address and be interrogated at intervals not exceeding 5 seconds.
29. One fault in any transmission path (TP) shall not affect the correct functionality of any other transmission path.
30. If more than 32 devices are installed on any one-transmission path than any one fault shall not affect more than 32 devices.
31. The maximum number of devices on any one detection circuit loop shall be as prescribed by the specific equipment manufacturer, but shall not exceed 120 devices.
32. A Maximum 480 points only shall be lost in case of one system fault (i.e. main processor fault).

33. All equipment connected to the system addressable loop, either directly or via interfaces, shall be proofed against electrical noise, high frequency pulses and electromagnetic influences from other equipment.
34. The control panel shall have a minimum of 4 sounder circuits expandable up to 16 by the addition of expansion boards.
35. The control panel shall have a minimum of 4 volt-free change over contacts with the programmability to assign any output to one or more detection devices. Typically these shall be used to activate communicators, door release systems, ventilation plant shut-down, smoke extract systems etc.

22.1.7 Access to Software

The selected equipment must leave the RMCE with complete freedom of choice in terms of selecting a Fire Alarm Maintenance Provider to maintain the system in the future. The Fire Alarm Specialist must submit all access codes and programming information to the RMCE as part of the Operations and Maintenance manual for the project.

22.1.8 Circuit Wiring

1. The detectors and break glass units shall be installed on a loop principal, allowing each device on the loop two transmission paths (i.e. loop in, loop out). No "T" connections shall be permitted on the system unless agreed in writing with the Engineer.
2. Sounders shall be wired on a separate loop to detector and break-glass units. Each Alarm Zone will be fed from Sounders supplied from two separate independent loops.
3. All cables used in the Fire Detection and Alarm system shall, as a minimum, meet the classification for Standard PH120 Cable (when tested in accordance with IS EN 50200, including the modifications as set out in Annex E.2) unless otherwise stated.
4. Loops of detectors or sounders shall employ a separate and distinct route for the feed and return paths, i.e. four-core or multi-core cable shall not be employed to carry both the feed and return cable cores.
5. Wiring to other items of plant or control panels shall be carried in the same manner as wiring to sounder circuits. Other plant items include:
 - Slam Shut Valve control panels.
 - AHU equipment for use in smoke venting.
 - Door access systems.
 - Fire suppression systems

22.1.9 Short Circuit isolators

1. Short Circuit isolators shall be included through out the system to isolate faults by automatically opening the loop either on side. Short Circuit isolators may be included as integral part of the detection or alarm devices or they may be independent units.
2. Short circuit isolators shall comply with EN54-17.
3. As a minimum isolators should be included so that no more than ten detection devices are lost during a fault condition. Loop driven sounders should not be effected by such faults. As an absolute minimum isolators shall be included as an integral part of all break glass units and all fire sounders.
4. Short circuit isolators shall be installed at every location where fire alarm cabling crosses from one fire compartment to another.

22.1.10 Manual Call Points

1. Manual call points shall utilise flexible plastic elements and shall comply with EN 54-11. Where finishes permit, manual call points shall be flush mounted using standard 86 mm square switch box of 35 mm depth. Elsewhere manual call points shall be surface-mounted using the manufacturer's standard back box.
2. Where they are viewed from the side (e.g. in corridors) they shall present a side profile area of not less than 750 mm². They shall be labelled 'Fire' and shall give concise instructions for operation. The call point shall be capable of being tested, without removing the element, by insertion of a special test key.

3. Where necessary the manual call points shall be mounted in a weatherproof housing, affording protection to IP 66.
4. All manual call points shall be red in colour
5. Break glass units shall be mounted at 1200 mm to centre of the box above finished floor level.
6. The addressable break glass units shall monitor and signal to the CIE the status of a switch operated by a "break glass" assembly. The addressable break glass units shall be provided with an integral red LED to indicate activation.

22.1.11 Smoke Detectors – Point Type

1. The point type smoke detectors shall have analogue outputs and shall be individually addressable. They shall be suitable for mounting on a common mounting base and shall comply with EN 54-7.
2. The mounting base shall be manufactured from self-extinguishing plastic and be provided with terminals to accommodate 1.5mm² cables. Detectors shall be suitable for surface mounting on to round conduit BESA boxes. Removal of detectors from mounting bases shall not break the connection to the next device on the circuit, however such action shall initiate a fault condition.
3. A remote indicating LED must be capable of being connected to the mounting base to operate in conjunction with the detector or group of detectors.
4. The ionisation smoke detectors shall be capable of detecting visible and invisible combustion gases emanating from fires, using a dual ionisation chamber in which the air is ionised by a single radioactive source. The radioactive source used shall be AM 241 of one microcurie or less.
5. The photoelectric smoke detectors shall be capable of detecting visible combustion gases emanating from fires and shall employ the forward light-scatter principle.
6. The point-type photoelectric smoke detectors shall be equally sensitive to a wide range of combustible materials.
2. The design of the point-type photoelectric smoke detector sensing chamber shall be optimised to minimise the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.
3. The smoke detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.
4. The smoke detectors shall be suitable for operation in air speeds of up to 10m/s and shall incorporate screens to minimise contamination by dust and small insects.
5. The smoke detector shall incorporate two LED's, clearly visible from the outside, to provide indication of alarm activation.
6. In locations where the detector is not readily visible, remote indicator units shall be provided.

22.1.12 Heat Detectors

1. The heat detectors shall have analogue outputs and shall be individually addressable
2. They shall be suitable for mounting on a common mounting base and shall comply with EN 54-5.
3. The mounting base shall be manufactured from self-extinguishing plastic and be provided with terminals to accommodate 1.5mm² cables. Detectors shall be suitable for surface mounting on to round conduit BESA boxes. Removal of detectors from mounting bases shall not break the connection to the next device on the circuit, however such action shall initiate a fault condition.
4. The heat detectors shall be capable of detecting rapid rise in temperature and/or fixed absolute temperatures.
5. The heat detectors shall employ two heat-sensing elements with different thermal characteristics to provide a rate of rise dependent response.
6. The heat detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.
7. The heat detector shall incorporate two LED's, clearly visible from the outside, to provide indication of alarm activation.

8. In locations where the detector is not readily visible, remote indicator units shall be provided.
9. Heat detectors shall not be installed on escape routes.

22.1.13 Anti-Ligature Smoke Detectors

1. The anti-ligature smoke detectors shall be designed for flush mounting into the building structure and shall comply with EN 54-7.
2. The anti-ligature detectors shall operate on the light-scatter principle utilising infra red LEDs within the detector body to create a virtual detection chamber.
3. The exposed face of the anti-ligature detectors shall consist of a 150mm x 150mm x 2mm thick stainless steel plate with detection windows which shall be secured to the ceiling using tamper proof fixings. The design of the plate shall be such that it cannot be used as an anchor point for a ligature.
4. The anti-ligature smoke detectors shall incorporate coloured LEDs to indicate Normal, Fault and Fire conditions.
5. The anti-ligature smoke detectors shall be self monitoring and shall self-adjust automatically in response to contamination of the detector. The detector shall generate a fault signal in the event that the contamination prevents the detector from operating normally and in the event of an attempt to tamper with the detector, e.g. by covering the detector windows.

22.1.14 Multi Sensor Detectors

1. The multi sensor detectors shall have analogue outputs and shall be individually addressable. They shall be suitable for mounting on a common mounting base and shall comply with EN 54-5, EN 54-7 and EN 54-29.
2. The mounting base shall be manufactured from self-extinguishing plastic and be provided with terminals to accommodate 1.5mm² cables. Detectors shall be suitable for surface mounting on to round conduit BESA boxes. Removal of detectors from mounting bases shall not break the connection to the next device on the circuit, however such action shall initiate a fault condition.
3. The multi sensor detectors shall contain an optical smoke sensor and a thermistor heat sensor within a single housing and whose outputs are combined to give the final analogue value.
4. The design of the point-type multi-sensor photoelectric smoke detector sensing chamber shall be optimised to minimise the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.
5. The multi sensor detectors shall incorporate screens to minimise contamination by dust and small insects.
6. The sensor should be able to operate in the following modes:
 Combination Mode.
 The sensor should be able to operate as a Photoelectric sensor but when the ambient temperature reaches 40° C or above, the thermal elements should be capable of sensing the 'Rate of Rise' and adjust the sensitivity of the photoelectric element automatically. The sensitivity of the photoelectric should be increased via an internal algorithm.
 Photoelectric Mode
 The sensor should be able to return the analogue value for the photoelectric element during a normal polling sequence. The sensor should also be able to signal to the CIE if the thermal sensing element exceeds a fixed temperature threshold.
 Thermal Mode
 The sensor should be able to return the analogue value for the thermal element during a normal polling sequence. The sensor should also be able to signal to the CIE if the photoelectric sensing element exceeds a pre-defined threshold.
7. The multi-sensor should have the capability of monitoring both sensing elements, if either and both of the elements fail it should be reported and displayed at the CIE.
 The multi-sensor detectors shall incorporate two LED's, clearly visible from the outside, to provide indication of alarm activation.
8. The multi-sensors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.

9. In locations where the detector is not readily visible, remote indicator units shall be provided.

22.1.15 Duct Smoke Detectors

1. Smoke detection within ventilation ductwork shall be provided by means of purpose designed enclosures to accommodate standard smoke detectors and bases.
2. The enclosures shall be mounted externally on the duct and shall have a transparent cover to allow viewing of the installed detector head and LED and shall have an integral smoke test port to enable the detector to be tested without introducing smoke into the ventilation duct.
3. Sampling and exhaust tubes shall extend into the ventilation duct from the smoke detector enclosure which shall cause air from the duct to be drawn through the smoke detector enclosure without the use of external fans. The sampling tube shall span the full width of the duct to ensure complete coverage of the airflow.
4. The duct detector unit shall be suitable for use in ducts up to 3,000mm and with airflow speeds from 0.5 m/s to 20 m/s.

22.1.16 Aspirating Type Smoke Detection Systems

1. The system shall consist of high performance laser based particle detection system based on the principal of forward light scatter, a high efficiency aspirator and a sampling pipe system designed to sample air from within the protected area. The system shall allow the following:
 - Programming of four smoke threshold alarm levels (no alarming is provided)
 - Time delays
 - Faults including airflow, detector, power and filter as well as an indication of the urgency of the fault
 - Seven configurable relay outputs for remote indication of alarm and fault conditions
2. The aspirating smoke detection system shall comply with the requirements of EN 54-120 and the British Fire Protection Systems Association (BFPSA) Code of Practice for Aspirating Smoke Detector Systems.
3. The detector, filter and aspirator shall be housed in a single purpose designed metallic cabinet and shall be arranged in such a way that air is drawn from the protected area through the Dual Stage Filter and Detector by the Aspirator.
4. The aspirator shall be a purpose-built rotary vane air pump. It shall be capable of allowing for multiple sampling pipe runs up to 300 ft. (91m) each, with a response time not exceeding 90 seconds.
5. Resistance to unwanted alarms is of paramount importance. The system shall incorporate advanced statistically based signal processing techniques proven to reduce unwanted alarms. Each detector shall utilise a system of Artificial Intelligence to ensure a consistent level of protection by constantly varying its operating parameters to match environmental changes within the protected area.
6. The detector shall incorporate a dual technology system for the automatic discrimination of signals from non-fire related sources such as dust. The system shall automatically adjust itself to eliminate any deterioration in performance caused by a build up of contamination.
7. The detector shall continuously monitor all internal and external components, and signal warning in the event of any malfunctions including; filter contamination, detection chamber operation, air flow in sampling pipes outside normal limits, microprocessor functioning correctly, power supply, etc.

22.1.17 Smoke Sampling Pipe Network for Smoke Detector, Aspirating Systems

1. The pipe layouts as indicated on the engineer's drawings are notional. The Commissioning Provider shall use the architectural plans and sections of the building to determine the quantity of pipe and fittings required.
2. The sampling pipe network shall be arranged to provide optimum efficiency. The response time for the least favourable sampling point in the system shall not exceed 90 seconds and the system shall be balanced so that the volume of air drawn from the last sampling point shall not be less than 70% of the volume from the first sampling point. The Fire Alarm Specialist shall submit: details of the pipework design

showing the proposed layout and this design shall be supported by computer-generated calculations showing response times, suction pressures and balance details of each sampling point.

3. The Fire Alarm Specialist shall install the system in accordance with the manufacturer's installation and instruction manual.
4. The main sampling pipes shall be red ABS of 20mm or 25mm diameter and shall be identified as a Fire Detection Sampling Pipe at intervals not exceeding the requirements of the BFPSA Code of Practice for labelling sampling pipe. The far end of each trunk or branch pipe shall be fitted with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design. All joints shall be air tight and made by using solvent cement, except at entry to detector mounting box. All pipe shall be supported at not less than 1200 centres.

