



# KhaNgwe

Intelligent Technology Solutions

## ELECTRICAL SYSTEM SPECIFICATION

|                         |  |
|-------------------------|--|
| <b>Client's Name</b>    | <b>Department of Education (DoE)</b>   |
| <b>Business Area</b>    | <b>Engineering Services</b>  |
| <b>Project Name</b>     | <b>Free State Department of Education Replacement of Structure Built with Inappropriate Materials on Cluster 1 Schools</b> |
| <b>Project Location</b> | <b>Dr Blok Secondary School</b>  |
| <b>Date</b>             | <b>04/02/2022</b>  |
| <b>Compiled by</b>      | <b>H Shivambu</b>  |



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### 1. Applicable Standards and Regulations

| Description  | Code             |
|--|------------------|
| The Wiring of Premises – Part 1: Low Voltage Installations   | SANS 10142-1     |
| Earth Leakage Protection Units – Part 1: Fixed Earth Leakage Protection Circuit Breakers   | SANS 767-1       |
| Plug and socket-outlet systems for household and similar purposes for use in South Africa.   | SANS 164: 1- 4   |
| Earthing of Low Voltage (LV) Distribution System   | SANS 10292       |
| Low Voltage Surge Protective Devices   | SANS 61643:1-11  |
| Low Voltage Switchgear and Control Gear Assemblies   | SANS 61439:1-5   |
| Low Voltage Switchgear and Control Gear Assemblies   | SANS 60439: 1-5  |
| Low Voltage Switchgear and Control Gear Assemblies   | SANS 60947: 1-8  |
| Low-Voltage Switchgear and Control Gear Assemblies Part 3: Safety of Assemblies with a Rated Prospective Short-Circuit Current of Up to and Including 10kA | SANS 1973-3:2008 |
| Distribution Transformers  | SANS 780         |
| Earthing of Low Voltage (LV) Distribution Systems  | SANS 0292        |
| Low-Voltage Switchgear Part 1: Circuit Breakers  | SANS 556-1       |
| Degrees of protection provided by enclosures (IP code)   | SANS IEC 60529   |
| Identification Colour Marking (Part 2)   | SANS 10140       |
| National Colour standard for paint   | SANS 1091        |
| Quality Systems  | ISO 9001         |

### 2. Applicable Drawings

| Description   | Drawing No      |
|---|-----------------|
| Main Kiosk A Single Line Diagram and GA               | KNE-D-EL031-001 |
| Main Kiosk B Single Line Diagram and GA               | KNE-D-EL031-002 |
| Main Kiosk C Single Line Diagram and GA               | KNE-D-EL031-003 |
| Admin Block Small Power and Lighting Layout           | KNE-D-EL030-001 |
| Admin Block Single Line Diagram and GA Layout         | KNE-D-EL030-002 |
| CL2+HOD Block Small Power and Lighting Layout         | KNE-D-EL030-003 |
| CL2+HOD Block Single Line Diagram and GA Layout       | KNE-D-EL030-004 |
| CL2+HOD+ABL Block Small Power and Lighting Layout     | KNE-D-EL030-005 |
| CL2+HOD+ABL Single Line Diagram and GA Layout         | KNE-D-EL030-006 |
| CL2+HOD+M.ABL Block Small Power and Lighting Layout   | KNE-D-EL030-007 |
| CL2+HOD+M.ABL Block Single Line Diagram and GA Layout | KNE-D-EL030-008 |
| Scie+CL4 Block Small Power and Lighting Layout        | KNE-D-EL030-009 |
| Scie+CL4 Block Single Line Diagram and GA Layout      | KNE-D-EL030-010 |

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|---|-----------------|
| Lib+Com Block Small Power and Lighting Layout               | KNE-D-EL030-011 |
| Lib+Com Block Single Line Diagram and GA Layout             | KNE-D-EL030-012 |
| CL1+MPC+F.ABL Block Small Power and Lighting Layout         | KNE-D-EL030-013 |
| CL1+MPC+F.ABL Block Single Line Diagram and GA Layout       | KNE-D-EL030-014 |
| CL3+HOD Block Small Power and Lighting Layout               | KNE-D-EL030-015 |
| CL3+HOD Block Single Line Diagram and GA Layout             | KNE-D-EL030-016 |
| Sec+W Block Small Power and Lighting Layout                 | KNE-D-EL030-017 |
| Electrical Cable Reticulation and Equipment Position Layout | KNE-D-EL016     |

### 3. Scope of Work

The Contractor shall provide all the Labour, supervision, installed and consumable materials, equipment, tools, services and every permanent or temporary equipment required to manufacture, supply, delivery, unloading, installation, commissioning and putting into service of the specified deliverables. The contractor shall be registered with the department of labor as an electrical installation contractor.

