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SSEG > 30 kVA

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Additional requirements for renewable power plants (RPPs) > 30 kVA

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23 July 2018

Energy Directorate
Electricity Generation & Distribution (EGD)
Additional requirements for renewable power plants (RPPs) > 30 kVA

A. General

1. South African Distribution Codes (V6.0), i.e. Glossary and Definitions, Network, Information Exchange and System Operating.
2. Grid Connection Code (GC) for Renewable Power Plants (RPPs) connected to the electricity transmission system (TS) or the distribution system (DS) in South Africa (Version 2.9).
3. City of Cape Town Requirements for small scale embedded generation (SSEG)and referenced specifications.
4. Interlocking detail of RPP use after islanding, if considered, must be provided.
5. Ramp rates equivalent of 10% MW/minute of rated generation capacity shall be applicable.
6. Monitoring and maintenance requirements of RPPs and 5 yearly physical retesting par to the original commissioning detail must be provided. An electrical ECSA registered professional engineer/technologist/certificated engineer must declare the RRP compliant to requirements every 5 years. The 5 yearly physical testing includes SCADA connectivity and functionality tests with the City's Network Control Centre that requires a month upfront notification from the RPP of the planned test date.
7. For wheeling, refer to the Proposed Wheeling Rules, Business Processes and Implementation (in preparation).

Additional requirements for renewable power plants (RPPs) > 30 kVA [continue]

B. RPP > 1 MVA:

Renewable Power Plants Grid Code for Category B (1 MVA – less 20 MVA) and Category C (20 MVA or higher):

1. Electricity Regulation Act generation licence from NERSA will be required before connection approval will be provided. The City will issue a use of system (UOS) letter to connect the RPP to the City' electrical distribution system in support to obtain the generation licence.
2. NRS 097-1: Code of practice for the interconnection of embedded generation to electricity distribution networks - MV and HV is not yet published and the Eskom Specification 240-61268576: Standard for the interconnection of embedded generators, is applicable for RPP Grid Code Categories B and C and any specification deviations must be approved by the City. Inter alia requirements as follows:
   2.1 The City's MV point of utility connection (PUC) substation must have circuit breaker control functionality for tripping during out of bounds conditions and a protected substation is required in all cases, property owner is cost responsible to provide if not existing. Where the City's substations mentioned above are on the customer premises, it shall be accessible for the City staff at any time.

Additional requirements for renewable power plants (RPPs) > 30 kVA [continue]

2.2 Protection:

- 2.2.1 Minimum protection requirements depending on existing network and mode of generation [export or not]:
  - 2.2.1.1 Over current and earth fault
  - 2.2.1.2 Sensitive earth fault where applicable
  - 2.2.1.3 Phase under and over voltage [5 limb voltage transformer required to detect residual under and over voltage when a star connected transformer is used]
  - 2.2.1.4 Residual over voltage where applicable
  - 2.2.1.5 Under and over frequency
  - 2.2.1.6 Loss of grid
  - 2.2.1.7 Synchronising check interlocking
  - 2.2.1.8 DC failure monitoring
  - 2.2.1.9 Breaker failure monitoring
- 2.2.2 RPP GC Category B and C - customer MV supplied and MV embedded generation (EG): Eskom Specification 240-61268576 applicable until NRS 097-1 published.
- 2.2.3 RPP GC Category B - customer MV supplied and low voltage (LV) EG: Single controllable motorised LV circuit breakers that disconnects the decentralised embedded generators on the site will be acceptable under the following conditions:
  - 2.2.3.1 Protection inter-trip (not by means of wireless) required between customer point of supply (POS) protection equipment and all the City's MV PUC circuit breakers using hard wire or multi-mode optic fibre and input/output unit.
  - 2.2.3.2 Protection tripping during out of bounds conditions are:
    a) Stage 1: open all the EG LV breakers, and;
    b) Stage 2: open site POC MV consumer breaker/s.

2.3 A City SCADA remote access terminal (RTU) installed in the City's feeder PUC protected substation that is connected to RPP RTU in consumer POC substation by means of multi-mode optic fibre in duct for all the RPP GC control and signal requirements between the RPP and the City's Network Control. Communication by means of IEC 60870-5-101 for HV and IEC 60870-5-101& DNP 3 for MV (IEC 60870-5-104 might be considered as alternative for both).

2.4 RPP protection and SCADA schemes shall be compatible with the City infrastructure and RPP will be cost responsible if changes required to the City's infrastructure.

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Additional requirements for renewable power plants (RPPs) > 30 kVA [continue]

3. Information exchange required between the RPP and the City includes the provision of related network data that must be used for design, operation and control in terms of RPP GC (V2.9), inter alia of Section A12.3 as follows:
   - 3.1 Fault levels [Sections A12.3.3(1)(a)(ii); A12.3.4(a)(i), (ii) and (iii); A12.3.4(b)(i), (ii) and (iii).
   - 3.2 Equivalent network diagram and surrounding network [Sections A12.3.3(1)(b); and A12.3.4(c)].
   - 3.3 Worst case contingency scenario [Section A12.3.4(b)(iv)].
   - 3.4 Power quality data before and after RPP connection [Section A12.3.4(c)(v)].

   Note: RPP must model the plant with the City's fault level and provide DigSilent software detail of RPP after connection [Section A12.3.4(a)(iii)] for all the above.
4. All the RPP GC (V 2.9) requirements for control, signals and communication applies.

