SPECIFICATION FOR LOW VOLTAGE DISTRIBUTION BOARDS

This specification covers Transnet National Port Authority requirements for low voltage distribution boards

REVISIONS		
REV	**DATE**	**APPROVED**
00	**MARCH 2012**	**S.Sewdayal**

INDEX

SECTION	CONTENTS
1	SCOPE
2	REFERENCES
3	SERVICE CONDITIONS
4	DRAWINGS AND INSTRUCTION MANUALS
5	STANDARD OF WORK, EQUIPMENT & MATERIALS
6	DISTRIBUTION BOARDS
7	ARC DETECTION SYSTEM
8	FUSE SWITCHES
9	FUSE LINKS
10.	AIR CIRCUIT BREAKERS (ACB)
11.	MOULDED CASE CIRCUIT BREAKERS
12.	MINIATURE CIRCUIT BREAKERS
13.	CONTACTORS
14.	LIGHTNING AND SURGE PROTECTION
15.	ANTI-CONDENSATION HEATERS
16.	INDICATING INSTRUMENTS
17.	CURRENT TRANSFORMERS
18.	MECHANICAL CABLE GLANDS
19.	LIGHT SENSITIVE CONTROL UNIT
20.	EARTHING
21.	CABLING AND WIRING
22.	LABELS
23.	PAINTING
24.	ADDITIONS AND MODIFICATIONS TO EXISTING DISTRIBUTION BOARDS
25.	INSPECTION
26.	TESTS
27.	GUARANTEE
28.	SPARES
ANNEXURE NO. 1	Statement of Compliance

1. SCOPE

1.1. This specification covers Transnet National Port Authority requirements regarding the design, supply, manufacture, population, works testing, delivery to site, site erection, site testing and commissioning of low voltage Distribution Switchboards consisting of fuse switches incorporating high rupturing capacity cartridge fuse links, air circuit breakers, moulded case circuit breakers and auxiliary equipment. The tenderer is required to familiarise themselves with all applicable Standards and Codes of Practice listed herein, and to ensure compliance in the execution of any work in terms of this document.

2. REFERENCES

2.1. The following publications (latest edition) are referred to herein:-

2.1.1. SOUTH AFRICAN BUREAU OF STANDARDS

Codes of Practice

SANS 10064	The preparation of steel surfaces for coating
SANS 10111	Engineering Drawings.
SANS 10142	Wiring of premises Part 1: Low voltage installations
SANS 62305	Protection against lightning - Physical damage to structures and life hazard

Specifications

SANS 60947	Low-voltage switchgear and control gear
SANS 60947-2	Low-voltage switchgear and control gear Part 2: Circuit breakers
SANS 60269	Low-voltage fuses
SANS 1091	National colour standards for paint
SANS 1195	Busbars
SANS 1274	Coating applied by the powder coating process
SANS 1973-1	Low-voltage switchgear and control gear assemblies Part 1: Type-tested assemblies with stated deviations and a rated short-circuit withstand strength above 10 kA
SANS 1973-3	Low-voltage switchgear and control gear assemblies Part 3: Safety of assemblies with a rated prospective short-circuit current of up to and including 10 kA
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
SABS ISO 9000	Quality management systems -- Fundamentals and vocabulary
SANS 1019	Standard voltages, currents and insulation levels for electricity supply
SANS 170	Fasteners

International Electrotechnical Commission

BS 3938	Current Transformers
IEC 61508	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems.
IEC 60051	Direct acting indicating analogue electrical measuring instruments and their accessories

3. SERVICE CONDITIONS

3.1 The equipment shall be designed and rated for continuous operation under the following conditions:-

3.1.1 Ambient/Environment Conditions:

3.1.1.1	Ambient temperature-	-5° C to +45° C (daily average +35° C).
3.1.1.2	Relative humidity-	As high as 95%
3.1.1.3	Lightning conditions-	Severe, with a maximum lightning ground flash density of eleven (11) flashes per km² per annum.
3.1.1.4	Atmosphere-	Salt laden and corrosive industrial atmosphere

3.1.2 Electrical Conditions:

3.1.2.1 The system of supply shall be three phase, 4 wire, 50 Hz alternating current with solidly earthed neutral at a nominal voltage of 400 / 231 Volts.

3.1.2.2 The voltage may vary within the range of ±5 % of the nominal and all equipment installed shall be suitably rated.

3.1.2.3 All equipment shall be adequately rated for prospective fault level ratings.

4 DRAWINGS AND INSTRUCTION MANUALS

4.1 All drawings shall be in accordance with SANS 10111 – Engineering Drawings.

4.2 The successful tenderer shall supply the following instruction manuals, all of which shall be included in the tender price and be to the satisfaction of Transnet National Port Authority.

4.2.1 THREE (3) sets of detailed drawings and instruction manuals, with illustrations where necessary and 2 sets of prints of the "As Built" General Arrangement drawings and the schematic and wiring diagrams to facilitate erection and adjustment of the switchgear.

4.2.2 A full set of electronic media including all information requested above.

4.2.3 These instruction manuals and drawings shall be supplied as soon as possible after placing of the order, but before delivery of the equipment.

5. STANDARD OF WORK, EQUIPMENT & MATERIALS

5.1. The distribution board shall conform to the requirements of the latest edition and amendments of SANS 10142-1 Code of Practice for the Wiring of Premises Part 1: Low voltage installations and any additional requirements thereto, described in this specification.

5.2. All equipment and material used shall be of high quality and the work shall be of a high standard of workmanship carried out by qualified staff under proper supervision by experienced and competent officers.

5.3. If any special tools are required for the maintenance of the switchboard, the tenderer shall supply three (3) sets at delivery of the switchboard to site.

6. DISTRIBUTION BOARDS

6.1. The distribution board shall comply with SANS 60439-1

6.1.1. The form of separation will be specified in the project specific documentation.

6.2. The degree of protection shall be to IEC Publication 144/EN60529 and shall conform to the following:

- Inside Substations and MCC Rooms: IP42
- Other Locations: IP65

6.3. The distribution board shall consist of either a framework of substantial steel sections covered with heavy gauge steel plates or of folded sheet steel sections, forming a robust construction.

6.4. Particular attention shall be given to the ventilation of panels, to eliminate build-up of excessive heat caused by the sun or internal heat generation. All necessary precautions shall be taken to ensure that the temperature of the air in any portion of the assembly does not rise more than 15°C above ambient air temperature

6.5. Every board shall be fitted with a suitable gasket incorporated into the frame to ensure that the arrangement is in accordance with the required degree of protection. Sealing strips and gaskets shall be made of durable, non-hardening rubber, neoprene or other synthetic material, suitably fixed to the door or frame to ensure that the seal does not become dislodged during normal operation.

6.6. Where possible the lock and door catch shall comprise of a combination unit. Door latching and relatching operations shall be smooth and quick, whilst ensuring proper compression of the sealing gaskets. Repeated opening and closing of the hinged doors and operations of the door locks and catches shall not cause chipping or scratching of the painted surfaces or any other blemishes to the finished boards

6.7. Lifting lugs shall be provided for floor standing enclosures and as needed for wall mounted enclosures.

6.8. The board shall have a separate latches hinged or removable front cover secured to the board by means of suitable captive type screws or bolts. When the cover is removed/ opened, easy access to that compartments components and wiring shall be possible.

6.8.1. The control units shall be mounted flush with the front cover so that only the operating handles protrude.

6.8.2. Large removable panels shall be supplied with handles for easy handling.

6.8.3. No possibility should exist for panels to come into contact with live parts.

6.9. Due care shall be taken to ensure that the live side of the MAIN SWITCH is suitably protected so that no live conductors are exposed when the panel door is opened or the panel cover is removed.

6.10. The board shall be equipped with a set of 3 phase and neutral copper busbars. The 3 phase busbars shall be continuously rated for the full load of the incoming supply switch. The neutral shall be 100%

of the phase busbars. Earth bar shall be rated to fault current and touch voltage.

