

		STRATEGIC ASSET MANAGEMENT QUALITY MANAGEMENT SYSTEM SPECIFICATION	
TITLE: SPECIFICATION FOR BUILDING LIGHTING AND SMALL POWER INSTALLATIONS		DOC NO: SAM EAM 00003 Spec	
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1 PURPOSE

- 1.1 The purpose of this specification is to provide a specification to which building lighting and small power installations are to be designed, manufactured, installed and commissioned, where required, on Rand Water operational sites.
- 1.2 The previous electrical specification, RW-00320-as-500, for Building Lighting and Small Power Installations has been superseded by this specification and shall no longer be utilized.

2 SCOPE

- 2.1 This specification covers the minimum qualifications and standards of materials, equipment, workmanship, general methods and procedures for the design and execution of the electrical works related to the building small power and lighting installations on Rand Water sites.

3 APPLICABILITY

- 3.1 This specification applies to Rand Water GMSAM and GMO divisions, Facilities, suppliers and contractors.

4 REFERENCES

Document Title	Document No.	Location
Galvanising	SANS 121	RW Library
Plugs and socket outlets for use in the fixed installation of stoves	SANS 337	RW Library
Low-voltage switchgear Part 1: Circuit breakers	SANS 556-1	RW Library
Low-voltage switchgear Part 2-1: Earth leakage circuit breakers	SANS 556-2-1	RW Library
Low-voltage switchgear Part 2-2: Earth leakage switches	SANS 556-2-2	RW Library
Low-voltage switchgear Part 2-5: Earth leakage switches- Switches that incorporate residual current protection	SANS 556-2-5	RW Library
Distribution transformers	SANS 780	RW Library
Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations	SANS 950	RW Library
Electric light dimmers (Metric units)	SANS 1012	RW Library
Earth rods, couplers and connections	SANS 1063	RW Library
Metallic wall outlet boxes for the enclosure of electrical accessories	SANS 1085	RW Library
Busbars	SANS 1195	RW Library
Mechanical cable glands	SANS 1213	RW Library
Plugs, socket-outlets and couplers for industrial purposes	SANS 1239	RW Library
Materials of insulated electric cables and flexible cords Part 1: Conductors	SANS 1411-1	RW Library
Electrical terminals and connectors Part 1: Terminal blocks having screw and screw less terminals	SANS 1433-1	RW Library
Electrical terminals and connectors Part 2: Flat push-on connectors	SANS 1433-2	RW Library
Safety of luminaires Part 22: Luminaires for emergency lighting	SANS 1464	RW Library
Electric cables with extruded solid dielectric insulation for fixed installations (300/500V to 1900/3300V) Part 1: General	SANS 1507-1	RW Library
Electric cables with extruded solid dielectric insulation for fixed installations (300/500V to 1900/3300V) Part 2: Wiring cables	SANS 1507-2	RW Library

Electric cables with extruded solid dielectric insulation for fixed installations (300/500V to 1900/3300V) Part 3: PVC Distribution cables	SANS 1507-3	RW Library
Photoelectric control units for lighting (PECUs)	SANS 1777	RW Library
Low-voltage switchgear and controlgear ASSEMBLIES Part 1: Type-tested ASSEMBLIES with stated deviations and a rated short-circuit withstand strength above 10 kA	SANS 1973-1	RW Library
Low-voltage switchgear and controlgear ASSEMBLIES Part 3: Safety of ASSEMBLIES with a rated prospective short-circuit current of up to and including 10 kA	SANS 1973-3	RW Library
Interior lighting Part 1: Artificial lighting of interiors	SANS 10114-1	RW Library
Interior lighting Part 2: Emergency lighting	SANS 10114-2	RW Library
The Wiring of Premises Part 1: Low voltage installations	SANS 10142-1	RW Library
The design and installation of earth electrodes	SANS 10199	RW Library
Earthing of low-voltage (LV) distribution systems	SANS 10292	RW Library
The application of the National Building Regulations Part A: General principles and requirements	SANS 10400	RW Library
Insulated bushings for alternating voltages above 1000V	SANS 60137	RW Library
Plugs, socket-outlets and couplers for industrial purposes Part 1: General requirements	SANS 60309-1	RW Library
Conduits for electrical installations Part 2: Particular specifications for conduits- Flexible conduits	SANS 60614-2-5	RW Library
Switches for household and similar fixed electrical installations Part 2-1: Particular requirements – Electronic switches	SANS 60669-2-1	RW Library
Automatic electrical controls for household and similar use Part 2-7: Particular requirements for timers and time switches	SANS 60730-2-7	RW Library
Low-voltage switchgear and controlgear Part 2: Circuit-breakers	SANS 60947-2	RW Library
Low-voltage switchgear and controlgear Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	SANS 60947-3	RW Library

Low-voltage switchgear and controlgear Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters	SANS 60947-4-1	RW Library
Low-voltage switchgear and controlgear Part 7-1: Ancillary equipment - Terminal blocks for copper conductors	SANS 60947-7-1	RW Library
Connecting devices for low-voltage circuits for household and similar purposes Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units	SANS 60998-2-1	RW Library
Connecting devices for low-voltage circuits for household and similar purposes Part 2-2: Particular requirements for connecting devices as separate entities with screw less-type clamping units	SANS 60998-2-2	RW Library
Cable trunking systems and cable ducting systems for electrical installations	SANS 61084-1	RW Library
Conduit systems for cable management Part 1: General requirements	SANS 61386-1	RW Library
Conduit systems for cable management Part 21: Particular requirements- Rigid conduit systems	SANS 61386-21	RW Library
Conduit systems for cable management Part 23: Particular requirements- Flexible conduit systems	SANS 61386-23	RW Library
Low-voltage switchgear and controlgear assemblies- Part 2: Power switchgear and control gear assemblies	SANS 61439-2	RW Library
Low-voltage switchgear and controlgear assemblies- Part 3: Distribution boards intended to be operated by ordinary persons (DBO)	SANS 61439-3	RW Library
Low-voltage switchgear and controlgear assemblies Part 4: Particular requirements for assemblies for construction sites (ACS)	SANS 61439-4	RW Library
Low-voltage switchgear and controlgear assemblies Part 5: Assemblies for power distribution in public networks	SANS 61439-5	RW Library
Safety of transformers, reactors, power supply units and combinations thereof Part 2-5: Particular requirements and tests for transformers for shavers, power supply units for shavers and shaver supply units	SANS 61558-2-5	RW Library

Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1100V Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers	SANS 61558-2-6	RW Library
Low-voltage surge protective devices Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods	SANS 61643-11	RW Library
Compulsory specification for manually operated switches for fixed installations	VC 8003	RW Library
Compulsory specification for plugs, socket-outlets and socket-outlet adaptors	VC 8008	RW Library
Compulsory specification for lamp holders	VC 8011	RW Library
Compulsory specification for earth leakage protection units	VC 8035	RW Library
Circuit breakers	VC 8036	RW Library
Compulsory specification for the safety of electric cables with extruded solid dielectric insulation for fixed installations (300/500V to 1900/3300V)	VC 8075	RW Library
Rand Water WKS Identification System Pocket Guide	RW/01200/L/012	MC Office
Specification for plant Codification labels	RW Maint 00007 Pr	MC Office
Quality management systems - Requirements	SANS/ISO 9001	RW Library
Occupational health and safety management systems - Requirements	ISO 18001	RW Library

5 TERMS, DEFINITIONS AND ABBREVIATIONS

5.1 TERMS

- 5.1.1 **The Engineer:** A suitably qualified person appointed by Rand Water to administer the contract.
- 5.1.2 **Contractor:** Refers to a person, company or organisation that is appointed by Rand Water to provide goods or services or perform construction work.
- 5.1.3 **Rand Water Representative:** Refers to the person appointed by Rand Water to act as the Design Engineer, Project Execution Engineer, Programme Manager, Project Manager or Station representative for the purposes of the contract and notified to the contractor.
- 5.1.4 **OEM:** Means Original Equipment Manufacturer, which is a company that has sole intellectual property rights to equipment that is used by Rand Water. The equipment cannot be sourced from any other supplier / manufacturer other than the OEM.

- 5.1.5 **Accredited Test House:** Refers to a Third-Party Organization duly authorized by an Accreditation Authority who has the necessary test plant to perform type-tests in accordance with ISO 17025 requirements.
- 5.1.6 **Data Sheets:** Refers to the drawings, tabulations and sketches, which clearly indicate the technical, electrical and physical requirements of the equipment.

5.2 DEFINITIONS

- 5.2.1 **Calibration:** Operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.
- 5.2.2 **IP Rating:** Is defined in international standard EN 60529 (British BS EN 60529:1992, European IEC 60509:1989). IP Ratings are used to define levels of sealing effectiveness of electrical enclosures against intrusion from foreign bodies (tools, dirt etc.) and moisture.