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Additional requirements for renewable power plants (RPPs) > 30 kVA [continue]

C. RPP > 30 kVA and < 1MVA

Renewable Power Plants Grid Code for Categories A2 (13.8 kVA – less 100 kVA) and A3 (100 kVA - less 1 MVA):

1. NRS 097-2-1: 2017 applies.
2. Centralised disconnection device (CDD) in terms of NRS 097-2-1: 2017, Section 4.2.2 that has a type tested network and system (NS) grid protection voltage and frequency relay that acts during abnormal conditions on the interface switch that incorporates two series connected appropriately sized robust load disconnect switches.
   - 2.1 The CDD is fully automated [Two in series switches automatically trips the total EG for any out of bounds condition using a hard wired (not by means of wireless) network and system (NS) grid protection voltage and frequency relay and restore automatically within specified requirements when all the out of bounds conditions dissipated or supply is restored from the PUC]. Manual restoration of the RPP is required by the property owner, if the CDD is not automatic.
   - 2.2 Labelling required at the PUC and POC.
   - 2.3 Property owners shall retrospectively install a CDD within 5 years from the City's commissioning approval, if not existing.
3. Category A3 RPP GC (V 2.9) requirements for control, signals and communication between the City's Network control and the RPP:
   - 3.1 RPP shall be equipped with the absolute production and power gradient constraints control functions as specified in RPP GC, Table 4. In addition, active and reactive power measurerands will be made available on the RPP Gateway.
   - 3.2 A RPP Gateway shall be provided with adequate communication ports that will be able to communicate with the City's DNP 3 over Ethernet protocol or IEC 60870-5-104. The following shall be provided:
     - 3.2.1 The RPP Gateway shall be an ADSL/3G router and must be VPN capable.
     - 3.2.2 RPP shall provide and maintain service level agreement with his/her own service provider and set up a VPN connection to the City's server.
   - 3.3 Property owners shall retrospectively install the abovementioned control, signals and communication equipment within 5 years from the City's commissioning approval, if not existing.

http://teamsites.capetown.gov.za/sites/esprotelmeas/SitePages/Home/.aspx/reference/ryno/vorms/requirements for category A3, B and C RPPs 2018-07-23

Grid-tied SSEG scenarios

Grid-tied SSEG

SSEG that is connected to the utility's electricity grid either directly or through a customer's internal wiring is said to be "grid-tied". SSEG that is connected to the grid through a reverse power flow blocking relay is also considered to be grid-tied.

Grid-tied hybrid SSEG

Grid-tied SSEG that islands after interruption of the utility supply or when the applicable electrical service conditions are outside stated limits or out of required tolerances and then supplies the load from the inverter, operating in the stored-energy mode via a suitably interlocked change-over switch, is said to be a "grid-tied hybrid" SSEG installation.

Off-grid SSEG

SSEG that is physically separated and electrically isolated from and can never be connected to the utility electricity grid – either directly or through a customer's internal wiring – is said to be "off-grid". Consumer loads cannot be simultaneously connected to the utility grid and the SSEG installation, and export of energy onto the utility grid by the generator must not be possible. SSEG that is connected to the grid through a reverse power flow blocking relay is not considered to be off-grid.

Passive standby UPS utilised as off-grid hybrid SSEG

Applies to any UPS operation functioning according to the following principle:

a. The normal mode of operation consists of supplying the load from the grid as primary power source.
b. When the latter is outside stated limits, the load is supplied from the UPS inverter, operating in stored-energy mode.

SSEG scenarios (continue)

Such a system is regarded as off-grid provided it is equipped with a suitably interlocked change-over switch, selectable as follows:

i. Charger/rectifier mode (normal): Batteries are charged by the SSEG installation or, if required, by the grid. The grid is the primary power source for all the loads, or;
ii. Inverter mode (when the grid supply is interrupted or applicable electrical service conditions are outside stated limits or required tolerances). The grid supply is disconnected and selected loads are supplied from the inverter, within the rating of the energy storage or SSEG.

Suitably interlocked change-over switch

Appendix 4: Suitably interlocked change-over switch for grid-tied hybrid SSEG and a passive standby UPS utilised as off-grid hybrid SSEG

a. This includes interrupters, transfer switches, bypass switches, isolation switches and tie switches.
b. The switch shall provide feedback of its position to the inverter/charger so that if the contacts fail to operate or malfunction [e.g. fused-closed contacts, inadvertent energising of the change-over switch coil, etc.], use of the inverter mode will be impossible.
c. The requirements of SANS 10142-1 Section 7.12.2.5 are applicable.
d. It shall be a separate, controllable switch, compatible with the applicable electrical service conditions and to the performance requirements of the passive standby UPS, in accordance with SANS / IEC 60947-6-1 and the following product specifications:
   - Static transfer systems (STS): SANS / IEC 62310-3.
   - Automatic transfer systems (ATS): SANS / IEC 60947-6-1.
   - Manual isolation, tie and transfer switches (MTS): SANS / IEC 60947-3.
e. The switch shall have a rated lightning impulse withstand voltage (BIL) of 4 kV at 1,2/50 µs in accordance with SANS / IEC 60947-1 (Tables H.1 and 12).
f. Characteristics of the transfer shall be break-before-make (open transition) – no transient cross-conduction during transfer. The transfer time of the switch shall be ≥ 20 ms.
g. The contactor gap of the switch shall exceed 4 mm in accordance with SANS 60950-1, S 2.10.3.3 and Table 2K for a fixed installation with overvoltage category 2.

Note: The Certificate of Compliance with the accompanied test report must provide detail of the suitably interlocked change-over switch as above in Sections 3 and 4 of the SANS 10142-1 Test report.

NRS 097-2-1: 2017 central disconnection device (CDD)

4.2.2.2.5 The disconnection device shall disconnect the generator from the network by means of two series connected robust automated load disconnect switches.

4.2.2.2.6 Both switches shall be electromechanical switches.

4.2.2.2.7 Each electromechanical switch shall disconnect the embedded generator on the neutral and the live wire(s).

NOTE The switching unit need not disconnect its sensing circuits.

4.2.2.2.9 A static power converter without simple separation shall make use of two series-connected electromechanical disconnection switches.

4.2.2.2.13 All EG installations larger than 30 kVA shall have a central disconnection device.

NOTE 1 This requirement may be amended by the utility, i.e. the utility may require a central disconnection switch unit for any size and type of generator.

