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Title: **BULK METERED POINTS LOAD CONTROLLER STANDARD**

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Content

1. Introduction

Eskom has implemented load limiting on installed smart meters in Gauteng, Fourways area. Instead of implementing load shedding when the system is constrained, smart meters on selected feeders are load limited to about 12.5% of the maximum load for the duration of load shedding. This leaves customer with enough power for light and electronic appliances but not enough to run heavy electricity consumption appliances such as geysers, stoves, pool pumps etc.

The selected feeders also have bulk metered customers and large power users that cannot be load limited using a smart meter. Bulk metered customers are mainly customers staying in complexes with multiple apartments where Eskom is only metering the bulk supply to the complex and apartments/houses are metered by a third-party company responsible for payments of the bulk point.

As such, a different automated system/solution is required to load limit or disconnect bulk metered customers and large power users during load limiting so that the selected feeders can give back the required megawatts during load shedding/limiting.

2. Supporting clauses

2.1 Scope

This document details requirements for Eskom's bulk load control solution.

2.1.1 Purpose

The purpose of this document is to detail requirements for Eskom's bulk load control solution.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] SANS 60947-2, Low-voltage switchgear and control gear Part 2: Circuit-breakers

[2] SANS 556: 2004, Low-voltage switchgear and control gear Part 1: Circuit-breakers

[3] SANS 1186-1, Symbolic safety signs Part 1: Standard signs and general requirements

[4] SANS 60529, Degrees of protection for enclosures (IP code)

[5] SANS 1091, National colour standards for paint

[6] SANS 60947-4-1 Low-voltage switchgear and control gear Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters

[7] Eskom's Technical bulletin 240-98195962 - chemical treatment of 3CR12 kiosks.

[8] 240-61266818: Specification for GSM/GPRS Modems for Remote Metering

[9] NRS049:2016 - Advanced Metering Infrastructure requirement for smart metering system

2.2.2 Informative

[10] ISO 9001 Quality Management Systems.

2.3 Definitions

2.3.1 General

Definition	Description
Bulk Load Control equipment	Equipment or a combination of equipment, providing dedicated functions intended to control the supply to the premises. This could be a whole current meter or a motorized circuit breaker
Bulk Load Control interface	On-board or off-board component that implements the communication with the BSCE. This could be a meter or any other devices with similar capabilities.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
4G	Fourth-generation wireless standard
AMI	Advanced Metering Infrastructure
BLCE	Bulk Load Control Equipment
BLCI	Bulk Load Control Interface
CIU	Customer Interface Unit.
GSM	Global System for Mobile communication
HES	Head End Systems
LCS	Load Control Switch
LPU	Large Power User
LTE	Long-Term Evolution
LV	Low voltage
MCCB	Molded Case Circuit Breaker
MIG	Metal Inert Gas
MMA	Manual Metal Arc
NB-IoT	Narrowband Internet of things
PAW	Plasma arc welding
ERPS	Enterprise Resource Planning System
PVC	Polyvinyl chloride
TIG	Tungsten Inert Gas
UV	Ultraviolet
WAN	Wide Area Network

2.5 Roles and responsibilities

Not Applicable

2.6 Process for monitoring

Not Applicable

2.7 Related/supporting documents.

Not Applicable

3. General requirements

The solution specified herein shall be for large power user (LPU) supplied by Eskom's low voltage (LV) network.

3.1 Bulk load control interface

3.1.1 Functional requirements

Figure 1 below, presents the reference architecture for the deployment of the bulk load control solution within Eskom. In Figure 1 the Head End System represents one of Eskom's existing HES. Furthermore, as per Figure 1 the BLCI can be implemented as an off-board (standalone) device or on-board device embedded in the BLCE.