5.3 ABBREVIATIONS

AC	Alternating Current
A	Amperes
ADS	Application data sheet
AMSL	Above mean sea level
ANSI	American National Standards Institute
BS	British Standards
CACA	Circulated Air Circulated Air
CACW	Circulated Air Circulated Water
CD	Compact Disk
CMR	Continuous Motor Rating
CSI	Current Source Inverter
CT	Current Transformer
DB	Distribution Board
DC	Direct Current
DOL	Direct-on-line
DOM	Design Office Manager
DVD	Digital Versatile Disk
EMC	Electromagnetic Compatibility
FAT	Factory Acceptance Test
FBA	Factory Built Assembly
GMO	General Manager Operations
GMSAM	General Manager Strategic Asset Management
HVAC	Heating, Ventilation and Air-conditioning
Hz	Hertz
IEC	International Electrotechnical Commission
IGBT	Insulated Gate Bipolar Transistor
IP	Ingress Protection

ISO	International Organization for Standardization
kA	kilo Amps
kW	kilo Watt
LCD	Liquid Crystal Display
LED	Light Emitting Diode
M	Meters
mA	milli Amps
MCC	Motor Control Centre
MLMST	Multi Level Inverter, Multi Secondary Transformer
mm	Millimetres
MV	Medium Voltage
OEM	Original Equipment Manufacturer
O&M manual	Operation and maintenance manual
PDS	Power Drive System (SANS 61800-4)
PFSC	Process Fail Safe Controller
PLC	Programmable Logic Controller
PWM	Pulse Width Modulation
PQ	Power Quality
PT100	Platinum resistor element with a nominal resistance of 100 Ohm at 0°C
QA	Quality Assurance
QAP	Quality Assurance Plan
QCP	Quality Control Plan
RFQ	Request for Quotation
RMS	Root Mean Square
RW	Rand Water
SABS	South African Bureau of Standards
SANS	South African National Standard
SCPD	Short Circuit Protection Device
SHEQ	Safety, Health, Environment and Quality
SPD	Surge Protection Device
SPIR	Spare Parts Interchange-ability Record
TEFC	Totally Enclosed Fan Cooled
TOU	Time Of Use
V	Volts
VSD	Variable Speed Drive
VSI	Voltage Source Inverter
VT	Voltage Transformer
WKS	Water Codification System
Ω	Ohms
°C	Degrees Celsius

6 RESPONSIBILITY AND AUTHORITY

6.1 OWNERSHIP

6.1.1 The Electrical Asset Manager is the custodian of this specification.

6.2 INTERESTED / AFFECTED PARTIES

6.2.1 The specification shall be made available to all interested / affected parties on request; and

6.2.2 Interested / affected parties shall adhere to this specification.

6.2.3 Interested / affected parties shall only use the latest revision of the standards referenced in this specification.

6.3 CONTRACTORS / SUPPLIERS

6.3.1 The contractor or supplier shall ensure that the installations are done in accordance with the external body standards referenced in the document.

6.3.2 Rand Water shall not issue any copies of the external body standards referenced in the document to any contractor; it is the responsibility of the contractor to have their own copies.

6.4 ACCREDITATIONS / VENDOR RESPONSIBILITIES

6.4.1 No claims for extras in respect of failure by the contractor to comply with any of the above regulations or specifications will be entertained by Rand Water.

6.4.2 Where conflict exists between any of the above regulations, the said conflict must be referred to the Engineer for a ruling.

6.4.3 Where conflict exists between any Rand Water technical specifications, the above regulations and the detailed technical specification or notes on drawings, the said conflict shall be referred to the Engineer for clarification.

7 ACTION / PROCEDURE / METHOD

7.1 OPERATIONAL REQUIREMENTS

7.1.1 General

7.1.1.1 The equipment shall be capable of continuous operation at full rating without the temperature rise of any component or compartment exceeding the maximum recommended by the supplier of that equipment or those temperatures recommended by the relevant SANS or IEC standard, whichever is the lesser.

7.2 MECHANICAL CONSTRUCTION

SMALL POWER AND LIGHTING DISTRIBUTION BOARD (DB) DESIGN CRITERIA		
INCOMING POWER SUPPLY DETAILS:		
Supply voltage	231 or 400, 1 or 3 phase 4 wire	VAC
Supply voltage variations	-15% and +15%	
Supply Frequency	50	Hz

Supply Frequency Variations	± 2.5	%
Phase Rotation	RWBR	clockwise
Neutral Earthing (secondary)	Solid	
Negative Phase Sequence Voltage	<2%	
Total Harmonic Content	< 3% up to 25th harmonic	
CURRENT RATINGS:		
Rated Operational Current I_n	\geq the full load current of the supply protection device	Amps minimum
Short Circuit Rating I_{cw}	\geq the prospective symmetrical short circuit current of supply protection device	kA for 1s
Rated Peak Withstand I_{pk}	2.1 times Short Circuit Rating	kA
VOLTAGE RATINGS & INSULATION SYSTEM REQUIREMENTS:		
Rated voltage U_e	400V for 380V systems and 450V for 400V systems	V
Insulation U_i	1000	V
Impulse Withstand Level	2500	V
BUSBAR SYSTEM:		
Busbars:		
Phases and Neutral Busbar Nominal Rating	\geq the full load current of the supply protection device	A
Rated Diversity Factor	1	
Busbar Construction	All busbars shall be manufactured from copper and shall be of constant cross sectional area throughout their full length.	
Busbar Maximum Current Density	1,55	A/mm ²
TEMPERATURE RISE SPECIFICATION:		
Assembly Temperature Rise Limit	As per SANS standards	°C
Busbar Support Temperature Rise	As per SANS standards	°C
Busbar Temperature Rise	As per SANS standards	°C
OTHER:		

Place of Installation	Indoor and outdoor	
Form	2b & 3b	
IP rating:		
Indoors	IP54	minimum
Outdoors	IP65	minimum
Type of entry	Top and bottom (Only bottom entry for outdoor DBs)	
Minimum clearances around distribution board	Directly in front	1000mm
Distribution board enclosure material:		
Indoors	Mild steel/ Polycarbonate	
Outdoors	3CR12	
Door Thickness	1,6	mm minimum
Door Hinges	At least two concealed or tamper proof metal hinges	
Chassis Plate Thickness	2	mm minimum
Gland plates:		
Built in dbs	Same material and thickness as tray construction	mm minimum
Floor standing DBs	All floor standing DB's to have 150mm plinth, and removable galvanised glad plate mounted min 300mm from floor level	mm minimum
Thickness:		
Built in dbs	1.6	mm minimum
Floor standing DBs	3mm removable	mm minimum
DB Paint Finish	Powder coated, structured finish with smooth white internal chassis and trays	
Colour:		
Normal Power Section	Electric Orange, B26	To SANS 1091
Essential Services Power Section	Signal Red, A11	To SANS 1091
231VAC UPS Power Distribution Section	Royal Blue, F01	To SANS 1091
Certification required:		
Distribution Board	Certificate of Compliance	To SANS 10142-1

Special environmental conditions:		
Humidity	95% (non-condensing)	%
Maximum Ambient Temperature	40	°C
Minimum Ambient Temperature	-10	°C
Altitude	1800 m	aMSL
Ventilation	Adequate natural ventilation is required to reduce condensation	

7.3 GENERAL REQUIREMENTS

7.3.1 Unless otherwise specified, all distribution boards, in non-domestic areas, shall be designed such that the normal, essential services and uninterruptible power sections are manufactured as three (3) separate distribution boards, namely:

7.3.1.1 Normal Power (Raw Power):

7.3.1.1.1 The Normal (raw) power shall be fed from the Normal Section of the relevant 400V switchgear panel and shall be utilised for general and non-essential load requirements. The colour of the normal power distribution compartment shall be Electric Orange, B26, structured to SANS 1091.

7.3.1.2 Essential Services Power (Generator Supply):

7.3.1.2.1 The essential power (Generator supply) shall be fed from the Generator Section of the relevant 400V switchgear panel and shall be utilised for strategic load requirements such as UPS backup power, for lighting of escape routes, as well as lighting and power for continuity of strategic administrative and operational works. The colour of the Essential Power distribution compartment shall be Signal Red, A11, structured to SANS 1091.

7.3.1.3 Uninterruptible Power Supply (UPS Supply):

7.3.1.3.1 Where the contractor is required to supply a **dedicated** UPS and Battery System, for the small power and lighting, the UPS shall supply power to the UPS compartment within the small power and lighting distribution board. The UPS in turn shall be fed from the **essential** power compartment of the small power and lighting distribution board. The colour of the UPS compartment shall be Royal Blue, F01, structured to SANS 1091.

- 7.3.1.3.2 If a **dedicated** UPS and Battery System, for the small power and lighting, is not required then the UPS compartment within the small power and lighting distribution board shall be fed from the Essential Services Power section in the relevant 400V switchgear panel.