NOTE 2 This requirement may be amended by the utility. The central disconnection switch unit will typically be waived only when a lockable disconnection switch, accessible to the utility, is installed.

NOTE 3 This is an interim requirement based on requirements of VDE AR 4105 and will be revisited as more information becomes available.

4.2.2.2.14 The network and system grid protection voltage and frequency relay for the central disconnection device will be type-tested and certified on its own (stand-alone tested). All clauses of 4.2.2, except 4.2.2.4 (anti-islanding) apply.

RPP GC communication/control (>100kVA)

Table 4: Control functions required for RPPs

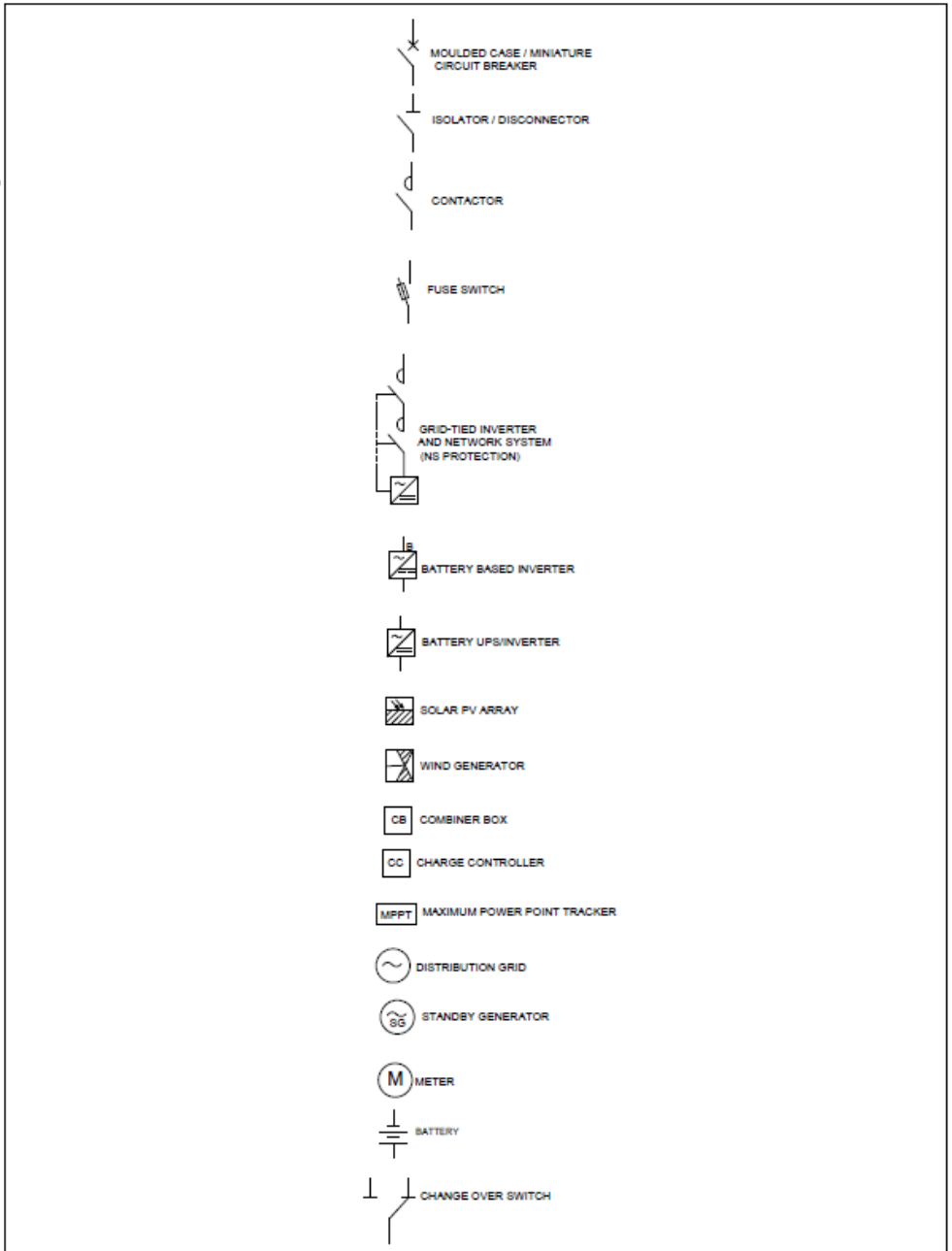
Control function	Category A3	Category B	Category C
Frequency control	-	-	X
Absolute production constraint	X	X	X
Delta production constraint	-	-	X
Power gradient constraint	X	X	X
Q control	-	X	X
Power factor control	-	X	X
Voltage control	-	X	X

RPP GC communication/control (>100kVA) [continue]

1. Power gradient constraint:
    a) Default positive and negative ramp rate: 10% of generation capacity [MW/min].
    b) NCC positive and negative ramp rate setpoints:
        i. 50% of default
        ii. default
        iii. 150% of default

2. Absolute production constraint:
    a) Default is 100% of generation capacity, dependant on irradiation and RPP efficiency [MW].
    c) NCC setpoints:
        i. 0% of default
        ii. 33% of default
        iii. 66% of default
        iv. default

