

**TENDER RW10399240 /22**

**DESIGN, MANUFACTURE, SUPPLY, DELIVERY, INSTALLATION, COMMISSIONING AND PUTTING INTO SERVICE OF ELECTRICAL EQUIPMENT ASSOCIATED WITH THE REFURBISHMENT OF THE ZKZ C13,15 HAMMER TANKS AND PIPELINE**

**ELECTRICAL SYSTEM SPECIFICATION**

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# ELECTRICAL SCOPE

The Contractor shall provide all labour, supervision, installed and consumable materials, equipment, tools, services and every permanent or temporary item necessary for the design, manufacture, supply, delivery, unloading, installation, commissioning and putting into service of the specified deliverables on C13,15 pipeline and Hammer tank.

The Project should comply and be delivered as per all applicable Rand Water and SANS standard specifications and the Contractor shall be responsible for the following in terms of the system specification as a minimum:

1. The detailed design of all electrical equipment as per the scope, drawings, specifications, Rand Water, national and international standards indicated here and the specific design requirements.
2. The provision of power supplies from the existing site electrical reticulation in proximity to the new installations at Zwartkopjes Pumping Station and upgraded supply from the local supply authority at Meyer’s Hill Reservoir. Included is the detection and protection of all services along planned cable routes.
3. Boundary Valve Chamber Distribution Boards and Distribution Boards to instrumentation supplies. Valve actuators and Zonal Flow Meters are specified elsewhere in the contract documents.
4. Excavation of cable routes, preparation of bed, danger tape and backfilling after installation, all to Rand Water standards.
5. Complete LV power, control and earthing cables and all the relevant gland/ termination kits to supply all applicable electrical equipment on both RW sites.
6. Ensure that all necessary safety precautions are taken into consideration as power outage might be of a concern.
7. Cable support systems in chambers and other locations as required.
8. Earthing and lightning protection of all electrical equipment and earth electrode systems for the electrical infrastructure.
9. Valve Isolating Panels for all valve actuator supplies.
10. Sump Pump Control Panels for Valve Chambers and Zonal Meters where specified.
11. Small Power and Lighting systems for all valve chambers as specified.
12. Investigate point of supply for C13&C15 Hammer Tanks at Zwartkopjes Pumping Station and provide drawings as per Rand Water Specification.
13. Re-configure the existing supply to supply the new Automation panel at C13 and C15 Hammer tanks at Zwartkopjes Pumping Station.
14. Refurbish and upgrade the Small power and Lighting for each hammer tanks.
15. Complete all WKS code numbering of wires and cables.
16. Testing and commissioning of the entire installation forming part of this installation.
17. Ensure that the area is made good after installation and commissioning.
18. All necessary project documentation such as signed As-Built drawings in the latest AutoCAD format test certificates e.g. Certificate of Compliance in terms of SANS 10142-1, operating and maintenance manuals.

# DESIGN REQUIREMENTS

* 1. The Contractor shall execute the electrical design requirements as follows:
     1. Present detailed Design drawings and calculations for Rand Water to verify against the system specifications and standards. The contractors’ designer shall present all these drawings on the latest Rand Water drawing templates and shall select vendors and manufacturers where required to update and finalize detail designs for construction for equipment to incorporate vendor specific details into these documents e g distribution boards, PV panels, Inverters, etc. selected for the installation. Vendor selected equipment and the entire proposed installation shall comply with Rand Water design criteria, Rand Water specifications, legal requirements and national and international specifications (SANS/IEC/IEEE).
     2. The Contractor shall allow for consultation with responsible Rand Water Design Office personnel and where required all engineering personnel from other applicable disciplines e g. Civil, Structural, Architectural, Mechanical, IT and Risk in the preparation of these drawings and schedules.
     3. The Contractor shall allow for a minimum of two draft submissions of drawings and schedules for each equipment set, to be presented to Rand Water before the final drawings and schedules are submitted for verification by the Rand Water Design Office Manager for manufacture by appointed vendors of the equipment.
     4. Prepare a detailed drawing and schedule register for the complete Works indicating the drawing No, drawing title description and revision No starting with Revision A
     5. Design drawings shall be in the Rand Water approved drawing templates for the drawing size. Design drawings shall incorporate the following on the template of the drawing as a minimum:
        1. Rand Water Drawing No which shall be different to the tender drawing No. New drawing Nos to be obtained from the Rand Water drawing office or Technical Information Centre.
        2. Station Name and Plant: Example- Rand Water Zwartkopjes Pumping Station and Meyer’s Hill Reservoir.
        3. Rand Water Contract No.
        4. Project SAP No and Network No
        5. Contractors Logo
        6. Contractors Name and Address, Company Registration No
        7. Contractors Contract No.
        8. Contractors Drawing No.
        9. Name and ECSA Registration No of the Company’s design engineer who will approve the drawings. The full name and ECSA No of the engineer shall be clearly legible on each drawing.
     6. Submit design documents or updated as built drawings in pdf and Auto Cad drawing format to Rand Water for verification together with the drawing and schedule register, and a transmittal note for signature by the Rand Water project manager, clearly indicating the documents submitted. The Rand Water Lead Design Engineer shall also receive the electronic versions of the above documents at the same time as submission to the Project Manager. Any submissions without an official transmittal note and an update drawing and schedule register and the correct updated Revision number will not be accepted.
     7. Receive comments or acceptance of design documents from Rand Water.
     8. Update design documents as required by Rand Water.
     9. Drawings or schedules verified by Rand Water will be returned to the Rand Water Project Manager together with the Rand Water Design Review Comments Document.
     10. Re submit documents updated complete with new Revision No e g B as required. Documents that are not rigorously checked by the contractor prior to submission and that contains repeated errors will be referred back in totality to the Contractor for proper checking. This will not be accepted as a delay in the project as far as design approval is concerned or for extensions of time.
     11. Rand Water reserves the right to implement penalties or other punitive financial measures against the Contractor if more than two submissions are submitted that are not finalized and design errors are carried over from one submission to the next.
     12. Accepted drawings and schedules will be taken to Revision 0 status, printed in hard copy, stamped “For Construction”, signed by the Contractors ECSA registered design engineer and signed as accepted by the Rand Water Lead Engineer.
     13. Revisions during construction will be taken to the next revision e g Revision 0A together with revision comments and follow the same process as in Clause above.