6.11. All busbars shall be designed, manufactured, marked and tested in accordance with SANS1195.

6.12. Busbar rating shall be 2A/mm^2 up to 630A and 1.6A/mm^2 thereafter.
6.13. Busbar temperature shall not exceed a 40^{0}C temperature rise.

6.14. The busbars shall be adequately braced and supported. The busbars shall be covered with a sufficient number of layers of high quality insulating tape or heat shrinkable sleeving and finished in standard colours.

6.15. Where busbar joints and terminations have not been covered, a kit shall be provided for covering during installation.

6.16. Alternatively, busbars shall be suitable enclosed in a busbar chamber or behind a protective barrier for protection against inadvertent contact with "live" busbars with access panels removed.

6.17. Inter-connectors between the busbars and control units shall be by means of fully insulated, adequately rated conductors firmly bolted to the busbar and secured to the appropriate terminals of the control units using crimped-on terminal lugs. Solid flat conductors shall be used if the rating exceeds 400 A or if the fault current exceeds 25kA rating. No conductor of less than 16mm^2 shall be used between busbars and control units. All conductors shall be suitably rated for the fault level.

6.18. The other terminals of the incoming and outgoing panel units shall be connected by means of conductors conforming to clause 6.17, i.e. they shall be robust, insulated, easily accessible terminals, of adequate size, conveniently located in the distribution board near the incoming and outgoing cable entries but with sufficient clearance and space to enable the incoming and outgoing cables to be connected to their corresponding terminals without difficulty or strain.

6.19. All the outgoing connections of MCCB'S greater than 400A 3 phase shall be done by means of copper bus bars, securely clamped using approved busbar clamping insulators, fixed to a robust metal section of adequate size, conveniently located in the rear of the distribution board to enable the incoming cables to be terminated in the back of the distribution board cubical behind each respective MCCB. This is to allow for the easy termination of the larger incoming cables, with sufficient clearance and space to enable the outgoing cables to be connected to their corresponding busbar terminals without difficulty or strain to the MCCB's. Each MCCB up to 250A shall be fitted with extended terminal complete with phase barriers as supplied by circuit breaker supplier.

6.20. Outgoing cable tails that connect to the busbars in clause 6.19 shall have securing places to enable the cable to be secured with nylon type cable fasteners in an approved manner.

6.21. The busbars that protrude into the back compartment of the distribution board shall be covered with a Perspex type barrier and shall have danger signs on each section.

6.22. Removable gland plates shall be provided. These gland plates shall be of adequate thickness or construction for the cables to be terminated without distortion of the gland plate, and shall not be less than 2mm mild steel (zinc passivated). Gland Plates shall not be mounted less than 300mm above ground floor level, alternatively a base frame of suitable depth may be provided.

6.23. Distribution board cases shall be of such dimensions that adequate space is available for manoeuvring and connecting the incoming and outgoing cables.

6.24. All cable entries shall be from the bottom of the distribution board unless stated otherwise.

6.25. Glands shall not be less that 300mm above floor level. Unless otherwise stated.

6.26. The terminals of all incoming and outgoing cables shall be firmly connected to the terminals on the lugs or ferrules, unless they are of a type that will grip the cable without splaying the strands of the conductor.

6.27. A substantial earthing terminal shall be firmly attached to the metal work of the distribution board and connected to an earth bar of cross sectional area not less than 50% of the phase bars, running the full length of the distribution board to which all earthing conductors of the incoming and outgoing circuits shall be firmly connected.

6.28. A removable link shall be provided in the Neutral busbar to ensure that the neutral busbar can be split in two sections for testing purposes. The link shall be secured in position with a bolt and nut arrangement.

6.29. The distribution board manufacturer shall allow for at least 30% capacity for the installation of additional switchgear in the distribution boards.

6.30. Each distribution board shall be fitted with the following labels as needed in suitable positions:

- Live busbars
- Flash signs
- Main label (always required)
- Voltage rating
- Current rating
- Fault level and time
- IP rating
- Job number
- Reference number
- Date of manufacture
- Form of separation
- Fed from
- Each feeder/starter to be labelled

6.31. Each distribution board shall be supplied with a test certificate. This certificate shall include all items as indicated in annexure 1 of SANS 1973–1 and annexure E of SANS 1973–3.

7. ARC DETECTION SYSTEM

7.1. All switchgears shall be equipped with an efficient and reliable arc detection system designed according to IEC 61508 with a safety level meeting at least SIL 2.

7.2. The system shall consist of one or more arc monitoring units and light detectors.

7.2.1. Arc detection system:

Arc detection system shall not be activated by interfering influences such as portable lamps, electro-magnetic fields, vibration or touching. In case of an arc occurring in the switchgear it shall be possible to identify where and when the arc has occurred. This information should be

accessible without opening the switchgear door and stored even if power is lost to the system. The HMI shall not affect the IP degree of the cabinet.

7.2.2. Arc monitoring unit and light detector:

The arc detection system shall use light as the main condition for tripping. Detectors shall cover each bus-bar section, respective circuit breaker and in any other areas where the designer of the switchgear considers or finds it as a potential risk for an arc. The detectors shall be made of optical fibre in order to avoid EMC disturbances. Without any extra calibration from the user the system shall not react for a light intensity lower than 3000 lux in order to avoid nuisance tripping. The light intensity shall also be constant regardless the length of the detector.

7.3. The trip signal shall be sent within less than 2 ms to the circuit breaker in an event of an arc

7.4. The arc monitoring unit shall provide at least three high speed solid state tripping outputs to the circuit breaker.

7.5. It shall be possible to configure the detectors to trip different breakers depending on which detector detects the arc.

7.6. The system shall have the possibility to mount up to 30 detectors in the space of the main unit in order to avoid space issues if the system would be extended.

8. FUSE SWITCHES

8.1. Fuse switches shall comply with SANS 152 and SANS 60947 – 3.

8.2. Fuse switches shall be enclosed, triple pole, quick break and dustproof.

8.3. Fuse switch handle shall have an IP rating of IP65 and the handle shall be defeatable to override the door interlock.

8.4. Fuse switches shall be of the double break type and the fuses shall be completely isolated when the switches are in the "OFF" position.

8.5. Fuse switch and handle shall have a test position. It will be possible to have an auxiliary for only indication test position.

8.6. The switches shall be interlocked to prevent the opening of the front covers unless the switches are in the "OFF" position and the closing of the switches with the covers open. The switches shall be lockable in the "OFF" position.

8.7. Fuse Switches shall have a lever or rotary action with a positive spring controlled opening and closing action for making or breaking the circuit under load conditions. Fuse carrier and base contacts shall be designed to give permanent high contact pressure and shall be designed to facilitate location of blown fuses without removal of the carrier. Fuse carriers and bases shall be of the highest grade phenolic mouldings to BS 771 and shall be non-flammable and non-hygroscopic, with a hard gloss black finish.

8.8. It shall be possible to install the fuse switch in any position without derating.

9. FUSE LINKS

9.1. HRC Fuse Links shall be of the high rupturing capacity type, compliant with SANS IEC 60269 – 1:2014. Fuse links shall incorporate a visual indication device to facilitate location of blown fuses and shall be designed to clip into the fuse carrier contacts without the use of fixing screws.

9.2. Breaking capacity of all fuse links shall be not less than Category of duty AC.50 at 415 Volts (SANS IEC 60269 - 1:2014). The Fusing factor of the fuses shall not exceed 1.5 (SANS IEC 60269 Class Q1).

9.3. Fuse current ratings shall be indicated on engraved 20 x 12mm white-black-white trifoliate labels in 4mm letters. The labels are to be fitted at the fuse bases and shall not be obscured by wiring.

9.4. Fifty- percent spare fuses of each size shall be provided in suitable cubicle on the switchboard. The door of this cubicle shall be suitably identified.