5. Sampling Holes of at least 2mm diameter shall be separated by intervals not more than 9m intervals along the length of the pipe. These intervals may vary according to calculations. Each Sampling Point shall be identified in accordance with the BFPSA Code of Practice. Consideration shall be given to local regulations and manufacturer's recommendations in relation to the number of Sampling Points and the distance of the Sampling Points from the ceiling or roof structure and forced ventilation systems.
6. Where false ceilings are installed, the sampling pipe shall be installed above the ceiling, and Capillary Sampling Points shall be installed on the ceiling and connected by means of a capillary tube. The minimum internal diameter of the Capillary tube shall be 10mm the maximum length of the Capillary tube shall be 3600mm unless the manufacturer in consultation with the engineer have specified otherwise. The Capillary tube shall terminate at a Ceiling Sampling Point. The performance characteristics of the Sampling Points shall be taken into account during the system design. A conventional tee fitting shall be provided in the main sampling pipe for each capillary sampling point.
7. Air Sampling Pipe Network Calculations shall be provided from a proprietary sampling pipe aspiration modelling program.
8. The Commissioning Provider shall visually check all pipes to ensure that all joints, fittings, bends, sampling points, etc. comply with the specification. He shall check the system to ensure the following features are operational and programmed in accordance with the specification.

22.1.18 Photo-Electric Beam Detection Systems

1. Photoelectric beam detection systems shall consist of a combined Infra-Red transmitter – receiver unit and a reflector and shall comply with the requirements of EN 54-12.
2. The system shall be suitable for operation across distances of up to 50 metres.
3. The system shall incorporate a visible spectrum laser for initial alignment and thereafter the detector head shall continuously align and compensate for any building movement.
4. The system shall automatically compensate for gradual contamination of the lenses to reduce the risk of false alarms and shall generate a fault signal in the event that the contamination prevents the detector from operating normally.

22.1.19 Interface Units

1. Fire alarm input / output units complying with the requirements of EN 54-18 shall be provided to interface the fire alarm system with other mechanical and electrical systems throughout the complex.
2. The Fire Alarm Specialist shall include fully for all necessary interface units, input/output units, relays and power supplies to implement the fire safety strategy as described elsewhere in this specification. They shall be typically used to initiate the following:
 - Ventilation plant shut down
 - Closing of Fire doors
 - Opening of Smoke vents in all areas
 - Closing of Gas slam shut valves
 - Automatic muting of PA system
 - Switching off Lifts
3. Interface units shall be provided to monitor the following ancillary fire safety systems in the building in the event of a fire. Detection of alarm status in such systems shall display details of the fault and activate a sounder within the CIE in the main security control room.
 - Computer Room Fire Suppression System
 - Kitchen Canopy Fire Suppression System
 - Sprinkler Systems – refer to separate section of this specification
 - Gas detection systems
4. The Fire Alarm Specialist shall liaise with all specialist/suppliers to ensure the systems to be interfaced are compatible.

22.1.20 Monitoring Of Sprinkler Valves & Plant

1. The fire detection system shall monitor the various sprinkler plant alarm facilities in accordance with the requirements of B.S. 5306, Part 2, 1990, Section 5 and as described elsewhere in this specification.
2. Local monitoring panels shall be supplied and installed as part of the fire alarm system to monitor each and every sprinkler valve on the installation. These monitoring panels shall be complete with LEDs to provide status indicator for fire and fault conditions of all valves. They shall be complete with addressable zone monitoring units as required for monitoring the valve micro switches and for interfacing with the fire detection loop.

22.1.21 Sounders

1. Fire alarm sounders shall be the electronic type with an output of 106 dB at 1 meter and shall comply with EN 54-3. They shall have a red flame retardant housing. The Fire Alarm Specialist with cooperation from the Electrical Specialist/Installer shall ensure that the sound cannot be easily confused with other alarm sounders in the building.
2. Sounders shall be suitable for surface mounting on round conduit BESA boxes and shall be complete with skirts which shall conceal the conduit box. They shall be mounted at approximately 2600 mm above floor level.
3. The number, type and location of all sounders shall be as indicated on the drawings. Where sounders are provided the Fire Alarm Specialist shall be responsible for ensuring that sounders shall provide the minimum sound levels required in the relevant "Audibility of Alarms" section of the latest version of IS 3218.
4. Should the Fire Alarm Specialist decide that it is not possible to achieve the required sound level using the number and/or layout of sounders shown, without using sounders with unacceptably high output levels, then the Fire Alarm Specialist shall advise the Engineer of any additional sounders considered necessary and indicate their preferred location.
5. The sounder adjacent to any CIE may have a reduced output e.g. in a security room, reception desk etc. to allow normal voice communication to continue.

22.1.22 Strobe lights

1. Strobe lights shall be installed as indicated on the drawings. They shall be heavy-duty, self-contained, high intensity warning beacons constructed from high impact resistant polycarbonate and complying with the requirements of EN 54-23. They shall be coloured red and labelled "Fire" They shall be 24 VDC operated.
2. They shall be capable of emitting high intensity strobe light bursts to indicate an alarm condition with or without the sounders operating.

22.1.23 Door Holders

1. Door holders shall comprise a wall or floor mounted 24V D.C. electro magnet with door mounted swivel plate armature. These units shall generally be mounted at low level or door head level. Floor types shall be complete with floor mounting bracket.
2. Door closer/hold-open devices shall comprise an over door closer with an integral 24V D.C. electro-magnetic door hold-open device. These shall be supplied and erected by the Main Contractor unless otherwise stated.
3. The electro magnets shall be fed from a central door release relay unit incorporating a 220 V A.C. to 24 V D.C. transformer/rectifier unit, individual circuit fuses, and a relay, the coil of which shall de-energise upon receipt of a fire alarm signal thereby switching off the 24 V supply to the electro magnets.

22.1.24 Zone Chart

A Zone Chart shall be permanently fixed beside the main CIE and each repeat indicator panel. The Zone Chart shall contain the information as required in the current version of IS 3218.

22.1.25 Repeat Indicator Panels

1. Repeater panels shall be similar in design and appearance to the main CIE and shall comply with the requirements of EN 54-2.
2. Repeater panels shall have an alphanumeric display and LEDs to repeat all text messages and indicators which are displayed on the main CIE and shall incorporate a full duplicate set of controls as are installed on the main CIE.
3. They shall be powered locally and shall contain their own standby battery unit.
4. The system shall be designed and configured so that a fault or damage on a repeater panel shall not have any adverse effect on the operation of the main CIE.

22.1.26 Automatic Receiving Centre (ARC)

1. The fire alarm system shall be monitored by a 24 hour x 7 day Automatic Receiving Centre via a digital communicator between a fire alarm system and an ARC. The requirements for relaying of a fire signal to the remote station shall comply fully with the relevant section of the latest version of IS 3218.
2. The Fire Alarm Specialist shall supply and install a dedicated digital communicator for the fire alarm system.
3. The digital communicator shall be equipped with the facility to connect to the Public Switched Telephone Network (PSTN) via a hard-wired connection and also a GSM network via a SIM card (to be supplied by RMCE).
4. The Electrical Specialist/Installer shall be responsible for the supply and installation of a dedicated telephone line back to the incoming telephone line distribution frame and for all necessary interface with the telecommunications services provider.
5. The telephone line shall be enhanced fire resistance cable of PH 120 classification to IS EN 50200 and shall be monitored for open and short circuit fault conditions.

22.2 TESTING AND COMMISSIONING OF FIRE ALARM SYSTEM**22.2.1 Introduction**

The Fire Alarm Specialist shall include for the complete testing, pre-commissioning, commissioning, certification and handover of the fire alarm system in accordance with IS 3218. This should include the following, as a minimum:

- Inspection and testing of the wiring installation for correct polarity, insulation resistance and earthing.
- Testing and recording the operation of all detection devices.
- Testing and recording the operation and audibility of all sounders and alarm devices.
- Testing and recording operation of all CIE, control panels, repeat indicators, and digital communicator etc.
- Testing and recording the operation of the fire strategy prior to demonstration to the engineer and client including all necessary consultation, site meetings etc. as required with other specialists.
- Programming the system and setting up text messages and displays to Client's requirements.
- Programming the system to implement the fire strategy
- Final testing and certification and verification of operation of the fire strategy
- Instructing Client's agent in the operation and maintenance of the system.
- Handover of all test records, certificates, log books, manuals etc.
- Checking the complete installation to ensure detectors have been installed in all areas as indicated on the contract drawings and that the design intent has been met

22.2.2 Fire Alarm Strategy

1. The fire alarm system shall be programmed or configured to provide an agreed safety strategy in the event of the fire.
2. The Fire Alarm Specialist shall include fully for all necessary interface units, input/output units relays and power supplies to implement this strategy.
3. The Fire Alarm Specialist in conjunction Electrical Specialist/Installer shall be responsible for liaising with all other specialists such as lift companies, Sprinkler companies, smoke vent system suppliers, BMS Contractors, mechanical contractor etc. to determine the appropriate method of interface and for carrying out a complete testing of all interfaces prior to demonstration to the engineers for acceptance and handover. Unless otherwise specified, activation of Evacuate Mode will be on the basis of:
 - Investigation time elapsing without manual intervention following activation of a single smoke / heat detector
 - Or activation of a second smoke / heat detector
 - Or activation of a manual call point
 - i. In tandem with the above the following shall typically occur:
 - All ventilation plant in the effected building shut down via MCC
 - Smoke vents open in all areas via direct interface with each ASV controller
 - Gas slam shut valves close via direct interface and by failing supply to valve solenoid
 - Automatic mute facility activated in the music / PA system
 - Lifts switch off via direct interface with Lift MCC. Refer to details above.
 - Fire signal relayed to Alarm Receiving Centre (ARC) via the Digital Communicator
4. The Fire Alarm Specialist shall produce a site specific Fire Strategy Verification Document to verify and record the operation of the Fire Safety Strategy. Each action in the document shall be signed by the Commissioning Engineer and countersigned by the Electrical Specialist/Installer as a witness.
5. A cause and effect strategy for the different buildings is appended to the rear of this document and outlined briefly in the following paragraphs.

22.2.3 Control of ventilation systems in the event of fire

Ventilation plant in a building will shut down via the interface with the MCC in the Plant Room if smoke is detected anywhere in that building.

22.2.4 Smoke Fire Damper (SFD) in the event of fire

The SFDs shall automatically close under the circumstances described in the Cause and Effect Strategy.

22.2.5 Atrium Automatic Smoke Vents (ASV) in the event of fire

Atrium Smoke Vents shall automatically open under the circumstances described in the Cause and Effect Strategy.

22.2.6 Stair Automatic Smoke Vents ASVs

Stair AOVs will only open if smoke is detected within the associated stairwells.

22.2.7 Automatic Opening Vents for smoke control

Automatic opening vents and doors (for provision of make up air for smoke control) shall automatically open under the circumstances described in the Cause and Effect Strategy.

22.2.8 Kitchen and Servery Fire Screens

Kitchen and servery fire screens will drive to the closed position if smoke is detected within the servery area. They should be supplied via a UPS circuit.

22.2.9 Control of Lifts In The Event Of Fire

If the lift is travelling when the fire alarm is activated it shall continue to a designated floor and switch off via a direct fire alarm interface with Lift Control panel as follows:

- Fire signal from the ground / main exit floor - lift to go to the nearest floor above.
- Fire signal from any other floor - lift to go to the ground / main exit floor.
- If the lift is stationary when the fire alarm is activated then the lift shall simply switch off.
- In either case the car and landing doors shall close but shall remain openable from the car control panel at all times.
- The Fire Alarm Specialist shall liaise directly with the lift supplier to determine wiring details for the interface with the fire alarm system.

22.2.10 Control and Monitoring of Gas

1. Where Gas detection systems and associated slam shut valves are to be installed in the building, they shall be controlled and monitored as follows.
In the event of gas being detected by the gas sniffer, the gas monitoring panel shall switch off the supply to the slam shut valve causing it to close. It shall also provide a "volt free" signal to the Fire Alarm System which shall be indicated as a "fault" on the Fire Alarm panel.
In the event of fire being detected, the Fire Alarm System shall break the supply to the slam shut valve by means of interface unit and relay.