SSEG schematic: Sht 1



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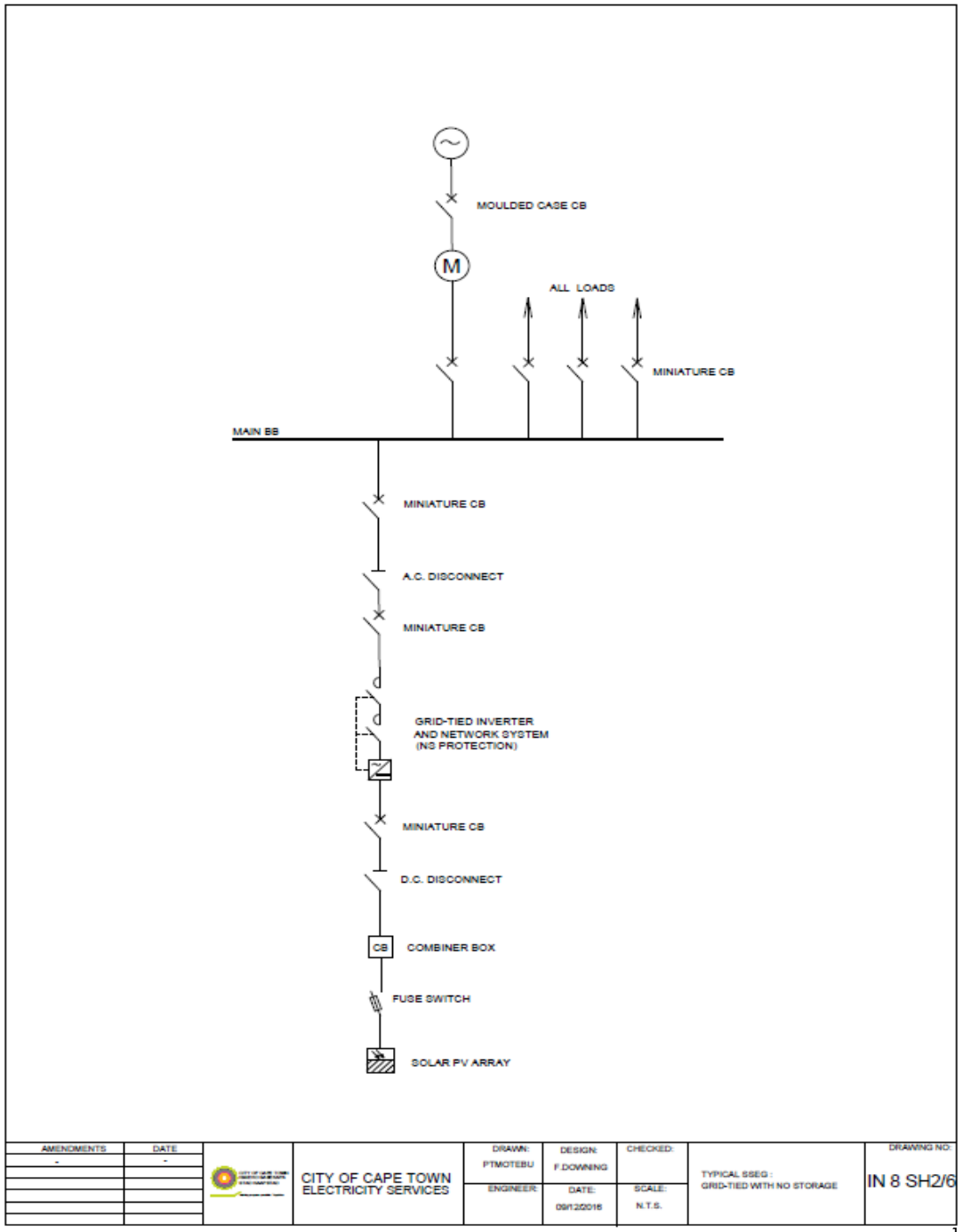
SSEG schematic: Sht 2



SSEG > 30 kVA

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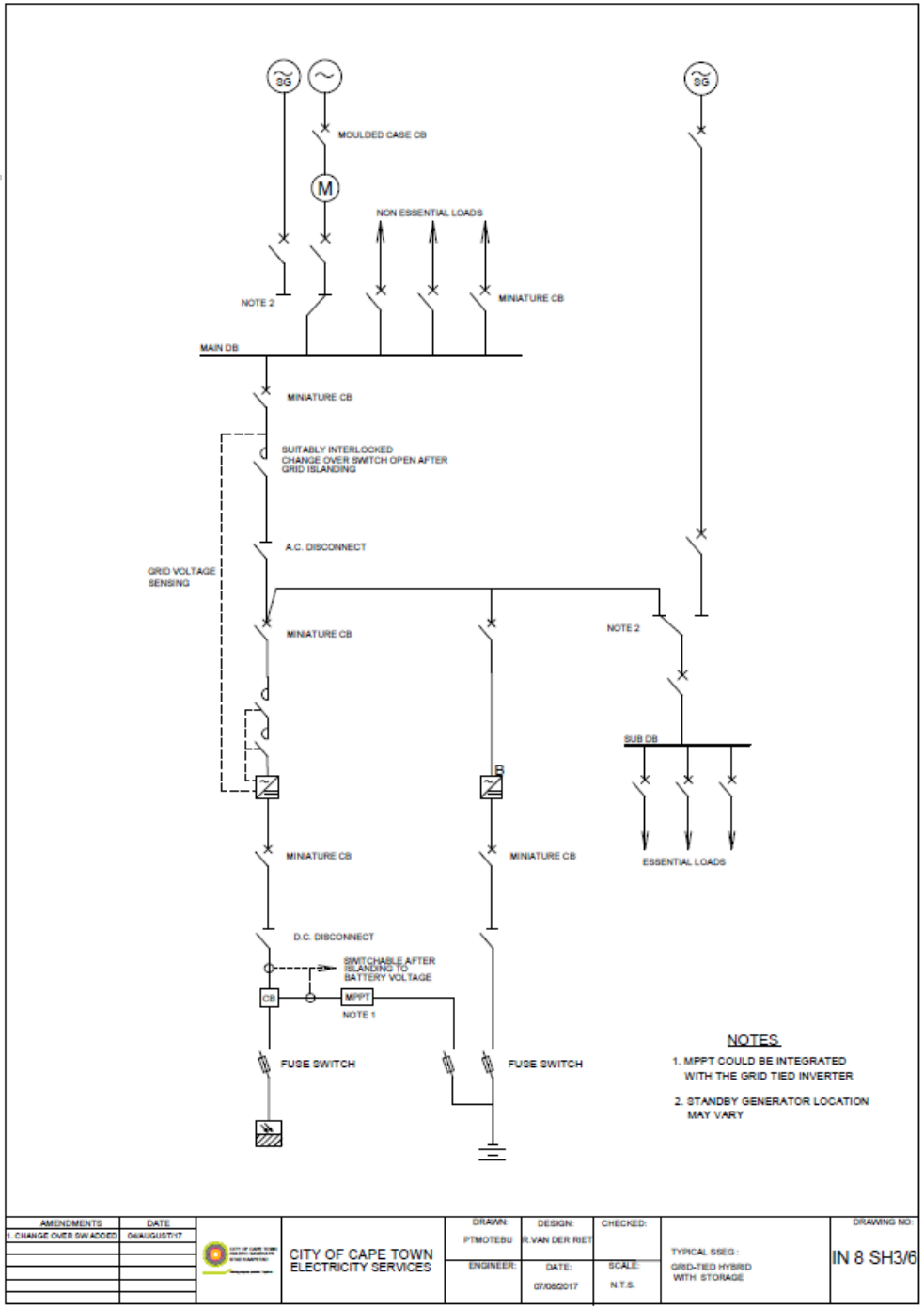
SSEG schematic: Sht 3