The contractor will be responsible for the following in terms of the system specification but not limited to:

- i. Supply, deliver, install, test, and commission the 400V Main Kiosk A, kiosk B and C as per Single Line Diagram.
- ii. Decommission, mark cables, remove the old existing distribution board.
- iii. Supply, deliver, install, concrete plinth for Main kiosk A, kiosk B and C.
- iv. Supply, deliver, offload, install, test and commissioning 400V and 230V distribution boards as per the Single Line Diagrams.
- v. Supply, deliver, offload, install and testing of all LV cabling and associated cable support systems, trenching, ducts, sleeves, sealing systems etc. to connect all electrical equipment related to this project.
- vi. Supply, deliver, offload, install, test and commissioning small power & lighting as per design.
- vii. Supply, install and test earthing and lightning Protection system including soil resistivity test.

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#### 4. Electrical Specification

##### 4.1. Qualifications and Competency

- The contractor shall be registered with the Department of Labour as electrical installation contractor.
- Upon completion of the installation the contractor shall provide a COC (certificate of compliance) for each distribution board completed by a person recognized by Electrical Contractors board of South Africa (ECB SA) and/or Department of Labour

##### 4.2. New Electrical Kiosks.

The contractor shall:

- Supply, manufacture and deliver the electrical kiosks as per drawings
- Install, test and commission the new kiosks on site.
- The contractor shall provide a general arrangement drawing for approval by engineers and DoE representative prior to the manufacturing
- The contractor to make provision for a factory acceptance test of the distribution board replacement equipment prior to delivery to site complete with certification for the factory-built assembly
- The contractor shall contract a 1500x300x300 cable duct

Specification Requirement

| <b>Main Kiosk A, Kiosk B and C</b> |   |
|------------------------------------|---|
| <b>Description</b>                 | <b>Requirement</b>                                |
| Applicable Drawing                 | KNE-D-EL031                                       |
| Supply Voltage                     | 400V  |
| Current Rating                     | 630A Main Kiosk A<br>250A Kiosk B<br>300A Kiosk C |
| Panel Short Circuit Rating kA      | 10 KA   |
| Circuit Breaker Type               | CBI/Schneider/ABB/Equivalent                      |
| Panel IP Rating                    | IP65  |
| Panel Material                     | 3CR12   |
| Panel Material Thickness           | 1.6mm / 2mm                                       |
| Panel Painting System Details      | Powder Coated Electric Orange                     |
| Panel Access                       | Front & Back                                      |
| Cable Entry Location               | Bottom  |
| Baseplate Material                 | Mild Steel / Aluminum                             |
| Baseplate Thickness                | 2mm   |
| Baseplate Mounting                 | Screw Type on the side of the panel               |

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|-------------------------|-------------------------------|
| Panel Mounting Location | Concrete Plinth (Floor)       |
| Panel Location          | Outdoor                       |
| Certification           | COC / Panel Manufacturing/ QA |

### 4.3. Distribution Boards

The contractor shall:

- Supply, manufacture and deliver distribution board (DB) as per drawings.
- Install, test and commission the DB on site.
- The contractor shall provide a general arrangement drawing for approval by engineers and DoE representative prior to the manufacturing.