The Contractor shall provide the following design deliverables:

|  |  |
| --- | --- |
|  |  |
|  | ***Low Voltage Distribution Boards*** |
|  | LV Load Flow analysis (Current flows) |
|  | LV Short Circuit Analysis (Fault levels: Three phase symmetrical, Single phase to earth) |
|  | Final LV Distribution Board design basis, requirements and equipment specification as per SANS IEC 60439 and 60947 |
|  | Final LV Distribution Board General Arrangement |
|  | Final LV Distribution Board Single Line Diagram |
|  | Final LV Distribution Board Schematic and Wiring Diagrams of each circuit |
|  | Final LV Distribution Board Chassis Plate Equipment Layout |
|  | Final LV Distribution Board Door Equipment Layout |
|  | Final LV Distribution Board Labelling |
|  |  |
|  | ***Earthing and Lightning Protection*** |
|  | Plant earthing and lightning protection philosophy and tie-in with existing system where applicable |
|  | Soil resistivity surveys |
|  | Design using proprietary software in accordance with SANS, IEC and IEEE criteria |
|  | Development of earth mat designs including electrodes, conductors etc in accordance with the software output above and detail documentation of the designs |
|  | Compliance with step and touch potentials limitations in terms of SANS, IEC and IEEE standards where there is human presence |
|  | Detail drawings of earth mat design connection points of components of the system and test points |
|  | Lightning protection requirements, risk assessments and design in accordance with SANS and IEC standards |
|  |  |
|  | ***Small Power and Lighting System*** |
|  |  |
|  | Lighting design and selection of fittings to achieve design criteria, meet Rand Water standards and legal requirements |
|  | Circuit Conductor Design and Specification |
|  | Lighting Layout Drawings (Plan and Elevation, Interior and Exterior) |
|  | Lighting Conduiting Layout (Plan and Elevation), Cable Access Requirements, Maintenance requirements |
|  |  |
|  |  |
|  | ***Cable reticulation and plant cabling*** |
|  |  |
|  | LV supply points from within the existing reticulation in the plant, including available capacity |
|  | Assessment of reliability of existing supplies and operational requirements e g effect of new plant when supply is shut down for maintenance |
|  | Cable installation philosophy (ducts, trenches, sleeves, protection from other services, cable transit system, road crossings) |
|  | Detailed cable route design |
|  | Interface to other services (buildings, pipes, roads, valve chambers, sewerage lines, telecommunications and data) |
|  | Requirements for ancillary equipment where required (Pushbutton stations, junction boxes, isolator panels) |
|  | Cable Design Schedules for low voltage power cables (Voltage, Size, De-Rating, Volt Drop, Fault Withstand etc) where required |
|  | Detailed Cable Schedules showing the connection of all cores |
|  | Cable Route Drawings with detailed dimensions where required and update of proposed cable route drawings. |
|  | Determination of core drilling positions sizing of core drill holes to accommodate expected cables entering buildings. Included is detection of reinforcing and planning entry to minimize destruction of reinforcement. |
|  | Cable Trench/Duct Cross- Sectional Layout Drawings with detailed dimensions and installation specifications |
|  | Cable road crossing design |
|  | Cable support system design calculations (mechanical loading) |
|  | Cable Design Schedules for Power Cables (Voltage, Size, De-Rating, Volt Drop, Fault Withstand etc) |
|  | Cable Schedules (Detailed Design with full cable termination details of each core of the cable) |
|  | Cable Trench/Duct Cross- Sectional Layout Drawings |
|  |  |
|  | ***Electrical interface with Civil, Architectural, Mechanical, Pipelines and Automation Requirements*** |
|  |  |
|  | Cable access to the storage facility (Cable slots, sleeves, cable transit systems, water ingress control) |
|  | Earthing system (connection to roofs, tie-in to rebar system, sleeves for earthing/down conductors) |

# CONSTRUCTION SUPERVISION

* 1. After verifications of all designs by Rand Water the Contractors’ design engineer shall be responsible for supervision of the entire electrical installation during construction as follows:
     1. The Contractors’ design engineer shall fulfil the duties of the electrical design engineer under Section 6 of the Construction Regulations and shall conduct design compliance inspections at all relevant milestone points in the project. At the completion of the project the design engineer shall declare the installation safe and fully complying with the final specification and issue a completion certificate.
     2. Obtaining a proposed quality control plan from every manufacturer of equipment and in consultation with the Rand Water Lead Engineer enter witness and hold points for each construction milestone of the manufactured equipment.
     3. Inform the Rand Water Lead Engineer of each construction milestone inspection required as per the quality control plan. Attend each construction milestone inspection and generate documentary evidence of the inspection in the form of a completed and signed attendance of all present at the inspection, sign off of the milestone if accepted or generate a punch list of items to be corrected, with actions required by each party and agreed completion dates, signed by the design engineer and the manufacturers’ representative. Records shall be kept of each such visit for submission in a monthly report to the Rand Water Lead Engineer.
     4. Once the manufactured equipment is ready for a Factory Acceptance Test the Contractors’ design engineer shall carry out the Acceptance Test with the following minimum tests:
        1. Construction quality checks for compliance with the requirements of the specifications.
        2. Point to point wiring checks of all wiring and agreement with the schematic diagrams.
        3. Injection tests on current transformers.
        4. Pressure tests and insulation resistance tests.
        5. Functional tests including closing, tripping and indication from all possible operational modes
     5. Labelling
     6. Protection settings and adjustments.
     7. Functionality of metering.
     8. Management of the QCP documents, including sign off.
     9. Generation of defects lists and management of clearance of defects.
     10. Relevant photographic evidence.
     11. A signed attendance register for each day of the Test shall be kept.
     12. A master set of approved construction documents shall be kept by the Contractors’ design engineer and the manufacturer on which tested and completed circuits shall be marked up. Any modifications that may be required shall also be recorded on the documents, together with the date(s).
     13. Once construction impacting any electrical part of the installation commences on site as follows:
         1. Attend site once a week or when a significant construction milestone such as lift in concrete pouring, finalization of concrete ducts, casting in of cable transit system boxes etc. is reached. A record of progress or events witnessed shall be kept in a site diary, together with dated photographic evidence. Where site instructions are issued these shall be communicated to the Rand Water Project Manager and Lead Engineer. Compliance to the Contractors’ approved design shall be checked and any deviations recorded as a site instruction. Every calendar month the Contractors’ design engineer shall submit a concise report containing all items above to the Lead Engineer and Rand Water Project Manager.
         2. Attend all scheduled project and technical meetings on site.
         3. Once the electrical installation commences on site the as follows:
         4. Attend site twice or more frequently a week or when a significant construction milestone such as delivery of a distribution board etc. is reached. The Contractors’ design engineer shall check that the installation on site such as cable racking, cable installation, installation of other equipment such as control panels etc. proceeds in accordance with the approved design. A record of progress or events witnessed shall be kept in a site diary, together with dated photographic evidence. Where site instructions are issued these shall be communicated to the Rand Water Project Manager and Lead Engineer. Compliance to the Contractors’ approved design shall be checked and any deviations recorded as a site instruction. Every calendar month until final handover of the completed installation the Contractors’ design engineer shall submit a concise report containing all items above to the Lead Engineer and Rand Water Project Manager.
         5. Once the completed installation or a logical part thereof e g an inverter is completed the Contractors’ design engineer shall carry out the commissioning and Site Acceptance Test on the completed installation with the minimum of the following tests:
         6. Construction quality checks for compliance with the requirements of the specifications.
         7. Checking the cable installation is as per the approved design.
         8. Cable supports are as per specification or best practice.
         9. Point to point wiring checks of all wiring between connected equipment and agreement with the schematic diagrams and cable schedules.
         10. Injection tests on current transformers.
         11. Pressure tests or insulation resistance tests.
         12. Functional tests including closing, tripping and indication from all possible operational modes.
         13. Labelling especially cable numbers
         14. Protection settings and adjustments.
         15. Functionality of metering.
         16. Management of the QCP documents, including sign off.
         17. Generation of defects lists and management of clearance of defects.
         18. Relevant photographic evidence.
         19. A signed attendance register for each day of the Test shall be kept.
         20. A master set of approved construction documents shall be kept by the Contractors’ design engineer and the manufacturer on which tested and completed circuits shall be marked up. Any modifications that may be required shall also be recorded on the documents, together with the date(s). Close out of the implemented modifications shall also be recorded on the documents complete with dates
         21. A commissioning report of the completed installation addressing all the results of testing and checking shall be submitted to the Rand Water Project Manager and Lead Engineer.