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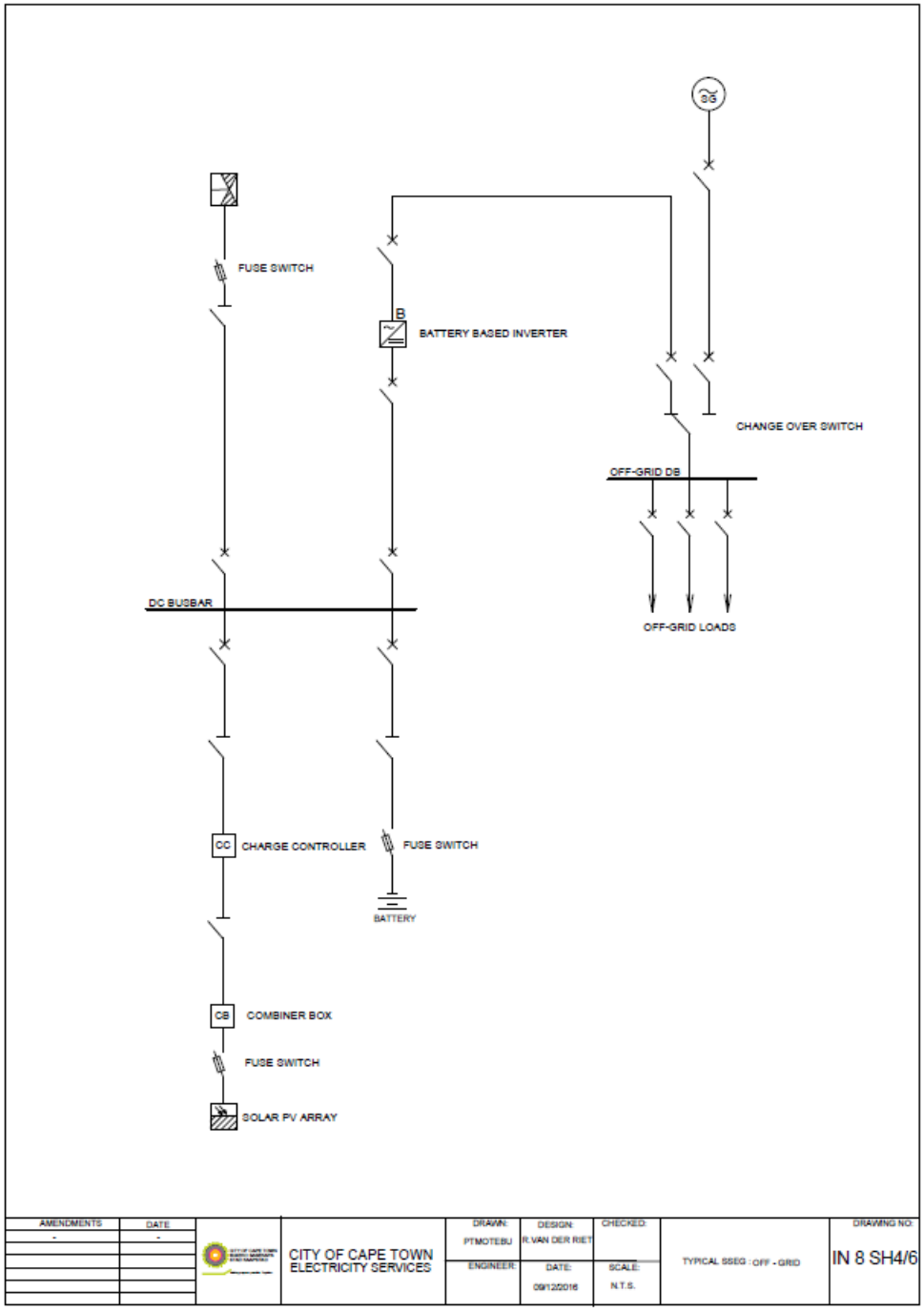
SSEG schematic: Sht 4