#### Specification Requirement

| <b>Distribution Board</b>       |                |                               |
|---------------------------------|----------------|-------------------------------|
| <b>Description</b>              |                | <b>Requirement</b>            |
| Applicable Drawing              |                | KNE-D-EL030                   |
| Supply Voltage                  |                | 400Vac                        |
| Current Rating                  |                | 60A                           |
| Panel Short Circuit Rating      |                | 5KA                           |
| Circuit Breaker Type            |                | CBI/Schneider/ABB/Equivalent  |
| Circuit Breaker Rating (Plugs)  |                | 20A, 230V, 1 Pole             |
| Circuit Breaker Rating (Lights) |                | 10A, 230V, 1 Pole             |
| Earth Leakage                   |                | CBI/Schneider/ABB/Equivalent  |
| Earth Leakage Rating            |                | 32A, 30mA, 2 Poles            |
| Earth Leakage kA Rating         |                | 5Ka                           |
| Wire Type                       |                | GP Wire                       |
| Wire Colour                     | Live           | Red/White/Blue                |
|                                 | Neutral        | Black                         |
|                                 | Earth          | Green and Yellow              |
| Wire Size                       | Socket Outlets | 6mm <sup>2</sup>              |
|                                 | Lights         | 2.5mm <sup>2</sup>            |
| Panel IP Rating                 |                | IP42                          |
| Panel Material                  |                | Mild Steel                    |
| Panel Painting System Details   |                | Powder Coated Electric Orange |
| Panel Access                    |                | Front                         |
| Cable Entry Location            |                | Bottom and Top                |
| Panel Mounting Location         |                | Wall Flush mount              |
| Panel Location                  |                | Indoor                        |
| Certification                   |                | COC / Panel Manufacturing/ QA |



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| <b>Distribution Board</b>       |                |                               |
|---------------------------------|----------------|-------------------------------|
| <b>Description</b>              |                | <b>Requirement</b>            |
| Applicable Drawing              |                | KNE-D-EL030                   |
| Supply Voltage                  |                | 400Vac                        |
| Current Rating                  |                | 100A                          |
| Panel Short Circuit Rating      |                | 5KA                           |
| Circuit Breaker Type            |                | CBI/Schneider/ABB/Equivalent  |
| Circuit Breaker Rating (Plugs)  |                | 20A, 230V, 1 Pole             |
| Circuit Breaker Rating (Lights) |                | 10A, 230V, 1 Pole             |
| Earth Leakage                   |                | CBI/Schneider/ABB/Equivalent  |
| Earth Leakage Rating            |                | 32A, 30mA, 2 Poles            |
| Earth Leakage kA Rating         |                | 5Ka                           |
| Wire Type                       |                | GP Wire                       |
| Wire Colour                     | Live           | Red/White/Blue                |
|                                 | Neutral        | Black                         |
|                                 | Earth          | Green and Yellow              |
| Wire Size                       | Socket Outlets | 6mm <sup>2</sup>              |
|                                 | Lights         | 2.5mm <sup>2</sup>            |
| Panel IP Rating                 |                | IP42                          |
| Panel Material                  |                | Mild Steel                    |
| Panel Painting System Details   |                | Powder Coated Electric Orange |
| Panel Access                    |                | Front                         |
| Cable Entry Location            |                | Bottom and Top                |
| Panel Mounting Location         |                | Wall Flush mount              |
| Panel Location                  |                | Indoor                        |
| Certification                   |                | COC / Panel Manufacturing/ QA |

| <b>Distribution Board</b>       |      |                              |
|---------------------------------|------|------------------------------|
| <b>Description</b>              |      | <b>Requirement</b>           |
| Applicable Drawing              |      | KNE-D-EL030-017              |
| Supply Voltage                  |      | 230Vac                       |
| Current Rating                  |      | 40A                          |
| Panel Short Circuit Rating      |      | 5kA                          |
| Circuit Breaker Type            |      | CBI/Schneider/ABB/Equivalent |
| Circuit Breaker Rating (Lights) |      | 10A, 230V, 1 Pole            |
| Earth Leakage                   |      | CBI/Schneider/ABB/Equivalent |
| Earth Leakage Rating            |      | 32A, 30mA, 1 Poles           |
| Earth Leakage kA Rating         |      | 5Ka                          |
| Wire Type                       |      | GP Wire                      |
| Wire Colour                     | Live | White                        |

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|                               |         |                               |
|-------------------------------|---------|-------------------------------|
|                               | Neutral | Black                         |
|                               | Earth   | Green and Yellow              |
| Wire Size                     | Lights  | 2.5mm <sup>2</sup>            |
| Panel IP Rating               |         | IP42                          |
| Panel Material                |         | Mild Steel                    |
| Panel Painting System Details |         | Powder Coated Electric Orange |
| Panel Access                  |         | Front                         |
| Cable Entry Location          |         | Bottom and Top                |
| Panel Mounting Location       |         | Wall Flush mount              |
| Panel Location                |         | Indoor                        |
| Certification                 |         | COC / Panel Manufacturing/ QA |

#### 4.4. Cabling and Ancillary Electrical Installation (incl. Trenching and Trunking)

**Function:** The basic and major function of a power cable is to transmit electrical energy from the source of supply to electrically operated equipment.