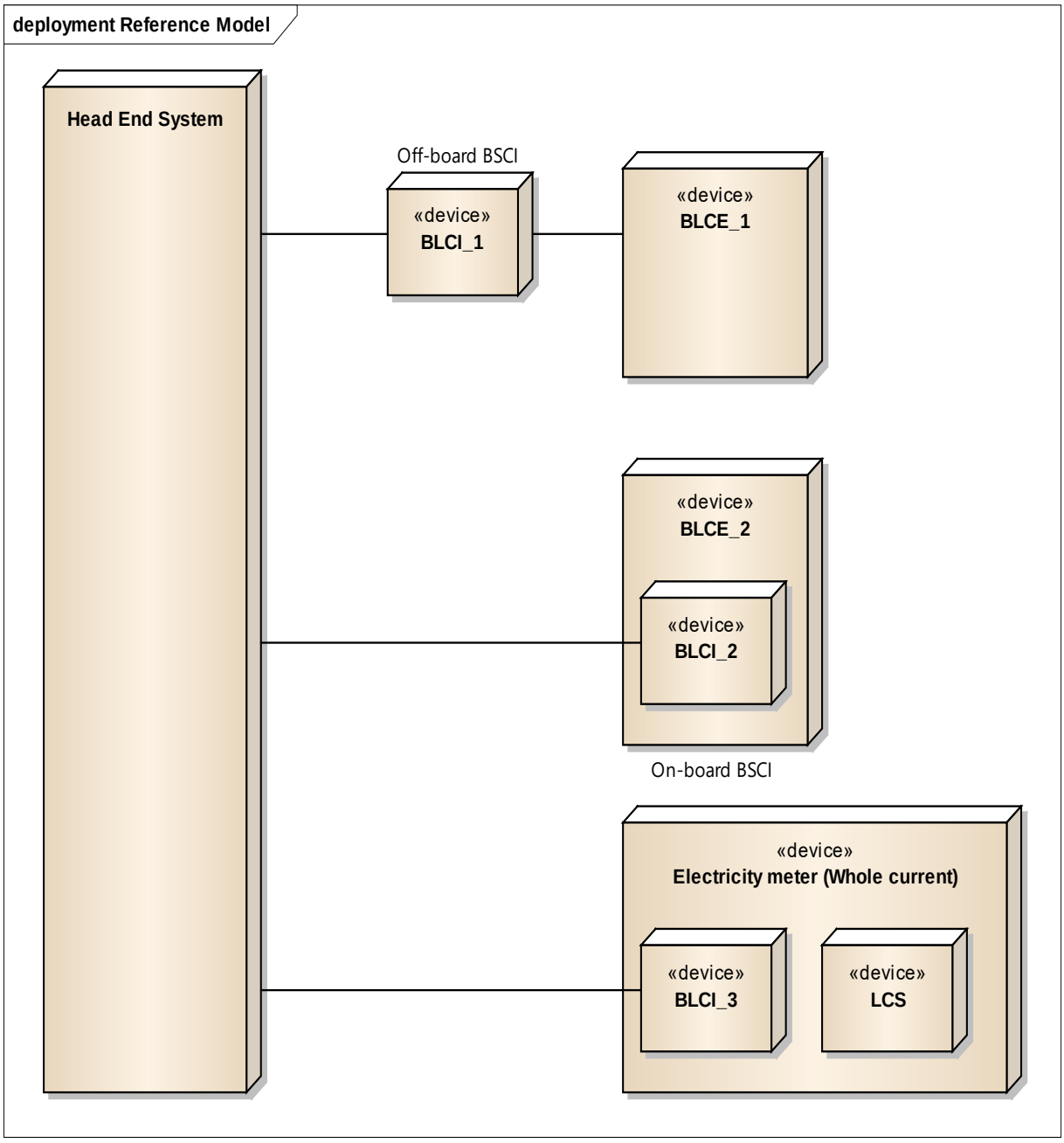

Figure 1: Reference architecture

The BLCI shall provide a communication interface to enable the actuation of remote disconnect / reconnect commands from the HES by the BLCE.

The BLCI shall be capable of communicating the status of the BLCE ('load disconnected' or 'load reconnected') to the HES.