# POWER SUPPLY FROM LOCAL AUTHORITY OR EXISTING RETICULATION

* 1. **Meyer’s Hill Reservoir:**
     1. Apply to local power supply authority for a 400V 400A Power Supply to Meyer’s Hill reservoir and connect to the new distribution board to feed the site.
     2. Contractor shall be responsible to liaise with the project manager and subsequently be responsible for the following:

### Identify the electricity supply authority responsible for the supply of electricity at the site in question.

### The Rand Water Project Manager will then provide the Contractor with a proxy appointment letter from the Manager Bulk Water Distribution to engage the supply authority on behalf of Rand Water.

### The Project Manager will also arrange for the provision of the Rand Water related documentation required by the supply authority to apply for an upgraded supply which may be amongst others title deed information, site development plans and servitude information for the site in question.

### Obtain and complete all application documents for an upgraded power supply at the site in question.

### After the application is processed by the supply authority the contractor shall present the deposit invoice generated by the supply authority for payment by Rand Water to the Project Manager. This will enable the investigation to proceed.

### After the Project Manager has processed the payment to the supply authority the contractor shall liaise with the supply authority to determine the best fit engineering solution for an upgraded solution.

### After the engineering solution with the technical and commercial proposal has been agreed the same shall be presented to Rand Water. The installation invoice generated by the supply authority for payment by Rand Water shall be presented to the Project Manager.

### After the installation invoice has been paid the contractor shall liaise with the supply authority concerning the site installation of the upgraded supply.

### If a site already has a single phase connection the supply authority will require to upgrade to three phase the existing supply will have to be decommissioned. This needs to be a phased approach to ensure continuity of power to existing equipment during the changeover.

### The contractor will advise the Project Manager in communications with Rand Water Central Depot to change the information on their system as well for payments and budgets.

* 1. **Zwartkopjes Pumping Station:**
     1. The contractor shall investigate and determine the most suitable and closest supply point source to supply the three Boundary Valve Chamber Distribution Boards at Zwartkopjes pumping station.

NB: Contractor to refer to Pipeline Spec: Table 6 and Table 7a.

The Boundary Valve will be grouped by the most suitable supply point.

* + 1. The most suitable supply point not exceeding 100m in distance away from the Automation distribution board, to reduce volt drops and to prevent the selection of an excessively sized cable. The supply point shall also be selected, based on the reliability of the supply, spare circuits in distribution boards, available capacity at source,access to the supply point refer to Pipeline Spec table 7a for Automation loads.
    2. A suitably rated 3 phase circuit breaker with neutral and with 300mA IDMT earth leakage protection shall be fitted at the supply point to feed the Boundary Valve Distribution Boards as per table 6 in the Pipeline Spec. Labelling shall be provided and drawings be produced.
    3. Investigate point of supply for C13&C15 Hammer Tanks at Zwartkopjes Pumping Station and provide drawings as per Rand Water Specification.
    4. Re-configure the existing supply to supply the new Automation panel at C13 and C15 Hammer tanks at Zwartkopjes Pumping Station.
    5. Refurbish and upgrade the Small power and Lighting for each hammer tanks.

# 400V MAIN DISTRIBUTION BOARDS

Function: To distribute power from 400V main distribution board to numerous loads located at Meyer’s Hill Reservoir.

Specific requirements:

|  |  |  |
| --- | --- | --- |
| **Description** | **Preferred** | **Alternative** |
| Panel supply voltage | 400VAC | N/A |
| Panel current rating | Contractor to supply | |
| Panel IP rating | IP65 | >IP65 |
| Panel material | 3CR12 | N/A |
| Panel painting system details. | Powder coated B26,structured to SANS 1091 | N/A |
| Panel form classification | 2a | >2a |
| Panel short circuit rating (3 sec) kA | 10kA | >10kA |
| Panel location | Outdoors | N/A |
| Panel access | Front | N/A |
| Panel mounting location | Installed on a unistrut support complete with cable racking | Wall mounted complete with cable racking . |
| Cable entry location | Bottom | N/A |
| Certification required | Assembly assessors certification | N/A |
| Power supply fed from | Meyer’s Hill: Local Supply Authority and PV Solar System with batteries | |

* 1. **The main distribution board at Meyer’s Hill Reservoir shall consist of the following as a minimum:**
     1. Protection against theft and vandalism.
     2. A suitably rated, incomer circuit breaker from the upgraded supply from the Local Authority.
     3. Individual suitably rated feeder circuit breakers to sump pumps, actuator, SP&L, Automation panel, etc.
     4. A suitably rated circuit breaker to feed the existing distribution board supplying power to the reservoir.
     5. 3 spare 20A feeder circuit breakers,
     6. 3 phase and neutral Class 1 and 2 combined surge arrestor,
     7. Anti-condensation heater circuit,
     8. A CEE 32 Amp, 4 pin, 400V, welding plug, complete with integral 30mA earth leakage, isolator and male plug top, mounted on the exterior of the distribution board.

