


Design, Supply, Install And Commission A Complete Electrical Power And Lighting System For The New Clothing Store Facility In The Port Of Durban

ELECTRICAL ENGINEERING DESIGN CRITERIA

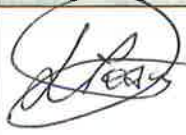

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Prepared: Sibonelo Shandu	Electrical Engineer		29/06/2023

I, the undersigned hereby approve this procedure.

ROLE	CAPACITY/ FUNCTION	SIGNATURE	DATE
Review & Acceptance: Lwandile Poswa	Senior Electrical Engineer		29/06/23
Reviewed and Accepts document for adequacy and practicability. Comments:			
Approved: Akash Tulsie	Senior Electrical Engineer		29/06/23
Approves document for use. Comments:			

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1. INTRODUCTION

The electrical design criteria prescribes the basic minimum requirements and principles for the electrical design, selection, and protection of electrical equipment, material and installation of electrical infrastructure at the new Clothing Store Facility in the Port of Durban.

2. SCOPE OF WORK

The electrical scope of work shall include power, lighting, lightning, earthing and supplies to electricity consuming apparatus throughout the installations.

The below design's shall be developed as part of the works,

- a) Design of a low voltage power supply to the entire clothing store facility
- b) Design the internal electrical cable reticulation system.
- c) Design of single line diagrams, schematics and panel diagrams for the distribution boards.
- d) Design of interior lighting, and power socket outlets.
- e) Design of the power provision for mechanical, security and electronic equipment, which comprises of CCTV, PA system, fire detection, fire suppression, audio visual and HVAC Equipment.
- f) Design of exterior lighting.
- g) Design of earthing and lightning protection.
- h) Specify a suitably sized standby generator and UPS unit

3. ABBREVIATIONS, DEFINITIONS, TERMS, UNITS OF MEASUREMENT

3.1 Abbreviations

The abbreviations and terms applicable to this report are summarised in the following table:

Table 1: Abbreviations and Terms

Abbreviation	Description
TNPA	Transnet National Ports Authority
CCTV	Closed Circuit Television
PA	Public Announcement
HVAC	Heating, ventilation, and air conditioning
kV	kilo-Volts
LV	Low Voltage
UPS	Uninterruptible Power Supply
M	Metres
mm ²	Squared millimeters
DB	Distribution Board
LED	Light Emitting Diode
SWA	Steel Wire Armouring
SANS	South African National Standards

3.2 Units of measurements

The units of measurement that are applicable to this report are summarized in Table 2:

Table 2: Units of measurement

Units	Name	Measure
%	Percent	percentage
M	metre	length
W	watts	Power (J/s)
V	Volts	Potential difference
kVA	Kilo Volt Ampere	Apparent Power

4. STATUTORY REQUIREMENTS

In addition to these specifications, the buildings shall comply with the following relevant South African Acts and Regulations and shall apply in the order of precedence as listed below:

- Occupational Health and Safety Act 85 of 1993
- The S.A. National Building Regulations and Building Standards Act. (Act 103 of 1977)
- South African National Standards and Codes of Practice
- IEC Standards and Recommendations
- International Standards and Codes – ISO, DIN, BS, ASME, ASCE, ANSI, ASTM, EU
- All local, provincial or S.A. Government laws in force at the time.

5. GOVERNING CODES, STANDARDS AND SPECIFICATIONS

The Electrical Engineering shall be in accordance with the latest edition of the following specifications and codes:

Note: Where reference is made to a code, standard or specification, the reference shall be taken to mean the latest edition of the code, standard or specification, including latest Addenda, supplements and revisions thereto.

5.1 Standards

Table 3: Standards

Standard No.	Description
SANS 10114-1	Interior lighting Part 1: Artificial lighting of interiors
SANS 10114-2	Interior lighting Part 2: Emergency lighting
SANS 10389-1	Exterior lighting Part 1: Artificial lighting of exterior areas for work and safety
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 10313	Protection against lightning - Physical damage to structures and life hazard
SANS 62305-01	Protection against lightning Part 1: General principles
SANS 62305-02	Protection against lightning Part 2: Risk management
SANS 62305-03	Protection against lightning Part 3: Physical damage to structures and life hazard.
SANS 62305-04	Protection against lightning Part 4: Electrical and electronic systems within structures
OHS Act 1993	Occupational Health and Safety Act (Electrical Installation regulations)
SANS 10142-1	Code of Practice for the Wiring of Premises Part 1 Low Voltage Installations.
SANS 10400-A	The application of the National building regulations- Part A : General principles and requirements
SANS 10064	The Preparation of steel surfaces for coating
SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles – specifications and test methods
SANS 1091	National colour standards for paint
SANS 14713	Zinc coatings – Guidelines and recommendations for the protection against corrosion of iron and steel in structures.
BS 5493	Protective coating of iron and steel structures against corrosion