7.3.2 Construction Methods and Systems

7.3.2.1 Distribution board structures will generally consist of the following components:

- 7.3.2.1.1 Sheet steel, pre-electro-galvanized enclosure to cover the sides, top, rear and also the bottom of surface and flush mounted distribution boards. The enclosure could be an integral folded metal structure or alternatively individual panels attached to a steel frame.
- 7.3.2.1.2 An internal pre-electro-galvanized mild steel frame to provide additional rigidity on larger boards.
- 7.3.2.1.3 Pre-electro-galvanized mild steel equipment chassis, punched and tapped, with DIN-Standard rails for mounting equipment onto.
- 7.3.2.1.4 Pre-electro-galvanized mild steel fascia plate to cover equipment as well as uninsulated live parts inside boards complete with cut-outs through which the operating handles of the circuit breakers and switches as well as the front panels of equipment, which require regular adjustment or setting i.e. timers, will protrude.
- 7.3.2.1.5 Pre-electro-galvanized mild steel architrave or surround, which will be used to cover uneven brick edges or plasterwork around the cut-out in the building structure for a flush mounted distribution board. The architrave may form part of a removable front panel of the distribution board. The architrave shall extend past the sides of the distribution board enclosure by at least 25 mm.
- 7.3.2.1.6 Steel hinged, mild steel, 3CR12 or Polycarbonate doors, as specified in the design documents.
- 7.3.2.2 All distribution boards shall be suitable for applications in single or three phase-and-neutral systems with a separate earth. These distribution boards shall be populated with moulded case air and miniature circuit breakers as well as various control devices such as earth leakage releases, timers, metering equipment, contactors and surge protection devices.
- 7.3.2.3 The distribution board(s) shall be dustproof, vermin proof and adequately ventilated to prevent overheating of the equipment. The minimum protection rating, unless otherwise specified, shall be IP54 for indoor installations and IP65 for outdoor installations. It shall not be possible to make accidental contact with any exposed live parts inside the distribution board, while the door of the distribution board is open, without intentionally removing the fascia plate.
- 7.3.2.4 Bolted steel plates shall form partitions between cubicles or sections in a distribution board. Each cubicle and section shall have a separate door.
- 7.3.2.5 The distribution board(s) shall be of robust construction consisting, in general, of a channel, square tubular or angle iron frame covered with pre-electro-galvanised sheet steel panel(s) of 1,6 mm minimum thickness. Welded joints shall be galvanized after manufacture. The panel(s) and doors shall be reinforced to prevent distortion and to ensure rigidity. Floor standing distribution boards shall be equipped with a plinth, which will be manufactured from a suitable steel channel section. The plinth shall be at least 150 mm high, when measured from the floor.

- 7.3.2.6 Facia plates shall be removable to provide access to the wiring, busbars and equipment. The panels shall be held in position by quarter-turn catches which will engage the structure of the distribution board. The use of screws to attach facia plates shall not be acceptable. The facia plate shall offer IP42 protection when the doors of the distribution board are open. Any cut outs in the facia plate over unpopulated areas of the board shall be closed off with temporary, removable blank plates so as to maintain the protection level.
- 7.3.2.7 Distribution board doors shall be equipped with non-lockable catches. Doors that are more than 1 m high shall have catches that will engage the structure at least two positions at the top and bottom of the door. The doors shall be attached to the structure by means of at least two concealed or tamper proof metal hinges.
- 7.3.2.8 All doors shall be equipped with rubber seals and all cutouts/apertures, where wires pass through/over, shall be fitted with suitable grommets or edging.
- 7.3.2.9 The facia plate shall not be the sole means of keeping components in position.
- 7.3.2.10 The internal layout of each distribution board shall be done in such a way that it will permit incoming and outgoing busbars and cables to enter the enclosure as specified, be manipulated and to be connected to their respective terminals without inconvenience during installation or maintenance. It shall be impossible for arcing to occur between live parts or between a live part and the frame (Spacing, or shielding with non-flammable and non-combustible insulating material shall be used to achieve this aim.). The functioning or safety of other equipment shall not be impaired. Equipment shall be accessible for maintenance purposes and conductors can easily be disconnected from the terminals.
- 7.3.2.11 The distribution board shall comprise of at least 30% unpopulated ways, excluding spares, as specified on design drawings. As an example, if 12 ways are occupied, including the spares, then at least a 16-way distribution board must be installed.
- 7.3.2.12 All drilling, cutting or any other metalwork shall be completed prior to any paint process being undertaken

7.3.3 Distribution board configurations

7.3.3.1 Four types of distribution boards (DBs) shall generally be specified:

- 7.3.3.1.1 Surface mounted DBs: Imply boards that will be mounted onto the surface of walls or structural elements of the building structure providing front access only.
- 7.3.3.1.2 Flush mounted DBs: Imply boards that will be built into walls providing front access only.
- 7.3.3.1.3 Semi-flush mounted DBs: Imply boards that will be built into walls, but will be partially protruding, providing front access only.
- 7.3.3.1.4 Floor standing DBs: Imply boards that will be free standing on the finished floor surface providing front and rear access.

- 7.3.3.1.4.1 For floor standing distribution boards the cable gland plates shall be galvanised, removable and of at least 3 mm thickness.
- 7.3.3.1.4.2 The gland plate shall be bonded to the main earth bar with a copper earth strap having a cross-sectional area equivalent to that of the earth bar.
- 7.3.3.1.4.3 When cables enter the top of the distribution board a similar cable gland plate shall be incorporated in the top of the distribution board and shall be connected to the main earth bar in a similar manner.
- 7.3.3.1.4.4 Spare entry holes in the top gland plates shall be provided with galvanised blank seals.
- 7.3.3.1.4.5 The entire distribution board shall be vermin proof after final cable installation.

7.3.4 Screws, nuts and bolts

- 7.3.4.1 All screws, nuts and bolts shall be hexagonal to ISO metric, commercial standards and shall be rust proof. Nuts protruding from exterior surfaces shall be domed, and either chrome or cadmium plated.
- 7.3.4.2 Self-tapping screws shall not be utilised for any purpose.

7.3.5 Painting of sheet metal fabrications

- 7.3.5.1 The final paint finish shall be epoxy powder. The minimum final paint thickness shall be 120 micrometres' and shall be measured at various points as indicated by the Engineer.
- 7.3.5.2 The DB manufacturer shall provide a calibrated test instrument capable of accurately determining the final paint thickness. This instrument shall be made available at the DB painted, sheet metal inspection.
- 7.3.5.3 A test sample plate shall be produced for each batch of powder coating.

7.3.6 Colours

- 7.3.6.1 The normal section of the DB shall be powder coated Electric Orange B26, to SANS 1091 and the final finish shall be structured.
- 7.3.6.2 The 231VAC UPS distribution section shall be powder coated Royal Blue, F01, to SANS 1091 and the final finish shall be structured.
- 7.3.6.3 The 400VAC essential services distribution section shall be powder coated Signal Red A11, to SANS 1091 and the final finish shall be structured.
- 7.3.6.4 If the DB Incomer is fed from an Essential Services supply, then DB door shall be powder coated Signal Red A11, to SANS 1091.

7.3.7 Quality of Final Finish

- 7.3.7.1 The application of the paint shall be uniform so as to prevent running or excessive "orange peel". Careful attention shall be applied to the application of paint to sharp edges and corners to prevent cracking or peeling of paint.
- 7.3.7.2 Any surfaces exhibiting these symptoms shall be rejected and shall be stripped and completely repainted.

7.4 ELECTRICAL CONSTRUCTION

7.4.1 Switchgear and equipment

- 7.4.1.1 Each distribution board shall have one main incoming circuit breaker and the required number of branch circuit breakers, as shown on the drawings, including spare circuit breakers and spaces for future expansion.
- 7.4.1.2 Single-phase circuit breakers shall be fed from the appropriate phase as indicated on the drawings. The phase allocation on the drawings is only provisional and the Electrical contractor shall be responsible for balancing the load across all three phases.
- 7.4.1.3 All electrical equipment installed in the DB shall be of the same brand/manufacturer.

7.4.2 Busbar construction

- 7.4.2.1 All busbars shall be sized to accommodate currents equal to or larger than the rated current of the supply protection device or incomer circuit breaker, in the distribution board, and shall be of sufficient in size to limit temperature rise to below the allowable insulation or equipment temperature ratings stated in the relevant SANS standards.
- 7.4.2.2 Where the supply cables to a distribution board are terminated directly onto the busbars i.e. in a loop-in-loop-out arrangement, the busbars shall be sized to accommodate currents equal to or larger than the rated current of the circuit breaker which is being used to protect the supply cable.
- 7.4.2.3 The busbars shall be braced for the prospective symmetrical rms fault currents, greater than or equal to the prospective symmetrical short circuit current of supply protection device, at the point of application, or 10kA, whichever is the larger, for a minimum of one second without degradation to the installation.
- 7.4.2.4 All busbars shall be manufactured from copper and shall be of constant cross sectional area throughout the entire length.
- 7.4.2.5 Other profiles such as rods and tubes are not acceptable. Aluminium busbars and laminated busbars are not acceptable.
- 7.4.2.6 The current density rating of busbar systems shall be less than or equal to 1.55A/mm².
- 7.4.2.7 The Main Neutral busbar shall be continuous through all sections, insulated from the enclosure structure and separate from the Earth bar.
- 7.4.2.8 The Main Neutral busbar shall have the same current rating as the phase busbars. Provision shall be made for the required number of feeder connectors complete with adequate brass bolts and nuts.
- 7.4.2.9 Each earth leakage device shall be equipped with a separate Neutral bar onto which the Neutral conductors of all the circuits that are protected by the device are connected.
- 7.4.2.10 Busbars and busbar droppers shall be identified by means of approved colour-coded heat-or air-shrink sleeves at intervals of not less than 400mm with a minimum length of 50mm each.
- 7.4.2.10.1 The clearance between phases and between phase and earth or chassis shall be at least 8 mm.