# BOUNDARY VALVE CHAMBER DISTRIBUTION BOARDS

## Function: To distribute power to valve chambers in close proximity and/or the controlling of small power loads, valve actuators, sump pumps, zonal flow meters etc.

## Applicable typical RW drawings:

|  |  |
| --- | --- |
| RB 20093 | Typical Boundary Valve Chamber Distribution Board Single Line Diagram |
| RB 28837 | Rain Cover |
|  | Meyers Hill Reservoir Schematic |
| R016737 | Zwartkopjes Pump Station Schematic |

| Description | Preferred |
| --- | --- |
| Panel supply voltage | 400VAC |
| Panel control voltage | As per drawing |
| Panel current rating | TBA A |
| Panel IP rating | IP65 |
| Panel material | 3CR12 |
| Panel painting system details. | Powder coated B26,structured to SANS 1091 |
| Panel form classification | 1 |
| Panel short circuit rating (3 sec) kA | 10 kA |
| Panel location | Inside the valve chamber or installed on a plinth or unistrut support structure complete with cable racking |
| Panel access | Front |
| Panel mounting location | Wall mounted, on a 300mm plinth or on a support structure complete with cable racking.  It shall be provided with a suitable steel canopy over it for operating during rainy conditions |
| Cable entry location | Bottom |
| Applicable Rand Water Standard Specification | SAM EAM 00001 Spec Rev 1 |
| Certification required | Assembly assessors certification |
| Power supply fed from | Boundary Valve Distribution Boards or  400 V Switchboard |

## Where applicable the distribution boards shall comply with Rand Water Standard Specification for Factory Built Assemblies of Low Voltage Switchgear and Control gear- SAM EAM 00001 Spec Rev 1.

## The boundary valve chamber distribution boards shall be equipped with at least the following circuits as follows:

## A suitably rated, separate incoming circuit breaker

## Individual suitably rated feeder circuit breaker to feed a valve actuator or zonal meter.

## A suitably rated circuit breaker to feed a sump pump complete with 30mA IDMT earth leakage protection

## Lighting circuit for lighting in the valve chamber

## Switched socket outlet circuit complete with 30mA earth leakage protection

## phase surge arrestor connected with suitably rated conductors and fuse protection

## Anti-condensation heater circuit

## The circuit breakers for the incomer, actuator, zonal meter and sump pump shall each have a potential free auxiliary contact wired to the PLC panel for “ON” status indication purposes. These auxiliary contacts shall switch 24VDC which shall be obtained from the PLC panel.

## Installation Requirements:

## Each boundary valve distribution board shall be fixed onto, but external to its valve chamber, on a galvanized Unistrut P1000 mounting frame that will present the panel at a height of 1 500 mm above finished ground for operation.

## The IP66 panel installation shall be complete with a rain shield top cover and painted to Rand Water specification suitable for exterior application subject to UV, temperature and humidity variations to cover an area 1 500 mm in front of the distribution board and 1 000 mm on either side. The structure of the shelter shall be manufactured from 3CR12 steel.

## Cable racking shall be supplied and installed for incoming cables and to the actuator and sump pump from ground level to the gland plate of the boundary valve distribution board.

## Where required for security and high risk of vandalism the distribution board shall be located inside the valve chamber.

# SUMP PUMP CONTROL PANEL

Function: To supply power to sump pumps and to ensure continuous water level control of sumps.

* 1. Contractor to refer to Pipeline Spec: Table 2a, Table 2b, Table 6 and Table 7a.
  2. Specific Requirements

| **Description** | **Preferred** |
| --- | --- |
| Panel supply voltage | 400VAC, 3Phase and neutral |
| Panel control voltage | 24VDC derived from 231 V AC main supply upstream of the main panel isolator |
| Control circuit supply | Dedicated Dual redundant 5 A 24 V DC rated power supply in panel |
| Panel current rating | TBA A |
| Panel IP rating | IP65 with double door arrangement |
| Panel material | 3CR12 |
| Panel painting system details. | Powder coated B26,structured to SANS 1091 |
| Panel form classification | 1 |
| Panel short circuit rating (3 sec) kA | TBA kA |
| Panel location | Outdoors |
| Main Circuit Isolator | Yes, Door handle operated, pad lockable |
| Local Remote Selector Switch | Yes |
| Pump Running Indication | Yes |
| Pump Tripped Indication | Yes |
| Thermal Overload Relay | Yes |
| Local Start/Stop Facility | Yes |
| Pump Motor Isolating Panel | Yes |
| Terminals | Yes |
| Panel access | Front |
| Panel mounting location | Installed on a unistrut support complete with cable racking and as part of the rain canopy at valve chamber. See installation of distribution boards |
| Cable entry location | Bottom |
| Certification required | Assembly assessors certification |

## The panel shall be equipped, as a minimum, with suitably rated circuit breakers, isolator, trunking, terminals, padlockable door interlock handle, selector switch, square key door catches, LEDs and labels.

## The panels shall be installed at an appropriate level above the sump to ensure that it is possible to operate the sump pump with the sump flooded, without the need to enter into the water.

## The panel doors shall be constructed with hinges and square key catches one of which shall be pad lockable.

## Three float level switches shall be provided with suitably rated changeover contacts installed at a low level to stop the pump, high level to start the pump and high-high level for a remote alarm.

# VALVE OR MOTOR ISOLATING PANEL FOR EACH CHAMBER

* 1. Function: Isolation of power to motor or valve actuator
  2. Contractor to refer to Pipeline Spec: Table 2a, Table 2b, Table 6 and Table 7a.

| Description | Preferred |
| --- | --- |
| Panel supply voltage | 400VAC 3Phase and neutral |
| Panel control voltage | As per drawing |
| Panel current rating | TBA A |
| Panel IP rating | IP65 |
| Panel material | 3CR12 |
| Panel painting system details. | Powder coated B26 to SANS 1091 |
| Panel form classification | 1 |
| Panel short circuit rating (3 sec) kA | TBA kA |
| Panel location | Pedestal or wall mounted at valve or motor with cable racking |
| Panel access | Front |
| Cable entry location | Bottom |
| Power supply fed from | Distribution Board |

## Every motorised device (less than 35kW) or motorised valve shall have an isolating panel which allows for the local isolation of the motor or valve actuator.

## The panels shall be equipped, as a minimum, with a suitably rated isolator, trunking, terminals, terminal numbers, wire numbers, pad lockable door interlock isolator handle, square key door catches, labels and support brackets.

## If a 4-20mA signal is utilized to control the valve actuator then, in addition to the above, each VIP (Valve Isolating Panel) shall include additional terminals and two suitably rated surge arrestors.