5.2 Specifications

The following Specifications shall apply and form part of the design development:

Table 4: List of Transnet Specifications and Drawings applicable to this report

	Specification No.	Description
1	TPD: 001-EL&P SPEC	Technical specification for Electrical Installations to Buildings Other than Dwellings Houses.
2	TPD: 002-DBSPEC	Specification for Low Voltage Distribution Boards
3	TPD:003-CABLESPEC	Specification for the supply and installation of medium voltage and low voltage electrical cables.
4	TPD:004-EARTHINGSPEC	Technical specification for earthing and the protection of buildings and structures against lightning.
5	TPD:009-STANDBYPLANTSPEC	Specification for the supply, delivery, offloading and installation and commissioning of diesel driven standby generator sets
6	TPD: 011-UPSSPEC	Specification for the supply, delivery, installation and commissioning of an Uninterruptible Power Supply (UPS) system

5.3 Units and Measures

The units and measures used to express numerical quantities in all notes, tables, data, calculations and instructions, and all dimensions shown on drawings, shall be in the SI system of units.

6. GENERAL

6.1 Safety and Reliability

Design of the electrical works shall be in accordance with applicable codes and standards.

Prime consideration shall be given to:

- maximizing health and safety for all personnel
- minimising environmental impacts
- maximizing the security of equipment
- maximizing continuity of service

- Maximizing energy efficiency and sustainability

The electrical system shall be self-protecting and designed so that any fault is rapidly isolated and also so that any power interruption is confined to the smallest practical area.

All equipment and materials shall be rated to withstand any electrical fault or mis-operation that may occur to the applicable standard.

The required reliability of the electrical system shall be based on spare units, multiple feeds to critical loads and automatic transfer of critical loads to an alternative source.

6.2 Service Conditions

All equipment shall be rated for continuous operation under the following conditions:

Altitude - 0 to 1 800 m above sea level.

Ambient air temperature - Max. 40 deg. C ;Min. -5 deg. C

Humidity - as high as 96 %

Lightning conditions – Mild with 4 flashes/km²/annum

In addition the atmosphere will be of a highly saline and dust-laden nature

6.3 Codes and Standards

All equipment and material to be supplied for the project must be designed, assembled and inspected in accordance with the publications shown in item 5 above. Each publication shall be the latest revision and addendum in effect on the date the specification is issued for construction unless noted otherwise.

Where conflicts occurs the more stringent requirement of the code, standards and project specifications must be met.

6.4 Drawings

Project engineering drawings shall include, but not be limited to, the following:

- Single line diagrams; showing power distribution from the incoming source to the various loads.
- Electrical reticulation layout
- Ground floor and first floor power layout
- Ground floor and first floor lighting layout
- Exterior lighting layout
- Earthing & lightning layout

Unless specifically directed otherwise, Transnet National Ports Authority standard format and symbols shall be used.

6.5 Documents

Project engineering documents shall include, but not be limited to, the following:

Electrical design criteria

Electrical design report

Lighting simulation report

Cable sizing calculations (use appropriate de-rating factors)

Conduit and Cable schedules

Electrical Bill of Quantities

NEC3 Works information

7. DESIGN REQUIREMENTS

7.1 Power system Data

Utility System Characteristics (i.e.)

Nominal system voltage: 400V

Maximum system voltage: 415V

Nominal frequency: 50Hz

No. of phases: 3

Allowed power factor: 90% lagging

7.2 Protective Devices

A properly co-ordinated protection system shall be designed for the power system at all voltage levels. The system shall be designed for maximum personnel protection, rapid clearing of faults and minimum service interruption. Disconnection of equipment shall be restricted to the minimum amount necessary to isolate the fault from the supply.

The low voltage network shall be a cascaded architecture with full discrimination.