10. AIR CIRCUIT BREAKERS (ACB) SHALL CONFORM TO THE FOLLOWING CHARACTERISTICS.

10.1. Functional characteristics:

10.1.1. Air circuit breakers for use on the incoming supply side of the distribution board shall comply with SANS 60947.

10.1.2. The circuit breakers shall have a continuous enclosed current rating as indicated on the relevant drawings with a minimum Icu (ultimate breaking capacity) of 42kA at 415 volts. The circuit breakers shall be tested for category P.2, unless specified otherwise.

10.1.3. The circuit breakers shall have an Ics (service capacity) rating equal to the Icu (ultimate breaking capacity) rating.

10.1.4. The circuit breakers shall have an Icw (withstand current) of 1 sec and 3 sec. The 1 sec Icw rating shall be equal to the Icu rating.

10.1.5. The air circuit breakers shall be of the enclosed, ventilated, independent manual spring, draw-out type with a rated service voltage of 690 volts and a rated insulation voltage of 1000 volts and be equipped for shunt tripping from a 115 V DC battery supply. The shunt tripping facility shall be wired so that the ACB shall trip when it's associated high voltage transformer circuit breaker trips.

10.1.6. The circuit-breakers shall have a rated impulse withstand voltage of 12 kV.

10.1.7. The rated uninterrupted current shall be between 100 and 6300 A with the possibility of set trip threshold of L protection from 40A.

10.1.8. Different versions of circuit-breakers shall be available, divided into their category of use: A (current-limiting) and B (selective).

10.1.9. Different versions shall be available with rated ultimate breaking capacity from 42 to 150 kA at 440 V AC and from 42 to 100 kA at 690 V AC for circuit-breakers in category B and with 130 kA at 415 V AC, 85 kA at 690 V AC for circuit-breakers in category A.

10.1.10. The mechanical life shall be at least 12000 operations with a frequency of 60 operations/hour without the need for maintenance of the contacts and arcing chambers

10.1.11. The electrical life at a voltage of 440 V AC shall be (with a frequency of at least 10 operations/hour and without the need for maintenance of the contacts and arcing chambers):

- at least 9000 operations up to 2000 A
- at least 5000 operations up to 3200 A

These values are intended to be valid only for category B circuit-breakers.

10.2. Environmental characteristics

10.2.1. Operating temperature: -25 °C...+70 °C (-13 °F...158 °F) and storage temperature: -40

10.2.2. Altitude: operation without derating shall be up to 2000 metres above sea level. (6600 ft), and with derating up to 5000 metres above sea level. (16500 ft).

10.2.3. Suitability for use in a hot-humid environment. With regard to this, the circuit-breakers shall undergo a topicalization process which makes them suitable for use in a hot humid environment, as established by the prescriptions of the main shipping registers and in accordance with the international IEC 60068-2-30 Standards.

10.3. Construction characteristics

10.3.1. All the models shall be available in the 3 and 4 pole versions both in the fixed (with rear horizontal, rear vertical and front terminals) and withdrawable (with rear horizontal, rear vertical, front and rear at terminals) versions.

10.3.2. There shall be total segregation between power and front shield, using double insulation where suitable so as to guarantee maximum operator safety.

10.3.3. Total segregation between the phases shall be guaranteed for safety reasons without need of phase barriers up to 1000V.

10.3.4. It shall be possible to inspect easily the arcing chambers easily and to check main contact wear with the circuit-breaker racked-out, by removing the arcing chambers.

10.3.5. All the circuit-breakers in the range shall have the same height and depth with the aim of standardising the supporting structures of the switchgear and the switchgear itself as far as possible.

10.3.6. IP30 degree of protection shall be guaranteed on the front part and IP20 on the rest of the circuit-breaker (excluding the terminals), with the possibility of having IP54 degree of protection (NEMA 3/3s/13) on the front, using the transparent cover which completely protects the front, but still leaves the panel underneath and the protection unit fully visible with the relative indications.

10.3.7. The whole range of air circuit-breakers shall be fitted with electronic protection releases. It shall be allowed the inter-changeability of protection releases from skilled personnel.

10.4. Special points for withdrawable versions:

10.4.1. The circuit-breakers in the withdrawable version shall be fitted with anti-racking-in locks to prevent racking a moving part into a fixed part with a different rated current.

10.4.2. In the case of the withdrawable version, the presence of a device shall prevent racking-out and racking-in with the apparatus closed.

10.5. Accessories

The following accessories shall be common to the whole range standard:

10.5.1. Electrical accessories:

10.5.1.1. Shunt opening/closing release.

10.5.1.2. Control and monitoring Test Unit - allows continuity of the different versions of the shunt opening releases to be checked;

10.5.1.3. Undervoltage release;

10.5.1.4. Time delay device for undervoltage release - allows release trip delay with established and adjustable times;

10.5.1.5. Geared motor for the automatic charging of the closing springs;

10.5.1.6. Mechanical and electrical signalling of overcurrent release trip;

10.5.1.7. Trip reset release;

10.5.1.8. Auxiliary contacts which allow signalling of the circuit-breaker state;

10.5.1.9. Current transformer for the neutral conductor outside the circuit-breaker;

10.5.1.10. Homopolar toroid for the main power supply earth conductor (star centre of the transformer).

10.5.2. Mechanical accessories:

10.5.2.1. Interlocks between 2 circuit-breakers or among three circuit-breakers can be used horizontally, vertically or in “L” position using different types of flexible cables:

10.5.2.2. Standard version (with maximum distance between two circuit breakers: up to 1200 mm if horizontally interlocked while up to 750mm if vertically interlocked).

10.5.2.3. Extended version (with distance between two circuit breakers: from 1200mm up to 1600 mm if horizontally interlocked while from 750 up to 1000 if vertically interlocked).

10.5.2.4. Mechanical locks to control enabling racking-in/out operations available also with interlocks. IP54 transparent front protection (NEMA 3/3S/13).

10.6. Protection Release

10.6.1. Basic Protection Functions

10.6.1.1. The release shall not require auxiliary power supplies since the power is taken from the current transformers.

10.6.1.2. The signals supplied by the release shall not operate with power supply supplied by internal batteries.

10.6.1.3. The protection against overload (L) with characteristic t=k/I2 shall always have setting ranges with timing adjustable up to 144s with I=3In.

10.6.1.4. The protection of neutral shall be set at 50%, 100%, 200% and OFF of the phase currents without changing any component.

10.6.1.5. All the protection functions except protection against overload shall be excludable.

10.6.2. Measurement Functions

10.6.2.1. The release shall always be able to provide measurement of the currents and voltages in the three phases, in the neutral and of earth fault (ammeter function), both in self-supply and with an auxiliary power supply. Measurement function shall be active, even without external supply, starting from 140 A of single-phase current, independently from the circuit-breaker size. Accuracy of the ammeter measurement chain (current sensor plus ammeter) shall equal or better than 1.5% in the 30% - 120% current interval of In.

10.6.2.2. The release shall not normally require auxiliary power supplies since the power is taken from the current transformers. For measurements and programming at very low currents, a power supply at 24 V DC shall be available. As alternative the release shall be able to receive power supply directly from busbars or terminals, up to line voltage equal to 690 V AC.

10.6.2.3. The release shall be able to acquire the waveforms of electrical values with a sampling frequency selectable from 600 to 4.800 Hz and sampling interval from 3 s to 27 s. Acquisition shall be frozen after a trip or a configurable event. Acquisition data shall be retrieved from an external device (personal computer or similar) for fault analysis purposes. The release shall show voltage measurements on display, with a precision equal or higher than 1%.

10.6.2.4. Measurement functions that shall be available:

- Current measurements
- Voltage measurements
- Power measurements
- Power factor measurements.
- Measurements of frequency and peak factor
- Energy measurements
- Historical measurements
- The last 10 trips information
- Complete trip information on display without batteries
- Data logger included as standard

10.7. Advanced Protections Functions

10.7.1. Thermal memory for functions L (overload protection) and S (short circuit protection).

10.7.2. Protection against over-temperature. It shall be possible to signal the presence of anomalous temperatures on the release by means of two LEDs (Warning and Alarm) and, if decided during the unit configuration phase, when the temperature is over 85 °C, to simultaneously control circuit-breaker opening.