## The main isolator shall have a potential free auxiliary contact wired to terminals for indication or interlocking purposes.

# CABLE INSTALLATION

Function: To provide for supply cables for the lighting installations on the facility and cable support and cable protection.

Applicable typical RW drawings:

|  |  |
| --- | --- |
| RB 6443 | Typical Cable Trench Cross Sectional Layout |
| B6477 | Re-instatement details for black top road |
| RB\_20146 | Typical Cable Schedule, Electrical Cable Numbers and Details |

* 1. The contractor shall be responsible for providing all cable trenches as required.
  2. Cable service detection shall be completed along the accepted cable routes
  3. All cable trenches shall be prepared and cables installed as per the typical cross-section RB 6443 above. This shall include the specified selected backfill, cable danger tape and concrete cable markers to indicate the cable routes.
  4. Where existing tar or paved roads are to be crossed cable sleeves shall be installed as per the typical cross-section above and the road then re-instated as per drawing B6477.
  5. The cable installation will be as per the designed cable routes and termination points.
  6. The work shall include terminations, joints, glands etc. The Contractor shall issue test certificates for all tests performed.
  7. The following shall apply to all LV power cables:
     1. Insulation Resistance test (Megger at 1000V) for the complete cable installation;
     2. Complete WKS code numbering of wires and the cable route must be indicated on a drawing complete with WGS 29 Deg coordinates;

**It is the contractor’s responsibility to produce the entire` plant design and thereafter to complete a cable schedule based on this overall design. The cable schedule shall incorporate the required cable interfaces between all electrical items within the plants.**

# CABLE TRENCHING

Typical Drawing Specification:

|  |  |
| --- | --- |
| RB 6443 | Typical Cable Trench Cross Sectional Layout |
| B6477 | Re-instatement details for black top road |

### The contractor shall be responsible for providing all cable trenches for low voltage supply cables to the electrical and automation panel installations:

* 1. The contractor shall plan his final cable routes and shall carry out service detection along the proposed route to check his route selection.
  2. Other services interfacing with the cables shall be properly protected.
  3. All cable trenches shall be prepared and cables installed as follows:
  4. Trenches shall be excavated to a depth of 800mm below Normal Ground Level for low voltage cables.
  5. Backfill with sifted material with maximum stone size 5 mm and compact a 150 mm layer to 93% MODAASHTO. River sand is not allowed.
  6. After installation and testing of control, low voltage power and fibre optic cables backfill shall be carried out in one compacted layer of 150 mm with sifted material with maximum stone size 5 mm to 90% MODAASHTO.
  7. After installation of danger tape (one tape per 500 mm width of trench) backfill shall be carried out in two compacted layers of 150 mm with sifted material with maximum stone size 5 mm to 90% MODAASHTO, to final natural ground level.
  8. The contractor shall prepare a quality control plan with witness and hold points at the following stages:
  9. Excavation of cable trenches and preparation of surface bed.
  10. Laying of layer and low voltage power cables and earth conductors and testing of cables and conductors.
  11. Backfilling of layer above layer and low voltage cables and compaction.
  12. Laying of LV power, control and fibre cables at second layer and testing of the cables.
  13. Backfilling of layer above layer of control cables and compaction.
  14. Backfilling to danger tape layer.
  15. Installation of danger tape(s).
  16. Final backfilling layer.

# CABLE SLEEVES

Function: Utilized for cable installation and cable protection.

* 1. Specific requirements:
     1. The contractor shall be responsible for providing heavy duty PVC sleeves as required. These sleeves shall be utilized for installing cables to remote distribution boards. All cables shall be installed underground. The size of sleeve shall be selected to ensure that it is not more than 70% occupied, after all cables have been installed.

# CABLE SEALING SYSTEM

* 1. Function: To prevent the ingress of water and other liquids and gases into buildings or structures the final installation will be by means of an approved water proof cable sealing system.
  2. The contractor shall plan the cable entry into valve chambers by selecting the points where cable entry holes will be core drilled with due consideration for minimizing the cutting of reinforcing bars. To this end the contractor shall employ reinforcing bar detection techniques to locate reinforcing bars.
  3. The cable sealing system shall consist of the following as a minimum:

1. A galvanised, mild steel or stainless steel frame that can be casted into the concrete wall or alternatively have a flange type configuration to fit on the wall or a PVC type sleeve purpose made for core drill applications.
2. The sealing system shall be modular unit with spare capacity and it shall be possible to add cables or pipe work in future without affecting the installed services.
3. The Sealing System shall be fire resistant, smoke and gas tight, and the water pressure will not move it or compromise its seal or security.
4. An explosion or temperature changes shall not compromise the integrity of the seal.
5. The actual sealing modules shall consist of multi diameter layers to allow for various cable/pipe sizes.

# CABLE RACKING SYSTEM

Function: Utilized for cable support, installation and protection.

* 1. The contractor shall be responsible for the design, supply, delivery and installation of a cable racking system where cable support is required e g against concrete structures.
  2. The system shall allow for any unistrut supports, straight lengths, bends, elbows, tees, reducers, fixing brackets, fixing materials and touch up cold galvanizing painting.

# SMALL POWER AND LIGHTING INSTALLATION

Function: provide for a complete small power and lighting installation as per SANS 10142-1, SANS 10114-1: SANS 10389-1:The Occupational Safety and Health Act and Rand Water specification SAM EAM 00003 for small power and lighting installations with reference to schematics and drawings associated with the flow meter chambers.

* 1. The contractor shall ensure that provision is made for conduits in all flow meter chambers.
  2. The lighting installations shall be designed in accordance with the standards in all flow meter chambers.
  3. The lighting lux levels shall be as per SANS 10114-1 &2
  4. A maintenance factor of 0,65 shall be applied when designing the installation.
  5. Light fittings shall be of the energy efficient, long life LED type. The fitting application shall be of the bulkhead or low bay type, with the following requirements:
     1. SABS approved.
     2. Corrosion resistant fitting, IP 65 rated
     3. Minimum lamp design life of 50 000 hours
     4. LED Wattage rating to suit the overall lighting design
     5. Internal protection circuits to safeguard the fittings against fluctuating voltages
     6. Powder coated, die cast aluminum, non-corrosive body
     7. Non-discoloring, impact resistant diffuser attached to body with stainless steel screws
     8. The installation shall be so planned that maintenance can be carried out efficiently and safely on the installation.