- 7.4.2.11 Joints and connections in main busbars and dropper busbars shall be made by means of suitable bolted pressure systems. Drilled and bolted busbar joints are acceptable provided that the effective cross sectional area of the busbar is not reduced.
- 7.4.2.12 All bolts used for busbar connections shall be high tensile and sheradised or cadmium plated.
- 7.4.2.13 Busbar sections overlapping at joints shall be either electrolytically silver plated or sanded to a bright, rough finish and sealed with a non-hardening silicone grease.
- 7.4.2.14 The length of the overlapping section shall not be less than twice the width of the busbars and shall maintain the same cross-sectional area as the main busbars. The busbars shall be prepared to allow for addition of extra tiers if so required in the future.
- 7.4.2.15 All busbar bolts shall be correctly sized and shall be tightened using a torque wrench. The manufacturer and installer shall demonstrate that he has an acceptable quality control procedure to ensure that busbar bolts are tightened to the correct torque.

7.4.3 Earthbars

- 7.4.3.1 Each distribution board shall be equipped with a copper earth bar to allow for the termination of all the incoming and outgoing main earth conductors. Provision shall be made for the required number of feeder protective earth connectors complete with adequate brass bolts and nuts. The Earth bar shall be firmly fixed to the chassis plate.
- 7.4.3.2 Earth continuity conductors with a cross-sectional area of 16 mm² or smaller shall be terminated onto separate earth bars with set-screw-type tunnel terminals.
- 7.4.3.3 Doors or hinged panels shall be separately bonded to earth if any electrical equipment is fitted onto such doors or hinged panels.
- 7.4.3.3.1 All earthing wires shall have green with yellow trace insulation.

7.4.4 Wiring

- 7.4.4.1 All wiring shall be carried out as per the latest SANS standards.
- 7.4.4.2 Only general purpose, 600V grade PVC insulated, copper conductor wire shall be utilized for SP&L installations and the wiring of DBs.
- 7.4.4.3 The wiring shall be connected to the busbars using hydraulically compressed solid crimping lugs which shall be bolted to the busbars using sheradised or cadmium plated bolts, nuts, spring washers and washers. No drilling and tapping of busbars is allowed.
- 7.4.4.4 Conductors shall be sized to suit the prospective maximum continuous current and the I²t energy let-through characteristics of the circuit protection devices. The minimum size of conductor on the busbar side of circuit protection devices shall, however, be based on the fault level withstand capabilities or the maximum size wire that the circuit breaker can accommodate.
- 7.4.4.5 All connectors and other live parts shall be shrouded to avoid inadvertent contact when servicing/accessing the panel.
- 7.4.4.6 All electrical equipment shall be mounted on rails fixed to chassis plates. No equipment shall be mounted on any other surface of the distribution board.
- 7.4.4.7 Any alternative wiring eg. Surfex, flat twin and earth, etc. must be approved by the Engineer and must be installed in wiring channels, conduit or power skirting, throughout the entire installation. No exposed wiring or cabling will be accepted.

- 7.4.4.8 The installation of wiring shall be carried out by means of the loop-in system, with joints being allowed only in accessible outlet boxes, wiring channels, power skirting and distribution boards.
- 7.4.4.9 Bay lighting circuits shall be fed directly from the distribution board circuit breakers and shall not be wired through light switches.
- 7.4.4.10 Any lighting circuit, exceeding 5 (five) kilowatts, shall be balanced between the relevant three phases, red, white or yellow and blue. Each of these phases shall be supplied via a suitably rated double pole circuit breaker, with individual neutral conductors wired back to the neutral bar.
- 7.4.4.11 Open wiring will not be permitted.
- 7.4.4.12 The contractor shall provide all voltage drop calculations, but the minimum sizes of conductor used, shall be as follows:

7.4.4.12.1 Lighting	1.5 mm ² cross-sectional area
7.4.4.12.2 220VAC Socket outlets	2.5 mm ² cross-sectional area
7.4.4.12.3 Hot water cylinders up to 4 kW	4 mm ² cross-sectional area
7.4.4.12.4 Space heaters up to 3 kW	4 mm ² cross-sectional area
7.4.4.12.5 Stoves up to 12 kW	10 mm ² cross-sectional area
7.4.4.12.6 Air conditioners up to 3 kW	4 mm ² cross-sectional area

7.4.5 Colour Coding of Wiring

- 7.4.5.1 Wiring of facilities shall be colour coded as follows, or otherwise identified as required by the Regulations:
 - 7.4.5.1.1 Neutral is to be black.
 - 7.4.5.1.2 Protective earth is to be green with yellow trace.
 - 7.4.5.1.3 Phase colours where not specified by the Regulations are to be red, white or yellow and blue.

7.4.5.2 Indication lamps, Push Buttons and Selector Switches

- 7.4.5.2.1 Indication lamps shall be of the LED type, with voltage ratings as indicated on the schematic diagrams and must be rated for continuous operation.

7.4.5.3 Surge Arresters

- 7.4.5.3.1 A combination of Class 1 and Class 2 surge arresters (SPDs) shall be fitted on each phase and neutral of the incoming supply, **after** the incomer circuit breaker.
- 7.4.5.3.2 The SPDs shall be preceded/protected via a suitably rated 4 pole (2 pole for single phase DBs) circuit breaker.
- 7.4.5.3.3 The SPDs shall be fail-safe, plug-in, modular types with individual end-of-life indicators, and preferably thermal disconnecting mechanisms.
- 7.4.5.3.4 The total wiring length from the phase or neutral to the SPD and then to earth shall not exceed 0.5m in length, to minimize additive volt drops. This wiring shall be the maximum cross-sectional area that the SPD can accommodate, with a minimum allowed cross-sectional area of six square millimetres.

7.5 SITE INSTALLATION REQUIREMENTS

- 7.5.1 The location where the distribution board will be installed shall be permanently dry and free of corrosive, explosive and flammable fumes and gasses. There shall be an unobstructed space with easy access of at least 1m in front of the distribution board.
- 7.5.2 Where applicable, the contractor shall be required to co-ordinate the casting of concrete plinths and foundations necessary for the installation of equipment. The contractor shall confirm that all fixing holes and penetration points, of conduits and sleeves, will align with cutouts and brackets in the distribution board.
- 7.5.3 The contractor shall balance all loads, as equally as possible, between the relevant three phases, red, white or yellow and blue.
- 7.5.4 Cable Glands
 - 7.5.4.1 Cables shall be terminated in metal, non-rusting, compression glands of the type which provide anchorage for the armour wires.
 - 7.5.4.2 Glands shall be suitable for PVC SWA and PVC sheathed general purpose 600/1000-volt cable.
 - 7.5.4.3 The gland shall be completely encased by a PVC or rubber shroud. On the cable entry side of the barrel, a groove shall be provided, to accommodate a rim of the waterproof shroud. The shrouds shall be made of non-deteriorating neoprene or synthetic rubber, and shall be resistant to water, oil and sunlight. The shrouds shall fit tightly around the glands and cable.
 - 7.5.4.4 The non-watertight glands shall be easily converted to watertight glands by means of sealing rings and waterproofing shroud.

7.5.5 Joints

- 7.5.5.1 Lugs or ferrules used for terminating or making T-taps and splices on conductors, with a cross-sectional area of 10 mm² and smaller, shall be of the compression type. The connector shall be of non-ferrous copper alloy, with insulating sleeves, and shall be attached to the conductor by means of a specialised mechanical crimping tool.

7.5.6 Low voltage cable installations

- 7.5.6.1 Where cables are to be installed vertically or horizontally against walls and in roof spaces, they shall be clamped to galvanised steel cable ladders, wire mesh-type cable trays or perforated galvanised steel heavy duty cable trays.
- 7.5.6.2 Cables passing through ventilation shafts shall be installed in steel conduits.
- 7.5.6.3 Cables installed through very high risers shall be supported at the upper end of risers and at intermediate points, by proprietary clamps, to relieve any stresses on the conductors.
- 7.5.6.4 Where a cable is fixed to a steel tray or supporting structure, approved galvanized steel clamps shall be used, at distances not exceeding 20 diameters of the relevant cable.