22.3 DEMONSTRATION OF FIRE ALARM SYSTEM

1. RMCE will require a full demonstration of the fire alarm system as a pre-requisite to accepting handover of the building. The contractor shall include for all costs associated with this and shall allow sufficient time in the programme for the demonstration to take place.
2. RMCE need to receive the fire alarm installation and commissioning certificates prior to the demonstration being scheduled. If the certificates contain any deviations which have not previously been discussed and agreed (e.g. a statement that additional detectors or sounders are required) then the demonstration will be postponed until after "clean" certificates are received.
3. The Control & Indicating Equipment will be inspected first. If there are any fault or disablement indicators present then the demonstration will be postponed to a later date after these have been cleared. Temporary disablement of some of the fire alarm interconnections with other systems can be made on the day to minimise disruption during the demonstrations if required.
4. Before proceeding with the physical demonstration, 100% of the fire alarm devices will be visually inspected to ensure that all protective caps have been removed and that there are no fault indicators present on any of the smoke sampling units, ceiling tiles and access hatches are to be left open where required to facilitate this.
5. RMCE will walk the building randomly activating devices to verify that the text which is displayed on the fire alarm panel corresponds to the device which has been activated. The contractor shall arrange for 2-way radios to be available to facilitate this process.
6. Sound levels from the alarm sounders will be spot-checked as part of this process, the contractor shall arrange for a calibrated sound level meter to be available for this test.
7. RMCE will walk the building a second time to verify that the cause & effect has been properly implemented. This will involve picking specific devices to activate and then verifying that the ancillary systems behave as they are supposed to, e.g. smoke dampers closing, MCC Panels shutting down, gas slam-shut valve closing etc. This part of the demonstration will involve personnel from the other specialists to be present.

23. SECURITY SYSTEMS : CCTV , ACCESS CONTROL & INTRUDER ALARM

The electrical specialist shall be responsible for the supply, installation and commissioning of all CCTV , Access Control & Intruder Alarm systems and equipment in accordance with the requirement of this specification and as indicated on the drawings.

All security recording devices, monitors and front end PC's to be rated for always on, 24hr & 7Days a week service.

23.1 CCTV SERVICES INSTALLATION:

The CCTV system generally comprises of internal and external day/night fixed dome cameras and external full function pan, tilt and zoom (PTZ) day/night cameras, colour display monitor(s), playback monitor(s), storage, controls and associated equipment.

The Contractor shall provide all equipment required to complete the system.

The contractor shall be solely responsible for protection of all CCTV system equipment from damage, dust and debris, likely to be encountered during the course of the works.

23.1.1 Standards

The materials, components and completed installations shall conform as applicable with the following standards, including all amendments, current at the time of tendering.

All CCTV, Access Control, Intruder Alarm and associated Monitoring Contractors shall be licensed with the Private Security Authority (PSA) in compliance with current Private Security Services Acts.

CCTV installers shall be manufacturer approved system integrators and as such shall be trained and authorised by the manufacturer to install, integrate, test and commission the CCTV system.

The system shall comply fully with:

EN 62676-4 2015	Video surveillance systems for use in security applications application guidelines - Part 4: Application Guidelines.
IS EN 62676-1-2 2014 (Including 2016 Amendments)	Video surveillance systems for use in security applications - Part 1-2: System Requirements - Performance Requirements for Video Transmission.
EN 62676-2-1, 2014	Video surveillance systems for use in security applications - Part 2-1: Video transmission protocols — General requirements
IS EN 62676-2-2 2014	Video surveillance systems for use in security applications Part 2-2: Video transmission protocols — IP interoperability implementation based on HTTP and REST services

IS EN 62676-3 2015
(Including 2018 Amendments)

Video surveillance systems for use in security applications Part 3: Analog and digital video interfaces

The CCTV installation shall also comply with the following:

CIR RPT 624-3 1986

Characteristics of television systems

ITU-R REPORT BT.624 1990
4th Edition

Characteristics of television systems

ITU-T J.61 1990
(Including 2007 Amendment)

Transmission performance of television circuits designed for use in international connections

IS EN 61000-6-3, 2007
(Including 2012 Amendments)

Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments

IS EN 50130-4 2011
(Including 2014 Amendment 1)

Alarm systems - Part 4: Electromagnetic compatibility - Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems

IS EN 50130-5 2019 11th Edition
(Including 2019 Amendment)

Alarm systems - Part 5: Environmental test methods

IS EN IEC 62368-1 2020
(Including 2020 Amendments)

Audio/video, information and communication technology equipment Part 1: Safety requirements

IEC 60065 2014 Rev. 8.0
(Including Amendments & Corr.3 2018)

Audio, video and similar electronic apparatus Safety requirements

IS EN 60068-1 2014

Environmental Testing - Part 1: General and Guidance

IEC 60068-1 2013 Rev. 7.0

Environmental Testing Part 1: General and Guidance

IEC 60950-1 2013 Rev. 2.2
(Including Amendments & Corrigenda)

Information Technology Equipment, Safety Part 1, General Requirements

IS EN IEC 62368-1 2020
(Including amendments)

Audio/video, information and communication technology equipment Part 1: Safety requirements (Including amendments)

IS EN 55032:2015+A1:2020

Electromagnetic compatibility of multimedia equipment - Emission Requirements

IS EN 61000-6-3 2021

Electromagnetic compatibility (EMC) Part 6-3: Generic standards - Emission standard for equipment in residential environments

IS EN 61000-3-2 2019

Electromagnetic compatibility (EMC) Part 6-2: Generic standards - Immunity standard for industrial environments

IS EN 61000-3-3 2022	Electromagnetic compatibility (EMC) Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
IS EN 55035 2017+A2021	Electromagnetic compatibility of multimedia equipment — Immunity requirements
IS EN 61000-6-1 2019	Electromagnetic compatibility (EMC) Part 6-1: Generic standards - Immunity standard for residential, commercial and light-industrial environments
IS EN 50121-4 2017+A1 2019	Railway applications - Electromagnetic compatibility Part 4: Emission and immunity of the signalling and telecommunications apparatus

All wiring shall comply fully with the latest and current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations.

The contractor shall allow for installing the electrical installation in full compliance with the standards specified herein, including all amendments, corrigenda and updated and renamed standards and regulations current at the time of installation.

23.1.2 Wiring & Containmentment

The contractor shall be responsible for the supply, installation and commissioning of a CCTV Security System in accordance with the Office of Public Works guidelines to meet with requirements for the building.

The contractor shall be required to install the conduits and cabling associated with the CCTV Systems. The cabling will be terminated and the CCTV Systems devices, components and outlets shall be supplied, fitted, tested and certified by the contractor.

All CCTV System cables installed by the electrical contractor shall be fully tested for continuity prior to acceptance by the security contractor. Cable faults shall be identified and repaired by the electrical contractor by replacing the faulty cable in its entirety.

The CCTV system cabling shall generally be installed within the ELV compartment section of cable basket, tray or trunking systems, however, where over capacity, the electrical contractor shall include for a network of suitably sized ELV basket, tray or trunking.

The electrical contractor shall note that all CCTV system wiring to individual peripheral items such as cameras and monitors shall be star wired from the local distribution board.

All cabling used in new CCTV systems shall be wired in Cat6A UTP EuroClass Cca-s1b,d2,a2, fibre optic cable or better cable in accordance with the specialist contractors and manufacturers requirements and the Data Comms (ICT) section of this specification, with local power supplies for equipment as noted on the drawings. Shielded Cabling shall be provided from the Access Control PC and CCTV NVR to the first controller.

Exposed external CCTV cabling shall be enclosed in armour sheathed Kopex complete with universal glands.

The above cables shall be terminated on a Cat6A patch panel located adjacent to the network video recorder (NVR)

All power supplies shall be mounted in a secure location between 600mm and 2000mm above finished floor level on the secure side of the access controlled door. Power supplies and door controllers must not be installed above ceilings or within raised access floor voids.

All power supplies shall be switch mode based (as opposed to transformer based) for energy efficiency.

PoE cameras will be powered by PoE switches provided by the Contractor. The Contractor shall provide 230V single phase supplies for the CCTV equipment and cameras where shown on the drawing(s) and as required by the CCTV Specialist. They shall all be wired on the same phase. These shall be unswitched fused connection units labelled 'CCTV System – Do Not Switch Off'.

All new cameras shall be patched directly to the network video recording device which is located as indicated on the drawings or unless otherwise stated in the ICT/Comms room of each building.

Patch leads shall be factory tested, minimum 2m long with both ends pre-terminated.

All cabling used in legacy analogue CCTV systems (where existing analogue equipment is being re-used) shall be wired from existing cameras to existing digital video recorder in RG59 co-axial cable in accordance with the specialist contractors requirements with local power supplies for equipment as noted on the drawings.

The contractor shall allow for all analogue to digital and/or digital to analogue converters required to interface new and re-used CCTV equipment.

All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.

The contractor shall be responsible to co-ordinate the electrical (LV) and CCTV Systems (ELV), that they will not share the same conduit, trunking compartments, channel or sleeve. The current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations (and definition of low voltage) shall be adhered to in this respect. Separate conduit systems shall be provided for each system as noted on the drawings.

23.1.3 Camera Lens Selection

The size of an object (target) on the monitor screen should have a relation to the operator task, e.g. identification, recognition, detection or monitoring. It shall be the responsibility of the CCTV contractor to select the most suitable lens to achieve the level of viewing specified. These viewing levels shall be as follows and shall indicate the height of the target (person being monitored) relative to the height of the monitor screen.

- a) For identification the target should represent not less than 120% of screen height.
- b) For recognition the target should represent not less than 50% of picture height.
- c) For detection of an intruder the target should represent not less than 10% of picture height.
- d) For crowd control (monitoring) the target should represent not less than 5% of picture height.

When selecting the lens the following should also be taken into account:

- a) The lens field of view (indicated in the manufacturer's nominal figure tables) may be reduced by any over scan in the display device;
- b) The illumination of the sensor in the camera is defined by the aperture number of the lens and its transmission number, which is dependent on the design of the lens;
- c) Internal lens reflections and ghosting can significantly impair the image;
- d) Some zoom lenses are subject to ramping whereby the effective aperture number of the lens increases as the focal length is increased.
- e) Accuracy of the pre-set shots if fitted.

NOTE: Having selected the camera-lens combination, it is recommended that, for difficult scenes, a camera of the type selected should be evaluated in conditions similar to those to be encountered at the installation.

23.1.4 Internal camera installation

All cameras shall be of the mini dome type or fixed type and strategically mounted to view the designated area of concern.

All internal cameras shall be capable of being recorded at 25 frames per second (FPS).

Cameras locations are indicated on the tender drawings.

23.1.5 External camera installation

All external cameras shall be installed to monitor the building peripheries and general open areas within each site complex. The cameras shall be positioned in such locations so as to monitor general pedestrian and vehicular traffic.

External fixed cameras shall be focused directly on external doors. Cameras locations are indicated on the tender drawings.

All external cameras shall be capable of being recorded at 25 frames per second (FPS).

23.1.6 Monitoring and recording

The recording of all images shall be stored on one or more Network Recording Device (ie Network Video Recorders (NVR's) and/or Servers) suitably sized to meet the resolution, frame rate and retention requirements of the system with 20% free storage capacity available. The Network Recording Devices shall be located as indicated on the drawings, or unless otherwise stated, in the ICT/Comms room of each building. Each of the Network Recording Device shall have an IP module for connecting it to the LAN (Local Area Network).

The CCTV Specialist will be required to provide Network Recording Device storage calculations as part of the Technical Submittal process.

Storage shall be provided for the following resolutions and durations:

General & External Areas Throughout Building

- Frame rate: 25 fps
- Resolution: 3072 x 2048 6MP
- Storage Duration: 31 days (744 hours)

Entrance Lobby / Foyer / Public Reception

- Frame rate: 25 fps
- Resolution: 3072 x 2048 6MP
- Storage Duration: 31 days (744 hours)

PEMS Area

- Frame rate: 25 fps
- Resolution: 3072 x 2048 6MP
- Storage Duration: 7 months (5,208 hours)

The Network Recording Device shall be capable of 25 frames per second live and 25 frames per second in playback at resolution 3072 x 2048 6megapixel and shall be capable of 31 days storage in general with the exception of the PEMS area in Garda Buildings which shall have 7 months storage.

Where legacy DVR's are re-used they shall be capable of 25 frames per second live and 25 frames per second in playback at D1 resolution (720x526 PAL) and shall be capable of 31 days storage.

Event logging will be required for the CCTV installation.

All monitors shall be colour LED flat screen type with 3072 x 2048 resolution for viewing Network Recording Device multi-screen and all monitors shall be supplied with low profile

VESA wall mounting bracket or VESA desk pedestal brackets to suit installation location. All brackets shall be tilt, turn, height and rotational adjustable.

Desk mounted monitors shall be a minimum size of 32" and wall mounted monitors shall be a minimum of 40".

A keyboard/control unit and 21" monitor shall be located at each Network Recording Device and DVR.

A second keyboard/control unit and 2 no 40" monitors (1 split screen & 1 live view) will be required at the Reception Desk or as indicated on the drawings.

The CCTV Specialist will be required to conduct a full review of monitor quantities and locations to ensure there is sufficient wall and desk space for the proposed monitors.

Legacy Analogue Video input and output cables installed shall have the following characteristics:

- The source and load impedance of a transmission system shall be 75 Ω on the unbalanced coaxial input and output
- The return loss in the inputs and outputs shall be 20 dB from 0.1 MHz to 5 MHz.