# EARTHING AND LIGHTNING PROTECTION

* 1. A specialist earthing contractor shall design, supply and install an earthing system, earth mat and lightning protection system as required at each site.
  2. The installation shall meet the requirements of SANS 10313, SANS 62305 Parts 1 to 4 and SANS 62561 Parts 1 to 7 and where applicable IEEE 80.
  3. The Contractor shall ensure that all electrical items including but not limited to distribution systems, valve isolating panels, sump pump control panels, flow meters, lighting etc. All electrical equipment shall be earthed utilizing copper coated steel conductor. No bare copper earth wire will be accepted.

## Earthing

### Earthing shall generally be done in accordance to SANS 10142-1, SANS 10199, SANS 10292 and SANS 1063 and where applicable IEEE 80.

### The contractor shall utilize a recognized proprietary software package to design the earthing and lightning protection systems to SANS, IEC and where applicable IEEE standards, also based on soil resistivity data. Attention shall also be given to allowable step and touch potentials as per SANS and IEC standards. The output of design calculations and its traceability to the final designs shall be provided in the design deliverables and the final documentation.

### All electrical equipment shall be earthed utilizing anti-theft type copper cladded steel wire. No bare copper earth wire will be accepted, except for the underground earthing system.

## Lightning Protection

### The installation shall be done in accordance with SANS 10313, SANS 62305 Parts 1 to 4, SANS 10199, SANS 1063 and SANS 62561 Parts 1 to 7 and.

### A specialist service provider registered with ELPA (Earthing and Lightning Protection Association) shall design, supply and install a lightning protection system for all buildings and structures.

### The contractor shall ensure he uses vandal resistant equipment such as solid drawn galvanized conductors on all exposed portions of the installation and in underground portions where the conductor will not be compromised by soil conditions.

### The designs shall be provided in PDF and Auto Cad formats on Rand Water drawing templates to be approved by Rand Water prior to construction.

### The Soil Resistivity testing shall be done at every installation where a lightning protection system shall be installed and these results shall be used to base the designs on. Provide for complete reports on findings.

### The contractor shall allow for a complete and full installation of the lightning protection including design, supply, delivery, installing in terms of the standards and strapping and supporting as necessary.

### The specialist shall supply test certificates and documentation verifying the installation and readings obtained for the lightning protection

# ELECTRICAL DRAWINGS

* 1. All drawings shall conform to Rand Water Standard for Electrical Drawings RW-EES-002-Rev\_0.0 as well as to the Rand Water format as per the examples given in the typical drawings to be provided to the appointed Contractor. The format shall be discussed with the Engineer prior to the commencement of the work. The drawings shall be based on the latest AutoCAD format.
  2. Should the makers consider any of the drawings or information to be confidential, the documents shall be marked "CONFIDENTIAL" and they will be treated as such by Rand Water.
  3. Sufficient information shall be given on the drawings to enable replacement parts to be made locally, if necessary
  4. All communications, pamphlets and technical literature shall be in English.
  5. All drawings shall utilize the WKS codification system for identification of plant elements and wire numbering as per standard.
  6. All electrical drawings shall use symbols in accordance with RW EES-002-Rev\_0.0 (section 9.3), NRS 002 and component numbering to comply with WKS standards.
  7. The Engineer may require the Contractor to submit, for approval, additional information, drawings and documentation in addition to those listed above. The Contractor shall supply a complete set of final drawings covering all the equipment supplied and shall submit a list of the final drawings and information that it is proposed to supply; this list shall include all the drawings listed in 1.1 and shall be approved by the Engineer
  8. Schematic and Wiring Diagrams:
     1. Complete single line and schematic diagrams of all power and control circuits for the plant shall be submitted to the Engineer for approval within four weeks after the contract is placed as part detailed design document. The schematic diagrams shall each include a detailed list of components showing type, make, rating, and grid reference on the drawings etc. Manufacture or Procurement of any equipment shall not be commenced until such time as approval has been obtained for the schematic diagrams. The single line diagram shall show the motor power & Current ratings.
     2. Final approved schematic diagrams of all power and control circuits of the plant shall be supplied as specified. The Certificate of Completion will not be issued until all such diagrams have been received.

# ELECTRICAL TESTS AND COMMISSIONING

* 1. All Electrical Installation shall not be energized before the necessary tests are carried out by a registered person in terms of the OHS act and this person certifies the installation as correct and safe to use.
  2. Tests shall be carried out using approved tests procedures that shall be formulated by the contractor and approved by the engineer. This test shall be witnessed by the relevant electrical representative from Rand Water
  3. The tests shall conform to the Rand Water Standard for the Design and Selection of Electrical Plant and Equipment RW\_00320\_S\_001\_D and all applicable SANS standards listed in section C3.1.7 of the Tender Document.
  4. Test records & check sheets shall be compiled by the contractor and approved by the Engineer before any acceptance of the plant for energizing.
  5. A Certificate(s) of Compliance, complete with a detailed test report in terms of the OHS act, shall be issued on the plant prior to dynamic tests on the plant.

# DOCUMENTATION

The contractor shall produce draft operating and maintenance manuals for approval. Details of all electrical equipment supplied under this contract shall appear in the manuals.

The following drawings and information shall be supplied by the Contractor for approval by the Engineer within the required time period specified elsewhere in the contract documents, but before manufacture of the plant commences and after approval these drawings shall be supplied as final drawings. Should the Contractor fail to provide the drawings and information by the due date, the penalty described in the Special Conditions of Contract will be imposed and the progress payments will be delayed.