10.7.3. Protection against missing and unbalanced phase (U) with characteristic t=k shall be possible.

10.7.4. Load control protection (K).

10.7.5. Undervoltage protection (UV)

10.7.6. Overvoltage protection (OV)

10.7.7. Residual voltage protection (RV)

10.7.8. Underfrequency protection (UF)

10.7.9. Overfrequency protection (OF)

10.7.10. Protection against reversal of active power (RP)

10.8. User Interface and Signalling LEDs

10.8.1. An alarm shall indicate by means of LEDs located on the release the disconnection of opening solenoid and current transformers. A trip shall also occur, after a short time delay, when the disconnection is detected.

10.8.2. The release shall allow parameterisation by means of keys and a LCD graphic display.

10.8.3. Access to control and configuration of the unit by means of a password (edit MODE).

10.8.4. The signals given by the permanent indicators shall guarantee maximum reliability.

10.8.5. Indication shall be available directly on display on request of the user for not less than 48 hours even without an auxiliary voltage and batteries and also be given in the case of re-losing on a fault. After 48 hours of inactivity the information shall be retrievable by external devices. Indication shall contain at least the protection tripped.

10.8.6. It shall be possible to read the current values and information on the last 10 measures (current values, protection tripped) at any time through external devices, some of which can transmit data via bluetooth;

10.8.7. In the event of CB tripped, shall be indicated the type of protective function that intervened.

10.8.8. Each alarm or warning alarm shall be clearly shown on the display, when it is active.

10.8.9. On the protection release two (2) led's shall be present.

10.8.10. Warning LED shall be in place indicating at least the following:

- Presence of one or more phases with current values in the 0.9*In< I <1.05*In range
- Presence, between two or three phases, of unbalance higher than the value programmed during configuration
- The first temperature threshold of T=70 °C has been exceeded
- Contact wear > 80%
- Harmonic distortion
- Out of range frequency
- Breaker status error

- Warning threshold override

10.8.11. Alarm LED shall be in place indicating at least following:
- Presence of one or more phases under overload with current values I >1,3*In (Overload Protection - L under timing)
- Timing in progress for protection function S (Selective short circuit protection)
- Timing in progress for protection function G (Earth fault protection)
- The second temperature threshold of T=85 °C has been exceeded
- Contact wear 100%.
- Timing in progress for protection function D;
- Timing in progress for protection function UV(Under Voltage), OV(Over Voltage), RV (Residual Voltage);
- Timing in progress for protection function RP(Reversal of Active Power);
- Timing in progress for protection function
- Timing in case of unbalance between the phases higher than the value set during configuration with trip set to ON;
- Current Sensors disconnected;
- Opening solenoid (Trip Coil) disconnected

10.8.12. The communication function shall be implemented on the release by means of:
- An internal bus, with interface RS485;
- An external bus, with Modbus RS485 protocol 2-Wire Twisted Pair, 19.2 kbit/s max.

10.8.13. There shall be the possibility of setting the release in remote and in local operating mode, and with the latter it shall not be possible to carry out data transmission from the system to the release. It shall be possible to automatically set the local mode by means of an external contact. An 24VDC auxiliary supply shall be used.

10.8.14. The protection release shall be able to send to the system these data:
Protection parameters set, phase and neutral currents, state of the circuit-breaker (open closed), position of the circuit-breaker (connected-isolated), state of the springs (charged discharged), number of circuit-breaker mechanical operations, total and for each protection number of trips, last interrupted current, contact wear, state of the protection functions (pre alarm function. L, timing function. L, S,G…), overtemperature protection function, state of internal communication bus.

10.8.15. The system shall transmit to the protection release the following data: protection parameters, circuit-breaker opening and closing commands, reset for tripping of some protection functions.

10.8.16. Adjustable inverse definite minimum time (IDMT) overcurrent release facilities are required in addition to the instantaneous fault trip for the air circuit breakers.

11. MOULDED CASE CIRCUIT BREAKERS (MCCB) SHALL CONFORM TO THE FOLLOWING CHARACTISTICS.

11.1. Functional Characteristics

11.1.1. AC rated service voltage for currents over 160 A: 690 V AC (50-60 Hz).

11.1.2. DC rated service voltage: 500 V DC for currents of 160 A and 750 V DC for currents over 160A.
11.1.3. Rated uninterrupted current for 1000 V AC or DC applications: 800 A (three and four poles).

11.1.4. Minimum rated insulation voltage for currents equal or over 160 A: 8 kV.

11.1.5. Rated insulation voltage for currents equal or over 160 A: 800 V AC.

11.1.6. Rated uninterrupted current between 160 and 3200 A with trip units settings starting from 1A.
11.1.7. According to IEC 60947-2 (§ 4.4) starting from 400 A the circuit breakers shall be category B

11.1.8. MCCBs shall be available with different ultimate short breaking capacities between 16kA and 200kA @ 380/415 V AC.

11.1.9. Both line up and line down supplying shall be possible without decreasing MCCBs performances or functionality

11.1.10. For rated uninterrupted currents up to160 A, the MCCB limiting features shall be enough to assure its conformity to IEC 60439-1 (§ 8.2.3.1) once installed into a type AS or ANS switchboard as general breakers. This shall be valid up to the MCCB's rated uninterrupted current (limiting versions are excluded).

11.1.11. A test bottom for the correct functionality checking (moving contacts opening) shall be place in front of the breaker.

11.2. Ambient Characteristics

11.2.1. Operating temperature: -25 °C. +70 °C (ambient temperature)

11.2.2. Storage temperature: -40 °C .. +70 °C (ambient temperature)

11.2.3. Reference temperature for setting the thermal element of the thermomagnetic trip unit: +40 °C
11.2.4. Maximum relative humidity: 98%

11.2.5. Maximum altitude: 2000 m above sea level, 5000 m above sea level with derating suitability for being used in hot-humid places. With regard to this, the circuit-breakers shall undergo a tropicalization process to make them suitable for use in hot-humid places, as established in the prescriptions of the major naval registers and in compliance with the International IEC 60068-2-30 Standards.

11.2.6. Circuit-breakers fitted with electronic trip units shall comply with the prescriptions of the International Standards on electromagnetic compatibility.

11.3. Construction Characteristics

11.3.1. The range of moulded case circuit-breakers shall cover a range of rated uninterrupted currents from 160 to 3200 A

11.3.2. By means of the double insulation technique, moulded case circuit-breakers shall guarantee complete separation between the power circuits and the auxiliary circuits.

11.3.3. Moulded case circuit-breakers shall have an operating lever which always indicates the exact position of the circuit-breaker contacts (positive operation), by means of safe and reliable

signals (I= closed, O= open, yellow-green line= open due to trip unit).

11.3.4. The operating mechanism shall be designed to operate all poles of the circuit breaker simultaneously for making, breaking and tripping.

11.3.5. Moulded case circuit-breakers shall be suitable for isolation in compliance with § 7.2.7 of the IEC 60947-2 Standard. This indication shall be clearly and indelibly marked on the circuit-breaker (in accordance with § 5.2 of IEC 60947-2) and in a position where it is visible with the circuit-breaker installed.

11.3.6. Moulded case circuit-breakers shall be available in the three-pole and four-pole version both in the fixed, and in any possible plug-in or withdrawable versions.

11.3.7. Circuit-breakers in the plug-in version starting from 250 A shall be available. In the case of a plug-in or withdrawable version, the presence of a device shall prevent racking-in or racking-out with the apparatus closed.

11.3.8. In the withdrawable version, racking-out with the door closed shall be possible.

11.3.9. The same depth and installation on a DIN EN 50022 rail shall be guaranteed up to the rated setting of 250 A inclusive. The same depth shall be guaranteed. This characteristic shall allow the switchboard and their support structures to be standardized.