The cameras shall record all images in the field of view for 5 seconds pre-motion and 5 seconds post motion in the designated area.

The type of legacy analogue cable chosen should have a characteristic impedance of 75 Ohms. For long cable runs amplifying or amplifying plus video equalising equipment may be required to meet the above performance. The contractor shall advise if amplifying equipment is required and clearly indicate this equipment in their returned form of tender.

The legacy analogue transmission equipment shall be connected and adjusted in accordance with the manufacturer's recommendations, for the recommended cables and up to their maximum specified length. Unless otherwise specified in the tests, the system shall operate at nominal input and output levels and terminated in a standard load impedance of 75ohms $\pm$ 5 %.

The contractor shall supply and install all CCTV monitors throughout.

23.1.7 CCTV system equipment

Cameras:

Each camera shall comply with the following.

General:

Each analogue camera must have loop through facility.

All cameras shall be capable of working with any manufacturers Network Video Recording Device.

Internal Fixed Dome Camera :

Camera Characteristics:

- 3072 x 2048 6megapixel resolution colour mini internal surface dome, vari-focal 3.4 – 10.5mm, 3 axis gimbal.
- Cameras shall be capable of operating at 6MPx as follows:
 - With IR: 0 lux in monochrome (black & white) mode @ F1.4
 - Without IR: 0.04 lux in color mode @ F1.4 or higher
 - Without IR: 0.02 lux in monochrome (black & white) mode @ F1.4 or higher

- Each dome camera shall be housed in a vandal resistant enclosure rated IK10.
- IP64 Ingress Protection Rating
- All internal cameras shall be capable of being recorded at 25 frames per second (FPS).

External Fixed Dome / Bullet Camera :

Camera Characteristics:

- 3072 x 2048 6megapixel resolution colour mini internal surface dome, vari-focal 3.4 – 10.5mm mm, 3 axis gimbal
- Cameras shall be capable of operating at 6MPx as follows:
 - With IR: 0 lux in monochrome (black & white) mode @ F1.4
 - Without IR: 0.04 lux in color mode @ F1.4 or higher
 - Without IR: 0.02 lux in monochrome (black & white) mode @ F1.4 or higher
- Each dome camera shall be housed in a vandal resistant enclosure rated IK10.
- Each fixed camera shall have infra-red lights that have adjustment (horizontal & vertical) that is independent form the cameras
- Three simultaneous video streams with up to 6 MPx, 3072 x 2048 resolution, Auto iris, and vari-focal lens capabilities.
- H.264 Main and High profiles; and capable of H.265, MJPEG compression
- Up to 6 megapixels
- Dual streaming (three independent IP video streams)
- Day/night operation with IR cut filter
- Effective Dynamic Range: True WDR p to 120 dB, per IEC62676
- IEEE802.3af PoE (Indoor), IEEE802.3at (Environmental) 18 ~ 32 VAC, 12 +/-10% VDC
- Shall be capable of Smart Compression Technology
- Analytics Suite including Adaptive Motion, Object Counting, Motion Detection, and Camera Sabotage.
- Multicast capable with unlimited H.264 and H.265 capable viewers
- Unicast capable with up to 5 simultaneous viewers
- Local storage via Micro SDHC and SDXC card, 2 TB addressable, 128 GB or more testable
- Audio input and output
- Alarm input and output
- IP66/67 Ingress Protection Rating and Type 4x Weather Rating
- IK10 Rating for Vandal Resistance
- All external cameras shall be capable of being recorded at 25 frames per second (FPS).

Camera Optics:

- Imaging:

<u>Model</u>	<u>Imaging Device</u>	<u>Maximum Resolution</u>
6 MPx	1/2.8-inch	3072 x 2048 (6.0 MPx)

- Imager Type: CMOS
- Electronic Shutter Range: 1/10,000 to 1 sec
- Minimum illumination:

Colour mode:

<u>Model</u>	<u>Sensitivity</u>
6 MPx	0.26 lux (33 ms, F1.4), 0.065 lux (200 ms, F1.4)

Black & white mode:

<u>Model</u>	<u>Sensitivity</u>
6 MPx	0.15 lux (33 ms, F1.4), 0.0375 lux (200 ms, F1.4)

- Scanning: Progressive

-
- Image Control Settings
 - White balance range: 2,000° to 10,000°K
 - IR Illumination: 850 nm adaptive IR, up to 50 meters
 - Day and night settings
 - Privacy zone definition: up to 8 zones of window blanking
 - 3D noise reduction

Lens:

- Built-in, vari-focal
- Focal Length: F1.4, 3.4 – 10.5mm
- Zoom: Remote
- Auto Iris: DC drive lens
- Auto Focus: Automatically focuses during runtime operation
- Field of view:

	<u>6 MPx</u>
Diagonal	124°~ 40°
Horizontal	94°~ 32°
Vertical	68°~ 24°

Video:

- The network camera system shall support up to three simultaneous streams; the second stream and third stream are variable based on the setup of the primary stream.
- Compression type: H.264 High or Main profiles; and capable of H.265, MJPEG
- Orientation modes: Corridor Mode, Mirror Mode, Flip Mode, Electronic Image Rotation 90°, 180°, and 270°
- Flicker Control: Selectable 50 Hz or 60 Hz modes
- Resolution:

<u>MPx</u>	<u>Width x Height</u>	<u>Aspect Ratio</u>
6.0	3072 x 2048	16:9
- Constant bit rate (CBR), constrained variable bit rate (CVBR) with configurable maximum value.
- Frame rate:

<u>MPx</u>	<u>Images per Second (ips)</u>
6.0	25
- ONVIF Compliance Profile S, Profile G, Profile M, and Profile T
- Video analytics including Motion Detection, Camera Sabotage, Audio Detection, Object Counting, Adaptive Motion, Object Removal, and Directional Motion.
- Shall be capable of Smart Compression Technology
- Low resolution JPEG stream for configuration of camera settings.

Storage and Recording:

- The network camera system control shall have onboard SD card storage.
 - Card type: microSD / microSDHC / microSDXC slot & read write speed Class V10 or better.
 - Capacity: up to 2 TB addressable, 128 GB testable
- The local SD storage shall have the ability to be backed up to alternate media without removal of the SD card from the camera.
- Local recording on the SD card shall commence upon loss of network connectivity, based on a pre-programmed schedule.
- The network camera system shall record video continuously in the case of network outage.
- Alarm recording: The network camera system shall capture selectable 1, 5, or 10 second video clips on camera sabotage, motion detection, or alarm input.
- Video recording and storage shall support ONVIF profile G.
- Manual Pan Tilt
 - Pan Range: 0° ~ 370°
 - Tilt Range: -15° ~ -90°
 - Rotate Range: 0° ~ 355°
- Simple motion detection and camera sabotage analytics.

All cameras shall be as manufactured by either:
American Dynamics, Bosch, Hikvision, Pelco

Pan,Tilt Zoom (PTZ) Camera External:

Each full function Pan, Tilt, Zoom camera shall comply with the following or equal and Approved

Camera Characteristics:

- Colour to black and white external full function dome, 3072 x 2048 6megapixel resolution
- Cameras shall be capable of operating at lighting levels of 0.025 lux 125ms & 0.1 lux 33ms colour @ F1.4 & 0.01 lux 125ms & 0.05 lux 33ms black & white @ F1.4.
- Review HAD 1/4" CCD integrated camera.
- Lens F1.6 – F4.44.5 wide - 135mm tele, zoom 30 X optical and 12 X digital, 3 X auto focus. 256 presets, Variable speed drive unit with preset speeds of 360degree/sec pan & preset speed of 200 degree/sec tilt speed.
- Manual speeds, Pan 0.1-80 degree/sec, 150 degree turbo, Tilt 0.1-40 degree/sec, subject to variable speed controller, non-variable speed controller, speed is 20 degrees/sec, complete with IWM wall mount wall brackets.
- Local Storage via on board Micro SDHC/SDXC card Storage (2TB capacity) with ability to be backed up without removing SD card.
- Variable speed/high speed pan/tilt drive unit with continuous 360° pan rotation up to 400°/sec (maximum pan speed) and up to 200°/sec (maximum tilt speed)
- H.264 High, Main and capable of H.265 Main and MJPEG
- 6 megapixels
- Up to three simultaneous streams
- Day/night operation with IR cut filter
- 12 X digital zoom, 30 X optical zoom
- Automatic gain Control: Yes
- True Wide Dynamic Range (WDR): Up to 120 dB, 100 dB per IEC 62676-5
- Analytics Suite: Simple Motion Detection, Loitering Detection, Camera Sabotage, Audio Detection and Object Counting
- Shall be capable of Smart Compression Technology
- 802.3at and 802.3bt PoE
- Multicast capable with unlimited H.264 and H.265 capable viewers
- Unicast capable with up to 5 simultaneous viewers
- Local storage via Micro SDHC/SDXC card
- Audio input and output
- Alarm input and output
- IP66 and IP67 (environmental models only)
- Aluminium construction, IK10 rated housing and nylon bubble
- Progressive scanning system

Camera Optics:

- Sensor: 1/2.8" CMOS Sensor
- Aspect Ratio: 16:9
- Light Sensitivity:
 - Colour (33 ms): 0.1 lux
 - Colour (125 ms): 0.025 lux
 - Mono (33 ms): 0.05 lux
 - Mono (125 ms): 0.01 lux
- Day/Night Capabilities: Yes
- Shutter Range: 1/4 - 1/30,000 sec
- Signal-to-Noise Ratio: >50 Db
- IR Cut Filter: Yes
- True Wide Dynamic Range: Up to 120 Db, 100 dB per IEC62676
- Iris Control: Auto iris with manual override
- Backlight Compensation: Yes
- Automatic Gain Control: Yes

- Active Noise Filtering 3D Noise Filtering
- Digital Image Stabilization Yes

Video:

- Video Encoding H.264 High, Main and capable of H.265 Main, MJPEG
- Video Streams Up to 3 simultaneous streams; the second and third stream is variable based on the setup of the primary stream
- Frame Rate 25 fps
- ONVIF Compliance Profile S, Profile G, Profile M, and Profile T

Lens:

F1.6 – F4.4, focal length 4.5 mm (wide) – 135 mm (tele)
 Horizontal angle of view: 59.8 ° (wide) – 2.34 ° (tele)
 Vertical angle of view: 40.5 ° (wide) – 1.48 ° (tele)
 Diagonal angle of view 67.8 ° (wide) – 2.77 ° (tele)

Storage and Recording:

- The Pan, Tilt, Zoom (PTZ) camera control shall have onboard SD card storage.
 Card type: microSD / microSDHC / microSDXC slot & read write speed
 Class V10 or better
 Capacity: up to 2 TB
- The local SD storage shall have the ability to be backed up to alternate media without removal of the SD card from the camera.
- Local recording on the SD card shall commence upon loss of network connectivity, based on a pre-programmed schedule.
- Video shall be recorded continuously in the case of network outage.
- Alarm recording: The PTZ camera shall capture selectable 1, 5, or 10 second video clips on camera sabotage, simple motion detection, or alarm input.
- Video recording and storage shall support ONVIF profile G.

Analytics:

- Analytics shall be pre-loaded in the Pan, Tilt, Zoom (PTZ) camera. (Be capable of analytics but not enabled unless specifically requested)

Network Video Recorders

All Network Video Recorder (NVR) shall be either:
 American Dynamics, Bosch, Hikvision, Pelco

Comm.'s Cabinet for CCTV Equipment.

The security specialist shall provide 1No. 42U, 600 X 1000 comm.'s cabinet compete with extractor fans, 10 way PDU, fixed and a sliding shelf's, cable management trunking and lockable mesh vented door with 85% free area.

The security specialist shall provide a minimum of 2 No. duty/standby smart controlled 1kVA, 800 watt, rack mounted UPS or suitably larger sized duty/standby UPS to match the systems hardware requirements.

CCTV equipment shall be installed within the ICT/Comms cabinet unless otherwise stated.

23.1.8 AUTOMATIC NUMBER PLATE RECOGNITION (ANPR) SYSTEM:

The CCTV contractor shall allow for all cabling, termination, panels, devices, hardware, software, interfaces test & commissioning to provide the ANPR site requirements identified within the particular specification and drawings associated with this tender.

Where required and specified in the particular specification, the CCTV system shall have search capacity and interfaces with the Access Control System in line with the cause and effect strategy identified in the particular specification and drawings associated with this tender.



Analytics shall be pre-loaded in each camera with facility to activate analytics provided via the on-site Network Recording Device where required and specified in the particular specification.

Where required Analytics shall be deemed to include the following: Objects in Area, Object Loitering, Objects Crossing Beam, Object Appears or Enters Area, Object Not Present in Area, Objects Leave Area, Object Stops in Area, Direction Violated, Tamper Detection, Corridor Mode.