The BLCI shall be capable of receiving load limiting / controlling parameters from the HES (e.g., "load limit threshold" or "demand limit threshold") and locally, monitor the actual load current or demand in comparison to the set current or demand threshold. Where the actual load exceeds the threshold, the BLCI shall issue a command signal to the BLCE to disconnect the load and enter into a lock out mode for a configurable period. Reconnection of the BLCE shall be prohibited during the lock out mode period.

The BLCI shall be supplied with Customer Interface Unit (CIU) for the purpose of displaying the status of the BLCI and any other useful customer information. It shall be possible to display the CIU information on the mobile phone.

The BLCI shall give a clear indication if the load has been disconnected due to power limit. This indication shall exist for as long as the BLCE is in the "off" state due to this condition.

The current or demand threshold shall be configurable from 0 to the maximum demand or current of the intended supply point.

The BLCI shall be capable of measuring and recording demand and current over configurable intervals of 5, 10, 15, 30, 60 minutes.

The BSCI shall have a real time clock configurable remotely through the HES. The BLCI shall maintain an accuracy to within 20 parts per million under reference conditions. Where a replaceable battery is used to maintain the time keeping function in the device, it shall be fitted under a separate cover. By design the battery shall have a minimum shelf life of ten years and a minimum standby service life of three years in the absence of supply to the device. During any loss of supply, the time of the clock shall be maintained for at least 7 days.

3.1.2 Remote information displayed on CIU

3.1.2.1.1 The CIU shall receive and display a free-format text message sent from ERPS or HES to the CIU of a single designated customer or to a group of designated customers.

3.1.2.1.2 The length of the text string shall be constrained by the capability of the type of interface on the CIU. In general, provision shall be made for text string lengths of 160 characters.

3.1.2.1.3 The CIU shall also receive and display the following information sent from the HES or HHU:

a) notification of impending supply disconnection when in post-payment mode;
b) notification of impending supply interruption;
c) notification of impending power limit reduction;
d) notification of appliance disconnection; and
e) notification of appliance reconnection.

3.1.3 Load control requirements

3.1.3.1 General

In order to spread the transition surge during group disconnect and reconnect actions a programmable random delay from 0 to 120 seconds in steps of 1 second shall be programmed into the load control algorithm.

It shall be possible for the meter to accept and process a command from the ERPS or HES to remotely program and operate the load control functions per single BLCI or per group of meters. Remote interrogation of the load control functions shall be performed per single BLCI by the HES.

Each disconnect and reconnect operation shall be treated as an event that will be recorded by the BLCI and sent to the HES.

Use cases for demand reduction shall apply to import and export energy. Import and export demand reduction control shall be separately programmable and shall function independently from each other.

Each phase of the supply shall be separately programmable from the other phases, but all phases shall disconnect or reconnect together.

An appropriate message is sent to the CIU and the mobile phone for each disconnect and reconnect event, indicating the cause of the event. A power bar shall also be displayed, indicating the active power limit setting and the actual power as measured by the BLCI

3.1.3.2 Remote load control configuration

The BLCI shall accept and process the load control parameters programmed into the BLCI from the ERPS or HES.

3.1.3.3 Local load control configuration

The BLCI shall accept and process the load control parameters programmed into the BLCI from the ERPS via the HHU.

3.1.3.4 Remote reading of load control status

The BLCI shall accept and process a request from ERPS or HES to read the load control parameters and the status of the load switch of the BLCI

3.1.3.5 Local reading of load control status

The BLCI shall accept and process a request from HHU or CIU to read the load control parameters and the status of the load switch of the BLCI.

3.1.3.6 Remote supply disconnection

The BLCI shall accept and process the command from the EPRS or HES to remotely disconnect the supply to the customer's premises. The event is displayed on the CIU.

3.1.3.7 Remote supply reconnection

The BLCI shall accept and process the command from the EPRS or HES to remotely reconnect the supply to the customer's premises. The event is displayed on the CIU.

3.1.3.8 Local supply disconnection

The supply to the customer's premises is disconnected by the HHU, CIU or mobile phone. The event is displayed on the CIU or the mobile phone if there is sufficient power reserve available.