11.3.10. Moulded case circuit-breakers with rated uninterrupted current up to 250 A shall have a 45 mm high face which makes them suitable for installation on modular panels.

11.3.11. All the installation positions shall be possible without jeopardizing the function of the apparatus. Starting from 630 A up to 1600 A the withdrawable version shall be mounted and operated horizontally.

11.3.12. For the front parts of the circuit-breakers the degree of protection of at least IP20 (excluding the terminals) shall be guaranteed, IP30 when they are installed in switchboards, and up to IP54 for circuit-breakers installed in a switchboard fitted with transmitted rotary handle and special accessory.

11.4. Protection Trip Units

11.4.1. Moulded case circuit-breakers shall be equipped with interchangeable trip units. From 160 A up to 800 A it shall be possible to choose between a thermomagnetic and an electronic protection. For the sizes higher than 800 A, the trip unit shall only be electronic. The trip unit shall be integrated in the volume of the apparatus.

11.4.2. From the 250 A size circuit-breakers, the trip unit shall be interchangeable. Trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorised access to the settings

11.5. Thermomagnetic Overcurrent Trip Units

11.5.1. Thermomagnetic trip units shall be fitted with protection threshold against overload (whose thermal element shall consist of a bimetal) and with protection threshold against short circuit.

11.5.2. The protection threshold against overload shall be continuously adjustable starting from 0.7 times the rated current of the trip unit and up to its rated value.

11.5.3. The reference temperature for setting the thermal element of the protection trip unit is 40°C.

11.5.4. The temperature performance of the trip unit shall be indicated as the temperature varies.

11.5.5. The protection threshold against short-circuit shall be either the fixed or adjustable type with continuity from 5 and up to 10 times the rated current of the trip unit. In the four-pole version, the neutral pole shall always be protected. For current values equal to or higher than 125 A, protection of the neutral pole shall, at choice, be at 100% or at 50% of the rated current of the trip unit. Vice versa, for current values of less than 125 A, protection of the neutral pole shall always be 100%.

11.5.6. For circuit-breakers with rated uninterrupted current of 160 A, 250 A, 400 A and 500A, a thermomagnetic trip unit shall be available for generator protection with adjustable thermal threshold, starting from 0.7 x In, and fixed magnetic threshold at 3 x In or adjustable magnetic threshold from 2.5 to 5 x In. Suitability for use in direct current.

11.6. Magnetic only overcurrent trip units

11.6.1. The overcurrent trip units with magnetic only threshold shall be suitable for protection against short-circuit.

11.6.2. The adjustable magnetic only trip units (suitable for motor protection) shall only be available in the three-pole version, whereas those with fixed threshold shall also be available in the four-pole version.

11.6.3. The adjustable magnetic only trip units shall be available for circuit-breakers up to 320 A. Suitability for use in direct current.

11.7. Electronic Overcurrent Release Trip Units

11.7.1. The electronic overcurrent trip units shall be self-supplied and shall be able to guarantee correct operation of the protection functions even in the presence of a single phase supplied with a current value equal to 20% of the phase current. They shall be unaffected by electromagnetic interference in compliance with the EMC directive on the matter.

11.7.2. The basic version shall be fitted with protection functions against overload (function L) and against short-circuit. The latter function can either be of the instantaneous type (function I) or, alternatively, with intentional delay selective short circuit protection (function S). The function of protection against short circuit shall be excludable.

11.7.3. A basic version shall also be provided with only the protection threshold against instantaneous short-circuit which cannot be excluded.

11.7.4. The complete version shall be fitted with protection threshold against overload (function L), against instantaneous short-circuit (function I) and with intentional delay (function S) and also with protection threshold against earth fault (function G). All the protection functions except for protection against overload shall be excludable.

11.7.5. The advanced version shall be suited for zone selectivity protection for the S and G protection functions. An integrated ammeter and many other additional features are provided over and above the protection functions. All the protection functions except for protection against overload shall be excludable.

11.7.6. The advanced version shall be suited for zone selectivity protection for the S and G protection functions. An integrated ammeter and many other additional features are provided over and above the protection functions. All the protection functions except for protection against overload shall be excludable.

11.7.7. A version dedicated to ultra-rapid short-circuit protection (with a detection time less than 5 ms) combined with zone selectivity shall be available.

11.7.8. An advanced version dedicated to motor protection shall be available with protection functions against overload (function L), against instantaneous short circuit (function I), against unbalanced or missing phase (function U) and against rotor block (function R).

11.7.9. A version dedicated to generator protection shall be available (up to 160A), with protection functions against overload (function L), against instantaneous short circuit (function I) and with intentional delay (function S). The S and I protection functions are not an alternative to each other. All these functions are imposed by the major naval registers.

11.7.10. All the advanced trip units shall be available with thermal memory.

11.7.11. All the protection functions shall be characterized by threshold and time tolerances according to the International Standards.

11.7.12. The trip unit shall allow parameterization of the trip thresholds and timing locally or remotely; in the case of any anomalies in remote parameterization, the protection shall automatically use the series of parameters set manually on the front of the circuit breaker.

11.7.13. On the advanced version, access to information and programming shall be allowed by a keyboard and graphic liquid crystal display.

11.7.14. Alarm signals for the protection functions will be available by means of LEDs located on the trip unit (complete version) and/or on the display (advanced version).

11.7.15. The size of the current sensors shall be a minimum of 10 A to a maximum of 3200 A so as to cover the widest possible current range.

11.7.16. Interchangeable rating-plugs shall be available starting from 400 A.

11.7.17. The four-pole circuit-breaker shall always be supplied with the neutral protected at 100% up to 125A excluded, and for higher values with protection selected between 50% and 100% of the rated current of the trip unit. Starting from 630A setting of the neutral at 150% and 200% shall be possible.

11.7.18. The current sensors for external neutral shall be optional.

11.7.19. Moulded Case Circuit breakers equipped with electronic releases shall be available a dedicated function to verify the correct connection between the trip unit, current sensor and trip coil. Eventual anomalies shall be signalled by a red led flashing.

11.8. Accessories for electronic trip units shall be available, such as the test unit for checking functioning of the tripping coil of the electronic trip unit, a trip signalling unit of the protections, a test and

configuration unit which allows the electronic trip unit protections to be tested and configured, an actuation unit which allows circuit-breaker opening and closing by means of a motor operator mounted on it, a battery unit which allows trip unit testing when the circuit-breaker and an external unit for wireless communication.

11.8.1. For both the complete and the advanced version a measurement module shall be available, in order to gauge the plant functioning parameters, such as phase and phase to phase voltages, powers and energies. On the advanced version all the available measurements can be displayed on the LCD. Furthermore, for the electronic trip units for motor protection, there shall also be a contactor control unit available.

11.8.2. The advanced version will be provided with a data logger function that automatically records and stores the instantaneous values of all the currents and voltages. Data shall be easily downloaded to any personal computer for elaboration. The data logger function freezes the recording whenever a trip occurs, so that a detailed analysis of faults can be easily performed. The sampling rate shall be adjustable up to 4800Hz, with total sampling time up to 27 s (@ 600Hz sampling rate). Tracking of up to 64 events shall be possible.