23.1.9 CAMERA POLES:

Camera mounting poles shall comply with the following criteria:

- Purpose made for CCTV applications, lighting columns will not be acceptable.
- Heavy duty tubular construction, capable of supporting up to 50kg load
- Galvanised threaded anchors
- High security access door locks
- Wind loadings suitable for 52 m/s
- Fitted with anti-climbing frame
- 6 metre height or as per particular specification
- Columns shall be Altron AW1545/6TD/UP 6m Tilt Down Pole 400sq cabinet base or equal and approved
- CCTV columns shall have RAL colour as per particular specification

23.1.10 BUILDERS WORKS:

The Electrical Specialist and CCTV Specialist shall be responsible for providing all builders work information to the Main Contractor at the outset of the project and for coordinating all on site. This particularly relates to the builders work requirements for the CCTV Columns.

23.2 ACCESS CONTROL SYSTEM:

23.2.1 Standards

The materials, components and completed installations shall conform as applicable with the following standards, including all amendments, current at the time of tendering.

The system shall comply fully with BS EN 60839-11-1 2015 Alarm and electronic security systems Part 11-1: Electronic access control systems — System and components requirements.

All CCTV, Access Control, Intruder Alarm and associated Monitoring Contractors must be licensed with the Private Security Authority (PSA) in compliance with current Private Security Services Acts.

The Access Control System installation shall also comply with the following:

IS EN 61000-6-3, 2007 (Including 2012 Amendments)	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
IS EN IEC 61000-6-4 2019	Electromagnetic compatibility (EMC) Generic standard, Emission standard for industrial environments
IS EN IEC 61000-6-1 2019 (Including Amendments)	Electromagnetic compatibility (EMC) Generic standard, Immunity standard for residential, commercial and light-industrial environments
IS EN 50561-1 2013 (Including 2015 amendments)	Power line communication apparatus used in low-voltage installations, Radio disturbance characteristics, Limits and methods of measurement Part 1: Apparatus for in-home use
BS EN 61000-4-6 2014	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
IS EN 61000 2021	Electromagnetic compatibility (EMC) Limits & Testing and Measurement Techniques
IS EN IEC 62368-1 2020 (Including 2020 amendments)	Audio/video, information and communication technology equipment Part 1: Safety requirements
IS EN 60068-1 2014	Environmental Testing Part 1: General and Guidance
IS EN 60068-2-1 2007	Environmental testing Part 2-1: Tests - Test A: Cold
IS EN 60068-2-2 2007	Environmental testing Part 2-2: Tests - Test B: Dry heat
IS EN 60068-2-6 2008	Environmental testing Part 2-6: Tests - Test Fc: Vibration (sinusoidal)
IS EN 60068-2-18 2017	Environmental testing Part 2-18: Tests - Test R and guidance: Water
IEC 60068-2-75 2014	Environmental testing Part 2-75: Tests - Test Eh: Hammer tests

IS EN 12453 2018	Industrial, commercial and garage doors and gates - Safety in use of power operated doors - Requirements and test methods
IS EN 12635 2002 (Including Amendment 2009)	Industrial, commercial and garage doors and gates Installation and use
IS EN 12604 2018 (Including Amendment 2021)	Industrial, commercial and garage doors and gates — Mechanical aspects — Requirements and test methods
IS EN 13241 2017 (Including Amendments 2017) BS EN 13637 2020	Industrial, commercial, garage doors and gates — Product standard, performance characteristics Building hardware — Electrically controlled exit systems for use on escape routes — Requirements and test methods
EN 179 2008	Building hardware - Emergency exit devices operated by a lever handle or push pad, for use on escape routes - Requirements and test methods
EN 1125 2008	Building hardware - Panic exit devices operated by a horizontal bar, for use on escape routes - Requirements and test methods

23.2.2 Wiring & Containmentment

All wiring shall comply fully with the latest and current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations.

The contractor shall be required to install all the conduits and cabling associated with the Access Control Systems. The cabling will be terminated and the Access Control Systems components and outlets/reader devices shall be supplied, fitted, tested and certified by the contractor.

All Access Control System cables installed by the electrical contractor shall be fully tested for continuity prior to acceptance. Cable faults shall be identified and repaired by the electrical contractor by replacing the faulty cable in its entirety.

The access control cabling shall generally use the ELV compartment section of cable basket systems, alternatively if over capacity the electrical contractor shall include for a network of suitably sized ELV basket, tray or trunking.

The electrical contractor shall note that all access control system wiring to individual peripheral items such as shall be wired in a home run star radial network topology from the main panel.

All power supplies and door control modules shall be mounted in a secure location between 600mm and 2000mm above finished floor level on the secure side of the access controlled door.

Power supplies and door controllers must not be installed above ceilings or within raised access floor voids.

All power supplies shall be switch mode based (as opposed to transformer based) for energy efficiency.

The Access Control System shall be provided with 12 hours battery backup.

Power Supply Units (PSU's) and door controllers shall be labelled with hard wearing plastic labels showing the door number and where the building uses a door numbering system, labelling shall match the buildings door numbering system.

A zone chart of the access control system shall be provided indicating the building general arrangement layout, room names, doors, door numbering, locations of controllers and PSU's and their label references.

Where required all fire alarm I/O's shall be mounted adjacent to door controllers and shall break all conductors supplying the locks.

Where Door Access Controllers are networked, the contractor shall allow for wiring controllers on a dedicated network with radial star topology utilising RJ45 ports located on the controller. Serial RS232 ports shall not be used for the purposes of networking unless otherwise specified and approved in writing by RMCE Mechanical & Electrical Engineering Section.

All external readers shall be ACTpro DESFire EV2 1050 (13.56MHz MIFARE DESFire EV2) proximity and PIN type unless otherwise specified within the Particular Specification.

All Exit Request shall be touch free.

All Green Break Glass units to have facility to be monitored via Access Control System and Intruder Alarm 24HR Zone Remote Monitoring Station. Where monitoring of Green Break Glass Units is indicated as a requirement within the particular specification, the contractor shall allow for all associated wiring, interface devices, termination, testing and commissioning associated.

Monitoring of Green Break Glass Units will be required in all Garda Stations and Courthouses.

Where access control locks are specified they shall be deemed to include Abloy Cylinder, Abloy Handles and Abloy Concealed Door Loops.

The security specialist shall be responsible for co-ordinating with the main contractor or PSCS (Project Supervisor Construction Stage) to ensure all doors can facilitate seamless integration of access control devices within doors, doorframes and the building fabric whilst also maintaining the buildings fire certificate requirements of architectural and structural elements.

Cabling used in the access control system shall be Beldon 9504 and 8 line cabling proprietary cable to reader & 2 core flex minimum 1mm sq. to lock.

All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.

The contractor shall be responsible to co-ordinate the electrical and access Systems, that they will not share the same conduit trunking compartments etc., channel or sleeve with low voltage electrical apparatus. The current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations (and definition of low voltage) shall be adhered to in this respect. Separate conduit systems shall be provided for each system as noted on the drawings.

23.2.3 Security classification

System Type 1

Access control system shall have the following security classification: PSA 67 Grade 3 (Proximity Chip & Pin Readers, Touchpad Release, Audio-visual stations with handset release)

Proximity cards shall be included with the system, 150 no dual protocol cards shall be included for unless otherwise stated to ensure card compatibility with legacy clock and data systems and MIFARE systems.

System Type 2

Access control system shall have the following security classification: PSA 67 Grade 3 (Proximity Chip Readers, Touchpad Release, Audio-visual stations with handset release)

Proximity cards shall be included with the system, 150 no dual protocol cards shall be included for unless otherwise stated to ensure card compatibility with legacy clock and data systems and MIFARE systems.

System Type 3

Access control system shall have the following security classification: PSA 67 Grade 1 (Keypads & Touch Pad Release, Audio-visual stations with handset release)

23.2.4 Access control system strategy for main building doors

Door Access System Type 1

The access control system should be 'proximity' type using dual protocol cards & PIN. Each door must have individual control capabilities and user groups should be set up on the system to authorise different user types. The system shall be comprised of an integrated network of Vanderbilt ActPro 1520e or ActPro 4000 series and MIFARE proximity readers.

The system shall employ distributed intelligence where controllers can operate in standalone operation or be connected to a series of local Door Stations over RS485 communication protocol.

Each ACTpro 1520 or ActPro 4000 shall support up to 32 local door stations and controllers shall support at least four Weigand and OSDP entry and exit readers per door and be capable of differentiating between valid entry and exit events.

The overall system shall support up to a maximum of 4000 doors.

The security specialist shall provide for access control to doors as indicated on the design drawings. Each access controlled door shall be provided with the following equipment;

- ACTPro 1520e or ActPro 4000 Single Scalable IP Door controllers TCP/IP based supporting Power over Ethernet (PoE++) located on the secure side of door
- ACTpro DESFire EV2 1050 (13.56MHz MIFARE DESFire EV2) card readers
- Proximity readers to also support OSDP (Open Supervised Device Protocol and 125kHz standard PROX formats
- Touch Pad release
- 12 Volt fail open Abloy Solenoid locking device c/w all necessary cylinders fittings and accessories. All mortise locks shall be supplied and installed with an insert fire sleeve to the fire hour classification of the door.
- Arch 2 (double door) or Arch 1 (single door) full door width transom (*mounted clear above 2000mm*) housing c/w mag lock on the secure side of door
- Green Break glass unit on the secure side of door (for mag locks only)
- Local 12 Volt 2 amp power supply unit for single doors and 12Volt 3 amp for double doors.
- Fire alarm I/O interface
- The contractor shall allow for access control locking devices that suit the site specific application in relation to the buildings use, fire regulatory requirements and site specific security requirements. The following shall be deemed to be included within the tender return:

1. Abloy Full width transom Mag

2. Abloy EL560 / EL561
3. Abloy EL520
4. Abloy EL420
5. Abloy Eff *****

Cabling to access controlled locks to be dedicated 1 No. 2-core 1mm sq. flex & 1 No. 8-core alarm cable. Separate dedicated cabling to be provided to readers, exit requests and break glass devices.

Door Access System Type 2

The access control system should be 'proximity' type using dual protocol cards. Each door must have individual control capabilities and user groups should be set up on the system to authorise different user types.

The system shall be comprised of an integrated network of Vanderbilt ActPro 1520e or ActPro 4000 series and MIFARE proximity readers .

The system shall employ distributed intelligence where controllers can operate in standalone operation or be connected to a series of local Door Stations over RS485 communication protocol.

Each ACTpro 1520 or ActPro 4000 shall support up to 32 local door stations and controllers shall support at least four Weigand and OSDP entry and exit readers per door and be capable of differentiating between valid entry and exit events.

The overall system shall support up to a maximum of 4000 doors.

The security specialist shall provide for access control to doors as indicate on the design drawings. Each access controlled door shall be provided with the following equipment;

- ACTPro 1520e or ActPro 4000 Single Scalable IP Door controllers TCP/IP based supporting Power over Ethernet (PoE++) located on the secure side of door
- ACTpro DESFire EV2 1030 (13.56MHz MIFARE DESFire EV2) card readers
- Proximity readers to also support OSDP (Open Supervised Device Protocol and 125kHz standard PROX formats
- Touch Pad release
- 12 Volt fail open Abloy Solenoid locking device c/w all necessary cylinders fittings and accessories. All mortise locks shall be supplied and installed with an insert fire sleeve to the fire hour classification of the door.
- Arch 2 (double door) or Arch 1 (single door) full door width transom (*mounted clear above 2000mm*) housing c/w mag lock on the secure side of door
- Green Break glass unit on the secure side of door (for mag locks only)
- Local 12 Volt 2 amp power supply unit for single doors and 12Volt 3 amp for double doors.
- Fire alarm I/O interface
- The contractor shall allow for access control locking devices that suit the site specific application in relation to the buildings use, fire regulatory requirements and site specific security requirements. The following shall be deemed to be included within the tender return:
 1. Abloy Full width transom Mag
 2. Abloy EL560 / EL561
 3. Abloy EL520
 4. Abloy EL420
 5. Abloy Eff *****

Cabling to access controlled locks to be dedicated 1 No. 2-core 1mm sq. flex & 1 No. 8-

core alarm cable. Separate dedicated cabling to be provided to readers, exit requests and break glass devices.

Applicable To Both Type1 & Type 2 Door Access Systems

Doors With Mag Locks:

- The incoming (secure side) of the door shall be controlled by a proximity card reader.
- The recessed touchpad release & recessed emergency break glass units (green in colour) shall be installed on the out going side of the controlled door and so maintaining the main escape route.
- The full door width transom panel shall be capable of with standing a minimum force of not less than 600lbs per square inch 270kg per door leaf.
- The access control system will automatically de-energise and fail open in the case of confirmed fire alarm activation.

Electronic Motor Door Locks (solenoid locking device):

- Function: a pull outside, inside handle or handle and pull: door can be opened by pushing or pulling when the electrical control is on (e.g. timer, reader, push button). Inside handle opens the lock always.
- The access control system will be fail safe and enable access at all times from the secure side of the door automatically de-energise and fail open in the case of confirmed fire alarm activation unless otherwise stated.