##### Specific Requirements:

##### Power Cables

The cabling and ancillary electrical installation shall be provided in compliance with SANS standard. The Electrical Contractor shall supply, install, connect and test all the cables called for in the schedules and where shown on the drawings. Cables shall be 600/1000V grade, PVC insulated, steel wire armoured and PVC sheathed, with stranded copper conductors or as called for in the cable schedules, constructed in accordance with SANS 10198. The armoring of any armoured cable is not acceptable as an earth conductor. Single core cables shall be un-armoured and run in trefoil formation.

##### Cable Termination Kits

All PVC/SWA/PVC or PVC/PVC cable terminations shall be non-corrodible metal compression glands similar and equal to those manufactured by "Pratley" or "CCG". Waterproof or flameproof glands shall be provided where necessary. Glands shall be complete with earthing ferrules, locknuts, bushes and shrouds.

Conductors shall be terminated onto equipment using compression lugs of the correct size and suitable for the application. Manual crimping shall be done with the Maker's special tools which will not release until the full crimping pressure has been achieved, the ends of conductors of 50mm<sup>2</sup> cross sectional area and greater shall be crimped by hydraulic machine. Each and every run of cable shall be a single length without joints, except

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when a run exceeds the standard drum length or where the length of cable is increased after installation; a through box will be permitted.

Drums of cable shall be delivered to site with their end seals intact and shall be off-loaded and stored in an approved manner. Any damaged cable shall be removed from site and replaced with undamaged cable at the Contractor's expense.

Cable drums shall be supported on an axle and supporting jacks, and when the cable is unreeled, the direction of rotation indicated on the drum flanges shall be observed. Rolling of drums along the ground is not permitted.

### **Cable Numbering**

The contractor shall fit a cable number at each cable gland. The cable number shall be in accordance with the Dr blok's Specification. The cable numbers shall be equal to the type manufactured by Bowthorpe Hellerman or similar approved.

### **Cable Glands**

All cable glands shall be suitable for use in highly corrosive locations and equal or similar to the CCG Posi guard and Posi seal types.

## **4.5. Small Power and Lighting**

**Function:** A small power and lighting allows electrical devices to be safely connected to an electricity supply and the give required lux level interior and exterior as per SANS 10142.

### **4.5.1. Socket Outlet**

The contractor shall supply and install complete wall and floor surface mounted switched socket outlet.

#### Specification Requirement

| <b>Description</b>   | <b>Requirement</b>             |
|--|--------------------------------|
| Type   | Crabtree or Equivalent         |
| Application  | Industrial / Commercial        |
| Material   | Steel                          |
| Ratings  | 16A, 240V, 50Hz                |
| Configuration  | SA/Euro Combined Socket Outlet |
| Colour   | White                          |
| IP Rating  | IP20                           |
| <b>Accessories</b><br>25mm Flush Mounted PVC Conduit<br>20mm Flush Mounted PVC Conduit<br>Power Skirting |                                |

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#### 4.5.2. Luminaires

The contractor shall supply and install all lighting complete with all accessories as per drawings.

Specification Requirement.

| Description  | Requirement                                     |
|--|---|
| Type   | 2x36W Open Channel T5 light fitting/ Equivalent |
| Application  | Industrial / Commercial                         |
| Material   | Epoxy Coated pressed steel                      |
| Ingress Rating   | IP 20   |
| Wattage  | 72W   |
| Colour   | White   |
| <b>Accessories</b><br>LED Colour Temperature – Neutral White<br>20mm Flush Mounted PVC Conduit |   |

| Description  | Requirement                        |
|--|------------------------------------|
| Type   | Bulkhead light fitting /Equivalent |
| Application  | Industrial / Commercial            |
| Material   | Epoxy Coated pressed steel         |
| Ingress Rating   | IP 65/ IP 28                       |
| Wattage  | 22W                                |
| Colour   | White                              |
| <b>Accessories</b><br>LED Colour Temperature – Neutral White<br>20mm Flush Mounted PVC Conduit |                                    |

#### 4.6. Earthing System and Equipotential Bonding

The contractor shall ensure the system is properly and effectively earthed.

Equipotential bonding is requirement for the entire electrical installations. The contractor shall create equipotential on which equipment (electrical and electronic) can operate and be safely interconnected avoiding large differential voltages according to SANS 62305-3.