11.9. Protections

The minimum performances of the protection functions of the electronic protection trip unit for distribution, where present, shall be:

11.9.1. Function L:adjustable trip threshold I1= (0.4-1) x In, trip curves for the basic version with time settings from 3 to 12 seconds – 2 different trip curves - (at 6 times the set threshold), whereas for the advanced version with time settings from 3 to 18 seconds – 4 different trip curves - (at 6 times the set threshold). For the advanced version, L function according to IEC 60255-3 shall be available. *Cannot be excluded.*

11.9.2. Function S: adjustable trip threshold I2= (1-10) x In, trip curves for the basic version with time settings from 0.1 to 0.25 seconds – 2 different trip curves – (at 8 times the rated current of the trip unit), whereas for the advanced version with time settings from 0.05 to 0.5 seconds – 4 different trip curves with inverse short time with definite time characteristic or curves with definite time – (at 6 times the rated current of the trip unit). For circuit breakers from 250 A to 630 A, in the advanced version, I2= (0.6-10)x In. *Can be excluded.*

11.9.3. Function I: adjustable trip threshold I3= (1-10) x In for the basic version (instantaneous trip), whereas for the advanced version I3= (1.5-15) x In (instantaneous trip). *Can be excluded.*

11.9.4. Function G: adjustable trip threshold I4= (0.2-1) x In with trip time settings from 0.1 to 0.8 s with curve with inverse short time and definite time characteristic. *Can be excluded.*

11.9.5. Function U: adjustable trip threshold I6= (2%…90%) x I1 with trip time settings from 0.5 to 60 s with curve with inverse short time and definite time characteristic. *Can be excluded.*

11.9.6. Function OT: fixed at 85 °C (with instantaneous trip). *Can be excluded.*

11.9.7. Function UV: adjustable trip threshold U8= (0.5-0.95) x Un with trip time settings from 0.1 to 5 s with curve with inverse short time and definite time characteristic. *Can be excluded.*

11.9.8. Function OV: adjustable trip threshold U9= (1.05-1.2) x Un with trip time settings from 0.1 to 5 s with curve with inverse short time and definite time characteristic. *Can be excluded.*

11.9.9. Function RV: adjustable trip threshold U10= (0.1-0.4) x Un with trip time settings from 0.5 to 30 s with curve with inverse short time and definite time characteristic. *Can be excluded.*

11.9.10. Function RP: adjustable trip threshold P11= (-0.3…-0.1) x Pn with trip time settings from 0.5 to 25 s with curve with inverse short time and definite time characteristic. *Can be excluded.*

11.9.11. Function UF: adjustable trip threshold f12= (0.9-0,99) x fn with trip time settings from 0.5 to 3sec with curve with inverse short time and definite time characteristic. *Can be excluded.*

11.9.12. Function OF: adjustable trip threshold f13= (1.01-1.10) x fn with trip time settings from 0.5 to 3 s with curve with inverse short time and definite time characteristic. *Can be excluded.*

11.9.13. The minimum performances of the protection functions of the electronic protection trip unit for motor protection shall be:

- Function L: adjustable trip threshold I1= (0.4-1) x In, trip curves in class 10A, 10, 20 and 30 or 3E, 5E, 10E e 20E in compliance with the IEC 60947-4-1 Standard, with temperature compensation and sensitivity to missing/unbalanced phase. *Cannot be excluded.*

- Function R: adjustable trip threshold I5= (3-10) x I1 + OFF, with 4 different trip curves with definite time with time settings t5= 1...10 s. Automatic exclusion of the function during the motor starting phase, and automatically reactivated after this. *Can be excluded.*

- Function I: adjustable trip threshold I3= (6-13) x In (instantaneous trip) with recognition of the motor starting phase.

- Function U: adjustable trip threshold I6= (0.4-0,9) x I1 e t6= 4 s. *Can be excluded.*

- Possibility of contactor control for trip of functions L and R.

- Possibility of connection to a PTC (temperature probe) inserted in the motor.

11.10. Dialogue

For circuit-breakers from 250 A to 1600 A dialogue shall be available, making the following functions possible:

11.10.1. Remote setting of the protection function parameters, unit configuration and communication.

11.10.2. Transmission of measurements, states and alarms from circuit-breaker to system transmission of events to the system.

11.10.3. Dialogue units able to support different standard market protocols shall be available:

11.10.3.1. Modbus RTU protocol, EIA RS485 physical transmission means, speed 9.6...19,2 Kbit/s, bus architecture.

11.10.3.2. Profibus DP protocol, RS485 physical transmission, speed 9.6...19,2 Kbit/s, bus architecture.

11.10.3.3. Device Net protocol, RS485 physical transmission, speed 9.6...19,2 Kbit/s, bus architecture, Wireless bluetooth protocol.

11.10.3.4. The dialogue unit shall make all the parameterization and measurement information of the protection unit available on the field bus, as well as the state of the circuit-breaker (open/closed, racked-in/racked-out) and of the related trip units. Shall be providing a tool able to analyse all these data by PC.

11.11. Accessories

11.11.1. Electrical Accessories

11.11.1.1. Internal Accessories has to be the same up to 250A as well from 250A to 1000A.

11.11.1.2. Auxiliary contacts: these shall allow the state of the circuit-breaker (open or closed; contact on change-over) and trip unit to be known. Auxiliary contacts for use at 250 V AC/DC, 400V AC and 24 V DC (digital contacts) shall be available.

11.11.1.3. Releases: the shunt opening and under-voltage releases shall be available with different power supply voltages both in AC and DC.

11.11.1.4. With circuit-breakers up to 250 A the electrical accessories shall be available both in the pre- cabled version and with 1m long un-cabled cables.

11.11.1.5. The addition of the electrical accessories shall not increase the volume of the circuit breakers.

11.11.2. Mechanical Accessories

11.11.2.1. Terminals: different types of terminals (both front and rear) shall be available for all the sizes, suitable for connection with copper, copper-aluminium cable and bus bar connections.

11.11.2.2. Up to the 160 A size, the circuit-breakers can be fitted with different types of terminals combined in different ways (higher of one type, lower of a different type). Terminal covers and phase separators shall also be available.

11.11.2.3. Multi-cable terminals shall be available for circuit-breakers for the 250-320-400-630 A size. Support for fixing onto DIN rail: supports for fixing onto DIN EN 50022 rail shall be available up to the rated current of 250 A inclusive.

11.11.2.4. Mechanical interlocks: mechanical interlocks shall be available for the whole series of circuit-breakers; the interlock can be of the front type for circuit-breakers with rated current up to 250 A. It shall be possible to interlock circuit-breakers of different sizes at least up to 250 A and between 250A and 630 A.

11.11.2.5. Rotary handle: a rotary handle operating mechanism both in the direct and transmitted version shall be available for the whole range of circuit-breakers, both padlockable in the open position and fitted, on request, with the following accessories: early contact for under-voltage release, compartment door lock and key lock in open position.

11.11.2.6. The whole range of moulded case circuit-breakers shall be fitted with motor operator (according to the rated current of the circuit-breaker, this can either be of the solenoid type, or with stored energy) for remote operation of the circuit-breaker.

11.12. Residual Current Release

11.12.1. General Aspects

11.12.1.1. The residual current releases used in low voltage installations shall be designed, constructed and tested in compliance with the International Standards and in particular with:

11.12.1.1.1. IEC 60947-2 appendix B and ANNEX M

11.12.1.1.2. IEC 60255-4 and IEC 61000: for protection against unwarranted trips

11.12.1.1.3. IEC 60755 for insensitivity to the continuous current components

11.12.1.2. It shall be possible to install the residual current releases in installations with line-to line voltage up to 690 V.

11.12.1.3. They shall be able to be used in close connection with circuit-breakers and/or switch disconnectors.

11.12.1.4. Shall be guaranteed the normal operating up to -25°C

11.13. Construction Characteristics

11.13.1. It shall be possible to combine the range of residual current releases with all the circuit breakers making up the range of moulded case circuit-breakers so as to cover the whole current range of MCCBs.

11.13.2. It shall be possible to combine the residual current releases with circuit-breakers in fixed, plug-in and withdrawable version.

11.13.3. Their installation on a DIN rail shall be possible.

11.13.4. Control of correct operation shall be possible according to the prescriptions of the reference Standards, by means of a test pushbutton on the front of the apparatus.

11.13.5. Residual current releases shall be available both in the three-pole up to 250A and in the four-pole version.

11.13.6. Dedicated residual current releases shall be available up to 1600 A

11.13.7. Type B residual current protection shall be available

11.13.8. It shall be possible to select the maximum threshold of sensitivity to the residual current fault frequency (3 steps: 400 700 1000 Hz).