7.5.7 PVC Conduit

- 7.5.7.1 Unless otherwise specified, PVC conduits shall only be utilized in Ferric Chloride and Chlorine dosing plants. In all other plants, steel conduit shall be utilized.
- 7.5.7.2 Switch and socket outlet boxes shall be the standard 60mm round PVC termination boxes.
- 7.5.7.3 All outlet termination boxes shall be the standard 60mm round PVC outlet box type.
- 7.5.7.4 PVC conduit shall be terminated by means of the applicable manufacture's male or female adapters. The protrusion of conduit only at termination points will not be accepted.
- 7.5.7.5 Conduit installations shall be installed level, square and perpendicular to the building and structure lines and present a neat and acceptable finish at all times.
- 7.5.7.6 All PVC conduit shall be supported at 1000mm maximum intervals, by means of pedestal saddles.
- 7.5.7.7 All PVC conduit installed in ceiling or roof cavities shall be supported at 1000mm maximum intervals, by means of pedestal saddles, or approved alternative support systems, where pedestal saddles cannot be utilized.

7.5.8 Steel conduit

- 7.5.8.1 Steel conduit shall be utilized for all installations except in Ferric Chloride and Chlorine dosing plants.
- 7.5.8.2 Steel conduit shall be hot dipped galvanised, heavy-gauge steel, welded or solid drawn to the latest SANS specifications.
- 7.5.8.3 All joints for steel conduits shall be as per the manufactures' requirements.
- 7.5.8.4 Switch and socket outlet boxes shall be of the 100mmx100mmx50mm or 100mmx50mmx50mm, galvanised heavy-gauge pressed steel type.
- 7.5.8.5 All termination boxes shall be galvanised heavy-gauge pressed steel type.
- 7.5.8.6 All cut threads shall be rendered rust and weatherproof.

- 7.5.8.7 Conduit threads shall be cut clean and of sufficient length to permit the conduits to be butted together at joints and hard against the shoulders of the conduit box spouts and other conduit screwed fittings.
- 7.5.8.8 Cut ends of the conduits are to be bevelled internally and all burrs removed. Where exposed on surface all threads are to be cleaned of cutting paste and painted with cold-galvanising paint.
- 7.5.9 Conduit: General
- 7.5.9.1 All conduit and conduit fittings shall be recessed (built in), concealed in concrete, walls, ceiling spaces, etc. No surface mounted conduit will be accepted without written approval from the Engineer.
- 7.5.9.2 Where the Engineer has accepted surface mounted conduits, these shall be run neatly parallel to vertical and horizontal building structures and individually fixed using multi-pedestal saddles.
- 7.5.9.3 Conduits shall be installed mechanically and electrically continuous throughout in accordance with the latest SANS specifications.
- 7.5.9.4 All conduits shall be securely bonded to equipment ensuring complete mechanical and electrical continuity throughout. Every conduit run shall likewise be bonded to earth.
- 7.5.9.5 Terminations of conduit shall be by means of screwing and locknuts on inside and outside of the box or appliance. Alternatively, conduits may be terminated by means of a coupling and a brass male bush. Only solid brass bushes may be utilized.
- 7.5.9.6 Conduits installed in concrete slabs or beams etc. shall be firmly fixed before the concrete is cast.
- 7.5.9.7 All joints shall be suitably sealed against the ingress of water or cement with all outlet boxes installed level and securely fastened to the shuttering.
- 7.5.9.8 The contractor shall inspect the entire installation, **before** the concrete is cast, to ensure that the above conditions have been satisfied. The contractor shall ensure that an electrical Rand Water representative is present during this inspection.
- 7.5.9.9 The contractor shall advise the Engineer, a minimum of 5 working days in advance, before concrete slabs are to be cast to ensure that the conduit installation may be inspected.
- 7.5.9.10 Where large conduit sleeves and/or large concentrations of conduit occur, these shall be carried out to the approval of the Structural Engineer, such approval being obtained prior to commencement of the installation of the conduit.
- 7.5.9.11 Conduits in roof spaces shall be run parallel and square to the roof trusses wherever possible and shall be supported by means of pedestal saddles or approved alternative support systems.
- 7.5.9.12 Conduits for future services shall be terminated with conduit boxes and oversized cover plates and shall be provided with galvanised draw wires.
- 7.5.9.13 Terminations that are likely to be exposed to the weather shall be suitably sealed with sealant or approved gasket systems.
- 7.5.9.14 Conduit shall only enter termination and outlet boxes from the top, bottom and sides, no rear access will be allowed. Extended screws may be utilized to attach surface mounted outlets.
- 7.5.9.15 In loop-in wiring systems, back entry loop-in boxes may be utilized.

7.5.10 Chasing of Walls

- 7.5.10.1 No chasing of brick walls, concrete slabs or any other surfaces will be accepted without the written permission of the Engineer.
- 7.5.10.2 If approved by the Engineer, the contractor shall do the necessary chasing such that the outer face of the conduit is a minimum of 12 mm deeper than the finished plaster surface.
- 7.5.10.3 All chasing carried out is to be completed by means of powered chasing machines and all chases are to be kept to the minimum dimensions required.
- 7.5.10.4 All chasing shall be done level, square and perpendicular to the building and structure lines.

7.5.11 Wiring Channels

- 7.5.11.1 Wiring channels, complete with covers and all accessories, shall be supplied and installed by the contractor, where applicable.
- 7.5.11.2 Unless otherwise specified, wiring channels shall be manufactured from hot dipped galvanized metal with a minimum thickness of 0.8 mm, or as per manufacturer's specifications.
- 7.5.11.3 Only purpose manufactured wiring channel accessories are to be utilised with the installation thereof.
- 7.5.11.4 The installation, fixing, size and type of channel must conform to the latest SANS standards.
- 7.5.11.5 Conduit terminations to wiring channels shall be either directly into the channels by means of a purpose manufactured adapter, a bushed entry or by means of a conduit box through a bushed hole in the back of the channel. No protruding objects shall be present and suitable care shall be taken to ensure that wiring does not pass over sharp edges.
- 7.5.11.6 Span support brackets shall consist of purpose manufactured support channels fixed onto holding surfaces or suspended with a minimum of 10mm galvanised suspension rod. Span supports shall not exceed 1.5 meters, unless otherwise recommended by the manufacturer.
- 7.5.11.7 The installation of the lighting, power, fire detection and protection, access control systems, CCTV systems, data system and intrusion alarm systems shall comprise of a combination of suitably sized wire channels, power skirting, wire baskets and conduits located at various and strategic heights and positions around the perimeter of pump pits and in the lift out ceiling or access floor voids of administrative areas.
- 7.5.11.8 Installation of wiring channels shall be of the highest standard and workmanship, and shall be installed level, square and perpendicular to the building or structure lines.
- 7.5.11.9 Wiring channels shall only be joined by means of manufacturer approved join/splice accessories.
- 7.5.11.10 Wiring channels must enter distribution boards by means of purpose made, manufacturer approved, interface adapters.
- 7.5.11.11 All wiring channels are to be completely vermin proof.
- 7.5.11.12 All wiring channels must be earthed as per the latest SANS standards.

7.5.12 Welded wire mesh cable trays

- 7.5.12.1 Welded wire mesh cable trays/baskets and all accessories shall be supplied and installed by the contractor, where applicable.
- 7.5.12.2 The installation, fixing, size and type of wire mesh cable trays/baskets must conform to the latest SANS standards.
- 7.5.12.3 The wire mesh cable tray shall be manufactured from hot dip galvanized wire.
- 7.5.12.4 Only purpose manufactured wire mesh cable tray accessories are to be utilised with the installation thereof.
- 7.5.12.5 Conduit terminations to wire mesh cable trays shall be directly onto the wire mesh cable tray by means of a purpose made adapter and bracket, supported with unique hold down flush saddles. Suitable care shall be taken to ensure that wiring does not pass over sharp edges.
- 7.5.12.6 Span support brackets shall consist of purpose made support channels fixed onto holding surfaces or suspended with a minimum of 10mm galvanised threaded rod. Span supports shall not exceed 1.5 meters, unless otherwise recommended by the manufacturer.
- 7.5.12.7 Installation of wiring channels shall be of the highest standard and workmanship and shall be installed level, square and perpendicular to the building or structure lines.
- 7.5.12.8 All welded wire mesh cable trays must be earthed as per the latest SANS standards.