The system to be installed shall use ACTPro 1520e or ActPro 4000 controllers complete with IP module. The systems shall be Actwin PRO two licence user.

The ACTPro 1520e or ActPro 4000 controller units will be located shall be located as indicated on the drawings. The controller unit will be linked to a maximum of 16 door expanders. The controller and the expander will be linked by a RS485 (beldon9504) twisted pair cable.

The wall mounted proximity reader shall be the ACTpro DESFire EV2 1040 & EV2 1030 (13.56MHz MIFARE DESFire EV2) units respectively and will be served by 8 core screened cable. The ACT cards shall be non-shell type with additional magnetic strip for time and attendance, 150 dual protocol cards shall be provided as part of this contract.

Microsoft windows based Vanderbilt ACTpro software two licence user. shall be provided on 1 No. PC. The PC shall be located in the main ICT/Comms room unless otherwise instructed. The security contractor shall provide 1 No. PC suitable for running the required security software.

The minimum requirements for the PC shall be as follows:

- Server/PC Processor: Intel Core Xeon X4 processor
- Operating system/Server: Genuine Microsoft Windows 10 Professional and Enterprise 64 Bit or later or Windows Server 2019 64 Bit or Later
- Memory: 16 GB DDR4 RAM, 3600GHz
- Required Supported Databases: Microsoft SQL Server 2016/14/12/08 Express or Professional *(must be supported by Microsoft)
- Minimum Database Disc Space: 500GB
- Harddrive: 1TB SSD & 10TB SATA 2 Hard Drive (7,200rpm) or higher (ie sized to suit max. quantity of Camera input ports and specified storage durations)

- Monitor: 21" 3072 x 2048 Resolution Flat Panel Monitor
- Network Interface Card: Integrated 10/100/1000 Ethernet
- Video Graphic Card: NVidia or Radeon 8GB or higher
- Sound Card: Integrated Audio
- Optical Drive / Writer: 32x DVD+/-RW Drive
- All server components and peripherals to be rated for 24hr 365days/yr continuous operation

Door Access System Type 3

- The ACTpro Digital Keypad
- Touch Pad release
- 12 Volt fail open Abloy Solenoid locking device c/w all necessary cylinders fittings and accessories. All mortise locks shall be supplied and installed with an insert fire sleeve to the fire hour classification of the door.
- Arch 2 (double door) or Arch 1 (single door) full door width transom (*mounted clear above 2000mm*) housing c/w mag lock on the secure side of door
- Green Break glass unit on the secure side of door (for mag locks only)
- Local 12 Volt 2 amp power supply unit for single doors and 12Volt 3 amp for double doors.
- Fire alarm I/O interface
- The contractor shall allow for access control locking devices that suit the site specific application in relation to the buildings use, fire regulatory requirements and site specific security requirements. The following shall be deemed to be included within the tender return:
 1. Abloy Full width transom Mag
 2. Abloy EL560 / EL561
 3. Abloy EL520
 4. Abloy EL420
 5. Abloy Eff *****

Cabling to access controlled locks to be dedicated 1 No. 2-core 1mm sq. flex & 1 No. 8-core alarm cable. Separate dedicated cabling to be provided to readers, exit requests and break glass devices.

Doors With Full Door Width Transom Mounted Mag Locks:

- The incoming (secure side) of the door shall be controlled by a ACTpro recessed keypad.
- The recessed touchpad release & recessed emergency break glass units (green in colour) shall be installed on the outgoing side of the controlled door and so maintaining the main escape route.
- The full door width transom panel shall be capable of with standing a minimum force of not less than 600lbs per square inch, 270kg per door leaf.
- The access control system will automatically de-energise and fail open in the case of confirmed fire alarm activation.
- All final exit doors to external areas shall have a push bar or paddle c/w microswitch to release the full door width transom mounted mag lock.

Electronic Motor Door Locks: (solenoid locking device):

- The incoming (secure side) of the door shall be controlled by a ACTpro recessed keypad
- Function: a pull outside, inside handle or handle and pull: door can be opened by pushing or pulling when the electrical control is on (e.g. timer, reader, push button). Inside handle opens the lock always.
- The access control system will automatically de-energise and fail open in the case of confirmed fire alarm activation.

The security specialist shall provide for access control to doors as indicate on the design drawings. Each access controlled door shall be provided with the following equipment;

23.2.5 Intercom System

Comelit Powercom one button surface Colour audio video intercom call unit complete with CCD camera, audio duplex speaker plus White light LED lighting for night viewing.

Comelit Powercom one button surface Colour audio video intercom call unit complete with CCD camera, audio duplex speaker plus White light LED lighting for night viewing automatic switcher. Internal Monitor Location; Security room Desk Mount.

Comelit Planux hands-free internal colour LCD screen audio video handset complete with Door release button. Planux weighted Desk mount bracket

The entire system shall be fully commissioned and certified by the security specialist in accordance with industry standards and the requirements of this specification.

The contractor shall include for the testing and commissioning of the complete installations and for demonstration of the functions to the client's representatives and for 1 year full maintenance and call-out service of same from date of handover

23.2.6 Access control system strategy gates, barriers

Gate System Type 1

Access control shall be provided using traffic barrier arms with chain skirt. Access shall be provided by proximity card readers and an audio visual intercom unit linked to a handset located as indicated on the drawings. The Audio Visual intercom unit shall be vandal proof external units with colour/monochrome cameras installed

There will be an access control pillar to facilitate standard height vehicles (e.g. cars and motor bikes)

A suitable external proximity card reader to match the type installed within the building , mounted on pillar will operate the traffic barrier arm with chain skirt. The pillar shall be made of 316 stainless steel .

The traffic barrier arms shall have an opening speed of not more than 4 seconds.

The boom arm will be elliptical tube bar with luminous indicating markers along its complete length. Boom arm shall be shock resistant.

The traffic barrier system shall utilise a photocell and an in-ground induction loop detector as method of preventing the traffic barrier arm from lowering on vehicles.

A traffic barrier arm (for exiting traffic) shall be linked to an induction loop located in the ramp way on the side used by exiting traffic. When vehicles drive over the loop the barrier arm will open to allow egress from the carpark.

Gate System Type 2

Access control shall be via gates using motorised gates on rollers. **(The motorised gates shall be provided on a separate contract)**. Access shall be provided by a ACT pro digital keypad & Comelit Powercom one button surface Colour audio video intercom call unit complete with CCD camera, audio duplex speaker plus White light LED lighting for night viewing. mounted on a 316 stainless steel pillar. All handset for the gate shall be located as indicated on the drawings. All Audio Visual intercom units shall be vandal proof external units.

The access control pillars shall facilitate standard height vehicles (e.g. cars and motor bikes)

Each motorised gate shall be linked to an induction loop located in the ground. When vehicles drive over the loop the motorised gate shall open.

Note: The motorised gates shall be provided on a separate contract, however it is the responsibility of the security contractor to link to the motorised gate systems so that keypads & handsets provided under this contract operate the motorised gates. All cabling required (except mains) shall be installed by the security contractor.

23.2.7 Stainless steel pillar

Pillars shall be 1.4m high stainless steel (316) rectangular 200x200mm . The pillar shall have smooth radius corners and be complete with a angled top surface of no less than 30degree angled slope. Any external weatherproof intercom unit will be mounted on the vertical side at 1100mm above finished floor level to the top of the intercom unit. Any external card reader shall be suitable for external use and shall be mounted directly below the intercom unit with a maximum of 50mm and a minimum of 20mm clear space between other units.

The contractor shall include in their costs for fully dimensioned drawings including plans & elevations of the pillar for approval prior to manufacturer

23.2.8 General

The Automated Gate Specialist shall include in his tender for the entire installation as indicated on the drawings and detailed in the Specifications .

The installation shall meet the requirements and follow the recommendations of the current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations and all other relevant codes and standards as detailed in this Specification.

The Automated Gate Specialist shall test the installation on the completion of the work. The test record sheet is to be included in the O&M Manuals. Should the installation fail to fulfil the requirements of the above regulation the Automated Gate Specialist shall at his own expense alter, amend and retest until such requirements are met, carrying out the test in the presence of the Engineer or his representative. On completion of the installation a certificate shall be given by the Automated Gate Specialist to the Engineer.

23.2.9 Automatic Gates

Refer to particular specification.

23.3 INTRUDER ALARM

23.3.1 General

The contractor shall be responsible for the supply, installation, test and commissioning for an Intruder Alarm Security System in accordance with IS EN 50131 2021 standard for the building as indicated on the attached drawings. The systems shall generally comprise the following:

- A central intruder Alarm Panel (upto 270 wired zones HKC Securewave SW10270 or Europlex SigNET 200, up to 512wired zones Europlex SigNET 300 or VanDerBilt/Siemens SPC6000 Series
- Zone Expanders, PSU's to suit the size of installation
- Hard Wired Combined Microwave & PIR movement detectors throughout (DualTEC - DD477AM)
- Hard Wired Combined contact/inertia sensors
- Hard Wired Remote key pads
- Hard Wired External SABB units
- Hard Wired Internal sirens (HKC Echo)
- In built capability to connect up to 270 wireless zones
- In Built GSM or GPRS (General Packet Radio Service) Digital communicator linked to central monitoring station
- In Built Radio link communicator connected to central monitoring station via long range wireless radio frequency
- In Built GSM/GPRS communicator connected to central monitoring station via World SIM
- Ethernet communicator to enable networking of panels and connection to Internet Service Provider
- EN Grade 2 Irish Garda Compliant BS 8243 : 2021 / BS PD 6662 : 2017 compliant

Where wireless devices are indicated on tender drawings the contractor shall allow for the supply, installation, test and commissioning of the following in addition to above:

- A central intruder Alarm Panel (up to 270 wireless zones HKC SW10270)
- Hard Wired HKC RF Expander
- Wireless Dualtec PIR (HKC- RF-PIR-DT)
- Wireless contact (HKC-RF-C)
- Wireless Inertia-contact (HKC-RF-CS)
- Keypads must be hard wired on the System with bus cable back to control panel.
- External SABBs must be hard wired on the System with bus cable back to control panel
- Internal sirens must be hard wired on the System with bus cable back to control panel

All other devices shall be hard wired.



23.3.2 Wiring

The contractor shall be required to install the conduits, trunking and cabling associated with the Intruder Alarm Systems. The cabling will be terminated and the Intruder Alarm Systems components and outlets/detector devices shall be supplied, fitted, tested and certified by the Contractor.

Wiring shall be in LSF sheathed 0.75-sq.mm 8-core proprietary intruder alarm cable manufactured by HKC/Aritech from each point back to the intruder alarm panel or nearest alarm station in an electrical riser. External alarm cabling shall be Poly/Poly 12 core cable. All intruder alarm system cables installed shall be fully tested for continuity prior to acceptance. Cable faults shall be identified and repaired by the contractor by replacing the faulty cable in its entirety. Replacement of cables or time costs associated with shall be at the contractors' expense

The intruder alarm cabling shall generally use existing ELV compartment section of cable tray systems, alternatively if over capacity, the electrical contractor shall include for a network of suitably sized ELV basket, tray or trunking.

The Intruder Alarm contactor shall allow for a full demonstration of the system to the client on completion of the installation and 2 days training on site.

The electrical contractor shall note that all intruder alarm system wiring to individual peripheral items such as door contacts, PIR's etc shall be wired in a home run star radial network topology to the local expander of the main panel.

All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.

The electrical contractor shall be responsible to co-ordinate the electrical and Intruder Alarm Systems, that they will not share the same conduit trunking compartments etc., channel or sleeve with low voltage electrical apparatus. The current IS 10101:2020 AC 1:2020 National Rules for Electrical Installations & National Wiring Regulations (and definition of low voltage) shall be adhered to in this respect. Separate conduit systems shall be provided for each system as noted on the drawings.

23.3.3 Installation

The security contractor shall be responsible for the supply, installation, test and commissioning of a Intruder System in accordance with IS EN 50131-1 2020 standard in compliance with the NSAI certification scheme for the building. On completion of the project the security systems supplier shall provide an NSAI approved certificate of compliance.

The central intruder alarm panel shall located as indicated on the drawings. Remote keypads shall be located as indicated and must be hard wired.

The system shall have a monitored power supply feature on both the mains and the battery and shall indicate the status on the keypad(s).

The intruder alarm system shall be configured in a number of zones/areas allowing the system to be deactivated in certain areas while leaving other areas protected.

The main system power supply shall be integral with the main control panel and shall comply with the requirements of IS EN 50131 : 2021. The security specialist is responsible for determining whether additional power supplies are required for the correct operation of the system and shall include for same with his tender.