11.14. Electrical Characteristics and Performances

11.14.1. Up to the rated current of 250 A, the service voltage shall be between 85 and 500 V AC line-to-line (operation up to 50 V phase-neutral). Trip thresholds Idn starting from 0.03A and up to 10 A shall also be available for the advanced version which shall also allow selection of the trip times (for the basic version, the trip shall be of the instantaneous type).

11.14.2. A contact signalling pre-alarm shall be available in the advanced version and the availability of an input for remote opening.

11.14.3. There shall be type A versions for alternating pulsed current, S selective and E for emergency stop of the residual current release.

11.14.4. The release shall be self-supplied and the power supply can come either from above or below.

11.14.5. Compliance with the International Standards on the matter of electromagnetic compatibility.

11.14.6. There shall be a switchboard residual current unit with voltage varying between 80 and 500 V AC and between 48 and 125 V DC. There shall be availability of several adjustment ranges from 0.03 to 30 A, with trip times from instantaneous to 5 s and pre-alarm threshold adjustment.

11.14.7. The toroidal transformers can either be closed (from 60 to 180 mm in diameter) or open (from 110 to 230 mm in diameter).

12. MINIATURE CIRCUIT BREAKERS SHALL CONFORM TO THE FOLLOWING CHARACTISTICS.

12.1. Functional Characteristics (1 to 63 Amps)

12.1.1. Miniature Circuit Breaker for cable protection according to:
DIN VDE 0641 Teil 11,
EN 60898, IEC 60947-2, EN 60947-2,
UL1077/C22.2 No.235, UL489/C22.2 No.5

12.1.2. Rated short-circuit capacity Icn shall be: 6/10/25 kA unless otherwise indicated.

12.2. Tripping Characteristics/curves shall be as follows

B: In 6/10/13/16/20/25/32/40/50/63 A
C: In 0,5/1/1,6/2/3/4/6/8/10/13/16/20/25/32/40/50/63 A
K: In 0,2/0,5/1/1,6/2/3/4/6/8/10/13/16/20/25/32/40/50/63 A
Z: In 0,5/1/1,6/2/3/4/6/8/10/16/20/25/32/40/50/63 A
Number of poles: 1/2/3/4/1+NA/3+NA

Energy Limiting Class: 3
Rated Voltage Un:
Single-pole: 230/400 VAC
Multi-pole: 400VAC
Max. Operating Voltage UBmax DC:
Single Pole: 72 VDC
Double Pole: 125 VDC
Suitable for isolation acc. IEC 60898-1

12.3. Environmental Characteristics

12.3.1. Operating temperature: -25 °C...+70 °C and storage temperature: -40 °C...+70 °C.

12.3.2. Altitude: operation without derating up to 2000 m (6600 ft), and with derating up to 4000 m.

12.3.3. Suitability for use in a hot-humid environment. With regard to this, the circuit-breakers shall undergo a tropicalisation process which makes them suitable for use in a hot humid environment, as established by the prescriptions of the main shipping registers and in accordance with the international IEC 60068-2-30 Standards.

12.4. Construction Characteristics

12.4.1. Guide edge for labels

12.4.2. Prepared for locking devices

12.4.3. Quick and easy removal of installed device

12.5. Wiring

12.5.1. *Busbars*: Terminals for in and out coming feeder on top of busbars. The MCB shall have a “safe terminal”. Each pole shall have 2 connection points. Combining busbar and wire in same terminal shall not be permitted. Combining wire of un-equal sizes in the same terminal shall not be permitted.

12.6. Accessories

12.6.1. Retrofit accessories (extract):

- Universal signal contact/auxiliary contact (right): 1SO
- Auxiliary contact (right): 1SO
- Auxiliary contact (left): 1NO/1NC, 2NO or 2NC
- Bottom-fitting auxiliary contact: 1NO or 1NC
- (bottom fitted without increasing width of MCB)
- Undervoltage- or Shunt trip release
- Hand operated neutral
- Motor operating device (remote control)
- DDA-Block
- Labelling system (marked or blank)
- Locking devices

12.7. Functional Characteristics (80 to 100 Amps)

12.7.1. Miniature Circuit Breaker for cable protection according to:
DIN VDE 0641 Teil 11, DIN VDE 0660 Teil 101, IEC 60898, EN

60898, IEC 60947-2, EN 60947-2

12.7.2. Rated short-circuit capacity shall be minimum: 6 kA unless otherwise stated.

12.8. Tripping Characteristics

12.8.1. B mit In 80/100 A
C mit In 80/100 A
Number of poles: 1/2/3/4
Energy Limiting Class: 3
Rated Voltage:
Single-pole: 230 VAC and 60 VDC
Single-pole: 400 VAC and 125 VDC
Suitable for isolation acc.: IEC 60947-1/-3

12.9. General Features

12.9.1. Label holder

12.9.2. Prepared to get equipped with toggle-locking device

12.10. Wiring

12.10.1. *Busbars*: Terminals for in and out coming feeder on top of busbars. The MCB shall have a "safe terminal". Each pole shall have 2 connection points. Combining busbar and wire in same terminal shall not be permitted. Combining wire of un-equal sizes in the same terminal shall not be permitted.

12.11. Accessories

12.11.1. Auxiliary contact: 2 or 3 contacts (screw-able or push-in-able)

12.11.2. Auxiliary contact (low power): 1 or 3 contacts

12.11.3. Signal contact or signal contact/auxiliary contact: 3 contacts

12.11.4. Undervoltage release or shunt trip

12.11.5. Neutral conductor

12.11.6. Printed labels

12.11.7. Labels for individual printing

12.11.8. Locking devices

12.12. Functional Characteristics (DC Protection)

12.12.1. Miniature Circuit Breaker for cable protection according to: DIN VDE 0641 Teil 12, DIN VDE 0660 Teil 101, IEC 60898, EN 60898, IEC 60947-2, EN 60947-2, UL1077

12.12.2. Rated short-circuit capacity: 4,5/6 kA

12.13. Tripping characteristics shall conform to the following

B: In 6/10/16/20/25 A
K: In 0,2/0,3/0,5/0,75/1/1,6/2/3/4/6/8/10/16/20/25/32/40/50/63 A
In 0,5/1/1,6/2/3/4/6/8/10/16/20/25/32/40/50/63A
Number of poles : 1/2/3/4 (K,Z); 1/2 (B)
Rated Voltage:
Single-pole: 230/400 VAC and 220 VDC
Multi-pole: 400 VAC and 440 VDC
Suitable for isolation acc: IEC 60947-1/-3

12.14. General Features

12.14.1. Label holder

12.14.2. Prepared to get equipped with toggle-locking device

12.15. Wiring

12.15.1. *Busbars*: Terminals for in and out coming feeder on top of busbars. The MCB shall have a "safe terminal". Each pole shall have 2 connection points. Combining busbar and wire in same terminal shall not be permitted. Combining wire of un-equal sizes in the same terminal shall not be permitted.

12.16. Accessories

12.16.1. Auxiliary contact: 2 or 3 contacts shall be (screw-able or push-in-able)

12.16.2. Auxiliary contact (low power): 1 or 3 contacts

12.16.3. Signal contact or signal contact/auxiliary contact: 3 contacts

12.16.4. Undervoltage release or shunt trip

12.16.5. Neutral conductor

12.16.6. Printed labels

12.16.7. Labels for individual printing

12.16.8. Locking devices

13. CONTACTORS

13.1. Contactors shall comply with SANS 60947. Duty cycle shall be AC3. Contactor coil voltage may be either 230V or 400V unless otherwise stated.

13.2. Lighting contactors for 24 to 63 Amps (AC1) shall be DIN mounted on the same rail as the MCBs and feature a DC solenoid actuator and are thus hum-free. They shall have a switching position indicator, integrated coil protection circuits and overvoltage protection for the solenoid coil up to 5kV.