In principle, all conductive systems entering the operation building from outside have to be generally included into the lightning equipotential bonding. The requirements of lightning equipotential bonding are fulfilled by the direct connection of all metal systems and by the indirect connection of all live systems via surge arresters. Equipotential bonding system shall create the most secured earthing system.

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In this system all earthing and all metal sections are engaged one another with equipotential bars. Thus, the voltage difference that may occur at any two points within the plant is prevented.

Bonding shall intentionally connect all exposed metallic (current carrying and non-current carrying) equipment to avoid different potential. Even if a failure of electrical insulation occurs, all bonded metal objects in the plant shall have substantially the same electrical potential, personnel and sensitive equipment shall be safe from dangerous potentials.

#### **4.7. Surge Arrester Protection**

Class 1+2/Type 1+2 on the kiosk(s) and class 2 surge protection devices inside the building distribution board shall be installed after the incomer.

To comply with the SANS 10142:1 stipulation, circuit breakers/fuses shall be installed after the main incomer but before the surge arresters to provide protection in the event of violent rupture of the surge arrester and to also allow safety maintenance practice.

### **5. Verification**

#### **5.1. Verification of Contractors Specification**

The contractor shall supply technical datasheets to DoE and/or its representative to confirm that his/her proposed equipment conforms to Department of Education requirements. The contractor shall only proceed with procurement of equipment upon approval of the provided specification.

**NOTE:** No equipment shall be procured until specifications of the proposed equipment has been reviewed and accepted by DoE and/or its representative.

#### **5.2. Verification of Physical Equipment**

Equipment verification procedure shall be in accordance to SANS10142-1.

The verification methods that are applicable are as follows:

- Tests
- Demonstrations
- Inspections
- Data Analysis of Manufacturers data/specification sheets

### **Factory Acceptance Test (FAT)**

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Verification will be conducted at the contractor’s premises before the equipment is transported to DoE premises and it will only be transported to DoE upon satisfaction of DoE engineering representative.

**Site Acceptance Test (SAT)**

After the equipment has been installed at DoE it shall also be tested separately and also with the entire system.

**Inspection, Installation, Testing and Commissioning**

During manufacturing and before dispatch of equipment DoE and/or its representative shall inspect and test the equipment at the manufacturer’s/contractor’s premises. Before and after installation, the equipment shall be tested to the satisfaction of DoE and/or representative and shall comply with applicable standards. The test shall be arranged by the contractor and shall also supply all necessary testing equipment. Should any of the equipment fails to meet the requirement the contractor is responsible to rectify the fault at the contractor’s cost.

**5.3. Verification of Qualifications and Competency**

- Registration certificate shall be submitted to DoE with the tender and it shall be verifiable with Electrical Contractors board of South Africa (ECB SA) and Department of Labour.

**5.4. Marking and Nameplate Ratings**

- Marking and nameplates of all equipment called for on this tender shall be done according to the applicable SANS standards.

**5.5. Testing and Documentation**

The following items shall form part of the works under this contract:

- The contractor shall produce operating and maintenance manuals for approval on applicable equipment. 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, 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 payments will be delayed.
- General arrangement drawings of all applicable equipment to be supplied and installed.
- Outline and foundation drawings for all the equipment to be supplied.

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- Proposed details of all labels.
- All technical information on the equipment to be supplied.
- Equipment schedules of all components coded to DoE numbering systems.
- Full QA plan for execution works and testing of the equipment at the factory and on site prior to the putting into service.
- The Contractor shall provide three copies of the operating and maintenance manuals within the required time.
- 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.
- Approved test certificates and detailed test reports for all equipment shall be supplied.
- Accredited assembly assessor's or evaluator relevant certification for each low voltage electrical distribution board.
- Certificates of Compliance to the OHS Act for all installations which were witnessed by DoE and/or Engineer. Certificates produced without DoE or DoE representative present will be rejected.
- Commissioning documentation to DoE standards and requirements
- Clear and marked up "as built" drawings of installation in hard copy based on existing drawings
- Detailed cable test certificates (insulation resistance and continuity tests) with a report on all test results
- Approved "as built" general arrangement drawings in hard copy and electronic format
- Full details of all equipment labelling and numbering
- Layouts and sizes of equipment
- Detailed operating and maintenance instructions for all equipment and systems
- Special tools requirements
- Installation instructions
- 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 and/or DWG format.