The system design proposal for the supply installation, test and commissioning of an intruder alarm incorporates anti-masking movement detectors, door contacts internal and

external audible alarms with external strobe, and alarm transmission system signalling to a remote alarm receiving centre.

The alarm system shall be configured so as the entry/exit from the premises is through the rear or front entrance doors. The keypad locations at final entry/exits are to be provided at secure positions within the building, to be used for setting/unsetting of the intruder alarm system.

Anti masking Dual-tech combined microwave and passive infra red detectors supplied by HKC/Aritech type dual technology DD477AM or similar are to be located as per the drawing mounted at a height of 2.3metres approximately in the corner of the each area and or room to detect movement in the area unless stated otherwise.

All external entry doors shall be provided with an Aritech GS711 or HKC reference HKC-SEN-IDWR or similar surface mounted combined shock sensors with magnetic contact for each door leaf located on the secure side of door to detect the opening of the door.

This panel shall be provided with keypad and battery backup in accordance with security standards. This panel will be located as indicated on the drawing.

The time allowed for initiation of the setting procedure to the final set of the intruder alarm system is a maximum of 45 seconds (exit time).

The time allowed for initiation of the un-setting procedure to fully unset the intruder alarm system is a maximum of 30 seconds (entry time).

Combined Microwave and PIR movement detectors shall be positioned adjacent to all alarm keypads directed towards the door. This detector shall not facilitate or confirm alarm activation.

The system on activation will send a coded message to a central station and also activate both internal and external sounders.

The front and rear entrance areas shall be provided with a 12 Volt internal siren as provided by HKC Echo or Aritech reference AS270.

The building shall be provided with an external self actuating sounder complete with strobe light and battery backup as supplied by HKC or Aritech located in a prominent wall location at minimum of 4m above ground level.

The flashing strobe light is designed to continue to operate after the audible alarm switches off automatically.

The audible alarm is designed to sound for a period of no longer than 15 minutes and shall rearm a max of 3 times after which the system shall shut down.

If the telephone company line is cut/signalling path lost, the sounder is to operate immediately when an alarm is present in the set condition or on a personal attack condition. If the wires are cut or the unit is removed from the wall, the sounder is to sound immediately. This unit shall incorporate a blue flashing light to give visual identification.

Under the Control of Noise Order it is an offence to create a noise nuisance. Accordingly the external sounder must switch off automatically after 20 minutes. This is also a requirement of the Local Authorities Act, which empowers authorised officers of the Local Authorities concerned to seek a warrant to enter premises to silence an alarm causing annoyance.

Under the Control of Noise Order, the security specialist is required to inform the Garda and Local Environment Health Authority that an active audible system has been completed for this project within 48 hours of the installation.

The quantities and locations of services nodes to be determined by the security contractor and agreed with the electrical contractor on site.

Interface units shall be provided as necessary to link the intruder alarm system with the CCTV system and access control system.

The system shall be connected to a remote monitoring centre via a CSL Digi Air Pro complete with World SIM GSM and GPRS communicator. Digital communicators must be complete with power supply and battery backup in accordance with security standards. The digital communicator shall report in SIA. The digital communicator shall be located within the main control equipment as indicated on the drawing. All communicators shall be capable of Dialler, Text and Voice communication.

The intruder alarm communicator shall be provided with dual path back-up complying with IS EN 50131-5-3 : 2017 in the event of encountering problems with one provider in connecting to manned security monitoring station.

The security specialist shall include for 12 months maintenance & remote monitoring of the intruder alarm system with his tender.

The alarm transmission will transmit a digital code number to a receiver unit at the remote 24 hour alarm receiving centre whenever an alarm is generated.

The premises shall be provided with Sequential Alarm Confirmation which requires that two independent detectors installed as part of the Intruder alarm system will need to be activated before the system will signal a confirmed alarm (Garda calling system) to the alarm receiving centre.

The sequentially confirmed alarm activations must also be within the confirmation time. The security specialist and client to confirm the time frame within which two independent activations must occur. On receiving a sequentially confirmed alarm at the Alarm Receiving Centre the Gardai will be notified.

The entire system shall be fully commissioned and certified by the security specialist in accordance with industry standards and the requirements of this specification.

23.3.4 Commissioning and hand-over

Prior to handing over the system to the customer, a qualified person should perform an inspection and test comprising of:

- The visual and functional check of all parts of the CCTV, Access Control & Intruder alarm system's installation. The basis for the functional check should be the test specification for the system developed from the operational requirement and system specification.
- The visual test covers the standard of workmanship of the installation, the functional quality of the equipment and their compliance with the system specification.
- The functional test includes checking the functional compatibility of the components of the installation.
- Inspection tests may be carried out on parts of the installation as they are completed.
- Confirmation that the operator manual and documentation for the system is complete.

- The performance specification and results from performance testing together with a signed inspection report.
- Recommended maintenance schedule for the system if no maintenance contract has been agreed.
- The contractor shall provide sufficient training to ensure correct operation of the system. 2 Days on site training should be allowed for each building at dates to be agreed with the occupiers.
- The contractor shall include for the testing and commissioning of the complete installations and for demonstration of the functions to the client's representatives

Upon completion of the project, the RMCE will perform a final inspection of the installation with the Contractor's Project Foreman. The final inspection will be performed to validate that all security systems were installed as defined in the drawing package, and that the installation meets the aesthetic expectations of the RMCE

23.3.5 System Documentation

The following section describes the installation, administration, testing and as-built documentation required to be produced and/or maintained by the contractor during the course of the installation:-

23.3.6 As-Built Drawings:

The installation contractor will be provided with 2 No. sets of drawings at the start of the project. One set will be designated for as the central location to document all as-built information as it occurs throughout the project. The central set will be maintained by the Contractors Foreman on a daily basis, and will be available to the Technical Representative upon request during the course of the project. Anticipated variations from the build-to drawings may be for such things as cable routing and actual equipment placement. No variations will be allowed to the planned termination positions of equipment unless approved in writing by the Owner.

The Contractor shall provide the central drawing set to the owner at the conclusion of the project. The marked-up drawing set will accurately depict the as-built status of the system including locations, equipment cable routing and all administration labelling for the equipment. In addition, a narrative will be provided that describes any areas of difficulty encountered during the installation that could potentially cause problems to the security system.

23.3.7 Test Documentation:

Test documentation shall be provided in a three ring binder(s) within three weeks after the completion of the project. The binder(s) shall be clearly marked on the outside front cover and spine with the words Test Results®, the project name, and the date of completion (month and year). The binder shall be divided by major heading tabs, horizontal and backbone. Each major heading shall be further sectioned by test type.

The test document shall detail the test method used and the specific settings of the equipment during the test.

When repairs and retests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be collocated in the binder.

Test results may be provided in a software format if prior agreement is made with the tender issuer.

Upon receipt of the test documentation, the RMCE reserves the right to perform spot testing of a representative sample of the cabling system to validate test results provided in the test document. RMCE testing will use the same method employed by the contractor,

and minor variations will be allowed to account for differences in test equipment. If significant discrepancies are found, the Contractor will be notified for resolution

23.3.8 Maintenance

Where special test instruments and tools are required for maintenance, this should be stated in the maintenance plan provided by the security contractor. Any special requirements or recommend test intervals should be stated in the maintenance plan.

24. EV CHARGING HARDWARE

The following applies to all EV Installations unless specified otherwise in the particular specification:

24.1 Standards

The materials, components and complete EV Charging installation shall conform as with the following standards and codes, including all amendments, current at the time of tendering.

IEC 61851	Electric vehicle conductive charging system
EC 62196	Plugs, socket-outlets, vehicle couplers and vehicle inlets – Conductive charging of electric vehicles
JEVS G104/G105	CHAdeMO Protocol
SAE J1772	SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler
IEC 14443	Identification cards – Contactless integrated circuit cards – Proximity cards
IEC21989	IT Telecoms and information exchange - GSM/3G/4G/5G
IEEE 802.XX	Wireless Standards
OCPP 1.6 J	Open Charge Point Protocol Version 1.6 JSON - Open Charge Alliance
S.I. 299 of 2007	Safety, Health and Welfare at Work (General Application) Regulations 2007
NSAI IS.10101:2020	National Rules for Electrical Installations IS.10101:2020 and all applicable amendments/addendums.
Ver. 7, August 2020	ESB Networks Distribution Code, Version 7, August 2020
DOC-030303-AEN	National Code of Practice for the Customer Interface, Version 5, April 2021
ISO 9001	Quality Systems – Model for quality assurance in design/development, production, installation and servicing.
ISO 14001	Environmental management systems – Specification with guidance for use
IEC 61439	Low-Voltage switchgear and control gear assemblies
IS EN62262	Degrees of Protection Provided by Enclosures

DIN 43 620	NH Fuses for 500 and 600 V AC and 440V DC
2014/30/EU	Electromagnetic Compatibility Directive
IEC61000	EMC Publications
768/2008/EC	The affixing and use of the CE conformity marking
2014/32/EU	Measuring Instruments Directive
IEC62056	Metering Data Exchange
IEC Guide 113	Materials declaration questionnaires – Basic guidelines
EU ROHS (2002/95/EC)	Restriction of the use of certain hazardous substances in electrical and electronic equipment
WEEE(2002/96/EC)	Waste Electrical and Electronic Equipment Directive

24.2 AC Standard Charging

24.2.1 General

The AC charging described herein refers to AC Charging equipment capable of delivering 22kW. Where dual outlets are requested, both outlets shall be capable of delivering 22kW simultaneously. The socket type and associated communications protocols shall be supplied to suit Type 2 mode 3 charging. It must be possible to configure the charge point to 7kW single phase operation or 11kW / 22kW 3-phase operation. The charge points shall be sufficiently equipped to allow authentication of users and communications with a Charge Point Management System.

AC Charge Points will be connected to a single or 3-phase power supplies, as appropriate to requirements. 22kW chargers must be capable of maintain full functionality when connected to a single phase supply.

24.2.2 Installation

The equipment covered in this specification is a charge point device suitable for charging electric vehicles. The charge points may be configured for multiple socket outlets or for a single outlet. Similarly individual charge points may be configured for single-phase or 3-phase power supplies.

The charging current on each phase shall not exceed 32A. With the exception of any protective devices installed in the charge point (MCBs, RCBOs), the materials and components within the Charge Points shall be capable of supplying 32A, charging to a suitable EV. Any such protective devices will be rated at a level suitable to protect the normal operating current of the Charge Point. The Charge Point should be configured so that only authorized personnel can adjust the current rating of the device.

Equipment installed for destination charging must have undergone a validation process with at least two of the EV manufacturers distributing electric vehicles in Ireland. Proof of the validation process should be provided.

The Charge Point shall support Mode 3 charging and be capable of charging electric vehicles that conform to the Control Pilot Function as described in IEC 61851-1 Edition 3.0 in all respects.

The following basic function shall be provided by the Charge Point

- Verification that the vehicle is properly connected
- Continuous protective earth conductor continuity checking
- Energisation of the system
- De-energisation of the system
- Selection of charging rate
- A means to ensure that the charging rate does not exceed the rated capacity of the mains, connector cable, vehicle or battery capabilities

The Charge Point shall have a socket conforming to the dimensions as set out in IEC 62196-2 for a Type 2 plug. Functionality will conform to IEC 61851-1 Mode 3.

The socket shall be behind a door or cover.

The Charge Point shall implement control pilot functionality as described in Annex A and Annex B of IEC 61851-1 Edition 3 and SAEJ1772.

It must be demonstrated that the pilot signal parameters of the Charge Point (timings, voltages etc.) have been validated by one or more electric vehicle manufacturer.

The Charge Point shall be able to identify the maximum current capability of the cable assembly by means of measuring the resistor between the proximity pin and earth in the Type 2 plug according to IEC 61851-1 Edition 3. The current supply shall be interrupted if the rating of this cable is exceeded.

In the case of multi-outlet charging solutions, each charging outlet shall be equipped with suitable protection to ensure disconnection of supply to the outlet in case of overload.

In the case of multi-outlet charging solutions, each charging outlet shall be equipped with protection against earth leakage fault currents above 30mA.

The Charge Point shall be equipped with the appropriate equipment that ensures disconnection of the supply in the case of DC fault current above 6mA.

A locking mechanism shall be used to prevent disconnection of the plug from the Charge Point under load. The plug shall unlock when the user indicates that they want to finish charging e.g. pressing a stop button. In the event of a power failure, the locking mechanism shall be released.

The Charge Point exterior shall comply with the tests as detailed in IEC 61439 parts 1 and 7. These tests consist of but are not limited to mechanical strength, resistance to corrosion, temperature variations, resistance to UV radiation and environmental tests.

The entire Charge Point shall provide a minimum degree of protection of IP44 with the plug both connected and removed. However, a rating of IP 54 or higher is required when the socket cover is shut

The Charge Point shall be protected against mechanical damage (impact severity AG2). The equipment shall comply with a minimum degree of protection against external mechanical impact of IK08 in accordance with the requirements of I.S. EN 62262. Where equipment achieves a lower IK rating, additional mechanical protection shall be provided.