* 1. General arrangement drawings of all applicable equipment to be supplied and installed.
  2. Full schematic diagrams of all circuits of all equipment to Rand Water RW-EES-002-Rev 0 standard, based on tender drawings.
  3. Complete wiring and connection diagrams of all circuits.
  4. Proposed details of all labels.
  5. All technical information on the equipment to be supplied.
  6. Full details of configuration software for the programmable equipment and full details of calculations for the protection settings of relays. Electronic and hard copies of all software shall be provided.
  7. Equipment schedules of all components coded to Rand Water WKS numbering systems.
  8. Full QA plan for the testing of the equipment at the factory and on site prior to the putting into service of the plant.
  9. The Contractor shall provide three copies of the operating and maintenance manuals within the required time specified elsewhere in the contract documents after the draft copy has been approved.
  10. Three approved sets of all technical information/manuals including test and calibration data and detailed operating instructions necessary for the correct operation and maintenance of all equipment being supplied under the Contract. Unique manuals shall be compiled to cover this contract only and all extraneous material shall be omitted.
  11. Approved test certificates and detailed test reports for all equipment shall be supplied.
  12. Approved factory test, cold and hot commissioning certificates, inclusive of all test results. Specific primary and secondary injection test certificates (where applicable) , insulation resistance tests, major circuit breaker main contact resistance and closing and opening speed tests(where applicable), are specifically included .
  13. Accredited assembly assessor’s relevant certification for each low voltage electrical distribution board.
  14. Certificates of Compliance to the OHS Act for all installations where required
  15. Commissioning documentation to Rand Water standards and requirements
  16. Approved “as built” schematic diagrams of all circuits of all equipment in hard and electronic copy (Autocad dwg format) to Rand Water template standards, and approved by an ECSA registered Professional Engineer
  17. Approved as built detailed cable schedules with all core connections, installed cable lengths and full cable type and size details
  18. Detailed cable test certificates (insulation resistance, continuity) with all test results
  19. Earthing and lightning protection installation results and certificates
  20. Approved configuration and settings for all programmable equipment with hard copies approved by an ECSA registered Professional Engineer.
  21. Approved "as built" drawings approved by an ECSA registered Professional Engineer.
  22. Full details of all labels of all equipment
  23. Layouts and sizes of equipment
  24. Recommended spares and suppliers’ contact details
  25. Detailed operating and maintenance instructions for all equipment and systems
  26. Special tools requirements
  27. Installation instructions
  28. After approval of the draft manuals the contractor shall issue 3 paper sets of final approved operating and maintenance manuals and shall transfer the same to 3 sets of CDs or DVDs in .pdf format

# APPLICABLE STANDARDS AND DRAWINGS

# LIST OF APPLICABLE DRAWINGS

|  |  |
| --- | --- |
| **Drawing No** | **Description** |
| RB 20093 | 400V Schematic Diagrams: Typical Boundary Valve Chamber Distribution Board, Single Line Diagram |
| RB 6443 | Typical Cable Trench Cross Sectional Layout |
| B 6477 | Re-instatement details for black top road |
| RB\_20146 | Typical Cable Schedule, Electrical Cable Numbers and Details |

# RAND WATER STANDARDS

|  |  |
| --- | --- |
| **DESCRIPTION** | **DETAILS** |
| Electrical Engineering Standards For Electrical Drawings | RW-EES-002 Rev 1 |
| General Electrical Specification For The Design And Selection Of Electrical Plant And Equipment | RW-00320-S-001 |
| Rand Water Electrical Engineering Standard for Earthing and Suppression. | RW-00320-AS-116 |
| Engineering Standard for the Control of Plant and Equipment | RW-00320-AS-488 |
| Rand Water Standard Specification for Factory Built Assemblies of Low Voltage Switchgear and Control gear | SAM EAM 00001 Spec Rev 1 |
| Rand Water General Specification for the Installation of Electrical Plant and Equipment | RW-00320-AS-496 |
| General Electrical Specification For Building Lighting And Small Power Installations | SAM EAM 00003 Spec Rev 1 |

# NATIONAL AND INTERNATIONAL STANDARDS

* + 1. **GENERAL**

|  |  |  |
| --- | --- | --- |
| No | Standard No | Description |
|  | SANS 1019 | Standard voltages, currents and insulation levels for electricity supply |
|  | SANS IEC 60529 | Degrees of protection provided by enclosures (IP code) |
|  | SANS 60050 | International Electro technical vocabulary. Chapter 441: Switchgear, control gear and fuses |
|  | SABS ISO 9001, Parts I, II and III. | Quality systems |
|  | SANS 1091 | National color standard for paint |
|  | OHS Act | Occupational Health and Safety Act (Act 85 0f 1993) |
|  | SANS 10142-1: | The wiring of premises Part 1: Low-voltage installations |
|  | N/A | Roxtec cable sealing systems |

* + 1. **CABLES AND CABLE INSTALLATION (LV, MV & EARTHING)**

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
|  | SANS 1507 | Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) |
|  | SANS 1507-1 | Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 1: General |
|  | SABS 1507-2 | Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 2: Wiring cables |
|  | SANS 1507-3 | Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 3: PVC distribution cables |
|  | SANS 1507-4 | Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 4: XLPE cables |
|  | SANS 1507-5 | Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 5: Halogen free distribution cables |
|  | SANS 1507-6 | Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 6: Service cables |
|  | SANS 10198-1 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 1: Definitions and statutory requirements |
|  | SANS 10198-2 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 2: Selection of cable type and methods of installation |
|  | SANS 10198-3 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 3: Earthing systems - general provisions |
|  | SANS 10198-4 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 4: Current ratings |
|  | SANS 10198-5 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 5: Determination of thermal and electrical resistivity of soil |
|  | SANS 10198-6 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 6: Transportation and storage |
|  | SANS 10198-7 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 7: Safety precautions |
|  | SANS 10198-8 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 8: Cable laying and installation |
|  | SANS 10198-9 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 9: Jointing and termination of extruded solid dielectric-insulated cables up to 3,3 kV |
|  | SANS 10198-10 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 10: Jointing and termination of paper-insulated cables |
|  | SANS 10198-11 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 10: Jointing and termination of screened polymeric-insulated cables |
|  | SANS 10198-12 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 12: Installation of earthing system |
|  | SANS 10198-13 | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 13: Testing, commissioning and fault location |
|  | NRS 028 | Cable lugs and ferrules for copper and aluminum conductors - Preferred requirements for applications in the electricity supply industry |
|  | NRS 053 | Accessories for medium-voltage power cables (3,8/6,6 kV to 19/33 kV) |
|  | VC 8075 | Safety of electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) |
|  | SANS 1574 | Electric cables- Flexible cords and flexible cables |