7.5.13 Power skirting

- 7.5.13.1 Power skirting, complete with covers and all accessories, shall be supplied and installed by the contractor, where applicable.
- 7.5.13.2 Power skirting shall be mounted at skirting level unless otherwise indicated.
- 7.5.13.3 Unless otherwise indicated power skirting shall be manufactured from metal with a minimum thickness of 0.8mm and the power skirting cover a minimum thickness of 0.6mm.
- 7.5.13.4 The power skirting shall be divided internally into three (3) separate wiring compartments for normal power, emergency or essential power and data, and shall have provision for flush mounted components to the compartments.
- 7.5.13.5 Power skirting shall be installed with the normal power compartment at the top, emergency or essential power in the middle and data at the bottom, and shall be fixed to walls or partition walls in an approved manner.
- 7.5.13.6 The power skirting shall be finished in a baked enamel finish. Colour to be confirmed by the Engineer.
- 7.5.13.7 All end caps, internal and external corner pieces and electrical components, such as socket outlets etc, shall be factory made and fit neatly and accurately within the power skirting.
- 7.5.13.8 The installation, fixing, size and type of power skirting must conform to the latest SANS standards.
- 7.5.13.9 The contractor shall install feeder conduits as required or indicated on the drawings. These conduits shall terminate behind the power skirting in flush conduit boxes. The conduit boxes shall align with the relevant power or data compartment to avoid mixing or crossing of power and data wires/cables.

- 7.5.13.10 Conduit terminations to power skirting, in a surface mounted installation, shall be either directly into the skirting by means of a purpose manufactured adapter or bushed entry. No protruding objects shall be present and suitable care shall be taken to ensure that wiring does not pass over sharp edges.
- 7.5.13.11 Where the power skirting is broken by doorways etc, suitable metal conduit links shall be installed to bridge the break in the power skirting run. Linking conduits shall be a minimum of 32mm diameter, unless otherwise specified, and separate conduits shall be provided for the each of the power and data compartment services, unless otherwise specified.
- 7.5.13.12 Electrical components shall be mounted by means of suitable cradles to secure components to basic channels, free from the covers.
- 7.5.13.13 All power skirting must be earthed as per the latest SANS standards.
- 7.5.13.14 Installation of power skirting shall be of the highest standard and workmanship and shall be installed level, square and perpendicular to the building or structure lines.
- 7.5.14 Earthing
- 7.5.14.1 The complete installation shall be thoroughly and effectively earthed as per the latest SANS standards.
- 7.5.14.2 A philosophy of equipotential bonding must be followed for any conductive parts that can develop step or touch potentials in the event of an earth fault.
- 7.5.14.3 All conductive hot and cold water pipes and steel waste pipes shall be bonded with copper tape and clamped by means of a brass bolt with nut and washers.
- 7.5.14.4 All television and/or radio aerials/masts shall be individually earthed to a dedicated earth spike/mat with a resistance of 1 Ohm or less.
- 7.5.15 Exterior, Interior, Emergency and Escape Route Lighting
- 7.5.15.1 The exterior, Interior and emergency lighting must be designed, selected and installed in accordance with the latest SANS standards. Where a discrepancy occurs between the relevant SANS standards and the OHS ACT, the most stringent values must be used. LED (light emitting diode) lighting must be used wherever possible. The following criteria shall be considered, as a minimum:
- 7.5.15.1.1 Lighting illumination levels and efficiency
- 7.5.15.1.2 Glare factor
- 7.5.15.1.3 Ta Ratings
- 7.5.15.1.4 IP Rating
- 7.5.15.1.5 Light Output Ratio %
- 7.5.15.1.6 Type and construction
- 7.5.15.1.7 Hazardous/corrosive environments
- 7.5.15.1.8 Accessibility and maintainability
- 7.5.15.2 When utilized, high bay luminaires should be mounted above the level of hoisting gantries. All equipment shall be positioned to enable easy access, for maintenance and repairs, by means of step ladders or by utilization of the platforms on the crane gantries.
- 7.5.15.3 Unless otherwise specified, all lighting outlets, for surface mounted luminaires, shall be provided by means of conduit, terminated in standard round outlet boxes.

- 7.5.15.4 Outlets shall be installed in the positions as indicated on the drawings.
- 7.5.15.5 Outlets provided for recessed luminaires shall be terminated by means of 5A un-switched socket outlets, mounted in boxes or ducts which are positioned in close proximity to the lighting luminaire.
- 7.5.15.6 Final connection between the socket outlet and the luminaire shall be carried out by means of 3 core silicone cable with a 5A plug top.
- 7.5.15.7 Bay lighting luminaires, not considered to be emergency fittings, shall be terminated by means of 5A un-switched socket outlets, mounted in boxes or ducts which are positioned in close proximity to the lighting luminaire.
- 7.5.15.8 "Live maintained" emergency fittings shall be terminated by means of 16A, 4 pin, un-switched socket outlets, mounted in boxes or ducts which are positioned in close proximity to the lighting luminaire
- 7.5.15.9 Final connection between the socket outlet and the "Live maintained" luminaire shall be carried out by means of 4 core silicone cable with a 16A plug top.
- 7.5.15.10 The luminaires shall be generally mounted in the positions indicated and should be symmetrical to ceiling panels and building features. All positions shall be checked on site and should any discrepancies be found, in that the layout cannot be adhered to, the matter shall be referred to the Engineer for clarification.
- 7.5.15.11 Where no facilities exist for the adequate supporting of luminaires, the contractor shall allow for supplying and installing hangers, brackets, wooden battens, etc that may be needed. The provision and installation of the above supports shall be to the approval of the Engineer.
- 7.5.15.12 Surface mounted luminaires shall be mounted with their bases, and in the case of pendant fittings, with their suspension member, fixed directly to the conduit box. Additional supports for heavier type fittings are to be provided where necessary and shall be to the approval of the Engineer.
- 7.5.15.13 Outdoor surface mounted luminaires shall be mounted with their bases fixed directly to the conduit box. A gasket shall be installed between the luminaire base and the conduit box to prevent any ingress of water and dust into the conduit box.
- 7.5.15.14 Luminaires mounted directly to the soffit of concrete slabs shall be fixed by means of, either conduit boxes cast into the concrete, expansion bolts, screws and approved plugs, or some other approved fixings. Where luminaires are mounted directly to slabs constructed of hollow blocks, butterfly nuts and screws shall be used where possible.
- 7.5.15.15 All luminaires 1200 mm in length, or longer, shall have two fixings in addition to the central fixing of the outlet box.
- 7.5.15.16 All surface mounted luminaires, wider than 200 mm, shall be provided with 4 fixings in addition to the central fixing of the outlet box.
- 7.5.15.17 Luminaires shall not be mounted in continuous lines, coupled together by means of nipples and locknuts with bushes.
- 7.5.15.18 Where luminaires are specified to be mounted as pendant type, such pendants shall be supported by 20 mm diameter conduit. The contractor shall allow for the provision of two such conduit supports where luminaires are 1200 mm or longer. The wiring to the luminaires shall be taken through the top of the pendants. Dome lids shall be provided for all pendants where the length of pendant exceeds 600 mm.
- 7.5.15.19 All lighting fixtures shall be suitably earthed.

7.5.15.20 All emergency and escape route lighting shall be designed and installed as per the OHS Act and latest SANS standards.

7.5.16 Lighting switches

7.5.16.1 Lighting switches shall be supplied, connected and installed by the contractor in the positions as indicated on the drawings.

7.5.16.2 All light switch assemblies shall consist of a metal switchbox, switch and cover plate especially designed for that purpose.

7.5.16.3 Lighting switches shall be rated at 16A, 250V.

7.5.16.4 Flush mounted switches shall be installed in 100mmx50mmx50mm pressed steel galvanised boxes provided with metal, oversized, bevelled cover plates. The switches shall be installed at a height of 1300 mm to the centre line, above finished floor level.

7.5.16.5 Unless specified to the contrary, switches adjacent to doors shall be installed on the side containing the lock. If the door swing is not shown on the drawing, the position of the switch shall be verified before installation thereof.

7.5.16.6 Switch boxes in partition, brick and concrete walls shall be installed 150mm from the door frame.

7.5.16.7 Where light switches are located on walls, where the lower section is of face brick and the upper section plastered, light switches shall be located in the plastered portion in order not to coincide with the junction line of the two wall finishes. Switches shall however not be more than 1600 mm above finished floor level.

7.5.16.8 Where glass panelling is utilized for construction and partitioning, the final location of the light switches shall be verified with the Engineer, before installation.

7.5.16.9 Surface mounted light switches shall consist of a metal switchbox, switch and cover plate especially designed for that purpose.

7.5.16.10 Switches installed outside and/or installed in damp areas shall have a minimum rating of IP65 and may be of the non-metallic type.

7.5.16.11 Switches utilized in hazardous/corrosive environments must be appropriately rated for that environment.

7.5.16.12 No switchbox shall contain more than one phase.

7.5.16.13 The arrangement of lighting switches in a ganged unit shall, where possible, correspond to the layout of the lighting points which they control.

7.5.17 Photocells and occupancy sensors

7.5.17.1 Photocells must be installed with a bypass circuit breaker and where applicable, a suitably rated contactor.

7.5.17.2 All photocells must be installed in a metal type, IP65 rated, bulkhead enclosure.

7.5.17.3 Occupancy sensors shall be installed as shown on the relevant drawings and shall be equipped with integral surge protection and manual bypass facility.