8. CORROSION PROTECTION

The Transnet's requirements for protective coating of iron and steel structures against corrosion is used and must be read in conjunction with the main specification as well as the following (latest editions):

SANS 10064: The preparation of steel surfaces for coating

SANS 121 Hot-dip galvanized coatings on fabricated iron and steel articles

SANS 1091: National colour standards for paint

BS 5493 Code of practice for protective coating of iron and steel structures against corrosion

The coatings specified are chosen according to BS 5439, Table 3, Part 9, to ensure that the condition of the surface will be at least RE2 on the European scale of degree of rust, after 10 years in an environment of frequent salt spray, chemicals and polluted

Galvanizing shall be done to SANS 121 heavy duty hot dip galvanizing to a thickness of at least 85µm.

9. ELECTRICAL, LIGHTING AND POWER

9.1 Electrical Power Supply

Power supply to the building will consist of normal supply and UPS supply. UPS power will be provided for selected essential services. Computers, IT equipment, and emergency exit lighting are considered to be essential services.

The electrical power supply to the building will be sourced from eThekweni Municipality's 400 V kiosk to be installed by them. Total demand will be informed by the Contractor's detail design and calculations.

The estimated load for the building shall be determined by using the method stipulated in SANS 10142-1, Annexure D

- a) For each lamp, the rated lamp load, at least 60W
- b) For sockets outlets, 3kW for the first 50 m², alternatively 5kW for the first 100 m² and 1kW for each additional 100 m² or part of 100 m².
- c) For water heaters and all other equipment, the total rated load.

The diversity factors that shall be applied to the connected load to assess the estimated load are the following:

- a) for appliances:
 - 1) lighting, heating, cooking and socket-outlet loads : 0,50;
 - 2) water heater loads and all motor loads : 1,00;
- 3) for elevators:
 - 1. elevator : 1,00
 - 2. elevators : 0,75
 - 3. or more elevators : 0,60

The mechanical engineering discipline shall provide the power requirements for the mechanical loads.

9.2 Low Voltage Standby Supply

The standby power supply at the installation shall be provided from a diesel engine generator set. The generator must be specified such that it starts automatically following a mains supply failure, this means that it must be specified with an automatic change over panel.

The standby generator set shall generate power at 400V, 3 Phase, 50Hz and shall be rated to supply emergency power only to the installation.

The generator will be an outdoor type unit enclosed in a weatherproof canopy provided by the supplier.

The generator shall be provided with a day tank that will be located at the bottom of the unit that will be manually refilled. A suitable location of the generator will be discussed and agreed with the architect and a concrete plinth will be constructed by the main contractor once the weight of the unit is confirmed by the supplier.

The selected rating of diesel generator shall ensure that the continuous running load on the generator will not be less than 30% of the engine rated output power in order to avoid problems associated with engine choking and resultant loss of reliability. The contractor shall design, supply and install the diesel generator in accordance to specifications BBH 2723 and TPD 009 – Standby plant specifications.

9.3 Distribution Boards

Distribution boards(DB's) shall be installed in each floor of the building i.e. first floor and ground floor.

All distribution boards shall comply as a minimum to SANS 10142-1 and TPD: 002-DBSPEC. All distributions boards shall be configured to FORM 1 and FORM2B as applicable.

All DB's shall be equipped with surge protection at Class 1, 2 and 3 at different tiers of distribution as relevant.

The enclosure for the main DB shall be surface mounted type manufactured from minimum 2mm 3CR12 stainless steel.

Where flush mounted switchboards are required, the recessed switchboard tray shall be built into the brick or concrete wall. All conduits from the floor or roof shall be fully

recessed and shall be bonded directly to the tray by means of locknuts on both sides and the ends of the conduits fitted with a brass bush.

Where surface mounted switchboards are specified but where the conduits can be fully recessed, the conduit shall be connected to a recessed connection box installed behind the switchboard. An opening with the same dimensions as the connection box shall be cut in the back of the switchboard and fitted with a suitable grommet.

The enclosure shall be supplied with hinged doors and epoxy powder coated orange (40 microns) with an IP 65.

All distribution boards shall be supplied with 30% spare ways for future expansion.

The distribution boards shall be earthed as per SANS 10142-1.

9.4 Wireways

Wiring throughout the building shall be done using suitable Unistrut, cable tray/ ladder and trunking or exposed conduits. Drawing layout with the complete tray/ladder or trunking system shall be prepared.

According to application, cable trays / ladders and fittings will be of galvanised steel, aluminium, rigid PVC M1 material, 316 stainless steel, or fibre-glass material. All the necessary supports, channels, brackets, straps and hangers shall be of compatible material.

Cover plates of the same material as the tray / ladder shall be provided as required and wherever trays / ladders are in close proximity to personnel or mechanised traffic, such as vertical trays / ladders emerging through floors or horizontal tray / ladder near stairs or walkways.