SSEG > 30 kVA

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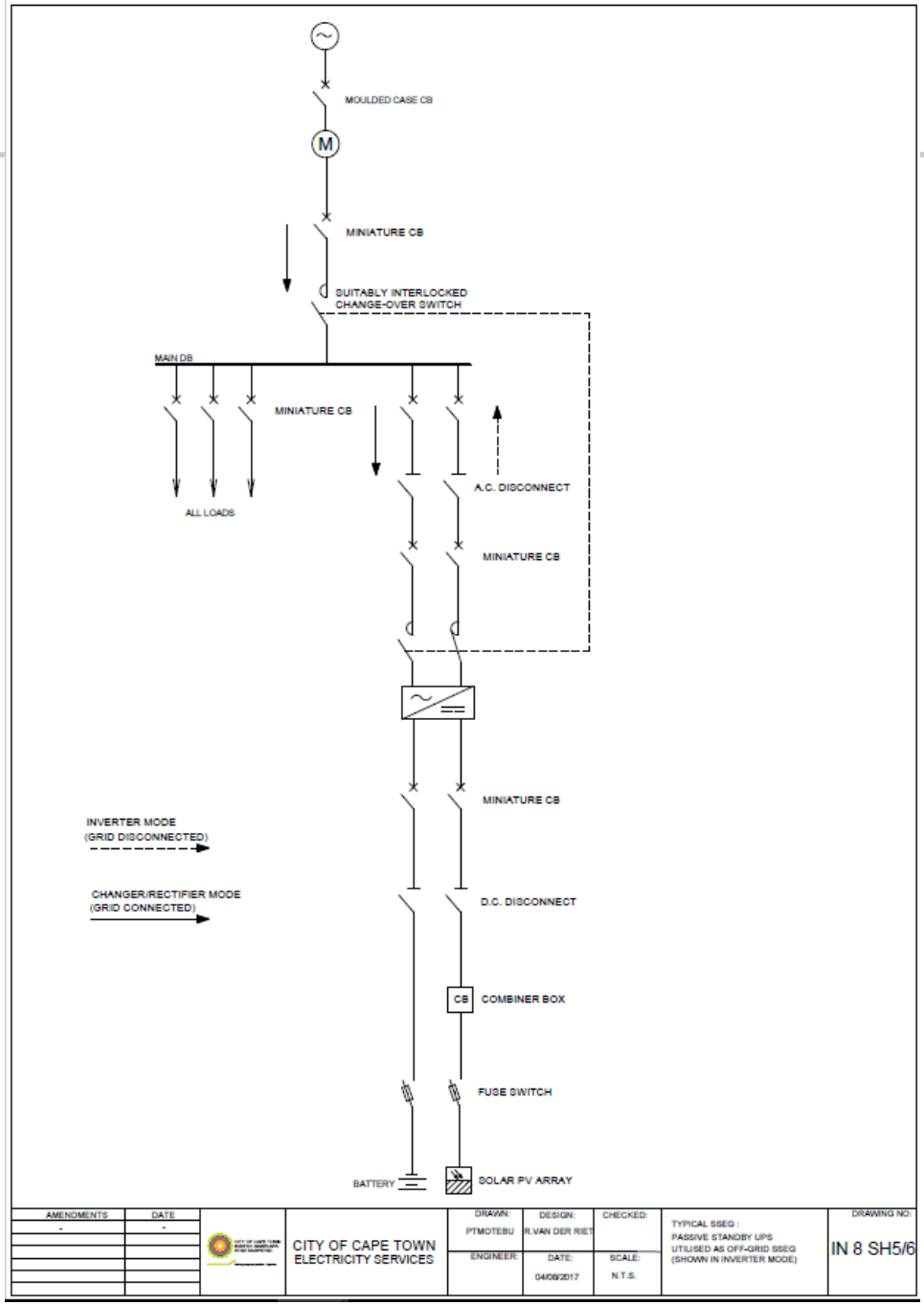
SSEG schematic: Sht 5



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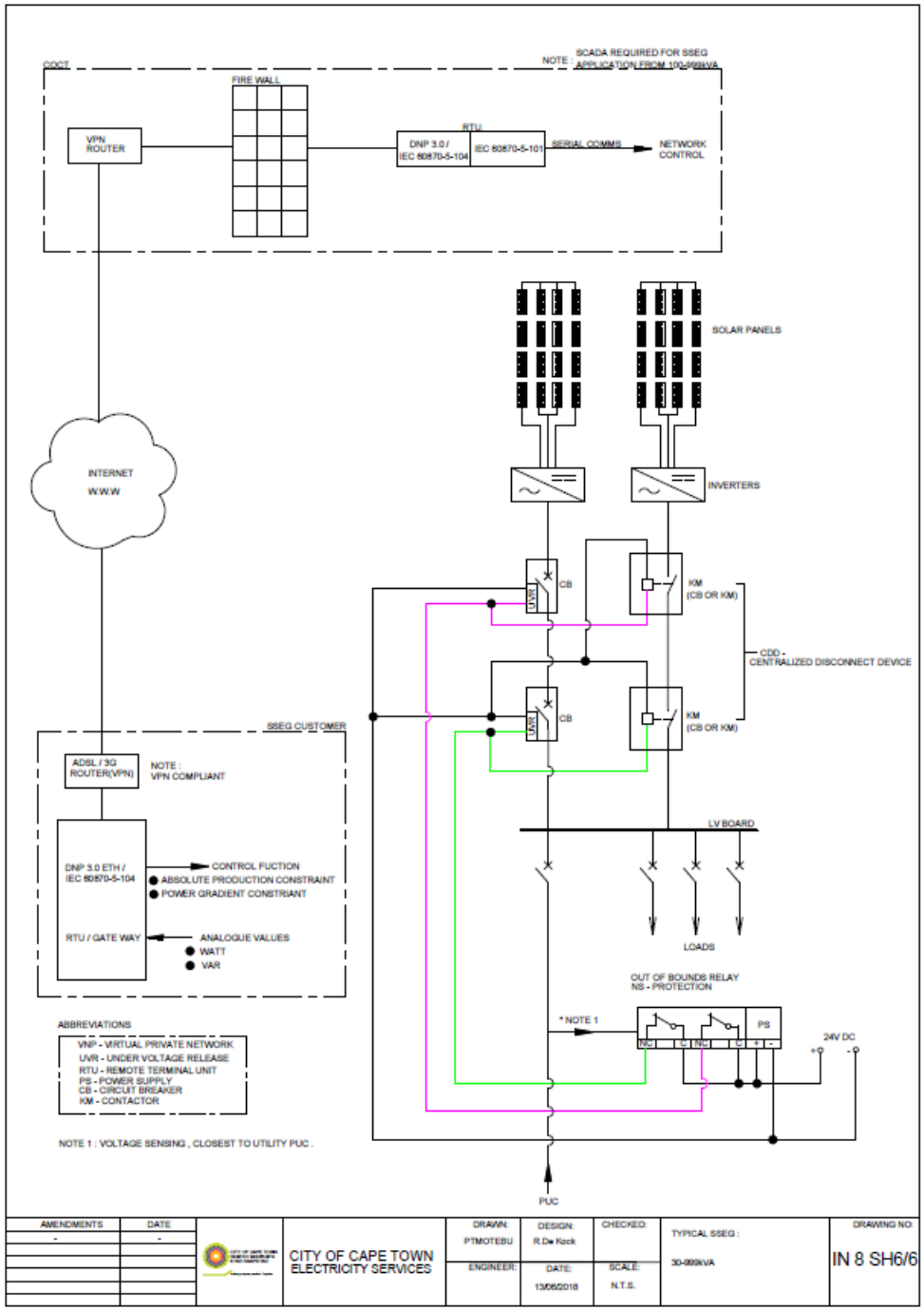
SSEG schematic: Sht 6