7.5.18 Socket outlets

- 7.5.18.1 Unless otherwise specified, all switched socket outlets, for normal power, shall be protected by a 30mA, earth leakage and shall consist of a white 16A single pole, 250VAC grade switch. These shall be mounted together on a common steel cradle with a 16A, 250VAC, 3 pin (line, neutral and round earth) shuttered type socket outlet. The outlet shall be complete with a white steel cover plate with fixing screws complying with SANS specifications.
- 7.5.18.2 Standard socket outlets shall be 250VAC, 16A rated, SABS approved 100mm x 100mm flush, or surface mounted, metal clad SANS 164-2 type standard socket outlet, unless installed with a combination of the SANS 164-2 & SANS 164-1 on one outlet.
- 7.5.18.3 Unless otherwise specified, all dedicated switched socket outlets, for emergency/essential power, shall not be earth leakage protected and shall consist of a red 16A single pole 250VAC grade switch, 3 pin (line, neutral and non-standard, flattened earth at ninety degrees) shuttered type socket outlet. The outlet shall be complete with a red steel cover plate with fixing screws, complying with the SANS specifications. These outlets shall be used with the appropriate red, flattened earth pin plug top.
- 7.5.18.4 Unless otherwise specified, all dedicated switched socket outlets for UPS power shall not be earth leakage protected and shall consist of a black 16A single pole 250VAC grade switch, 3 pin (line, neutral and non-standard, flattened earth at forty-five degrees) shuttered type socket outlet. The outlet shall be complete with a black steel cover plate with fixing screws, complying with SANS specifications. These outlets shall be used with the appropriate black, flattened earth pin plug top.
- 7.5.18.5 Socket outlets, in hostel bedrooms, shall be wired on one circuit and connected to a 20A, 30mA earth leakage unit.
- 7.5.18.6 Hostel socket outlets, connected to a common earth leakage unit, shall be provided with double pole circuit breakers in the distribution board, to isolate the phase **and neutral** conductors, on the load side of the circuit.
- 7.5.18.7 Unless otherwise specified, switched socket outlets shall be mounted at the following heights above finished floor level:
- | | |
|---|--------|
| 7.5.18.7.1 Flush/surface mounted switched socket outlets for hostels/domestic | 450mm |
| 7.5.18.7.2 Flush mounted switched socket outlets shops, offices and showrooms | 450mm |
| 7.5.18.7.3 Flush/surface mounted for kitchens and laundries | 1100mm |
| 7.5.18.7.4 Flush/surface mounted for plant areas and sub stations | 1100mm |
| 7.5.18.7.5 Flush/surface mounted for garages | 1100mm |
- 7.5.18.8 For flush mounted installations the IP65 rated switched socket outlets shall be installed on 60mm round termination boxes.
- 7.5.18.9 IP65 rated switched socket outlets shall be provided where installed in any positions exposed to the atmosphere or damp surroundings.
- 7.5.18.10 Plinths in a pump pit shall each be provided with an IP65, 250VAC, 16A, single phase socket outlet.
- 7.5.18.11 As a minimum, the following general purpose socket outlets shall be supplied and installed for personnel workstations and shall be positioned to cover a radius of 6 meters:

7.5.18.11.1 Data outlet

7.5.18.11.2 Normal power outlet (white in colour)

7.5.18.11.3 Essential power outlet (red in colour)

7.5.18.11.4 UPS power outlet (black in colour)

7.5.19 Stove supplies

7.5.19.1 Unless otherwise specified, electric stoves (cooking appliances) will be supplied and placed into position by others.

7.5.19.2 The contractor shall install all conduit, wires and stove outlets.

7.5.19.3 Stove outlets shall consist of a flush mounted 100mmX100mm, galvanized, wall outlet box, mounted 450mm above finished floor level, on the wall directly behind the stove.

7.5.19.4 Final connections between the outlet box and the stove shall be made by means of wiring, enclosed in flexible metal conduit with sufficient slack, to allow the stove to be moved 800mm away from the wall.

7.5.19.5 Angle connectors shall be used to couple the flexible metal conduit to the cover plate of the outlet box and to the stove, where necessary, to avoid horizontal entry of the flexible conduit.

7.5.19.6 Stove outlets shall be wired with suitably rated phase wire/s and copper earth wire.

7.5.19.7 Unless otherwise specified, a local isolator must be provided for each stove connection. This isolator shall be rated at a minimum 60A, or larger, as dictated by the stove rating.

7.5.19.8 The isolator shall be flush-mounted in a box, at a height of 1500mm above the finished floor level, in a suitable position.

7.5.19.9 Due regard shall be taken to ensure that the isolator is positioned on either the tiled or plastered wall surface and shall not be obstructed by the stove, or subjected to excessive heat or moisture.

7.5.19.10 All stoves shall be fed from a 30mA earth leakage protected supply.

7.5.20 Hot water cylinders and heat pumps

7.5.20.1 Hot water cylinders and heat pumps will be supplied and installed by others, unless specified to the contrary.

7.5.20.2 The conduit to the hot water cylinder/heat pump outlet shall terminate in an appropriately sized isolator box, located adjacent to the hot water cylinder/heat pump.

7.5.20.3 The final connection between the isolator box and the water heater/heat pump shall be carried out by means of flexible metal conduit.

7.5.20.4 For indoor installations, a local 30A, double pole, metal-clad surface-mounted isolator shall be provided adjacent to the hot water cylinder/heat pump.

7.5.20.5 For outdoor installations, a local IP65 rated, surface-mounted isolator shall be provided adjacent to the hot water cylinder/heat pump.

7.5.20.6 All hot water cylinders/heat pumps shall be fed from a 30mA earth leakage protected supply.

7.5.21 Heating, Ventilation and Air-conditioning units

7.5.21.1 Air-conditioning units

- 7.5.21.1.1 Unless otherwise specified, air-conditioning units shall be supplied by others.
- 7.5.21.1.2 Conduit or cables to air-conditioning **condenser** units shall be terminated in appropriately sized isolator boxes.
- 7.5.21.1.3 Each air-conditioning **condenser** unit shall have a suitably rated, lockable, IP65 isolator, installed adjacent to the **condenser** unit.
- 7.5.21.1.4 Conduit or cables to the air-conditioning **evaporator** unit shall be terminated in a dedicated 16A, 250VAC socket outlet installed adjacent to the **evaporator** unit.
- 7.5.21.1.5 This socket outlet must be fed from a 30mA earth leakage protected supply.
- 7.5.21.2 Extraction fans
- 7.5.21.2.1 Unless otherwise specified, extraction fans shall be supplied by others.
- 7.5.21.2.2 Unless otherwise specified, conduit or cables to the extraction fans shall be terminated in a dedicated 16A, 250VAC socket outlet installed adjacent to the unit.
- 7.5.21.2.3 This socket outlet shall be fed from a 30mA earth leakage protected supply.
- 7.5.21.3 Space heaters
- 7.5.21.3.1 Unless otherwise specified, space heaters shall be supplied by others.
- 7.5.21.3.2 Space heater shall be of the surface mounted type, mounted on spacers or brackets provided with the heaters.
- 7.5.21.3.3 Each space heater shall have a suitably rated, double pole isolator installed adjacent to the heater.
- 7.5.21.3.4 The connection from the wall isolator box to the heater terminal block shall be carried out with 3 core silicone flex, taken through a bushed hole in the isolator cover plate complete with cord grip attachment.
- 7.5.21.3.5 Each space heater shall be fed from a 30mA earth leakage protected supply.
- 7.5.22 Telephone and data service provisions (access control, CCTV, alarms, fire systems, etc)
- 7.5.22.1 Where provisions for telephone and other services are specified, the contractor shall supply and install the necessary conduit, channels, cable trays, boards, draw boxes, outlet boxes, etc.
- 7.5.22.2 Conduits for data services shall be metal, 25mm, unless otherwise specified, and provided with galvanised draw wires. Conduits and outlets for all other services shall be sized as detailed and also fitted with galvanised draw wires.
- 7.5.22.3 Outlets for data services shall be galvanised pressed steel boxes with cover plates, to match equipment to be installed.
- 7.5.22.4 The contractor shall co-operate with the installer of the data equipment and other services and shall provide whatever information is required relating to the provisions made for these services.
- 7.5.22.5 Unless otherwise specified, all data equipment shall be supplied and installed by others.