* + 1. **LOW VOLTAGE SWITCHGEAR**

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
|  | SANS IEC 60439- 1 | Low voltage switchgear and control gear assemblies Part 1: Type-tested and partially type-tested assemblies |
|  | SANS IEC 60439- 2 | Low voltage switchgear and control gear assemblies Part 2: Particular requirements for bus bar trunking systems (busways) |
|  | SANS IEC 60439- 3 | Low voltage switchgear and control gear assemblies Part 3: Particular requirements for low voltage switchgear and control gear assemblies intended to be installed in places where unskilled persons have access to their use- Distribution boards |
|  | SANS IEC 60439- 4 | Low voltage switchgear and control gear assemblies Part 4: Particular requirements for assemblies for construction sites (ACS) |
|  | SANS IEC 60439- 5 | Low voltage switchgear and control gear assemblies Part 5: Particular requirements for assemblies intended to be installed outdoors in public places- Cable distribution cabinets (CDC’s) for power distribution in networks |
|  | BS 5486-12 | Low-voltage switchgear and control gear assemblies. Specification for particular requirements of type tested miniature circuit- breaker boards |
|  | SANS IEC 60947-1 | Low Voltage Switchgear and Control Gear Part 1: General Rules |
|  | SANS IEC 60947-2 | Low Voltage Switchgear and Control Gear Part 2: Circuit Breakers |
|  | SANS IEC 60947-3 | Low Voltage Switchgear and Control Gear Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units |
|  | SANS IEC 60947-4-1 | Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 1: Electromechanical contactors and motor-starters |
|  | SANS IEC 60947-4-2 | Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 2: A C semiconductor motor controllers and starters |
|  | SANS IEC 60947-4-3 | Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 3: A C semiconductor controllers and contactors for non-motor starters |
|  | SANS IEC 60947-5-1 | Low Voltage Switchgear and Control Gear Part 5: Control Circuit devices and switching elements- Electromechanical control circuit devices |
|  | SABS 763 | Hot dip (galvanized) zinc coating |
|  | SABS 1473-1 | Low-voltage switchgear and control gear assemblies Part 1: Type-tested and partially type-tested assemblies |
|  | SABS 1473-2 | Low-voltage switchgear and control gear assemblies Part 2: Bus bar trunking systems |
|  | SABS 1973-3 | Safety of assemblies with a rated prospective short-circuit current of up to and including 10 kA |
|  | SANS 1973-1 | Low-Voltage Switchgear and Control Gear ASSEMBLIES  Part 1: Type-Tested ASSEMBLIES With Stated Deviations And A Rated Short-Circuit Withstand Strength Above 10 kA  Use with: SANS 60439-1:2004 |
|  | SANS 1973-3 | Low-Voltage Switchgear And Control Gear ASSEMBLIES Part 3: Safety Of ASSEMBLIES With A Rated Prospective Short-Circuit Current Of Up To And Including 10 kA |
|  | SANS 1973-7 | Low-Voltage Switchgear and Control Gear ASSEMBLIES Part 7: Requirements for Testing Under Conditions of Arcing Due to Internal Fault  Use with: SANS 60439-1:2004 |

* + 1. **BUSBARS**

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
| 1 | SANS 1195 | Busbars and Busbar Connections |

* + 1. **CIRCUIT BREAKERS & EARTH LEAKAGE PROTECTION**

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
|  | VC 8035 | Compulsory Specification for Earth Leakage Units |
|  | VC 8036 | Compulsory Specification for Circuit Breakers |
|  | SANS 156 | Moulded-case Circuit-Breakers |
|  | SANS 767-1 | Earth leakage protection units Part 1: Fixed earth leakage protection circuit-breakers |
|  | SANS 767-2 | Earth leakage protection units Part 1: Single phase, portable units |

* + 1. **SURGE ARRESTORS AND PROTECTION**

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
|  | SANS 60099-4 | Surge Arresters Part 4: Metal-Oxide Surge Arresters Without Gaps For A.C. Systems |
|  | SANS 61643-1 | Low-voltage surge protective devices Part 1: Surge protective devices connected to low-voltage power distribution systems - Requirements and tests |
|  | SANS 61643-11 | Low-voltage surge protective devices Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods |
|  | SANS 61643-12 | Low-voltage surge protective devices Part 12: Surge protective devices connected to low-voltage power distribution systems - Selection and application principles |
|  | SANS 61643-21 | Low voltage surge protective devices Part 21: Surge protective devices connected to telecommunications and signaling networks - Performance requirements and testing methods |
|  | SANS 61643-22 | Low-voltage surge protective devices Part 22: Surge protective devices connected to telecommunications and signaling networks - Selection and application principles |
|  | SANS 61643-321 | Components for low-voltage surge protective devices Part 321: Specification for avalanche breakdown diode (ABD) |
|  | SANS 61643-341 | Components for low-voltage surge protective devices Part 341: Specification for thyristor surge suppressors (TSS) |
|  | SANS 60099-1 | Surge Arresters Part 1: Non-Linear Resistor Type Gapped Surge Arresters For A.C Systems |
|  | SANS 60099-5 | Surge arresters Part 5: Selection and application recommendations |

* + 1. **EARTHING**

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
|  | SANS 0292 | Earthing of low-voltage (LV) distribution systems |
|  | SANS 0199 | The design and installation of an earth electrode |
|  | SANS 1063 | Earth rods and couplers |

* + 1. **LIGHTING**

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
|  | SANS 10114-1 | Interior lighting Part 1: Artificial lighting of interiors |
|  | SANS 10398-1 | Exterior lighting Part 1: Artificial lighting of exteriors |

* + 1. **BUILDING ELECTRICAL INSTALLATIONS**

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
|  | SANS 10142-1 | The wiring of premises Part 1: Low-voltage installations |
|  | SANS 1239 | Plugs, socket outlets and couplers for industrial purposes |

## PV SYSTEMS

|  |  |  |
| --- | --- | --- |
| **No** | **Standard No** | **Description** |
| 1 | NRS 048-2 | Inverters-Electrical Supply quality specifications |
| 2 | NRS 097-2-1 | Inverter- Embedded generator specifications |
| 3 | IEC 60529 | IP Ratings for Electronics |
| 4 | IEC 62109 | Safety of power converters for use in photovoltaic power systems |
| 5 | IEC 62116 | Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters |
| 6 | IEC 62093 | Balance-of-system components for photovoltaic systems - Design qualification natural environments |
| 7 | EN 61000 | Electromagnetic compatibility (EMC) |
| 8 | IEC-EN 61724 | Photovoltaic system performance monitoring – Guidelines for measurement,  data exchange and analysis |
| 9 | IEC-EN 61727 | Photovoltaic (PV) systems - Characteristics of the utility interface |
| 10 | IEC/EN 61215 | Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification  and type approval |
| 11 | IEC/EN 61730 | Photovoltaic (PV) module safety qualification |
| 12 | NRS 052-3 | Off-grid solar home systems |
| 13 | IEC 61836 | Solar Photovoltaic energy systems: Terms, definition and symbols |
| 14 | IEC-EN 60870-5-102 | Tele-control equipment and systems – Part 5: transmission protocols –  section 102: Companion standards for the transmission of integrated totals in electric power  systems |
| 15 | IEC-EN 62056 | Electricity metering – Data exchange for meter reading, tariff and local control |
| 16 | NRS 057-4 | Electricity metering Part 4: Code of practice |
| 17 | NRS 097 | Grid interconnection for embedded generation: Installations <100kW |
| 18 | NRS 048-2 | Electricity supply - Quality of supply Part 2: Voltage characteristics, compatibility  levels, limits and assessment methods |
| 19 | NRS 048-4 | Electricity supply – Quality of supply Part 4: Application guidelines for utilities Suggested System Design – Grid Tied String PV system |