Cable trays/ladder or trunking shall be mounted and located to ensure reasonable access for installation and maintenance.

Metallic cable trays / ladders shall be installed with a minimum of 6mm² bare copper ground wire, bonding all tray / ladder sections. Bonding between sections with fish plate connection pieces shall be acceptable as directed by the Electrical Engineer.

The cable tray / ladder or trunking loading shall be limited to 40% of available fill volume and to two layers of cables.

Cables in vertical trays / ladders shall be adequately tied to the tray / ladder with synthetic, non-flammable ties or stainless steel as directed by the Electrical Engineer

Common wire-ways will only be permitted for relatively light current-carrying conductors such as lighting and socket-outlet circuits. Heavy current-carrying conductors such as feeders to distribution boards and large power points, shall be installed in separate conduits or wire-ways.

9.5 Manholes

Underground manhole locations and configurations shall be engineered to suit the site constraints and to ensure that the minimum bend radii of associated cables can be accommodated for.

Manholes must be suitably sized to allow easy manual handling and ergonomics for the installers and the maintenance staff.

Manhole covers shall be designed such that they shall not be movable by hand by more than one person for security purposes.

Sleeve arrangements in manholes shall be adequately spaced to ensure minimum deration of the main supply cables.

Sleeves shall cross roads and railway tracks at right angles.

Spare sleeve capacity to service future expansion requirements shall be catered for.

Manholes shall be equipped with suitable drainage and/or sumps to ensure that any water collecting in the manholes shall drain in a reasonable time period.

9.6 LV Cables

Wiring throughout the building shall be done using suitable Unistrut, cable trays or exposed conduits. Self-protected (mechanically shielded, ECC type) cables will be specified where required. Conductor characteristics for power and control shall be in accordance with site conditions and the required service.

Conductors for special purposes, multi-conductor cords and cables shall use extra flexible stranding for the required service. Various sizes and type of low voltage cables shall be used for different applications.

Low voltage cables shall provide LV power supply to building's lighting, exterior lighting, and other applications. All LV cables are to be rated at 400V, current carrying capacity may vary.

Cables installed externally shall be laid in accordance to the Specification No. TPD: 003-CABLESPEC

Cable markers shall be installed at the beginning and end of a cable run (e.g. where a cable enters a substation or building), at all changes of direction, above all joints, above cable pipe entries and exits and at intervals not exceeding 50 m along the cable route.

All Cable calculations shall be simulated on ETAP/ABB Doc and or manual calculations from first principles.

Cable shall be sized for current carrying capacity with applicable de-rating factors (i.e. ambient temperature, conduit fill, conduit spacing, altitude de-rating factors and others) shall be used in sizing the cable for the intended application. The conductor size shall be increased for long runs where the voltage drop exceeds the specified value.

A Cable selection guide shall be used as a reference basis.

9.7 Conduit System

Conduit System shall meet at least the following:

The preferred method for outdoors facilities shall be UV resistant schedule 80 PVC conduits.

Special applications requiring PVC covered galvanised conduit shall be UV resistant.

The minimum size of conduits shall be as per SANS 10142-1.

Conduit expansion fittings will be employed in each conduit supported by a building structure, where the conduit crosses a building or structure foundation expansion joint.

Conduit sleeves will be provided for all penetrations. All penetrations through walls, ceilings and floors shall be sealed dust-tight and with fire stop.

The ends of all sleeves shall be sealed with a non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall likewise be sealed.

Where conduit rises above ground or finished floor levels, the conduit shall be sealed using suitable polyurethane foam that is removable.

9.8 Lighting

9.8.1 Lighting Levels

The lighting lux level calculations shall be undertaken using computer programs based on the inverse square law method. The results for all calculations shall be attached in the design report after all simulations are completed. The lighting designs shall be concluded to meet the minimum average values of maintained illuminance measured on the horizontal plane according to OHS Act 83 of 1993, SANS 10114-1, SANS 10114-2, SANS 10389-1.

The lighting lux levels shall be designed to the following minimum average values of maintained illuminance as measured on working planes unless otherwise indicated:

Table 5: Lighting Levels

Offices and meeting rooms	500 lux
Reception areas	200 lux
Reception desk	300 lux
Passages	200 lux
Kitchen and canteen	200 lux
Store rooms	150 lux
Toilets, showers and change rooms	200 lux
Stairway	150 lux
Print room	300 lux
Exterior lighting – For safety & security	10 lux
Parking lots (Medium traffic)	10 lux

Special attention will be given to illumination at exit and moving machinery. Where high intensity discharge lamps are installed emergency lighting units shall be provided to avoid dark areas after black-out (especially to provide safe means of egress). Energy saving lighting luminaires shall be used.