3.1.3.9 Local supply reconnection

The supply to the customer's premises is reconnected by the HHU, CIU or from the mobile phone. The event is displayed on the CIU or the mobile phone.

3.1.3.10 Remote demand control through load limiting

3.1.3.10.1 There shall be a programmable restricted demand limit and a programmable emergency demand limit, which will normally be set below the restricted limit.

3.1.3.10.2 The restricted and emergency demand limit control functions shall be activated and deactivated by the ERPS or HES and sent to the BLCI via the AMI network.

3.1.3.10.3 The control algorithm shall operate in the following steps:

3.1.3.10.3.1 The CIU shall warn the customer 60 minutes ahead of time that the demand limit is about to be activated.

3.1.3.10.3.2 It shall sound an audible alarm and display the current demand value, the new limit value that will be activated and the duration for which the new limit will be applied.

3.1.3.10.3.3 An audible alarm on the CIU and the mobile phone shall also warn the customer if the demand limit is about to be exceeded and shall automatically cancel when the demand falls below the warning threshold. The warning threshold shall be programmable from 5 % to 20 % in increments of 5 % below the active demand limit.

3.1.3.10.3.4 The customer is able to pro-actively reduce his current demand to below the required new limit by switching off some of his appliances by means of manually switching off running appliances.

3.1.3.10.3.5 During the time that the demand limit is active, the load switch shall open if the average kW demand during the last A minutes is greater than the active demand limit B kW, where:

a) A is programmable from 1 to 60 minutes in steps of 1 minute.
b) B is programmable from 1 to rated demand in steps of 0,5 kW.

3.1.3.10.3.6 The load switch shall remain open for a period of C minutes, where C is programmable from 1 to 60 minutes in increments of 1 minute, after which it shall automatically reclose.

3.1.3.10.3.7 If the demand still exceeds the active demand limit, the value of C shall increment by a programmable amount and then recursively repeat from step 4) above until the demand reduces to below the active demand limit, or until the demand limit function is deactivated by the ERPS or the HES.

The emergency demand limit control function shall operate the same as for restricted demand limit control, except that it shall take priority over any other active load control function.

The emergency demand limit shall remain active for a duration of D hours, programmable from 1 to 24 h in steps of 1 h, after which the BLCI shall resume its previous operational state.

3.1.3.11 Local demand control through load limiting

3.1.3.11.1.1 The BLCI restricts the demand limit in accordance with a programmable schedule.

3.1.3.11.1.2 The demand limit schedule shall be activated and deactivated by the ERPS or the HES.

3.1.3.11.1.3 Provision shall be made for 5 times intervals per day from Monday to Friday and 5 times intervals per day from Saturday to Sunday. During these time intervals the load control shall operate automatically in accordance with the programmed schedule.

3.1.3.11.1.4 The control algorithm shall operate in the following steps:

a) the CIU shall warn the customer 60 minutes ahead of time that the demand limit is about to be activated

b) it shall sound an audible alarm and display the current demand value, the new limit value that will be activated and the duration for which the new limit will be applied.

c) an audible alarm on the CIU shall also warn the customer if the demand limit is about to be exceeded and shall automatically cancel when the demand falls below the warning threshold.

NOTE The warning threshold shall be programmable from 5 % to 20 % in increments of 5 % below the active demand limit.

d) the customer is able to pro-actively reduce his current demand to below the warning threshold by switching off some of his appliances by means of manually switching off running appliances, and

e) during the time that the demand limit is active, the load switch shall open if the average kW demand during the last *A* minutes is greater than the active demand limit *B* kW, where:

i) A is programmable from 1 to 60 minutes in steps of 1 minute, and
ii) B is programmable from 1 to rated demand in steps of 0,5 kW

f) the load switch shall remain open for a period of C minutes, where C is programmable from 1 to 60 minutes in increments of 1 minute, after which it shall automatically reclose.

g) if the demand still exceeds the active demand limit, the value of C shall increment by a programmable amount and then recursively repeat the process until the demand reduces to below the active demand limit, or until the demand limit schedule automatically terminates, or until the demand limit function is deactivated by the ERPS or HES.