7.6 LABELLING

- 7.6.1.1 In addition to the labelling requirements of SANS 10142-1, all socket outlets, light switches, isolators and light fittings shall be clearly labelled. The labels shall indicate from which distribution board and the relevant circuit breaker the circuit is fed. eg. DB01CB4.
- 7.6.1.2 The final label designs shall be submitted to the engineer, for approval, prior to any procurement.
- 7.6.1.3 All labels shall be of the engraved type.
- 7.6.1.4 The securing method of all labels shall be presented to the engineer, for approval, before installation.
- 7.6.1.5 In addition to the above requirements, all distribution boards shall have labels displaying the following information, on the outside of the distribution board, as a minimum:
 - 7.6.1.5.1 Designation (WKS)
 - 7.6.1.5.2 Fed from
- 7.6.1.6 All distribution boards shall have a label displaying the following information, on the inside of the distribution board, as a minimum:
 - 7.6.1.6.1 Incoming cable size
 - 7.6.1.6.2 Upstream protection device rating
 - 7.6.1.6.3 Busbar capacity (for boards rated at 100A and above)
 - 7.6.1.6.4 Phase rotation
 - 7.6.1.6.5 Prospective short circuit current rating
 - 7.6.1.6.6 Date of manufacture
 - 7.6.1.6.7 Rand Water contract number
- 7.6.1.7 Each sub distribution board shall be labelled in the same manner.
- 7.6.1.8 Clear perspex covered, framed legends shall be fixed to the inside of the distribution board doors:
 - 7.6.1.8.1 These legends shall be typed, laminated and shall be legible.
 - 7.6.1.8.2 The legends will correlate the circuit breaker labels to the actual loads that are being supplied from each circuit breaker. The actual location of these loads shall also be indicated.
- 7.6.1.9 Circuit breaker labels shall correspond with the circuit numbering on the drawings.
- 7.6.1.10 In the case of cascaded systems warning labels to this effect shall be attached to all fascia plates.
- 7.6.1.11 All labels shall comply with the relevant Rand Water WKS labelling specification.

7.7 DRAWINGS AND DOCUMENTATION

7.7.1 All drawings shall be completed according to Rand Water's drawing standard.

7.7.2 Prior to the commencement of manufacture and installation, all drawings for construction shall be of Rev.0 and shall have been signed and accepted by Rand Water and approved by the contractor.

7.7.3 Schedules indicating the circuit breakers' manufacturer, ratings and trip settings shall be submitted prior to manufacture of the distribution board.

7.7.4 The contractor shall submit the following for acceptance:

7.7.4.1 General Arrangements (GAs)

7.7.4.1.1 Fully dimensioned drawings of the proposed layout and construction of all distribution boards, specified or offered.

7.7.4.1.2 Building layouts indicating the positioning of all small power and lighting equipment as well as connection points.

7.7.4.1.3 Duplicate copies of GAs shall also be submitted to Rand Water for information and comments, if any.

7.7.4.1.4 The onus shall remain on the contractor to check for:

7.7.4.1.5 compliance with specifications

7.7.4.1.6 correct sizes

7.7.4.1.7 location

7.7.4.1.8 accessibility

7.7.4.1.9 Busbar details, including sizes and layout arrangements, shall be shown.

7.7.4.2 Single Line Diagrams (SLDs)

7.7.4.2.1 Typical SLDs will normally be issued by Rand Water together with contract documents. (In the event of non-existence of SLDs, the contractor shall supply a SLD for approval by the Engineer prior to the commencement of works).

7.7.4.2.2 A SLD indicating; sizes of conductors and protective equipment, as well as the designation of circuits as installed and connected, such as light fittings, socket outlets etc, must be supplied.

7.7.4.3 Lighting Simulation Reports

7.7.4.3.1 A comprehensive lighting simulation report must be submitted to Rand Water for acceptance, before the procurement of any equipment.

7.7.4.4 "As Built" drawings

7.7.4.4.1 On completion of the contract, the contractor shall supply all "As Built" drawings, of Rev.2, accurately indicating the completed installation and these shall have been signed and accepted by Rand Water and approved by the contractor.

7.7.4.4.2 On completion of the lighting installation, the contractor shall provide an "Actual lux level" test report

7.8 QUALITY ASSURANCE REQUIREMENTS

7.8.1 Quality assurance plan and procedures (QAP)

- 7.8.1.1 All inspection and testing procedures shall be developed and controlled under the guidelines of the Supplier's quality system. This system must be registered to ISO 9002 and regularly reviewed and audited by a third party registrar.
- 7.8.1.2 All incoming material shall be inspected and/or tested for conformance to quality assurance specifications.
- 7.8.1.3 All equipment shall be inspected and/or tested for conformance to Supplier's engineering and quality assurance specifications.
- 7.8.1.4 The manufacturer shall submit to Rand Water a short form copy of its Quality Assurance Procedures manual for appraisal by the Engineer at time of tendering.
- 7.8.1.5 After award of the tender, the manufacturer shall submit a full Quality Assurance Plan for approval by the Engineer. Rand Water shall be given the opportunity to indicate hold and witness points on the plan.
- 7.8.1.6 Such QAP in association with a manufacturing programme shall be submitted to Rand Water within the time periods specified in tender documents after award of the contract, at which time the Engineer shall indicate witness and inspection points required.

7.8.2 Inspection during manufacture

- 7.8.2.1 The Engineer or his appointed representative shall be permitted to carry out, during normal working hours, periodic inspections of the distribution boards and equipment covered by this specification over and above the witness and hold points indicated on the QAP. Inspections shall include but shall not be limited to:
- 7.8.2.2 Checks to determine that the distribution board steelwork and painting fully and strictly comply with this specification.
- 7.8.2.3 Checks to determine that the distribution board and components fully and strictly comply with this specification.

7.8.3 Factory acceptance testing

- 7.8.3.1 The Engineer or his appointed representative shall be invited to witness final Factory Tests of the distribution board and equipment before delivery will be permitted. Tests shall include but shall not be limited to:
 - 7.8.3.1.1 Checks to determine that the distribution board and components fully and strictly comply with this specification, and all relevant design drawings.
- 7.8.3.2 The manufacturer shall provide all power supplies, testing equipment, means of simulating related remote devices and competent personnel to conduct the tests.
- 7.8.3.3 The manufacturer shall give at least ten (10) working days' notice of readiness for final inspection and factory tests.
- 7.8.3.4 A list of defects and deviations will be provided by the Engineer, or his appointed representative, during the inspections. The issue of such list does not relieve the manufacturer of his responsibility to ensure full compliance with this specification.
- 7.8.3.5 Items considered as deviations, by the contractor, from this specification shall be dealt with as per the contractual requirements.

- 7.8.3.6 All test results shall be recorded on the manufacturer's standard test certificates, three copies of which, duly approved, shall be supplied to Rand Water as per the contractual requirements.
- 7.8.3.7 Equipment may not be delivered to site until the manufacturer has cleared all defects listed by the Engineer and the Engineer has re-inspected the distribution board to confirm rectification of work on the defect list.
- 7.8.4 Preparation for delivery
- 7.8.4.1 The distribution board to be transported to site shall be wrapped in suitable materials to prevent damage during shipment, both from mechanical and environmental damage.
- 7.8.4.2 The contractor shall ensure that the site is ready for offloading and installation prior to delivery.
- 7.8.5 Offloading
- 7.8.5.1 Only suitably qualified personnel and certified equipment shall be utilized for lifting the distribution board onto and off the transport vehicle and positioning it in the final installation location. The contractor shall ascertain the exact position of the distribution board before delivery.
- 7.8.6 Installation on site
- 7.8.6.1 Site installation shall include for all suitable skilled labour, lifting apparatus and materials necessary for the complete installation and readying for service of the distribution board. It shall include all bolts and nuts and connection of busbars and reconnection of any wiring disturbed for shipment. It shall also include the checking and re-torquing, where applicable, of all connections.
- 7.8.6.2 The re-torquing of all busbars shall be witnessed by a RW representative.
- 7.8.7 Site acceptance testing
- 7.8.7.1 On completion of contract, the necessary certificate(s) of compliance shall be issued. These tests are to be witnessed by the Engineer, or an RW appointed electrical representative, and the said certificate shall be required before the final acceptance certificate is passed and final payment is made.
- 7.8.7.1.1 On completion of the lighting installation, the contractor shall provide an "Actual lux level" test report. The contractor shall ensure that an electrical representative, from Rand Water, is present during all final lux level verification. The verification shall take place at night when it is sufficiently dark.
- 7.8.7.2 The contractor shall timeously make all the necessary arrangements for the testing and inspection of the works. Appointment dates for inspections and witnessing of tests shall be made at least 10 (ten) working days prior to the execution thereof.
- 7.8.7.3 The contractor shall provide all tools, power supplies, testing equipment, access ladders and competent personnel to conduct the tests.
- 7.8.7.4 Certificate of Compliance tests not witnessed by the Engineer will not be accepted.

7.9 SERVICE TOOLS

7.9.1 Two sets (per distribution board) of any special tools or devices required for the operation and maintenance of the distribution board, shall be provided.

7.10 SPARES

7.10.1 The following spares, as a minimum, shall be supplied with each completed distribution board:

Equipment	Quantity
Spares as listed in the applicable drawings	As listed in the applicable drawings

8 REFERENCES

Record Document	Form/Doc Number	Location
SANS standards	As per Item 4: References	Rand Water Library

9 DOCUMENT CHANGE HISTORY

The following table contains the history of this document with a description of each revision.

Date	Previous Revision Number	New Revision Number	Description of Each Revision
August 2021	None	01	Converted RW-00320-AS-500: GENERAL ELECTRICAL SPECIFICATION FOR BUILDING LIGHTING AND SMALL POWER INSTALLATIONS, to new standard ISO template.