SSEG > 30 kVA

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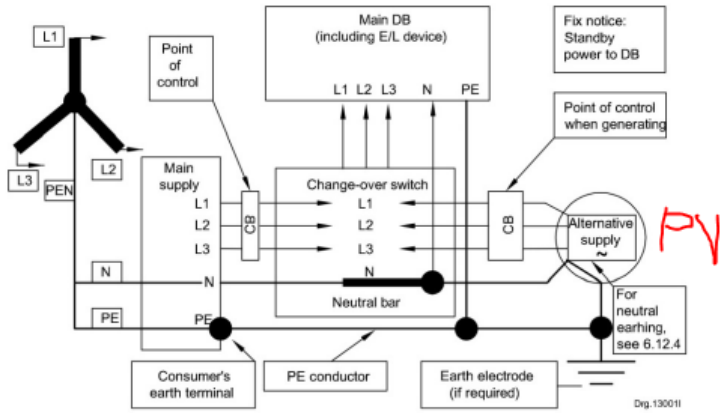
SANS 10142-1 Alternative supply

Annex P
(informative)

Examples of emergency power installation configuration

P.1 Change-over switch connection where standby power feeds in at main supply



Key

CB	circuit-breaker	E/L	earth leakage
DB	distribution board		

NOTE 1 A three-pole change-over switch may be used where the supply is from a TN system of supply and the standby power is connected at the main supply.

NOTE 2 It may be necessary to break the neutral when neutral currents are present in the utility supply.

Figure P.1 — Change-over switch connection where standby power feeds in at main supply

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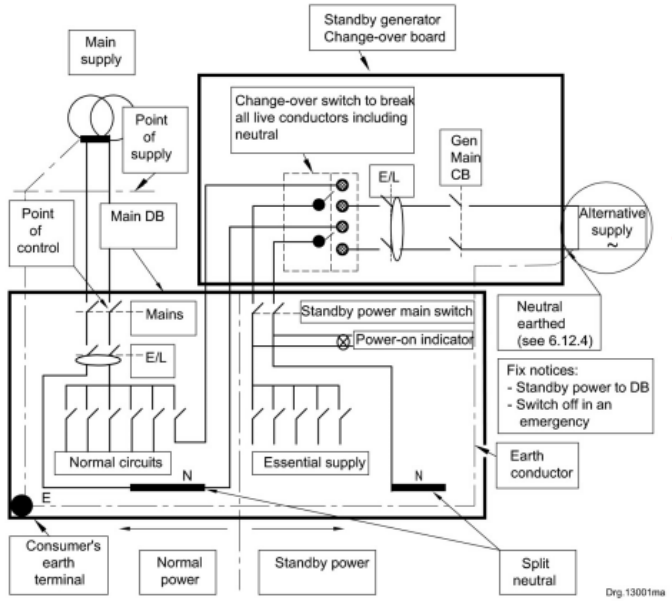
SANS 10142-1 Alternative supply [continue]

P.2 Change-over switch connection where a standby power generator feeds into a section of the main distribution board



Key

CB	circuit-breaker	E/L	earth leakage
DB	distribution board		

NOTE See the split neutral bars.

The main switch may be an E/L device.

Figure P.2 — Change-over switch connection where a standby power generator feeds into a section of the main distribution board

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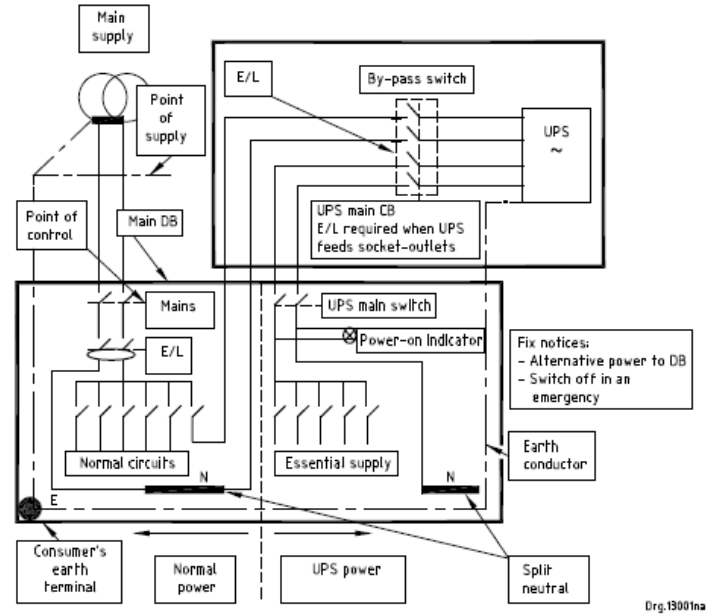
SANS 10142-1 Alternative supply [continue]

P.3 Connection where UPS power feeds into a section of the main distribution board



Key

CB circuit-breaker
DB distribution board
E/L earth leakage

NOTE See the split neutral bars.