3.1.4 Communication requirements

The BLCI shall be capable of exchanging data and commands with either of the two existing Eskom Head End Systems over the public cellular network or any another Eskom approved network using the communication protocols implemented in the HES.

In order to provide a level of futureproofing, the telecommunication modems used in the BLCI shall be modular and capable of being upgraded in the field. It shall be possible for example, to replace GSM modem with another modem that supports any other WAN communication technology Eskom prefers.

The GSM modem shall be as a minimum 4G with NB-IoT enabled.

3.2 Bulk load control equipment

The BLCE shall be capable of safely disconnecting and reconnecting bulk loads at the supply points listed in below. This can be implemented using a motorised circuit breaker or contactor or an LCS embedded in a whole current electricity meter.

The BLCE shall be encased in an electrical kiosk intended for installation at the following supply points:

- 100 kVA supply point
- 200 kVA supply point
- 315 kVA supply point
- 500 kVA supply point

The BLCE could be a motorized circuit breaker, contactor or whole current meter with disconnecting capability that is able to carry the rated current of the bulk meter or large power user (LPU) of a specific point of supply.

3.3 BLCE kiosk requirements

3.3.1 Meter kiosk construction

The kiosks shall be manufactured from 1.5 mm 3CR12 steel except for the gland plate and base of the kiosk which shall be of 2mm 3CR12. The completed kiosk shall have an IP rating of 3 for protection against touching live parts and it shall have an IP rating of 3 for protection against ingress of liquids. (IP33)

Provision must be made for the kiosk to be ground mounted with the use of a kiosk base and pole mounted.

A rubber seal shall be fitted around the entire inside perimeter of the door sills to ensure sealing of the doors to the kiosk.

3.3.2 Box

The sides shall have vermin proof louvres with an effective width of 150mm and an effective height of 100mm at the top and bottom as shown in the relevant drawings. The width of the opening in the louvres shall be between 2mm and 5mm. A UV stabilised plastic mesh with openings of not more than 2mm shall be fitted onto the back of the louvre.

Sufficient space shall be allowed between the terminals of the load limiting equipment and the bottom of the kiosk to allow for ease of cable fitment.

3.3.2.1 Door surround

The door surrounds for the kiosk shall incorporate a splash proof sill around the inner border of the door opening of the kiosk.

3.3.2.2 Bottom of enclosure (Gland plate)

The gland plate shall form part of the box and shall not be a separate item. All the holes in the bottom of the enclosure for cable entries shall be fitted with square knockouts which cover the hole. The knockouts shall be spot welded onto the gland plate on one corner of the square.

An area surrounding the holes shall not be powder coated to allow for proper earthing of the cables through the glands.

The following holes for the fitment of the cables shall be provided as a minimum for the different options:

- 100kVA BLCE kiosk
    - 2 x holes for the fitment of compression glands to accommodate 70 mm^2 armoured 4 core cables.
    - 2 x holes for the fitment of compression glands to accommodate 150 mm^2 armoured 4 core cables.
- 200kVA BLCE kiosk
    - 4 x holes for the fitment of compression glands to accommodate 70 mm^2 armoured 4 core cables.
    - 4 x holes for the fitment of compression glands to accommodate 150 mm^2 armoured 4 core cables.
- 315kVA BLCE kiosk
    - 4 x holes for the fitment of compression glands to accommodate 150 mm^2 armoured 4 core cables.
    - 4 x holes for the fitment of compression glands to accommodate 185 mm^2 armoured 4 core cables.
- 500kVA BLCE kiosk
    - 6 x holes for the fitment of compression glands to accommodate 150 mm^2 armoured 4 core cables.
    - 6 x holes for the fitment of compression glands to accommodate 185 mm^2 armoured 4 core cables.
- Holes with knock-outs shall also be provided for the fitment of the kiosk to a kiosk base.