Each Charge Point outlet shall be monitored by a revenue grade energy meter, compliant with the Measuring Instrument Directive (MID), the data from which shall be available for use by a charge point management system.

The Charge Point shall maintain full functionality after an electrical supply interruption. An LCD display shall communicate the status and availability of the Charge Point to the user.

All information displayed shall be in the English language. An option for an Irish language interface is desirable.

The device shall be supplied with operating instructions and installation instructions, printed in the English language. Irish language versions are desirable.

The Charge Point including all components and accessories shall be fully guaranteed against all defects arising from faults in design, manufacture and workmanship for a period of 48 months from delivery.

The Charge Point shall be Open Charge Point Protocol (OCPP) certified version 1.6J or later. Charge Point software should be remotely upgradeable as new versions become available. Equipment should be tested with at least two OCPP back-office systems. Verification of successful testing must be provided.

The charge point shall include RFID Authentication. The RFID reader shall conform to IEC14443. Mifare Classic at 13.85Mhz.

The Charge Point shall include a GSM/3G/4G/5G modem to facilitate the connection of charge points to a Charge Point Management System.

The Charge Point shall have appropriate ethernet connection to facilitate connection to a Charge Point Management System via Local Area Network (LAN).

The charge point shall be capable of accepting load limit requests over the OCPP protocol, the purpose of which, is to control site load to remain within connection limits.

The Charge Point shall comply with accessibility best practice guidelines as set out by the Irish Wheelchair Association. In addition, the Charge Point shall comply with Disability Discrimination Act (DDA) and/or American Disabilities Act (ADA).

24.2.3 Installation Requirements

Due to the varied nature of installation locations, particularly regarding available power supplies, it will sometimes be necessary for charge points to be configured such that individual outlet sockets are assigned to rotated supply phases on a sequential basis. As such, it must be possible to assign the outlet pins in sequence to R-S-T, S-T-R or T-R-S (L1-L2-L3, L2-L3-L1, or L3-L1-L2).

In all cases, the order of phase rotation shall be adhered to, with 120 degrees phase separation between consecutive pins.

In all cases, the charge point shall maintain full functionality.

In all cases, operation shall be maintained so that protective devices and isolators must switch all phases simultaneously, without hinderance.

In all cases, the installation shall maintain adherence to NSAI, IS10101:2020 National Rules for Electrical Installations.

In all cases, the internal wiring of the charge point shall be clearly labelled, indicating the rotation of phases.

Example:

A double socket charger may be required to assign the pins on Outlet 1 to R-S-T in this order, while assigning Outlet 2 to S-T-R.

Final configuration requirements will be specified at the time of each individual order.

24.3 Fast Charger DC/AC

24.3.1 General

The DC/AC charging described herein refers to DC Charging equipment capable of delivering up to 50kW DC per outlet and up to 22kW AC. The connector type and associated communications protocols shall be supplied to suit Combined Charging System, CCS2 CHAdeMO, and AC Type 2 outlets. The charge point shall be capable of supplying any one of the DC outputs and the AC output, simultaneously. The charge points shall be sufficiently equipped to allow authentication of users and communications with a Charge Point Management System.

The Charge Point will be connected to a 3-phase 400VAC power supply.

24.3.2 Installation

The equipment covered in this specification is a DC/AC charge point suitable for charging electric vehicles. The charge point shall be connected to a 3-phase 400VAC electricity supply. Voltage and Current levels shall adhere to the relevant standard as applicable to the connector types used.

The Charge Point must be free standing.

Electrical protection shall be sized to adequately protect all individual components from electrical overload. The Charge Point should be configured so that only authorized personnel can adjust the current rating of the device.

Equipment installed for fast charging must have undergone a validation process with at least two of the EV manufacturers distributing electric vehicles in Ireland. Proof of the validation process should be provided.

The Charge Point shall support Mode 3 and Mode 4 charging and be capable of charging electric cars that conform to the Control Pilot Function as described in IEC 61851-1 Edition 3.0 and IEC61851-21 as appropriate to the connector in all respects.

The following basic function shall be provided by the Charge Point

- Verification that the vehicle is properly connected
- Continuous protective earth conductor continuity checking
- Energisation of the system
- De-energisation of the system
- Selection of charging rate
- A means to ensure that the charging rate does not exceed the rated capacity of the mains, connector cable, vehicle or battery capabilities

The Charge Point shall support Mode 4 charging and be capable of charging electric cars that conform to IEC61851-21.

The Charge Point shall have a plug conforming to the dimensions as set out in IEC 62196-2 for a Type 2 plug. Functionality will conform to IEC 61851-1 Mode 3.

The Charge Point shall support CCS2 Mode 4 charging.

The Charge Point Shall support CHAdeMO Mode 4 charging. JEVS G104, JEVS G105.

The Charge Point shall implement control pilot functionality as described in Annex A and Annex B of IEC 61851-1 Edition 3 and SAEJ1772.

The Charge Point shall be able to identify the maximum current capability of the cable assembly by means of measuring the resistor between the proximity pin and earth in the

Type 2 plug according to IEC 61851-1 Edition 3. The current supply shall be interrupted if the rating of this cable is exceeded.

It must be demonstrated that the pilot signal parameters of the Charge Point (timings, voltages etc.) have been validated by one or more electric vehicle manufacturer.

In the case of multi-outlet charging solutions, each charging outlet shall be equipped with protection against earth leakage fault currents above 30mA.

In the case of multi-outlet charging solutions, each charging outlet shall be equipped with suitable protection to ensure disconnection of supply to the outlet in case of overload.

The Charge Point shall be equipped with the appropriate equipment that ensures disconnection of the supply in the case of DC fault current above 6mA.

A locking mechanism shall be used to prevent disconnection of the plug from the Charge Point under load. The plug shall unlock when the user indicates that they want to finish charging e.g. pressing a stop button. In the event of a power failure, the locking mechanism shall be released.

The Charge Point exterior shall comply with the tests as detailed in IEC 61439 parts 1 and 7.

These tests consist of but are not limited to mechanical strength, resistance to corrosion, temperature variations, resistance to UV radiation and environmental tests.

The entire Charge Point shall provide a minimum degree of protection of IP44 with the plug both connected and removed. However, a rating of IP 54 or higher is desirable.

The Charge Point shall be protected against mechanical damage (impact severity AG2). The equipment shall comply with a minimum degree of protection against external mechanical impact of IK08 in accordance with the requirements of I.S. EN 62262.

Each Charge Point outlet shall be monitored by a revenue grade energy meter, compliant with the Measuring Instrument Directive (MID), the data from which shall be available for use by a charge point management system.

The Charge Point shall maintain full functionality after an electrical supply interruption.

An LCD display shall communicate the status and availability of the Charge Point to the user.

All information displayed shall be in the English language. An option for an Irish language interface is desirable.

The device shall be supplied with operating instructions and installation instructions, printed in the English language. Irish language versions are desirable.

The Charge Point including all components and accessories shall be fully guaranteed against all defects arising from faults in design, manufacture and workmanship for a period of 48 months from delivery.

The Charge Point shall be Open Charge Point Protocol (OCPP) certified version 1.6J or later. Charge Point software should be remotely upgradeable as new versions become available. Equipment should be tested with at least two OCPP back-office systems. Verification of successful testing must be provided.

The charge point shall include RFID Authentication. The RFID reader shall conform to IEC14443. Mifare Classic at 13.85Mhz.

The Charge Point shall include a GSM/3G/4G/5G modem to facilitate the connection of charge points to a Charge Point Management System.

The Charge Point shall have appropriate ethernet connection to facilitate connection to a Charge Point Management System via Local Area Network (LAN).

The charge point shall be capable of accepting load limit requests over the OCPP protocol, the purpose of which, is to control site load to remain within connection limits.

The Charge Point shall comply with accessibility best practice guidelines as set out by the Irish Wheelchair Association. In addition, the Charge Point shall comply with Disability Discrimination Act (DDA) and/or American Disabilities Act (ADA).

25. OPERATION & MAINTENANCE MANUALS (O&M)

25.1 Introduction

The LV Switchgear Specialist shall include for operations and maintenance O&M manuals including "as-installed" schematic drawings for issuing to the RMCE upon completion of the works.

The term maintenance manual shall be deemed to include all necessary maintenance and operating instructions and record drawings for the entire installation.

25.2 Applicable standards

In general the preparation of O&M manuals should be based on the following generic guideline documents:-

- BS 4884 Parts 1 & 2 Specification for Technical Manuals
- BSRIA Technical Note TN1/84– Guidelines for Building Services Operating and Maintenance Manuals
- BSRIA Application Guide 187– Operating & Maintenance Manuals for Building Services Installations
- BSRIA Technical Note T/1286– Fault Finding Procedures in the Building Services Industry

25.3 O&M retention fund

In addition to any retention specified in the contract conditions, a further 5% of the contract value shall be retained on the final payment certificate pending handover of the approved O&M manuals to the client. The value that the contractor has allowed for the O&Ms in his tender will have no bearing on the amount retained.

Where the contractor fails to submit manuals in the agreed format described below or by the agreed date, the O&M retention fund will be used to pay for a third party to complete the manuals on the contractors behalf.

25.4 Approval Procedure

A draft maintenance manual shall be issued to the Engineers for approval at least one months in advance of the intended date of practical completion.

Prior to submitting this manual the contracts manager shall confirm in writing that he has crossed checked the manual against the requirements of this section of the specification and that in his or her opinion it is ready for inspection and approval by the engineers.

The Contractor shall carry out any amendments requested by the Engineers and resubmit the manual for final approval. Any subsequent checking of the manual beyond that stage will be subject to a charge by the engineers to be calculated on a time basis.

25.5 Final Approved Copy of O&M manual

The Contractor shall hand over two "hard" copies of the approved of the O&M manual to the client along with 2 No copies on USB Pen Drives containing the full contents of the manual in electronic format. He shall instruct the client's staff in the operation and maintenance of the various components forming the installation. All as installed drawings on the USB Pen Drives shall be saved in both PDF and AutoCAD formats.

25.6 Hard Copy Format

The hard copy of the manual shall comprise one or more A4 lever arch ring binder files, endorsed with the project details and contractors name and address. Where there is more than one manual required, each one shall be identified by a reference e.g. "Volume 3 of 4 – Security Systems". The contents of each other volume shall be indicated on the front page with the actual volume highlighted for clarity

A typed index shall be included at the start of each manual. Proprietary numbered cardboard dividers shall be provided to separate the various sections of the manual.

Transparent cellophane envelopes shall be provided to hold copies of the "as-installed" drawings and any other items, which cannot be punched.

25.7 Electronic Copy Format

The electronic copy of the manual shall be presented on one or more USB Pen Drives and shall follow the same indexing as the hard copy. The USB Pen Drives shall be clearly tagged and labelled with the project details printed on the label. The USB Pen Drives shall be contained in a plastic pocket within one of the ring binders referred to above.

26. IDENTIFICATION AND MARKING OF ELECTRICAL SERVICES

26.1 General

Provide for the supply and installation of labels and notices as required by IS 10101 National Rules For Electrical Installations on electrical and mechanical systems generally as follows:

Identification of all main and sub-distribution equipment:

- Main incomer
- Generator protective device and changeover equipment
- Sub-mains protective devices
- Power factor protective devices and associated equipment etc

Sub-distribution Boards and Panels

Sub-distribution boards and panel devices

Warning Notices, voltages in excess of 230volts.

All outlets (distribution board, device number, circuit number)

Earth electrode connections

Bonding connections

Exceptional Areas – Warnings and Notices

Earth free areas

Electrical separation

26.2 Label and Notices – Materials

Materials should be adequate to show no appreciable wear in the lifetime of the equipment with a minimum expected life of 20 years

Boards and Panels, Warning Notices – Engraved thermosetting plastic laminate
– Colour White on Black

Local Outlets – Engraved thermosetting plastic laminate
- Colour Black on White

Warning Notices – Engraved thermosetting plastic laminate
- Colour White on Red

Fixing of labels shall generally be proprietary adhesive except external labels shall be stainless steel screw fixed. Please note that the integrity of the IP rating should not be affected by any fixings.

28. COMMISSIONING

28.1 PRE-COMMISSIONING

During the course of the works the Contractor shall carry out on an on-going basis the pre-commissioning of the works and shall assemble all necessary handover material which will be required at hand-over.

The pre-commissioning shall be sufficiently thorough and systematic so as to identify together with normal site inspections any obvious installation deficiencies, design errors or omissions.

The Contractor shall be responsible for the rectification of the defective work. Any problems which result from design or omissions shall be referred to the Engineers.

28.2 ELECTRICAL - VERIFICATION AND CERTIFICATION

The contractor shall carry out all inspections and tests as required by IS 10101