The main switch may be an E/L device.

Figure P.3 — Connection where UPS power feeds into a section of the main distribution board

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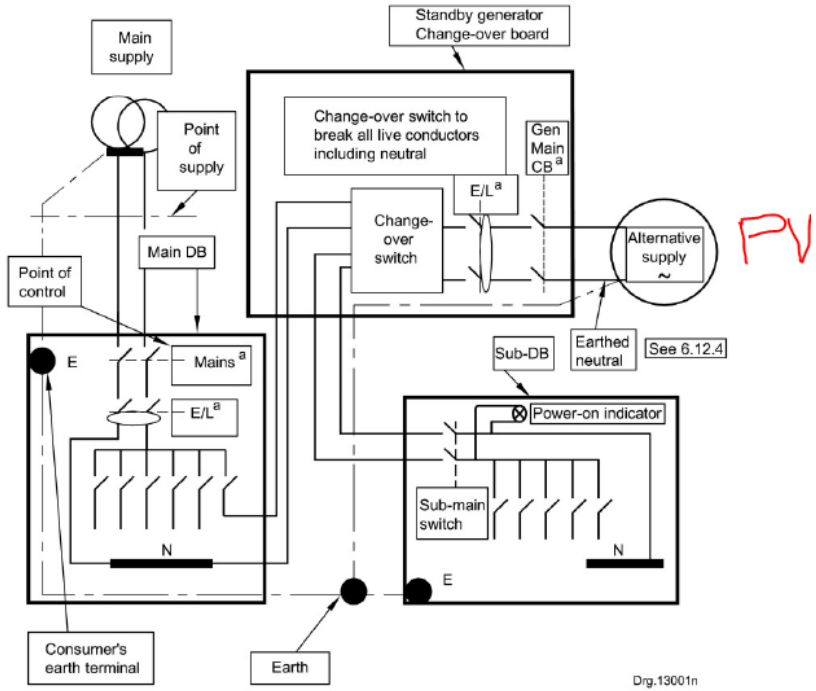
SANS 10142-1 Alternative supply [continue]

P.4 Change-over switch connection where standby power feeds in after the main distribution board (point of supply) into a sub-distribution board



a The main circuit-breaker may be an earth leakage device with isolation function.

Figure P.4 — Change-over switch connection where standby power feeds in after the main distribution board (point of supply) into a sub-distribution board

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SSEG > 30 kVA

Proposed NRS 097-2-1: Dead grid safety lock [DGSL]

THE POWERLINE SERIES

Dead Grid Safety Lock

DGSL rev1

Features

- Dual Contactor Safety Operation
- Grid Side Activation Only
- Surge & Lightning Protection
- Lockable Isolation Switch
- IP65 Enclosure
- Concealed Hinges

The Dead Grid Safety Lock (DGSL) provides a means to ensure the safety of utility staff in the presence of Embedded Generators (EG) on Low Voltage feeders in concert with normal safety procedures for working on installations, dead. If these procedures are followed normally, the DGSL will ensure that it is not possible for EG's to accidentally become live to be a hazard to the workers on the network and the locked out isolation point and the Embedded Generator.

*Specifications subject to change without prior notice due to continuous improvements

Order Code	12-00318	12-00562	12-00599
Specifications	Single Phase 20A	Three Phase 30A	Three Phase 50A
Power Surge Protection	L-N	PE-N	
Nom. Input Voltage	230/400 VAC 50Hz	230/400 VAC 50Hz	
Max. Continuous Voltage	275VAC	275VAC	
Test Class	Class II	Class II	
Nom. Discharge Current	20kA (8/20us)	20kA (8/20us)	
Max. Discharge Current	40kA (8/20us)	40kA (8/20us)	
Funtional Relay			
Contacts	2 Pole (DPDT)		
Operating Voltage	230VAC		
Safety Protection	Dual Relay		
Standard	IEC 60255		
Monitoring	Over/Under Voltage	Voltage, Neutral & Phase Sequencing	
Isolator			
Contacts	3 Pole		
Rated Operating Voltage	300V		
Current Rating	32A		63A
Mounting	DIN with extension shaft and door interlock		
Main Contactor			
Contacts	3 Pole (NO) + 1 Aux (NC)		
Rated Operating Voltage	690VAC		
Coil Voltage	230VAC 50Hz		
Current Rating (AC1 / AC3)	32A / 22A	50A / 32A	80A / 50A
Power Rating (AC3)	11kW	15kW	22kW
Mechanical Life	16 (million ops)		
Electrical Life	3.6 (million ops)		
Coil Power Dissipation	2.5W	5W	9.6W
Other			
Wiring Diagram	Fig.1	Fig.2	
Enclosure Material	Powder Coated Mild Steel		
Mounting	Wall Mount		
IP Rating	IP65		
Dimensions	340 x 300 x 200 mm		

Fig 1

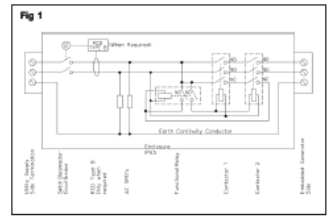
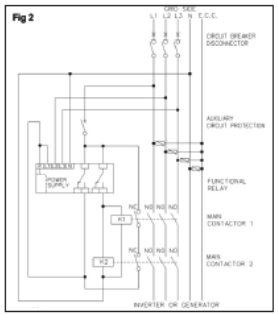


Fig 2



Designed and Manufactured by:
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Midrand, South Africa
P.O. Box 5985, Halfway House, 1685
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E-mail: info@clearline.co.za
www.clearline.co.za

CLEARLINE
THE ELECTRONIC PROTECTION COMPANY

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Thank You

For queries contact (insert ryno.vanderriet@capetown.gov.za)

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