3.3.2.3 Busbars

Busbars installed for the fitment of the cables shall be of tinned copper. The minimum size of the busbars shall be:

- 100kVA BLCE kiosk
  - 20mm x 10mm.
- 200kVA and 315kVA BLCE kiosk
  - 32mm x 10mm.
- 500kVA BLCE kiosk
  - 40mm x 10mm.

If insulators are required to support the busbars, then they shall be 40mm long and 40mm diameter insulators. The insulators shall have a cylindrical shape (without sheds). The insulators shall have M10 inserts on either end. The minimum diameter of the flat circular surface where the insulator makes contact with the frame and busbar shall be 25mm. The insulators shall be coloured to indicate the phase of each busbar.

Holes for the fitment of the cables onto the busbars shall come fitted with stainless steel 35mm M12 set screws, nuts and spring washers.

The busbars shall be spaced to allow for sufficient clearances and ease of cable installation.

3.3.2.4 Earthing details

An earth stud shall be provided. The earth stud shall be an M10 35mm stainless steel set screw (welded onto the bottom plate) and bolt and nut.

All metal components of the panel, doors and devices shall be effectively connected to this earth stud by green 2.5mm^2 PVC insulated earthing conductors. All earth connections shall be as short as possible and shall not be coiled.

3.3.3 Door

The doors shall be fitted with stainless steel hinges on the left side of the door.

A sturdy door stay shall be provided on the doors to ensure that the door can be kept in a 90 º open position. The door stays shall be manufactured from a non-ferrous metal.

Stainless steel three-way lever locks suitable for a padlock with an 8mm diameter shackle shall be fitted horizontally on the right. The holes in the lever lock shall have a minimum diameter of 12mm. A protective box which is open on the bottom shall be fitted over the lever lock.

3.3.4 Base

The base shall be manufactured from 2mm 3CR12 steel.

Four M10 30mm stainless steel set screws, nuts and spring washers shall be provided to secure the kiosk onto the base. 13mm diameter holes shall be drilled or punched in the base and the nuts shall then be welded inside the base centred over the holes to allow the bolts to be screwed from the outside into the nuts.

Two inspection covers shall be fitted onto the front and back of the base and each shall be secured onto the base by six stainless steel set screws and nuts. The nuts shall be welded onto the inside of the base.

Six M8 20mm stainless steel set screws, nuts and spring washers for each of the cover plates shall be provided to secure the plates onto the base. 12mm diameter holes shall be drilled or punched in the base and the nuts shall then be welded inside the base centred over the holes to allow the bolts to be screwed from the outside into the nuts.

3.3.5 Set screws, nuts and spring washers

All set screws, nuts and spring washers used for the fitment of different parts or equipment in the kiosk shall be of stainless steel. All set screws and nuts shall be fitted with spring washers.

3.3.6 Fabrication of 3CR12 steel kiosks

All cutting, forming, forging, machining, welding, fastening, annealing, stress relieving, post weld cleaning and coating shall comply with the internal standards of the manufacturer of 3CR12 steel.

3.3.6.1 Cutting

In all cutting operations, whether thermal or mechanical, carried out on 3CR12 steel, no contamination by ferrous (iron or steel) material or particles shall take place. Sharp or rough edges shall be removed by manual grinding or filing.

3.3.6.2 Bending

It is important to ensure that there is no contamination of the 3CR12 steel from mild steel particles adhering to the tooling. It is recommended that the tooling be thoroughly cleaned before running 3CR12 steel.

3.3.6.3 Welding

For Manual Metal Arc (MMA) welding type 309L electrodes are recommended for welding 3CR12 steel, although E308L and E316L may also be used.

For Tungsten Inert Gas (TIG), Metal Inert Gas (MIG) and Plasma arc welding (PAW) the recommended welding consumables are AWS A5.9 ER309L, ER308L or ER316L.

When welding stainless steel studs, bolts or nuts onto 3CR12 steel it is recommended that the weld consumable shall be the AWS class 309L to avoid excessive weld metal dilution.

Where the manufacturer is using stud welding onto 3CR12 steel then 304L stainless steel studs shall be used.

Spot welding (resistance welding) shall only be used on parts of the kiosk that are not directly in contact with the outside atmosphere.