9.8.2 Interior Lighting

Interior lighting design shall aim to ensure safety of personnel in industrial applications and enhance accuracy of personnel in office based applications. Interior lighting shall consist of the following:

- All lighting circuits shall be self-controlled using occupancy sensors and or manually controlled using light control switch.
- All interior lighting luminaires shall be either ceiling recessed, roof structure surface mounted and or suspended on the roof structure.
- All areas which are classified as hazardous, shall include flameproof (Exd type) luminaires and or equipped with flameproof luminaire enclosure.
- All office based rooms shall have luminaires with a suitable reflector system to ensure that lighting is directly aimed to the desired areas.
- All ablution rooms including but not limited to the locker rooms shall have a vapour ingress protected luminaire enclosure or shall be of prismatic type luminaires.
- All kitchen and mess rooms shall be contain a vapour ingress protected luminaire enclosure or shall be of prismatic type luminaires.
- Boardrooms luminaires shall be equipped with a control gear to enable output light level control in the form of dimming.
- In the case where building management system is available, all interior luminaires shall be equipped with a control gear to enable electronic and remote control of the lighting in buildings.
- Down-lighters shall be used in areas such as boardrooms, passage and building reception areas for aesthetics purposes.
- All interior lighting luminaires shall be LED type unless otherwise specified or unavailable for the type of application.
- In the case where fluorescent type luminaires are used in the design, T5 fluorescent tubes shall be used as the luminaires.
- Maintenance of all interior luminaires shall be by “plug out” and repair philosophy without the need for interruption of any of the lighting circuits.

- Lighting circuits will be provided for reducing lighting levels during daylight and reduced activity periods e.g. weekends in offices as required.

9.8.3 Emergency Lighting

Emergency lighting designs shall be completed for safe evacuation in case of emergency and or for continuous lighting operation in critical areas. Emergency lighting designs shall be included in the following scenarios:

- Each exit points intended to be used in an emergency
- Where mandatory emergency exit and safety signs are installed
- All emergency evacuation corridors and stairways

Emergency lighting designs shall consist of the following:

- Emergency lighting will be provided using self-contained and automatic charging autonomous units with maintenance free batteries, suitable for the environment in all areas of the building.

9.8.4 Exterior Lighting

The lighting levels shall be designed in accordance to SANS 10389-1:Artificial lighting of exterior areas for work and safety. The lighting lux levels shall be designed to the minimum average value of 10 lux. Outdoor lighting in general shall be photoelectric cell controlled. Exterior lighting will be provided with lighting fixtures mounted on the outside structure of the building. The exterior lighting shall be at an illumination level to ensure a high definition.

9.9 Earthing and Lightning Protection

Earthing & lightning protection shall be designed accordance to Specification No. TPD: 004-EARTHINGSPEC, SANS 10142-1 section 6.12-6.13 , SANS 62305 and SANS 10313.

For the purpose of design, the ground / earth resistivity shall be measured on the site of the future installation during installation.

Soil treatment may be employed around the ground / earth grid / earth rods to reduce conductor resistance to earth to meet the overall ground / earth resistance requirements if necessary and with permission of the Electrical Engineer.

Building steel columns, railways, substation structures, overhead cranes, fences, etc. shall be grounded / earthed.

Particular site conditions shall be considered for the design of lightning protection:

- A study by the successful contractor shall be performed which shall include soil resistivity tests at the proposed earth spike areas.
- Should the study indicate that lightning protection is not required, the specialist shall approach the Electrical Engineer for a final decision regarding the installation of lightning protection (The specialist shall not assume that lightning protection may not be required based on the outcome of his study).

9.10 Surge Protection

All Distribution boards shall be equipped with surge protection at Class 1, 2 and 3 at different tiers of distribution. The surge protection devices shall be protected by back up fuses or suitably selected circuit breakers.

9.11 Specialist Installations

It is envisaged that the following specialist work packages shall be for the contractors design. It is further understood that the necessary due diligence will be adhered to by a suitably qualified professional acting on behalf of the contractor.

Where reference is made to this package elsewhere in this document it is to illustrate philosophies and conceptual ideas for further development:

- Earthing and lightning protection.