3.3.6.4 Post weld cleaning (pickling and passivation)

Post weld cleaning, pickling and passivation shall be done according to Technical Bulletin 240-98195962 - chemical treatment of 3CR12 kiosks.

3.3.6.5 Powder coating

Before powder coating can take place, it is very important to ensure that there is no oil present on the kiosk. The kiosk shall be degreased before powder coating.

The inner plate shall be powder coated with white epoxy-polyester powder (SANS colour code 69-0135) to ensure a coating thickness of between 60µm and 80µm.

The kiosk (box, roof and/or base) shall be powder coated with light navy grey polyester powder (SABS colour code G35) and the thickness shall be between 60µm and 80µm.

3.3.7 Meter kiosk electrical equipment

All equipment used within the kiosk shall be touch safe i.e. have enclosed terminals, recessed screws etc. They shall comply with clause 8.2 of IEC 60898, which states all the requirements for equipment to be touch safe.

Where equipment is used that does not allow for the touch safe requirement, then they shall be protected by means of suitable covers.

Any live part of the equipment shall have at least 20mm of clearance from metal parts that is connected to earth.

3.3.7.1 Wiring

All wiring shall be done in stranded copper PVC insulated conductor which shall comply with SANS 1507 and SANS 1411.

3.3.7.2 Contactors

Contactors shall comply with SANS 60947-4-1.

The rated breaking capacity of the contactors shall not be less than 8 times the nominal current.

Phase barriers between the phases shall be installed on both the load and supply side of the contactor.

The following size contactors shall be utilised:

- 100kVA BLCE kiosk
  - 150A contactor
- 200kVA BLCE kiosk
  - 300A contactor.
- 315kVA BLCE kiosk
  - 450A contactor.
- 500kVA BLCE kiosk
  - 800A contactor.

3.3.7.3 Circuit breakers

Moulded case circuit-breakers shall comply with SANS 556 and SANS 60947-2. Their operating mechanism shall be hydraulic-magnetic or electronic-magnetic.

The rupturing capacity of the circuit-breaker shall not be less than 20kA.

Phase barriers between the phases shall be installed on both the load and supply side of the circuit-breaker.

The following size moulded case circuit breakers shall be utilised:

- 100kVA BLCE kiosk
  - 150A MCCB
- 200kVA BLCE kiosk
  - 300A MCCB.
- 315kVA BLCE kiosk
  - 450A MCCB.
- 500kVA BLCE kiosk
  - 800A MCCB.

3.3.8 Notices, labeling and packaging

3.3.8.1 Notices

Notices shall be provided as required by the Occupational Health and Safety Act. All notices shall be fastened to the kiosks by self-tapping stainless-steel screws or by rivets.

A standard “Danger” notice in accordance with SANS 1186 shall be provided and placed on the front and back of the kiosk.

3.3.8.2 Labels

A label showing the name of the manufacturer, the date of manufacture and the various quality checks shall be placed on the inside of the kiosk door. The label shall be durable preferably of metal.

3.3.9 Packaging

Each kiosk shall be wrapped in bubble wrapping or cardboard before shipping to Eskom stores. This covering shall protect the kiosk and its components from reasonable transport related wear and tear from the supplier’s works to the end customer. The cabinet shall be clearly labelled as follows:

- Full delivery address
- Detailed content description as stated on the order.
- Dispatch date
- Eskom and supplier order number

Note: (Label shall also be placed inside the cabinet. This helps when the packaging is damaged.)

3.3.9.1 Kiosk identification

The kiosks shall be marked according to the size of the kiosk with a permanent black marker (pen) on the outside, top, left side of the door (front door). A stencil that represents an Arial font size 72 (± 18-25mm high) shall be used.

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Deon Van Rooi	Middle Manager – Technology and Engineering
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5. Revisions

Date	Rev.	Compiler	Remarks
February 2024	0.1	ME Makwarela	Document first issue

6. Development team

The following people were involved in the development of this document:

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7. Acknowledgements

Insert text here.