13.3. Contactors from 9 to 38 Amps shall be electronic coils.

13.4. For contactors from 50 to 300 Amps, standard coils will be accepted.

13.5. Contactors from 400 to 2050 Amps shall be electronic coils.

13.6. Mixture of contactors shall not be permitted.

13.7. Ambient characteristics

13.7.1. Climatic withstand according to IEC60068-2-0 AND 60068-2-11

13.8. Construction characteristics

13.8.1. Contactors with electronic coils 9 to 38 Amps AC3 shall have:

13.8.1.1. Maximum of two frame sizes from 9 to 16 amps AC3

13.8.1.2. Width not to exceed 45mm for contactors 9 to 38 amps AC3 rating

13.8.1.3. Contactor up to 16 amps to include built in auxiliary contact

13.8.1.4. Common auxiliaries for contactors 9 to 38 amps AC3

13.8.2. Contactors 9 to 110 Amps with standard coil shall have:

13.8.2.1. Mounting positions: only position 6 not permitted (see appendix 1)

13.8.2.2. Maximum of 4 frame sizes from 9 to 110 amps

13.8.2.3. Quick fixing on mounting rail according to IEC 60715 standards as:-

- 35 x 7.5 mm for 9 to 40 amps contactors
- 35 x 15 mm for 9 to 75 amps contactors
- 75 x 25 mm for 50 to 110 amps contactors
- Terminal with captive screws
- Terminal screws to be of Pozidriv type up to 75 amps AC3
- Terminal screws to be M8 Hexagon socket for main terminals and Pozidriv for coil terminals

13.8.3. Contactors 145 to 750 Amps AC3 with Standard or Electronic Coil shall have:

13.8.3.1. Maximum of 4 frame sizes from 145 amp to 750 amp

13.8.3.2. Mechanical design to incorporate power terminal at base of contactor, operating coil to be mounted on top of contactor. Coil removal to side of contactor shall not be permitted.

13.8.3.3. Shall have front access to coil , with no need to remove the power cables when changing coils

13.8.3.4. Shall have front access to main fixed and moving contacts , without the need to remove the power cables

13.8.3.5. Removal and replacement of the fixed and moving contacts shall be able to be accomplished without the need to remove the power cables

13.8.3.6. Contactor shall have quick release quarter turn screws for easy access to main contact inspection

13.8.3.7. Clear marking of contactor electrical information, marking to be clearly visible on front of contactor

13.8.3.8. Electrical characteristics and performances

13.8.3.8.1. All Contactors shall be electrically coordinated with upstream protection device, whether device or the fuse type, MCCB, or manual motor starter. All coordination to be backed up by Manufactures coordination tables, available on request.

13.8.4. Contactors with electronic coils 9 to 38 Amps AC3

13.8.4.1. Same coil to cover both the AC or DC control supplies

13.8.4.2. Coil to be of torroidal design

13.8.4.3. Coil to have extended voltage operating limits.

13.8.4.4. 4 coil types only covering: 24..500 V 50/60Hz and 20..500 V DC

13.8.4.5. Coil Consumption not to exceed the following limits

13.8.4.6. On pull in 50VA

13.8.4.7. On holding 2.2VA

13.8.4.8. Built-in surge protection to be incorporated

13.8.4.9. Flexible position of Coil terminals i.e. can be transferred from the top to the bottom of contactor

13.8.4.10. With additional coil terminal block, it shall be possible to connect the coil both at the top and at the bottom.

13.8.5. Contactors with standard AC coil 50 to 30 Amps AC3 shall have:

13.8.5.1. Rated operational voltage 690V for contactors up to 40 amp AC3

13.8.5.2. Rated operational voltage 1000V for contactors 50 to 750 amps AC3.

13.8.5.3. Rated making capacity to be equal to 10 x AC3 rated operational current, or greater.

13.8.5.4. Rated breaking capacity to be equal to 8 x AC3 rated operational current, or greater.

13.8.5.5. Coil operating limits (according to IEC60947-4-1) 0.85 ….1.1 x rated Control circuit voltage, at temperature less or equal to 55degrees Celsius

13.8.5.6. Drop out voltage in %age of rated Control Voltage approximately 40 to 65%

13.8.5.7. Contactors 400 amp AC3 upward to incorporate electronic coil technology

13.8.6. Contactors with electronic coils 400 to 750 Amps AC3 shall have:

13.8.6.1. As above but to include the following

13.8.6.2. Same coil to cover both the AC or DC control supplies

13.8.6.3. Coil to have extended voltage operating limits.

13.8.6.4. Can withstand voltage interruptions or voltage dips in control supply up to 20ms.

13.8.6.5. Distinct opening and closing voltages as follows

13.8.6.6. Opening 0.55 x min operating voltage

13.8.6.7. Closing 0.85 x min operating voltage

13.8.6.8. Coil types only covering: 24..500 V 50/60Hz and 20..500 V DC

13.9. Accessories

13.9.1. All auxiliary contacts shall employ the "wipe action" mechanism for the self-cleaning of the contact tips.

13.9.2. Front mounted auxiliary contact blocks rated insulation voltage equal to 690V a.c or greater

13.9.3. Rated operation voltage 24…690VAC

13.9.4. Rated making capacity 10 x AC-15 rated operational current

13.9.5. Rated breaking capacity 10 x AC-15 rated operational current

13.9.6. Rated short time withstand current 100amps for 1sec:, 140 amps for 0.1 sec

13.9.7. Electrical durability, max electrical switching frequency 1200 cycles per hour or greater

13.10. Side Mount Auxiliary Contact Blocks shall have:

13.10.1. Rated insulation voltage equal to 690V a.c or greater

13.10.2. Rated operation voltage 24…690V a.c

13.10.3. Rated making capacity 10 x AC-15 rated operational current

13.10.4. Rated breaking capacity 10 x AC-15 rated operational current

13.10.5. Rated short time withstand current 100amps for 1sec:, 140 amps for 0.1 sec

13.10.6. Electrical durability, max electrical switching 1200 cycles per hour or greater.

14. LIGHTNING AND SURGE PROTECTION

14.1. Main Distribution Board

14.1.1. According to the IEC 62305 recommendations, electrical installations shall be protected against direct lightning and surge impulses with din rail Class 1/Type 1 (10/350µs) lightning current arresters.

14.1.2. SPD shall use a triggered spark gap technology to allow high lightning discharge current, unpluggable type to avoid ejection of the cartridge during the discharge of the current and non-blow out technology to avoid fire risks.

14.1.3. The SPD shall provide either common protection in TNC network or common and differential mode protection in TT and TNS network according to the IEC60364 recommendations.

14.1.4. Lightning arresters shall have the following technical specifications:

14.1.4.1. Class of test (IEC 61643-1) I

14.1.4.2. Lightning impulse current: Iimp/pole (10/350µs) ≥ 25kA

14.1.4.3. Nominal voltage Un 230 / 400V

14.1.4.4. Maximum continuous AC voltage Uc 255V

14.1.4.5. Follow current extinguishing capability Ifi ≥ 50kA

14.1.4.6. Protection level Up : 2.5kV

14.1.4.7. Max. back up fuse gG/gL: 125A

14.1.4.8. Visual state indicator: Yes

14.2. Sub-Main Distribution Board

14.2.1. According to the IEC 62305 recommendations to avoid oscillations and magnetic coupling phenomenon, sensible equipments shall be protected against indirect surges with din rail Class 2 / Type 2 (8/20µs) surge arresters.

14.2.2. The SPD shall have a safety reserve system and shall be pluggable for preventive and easy maintenance. The SPD shall provide either common protection in TNC network or common and differential mode protection in TNS and TT network according to the IEC 60 364 recommendations.

14.2.3. In case of common and differential mode protection the SPD shall use an association of MOV and GDT to provide isolation to the ground and low protection level in all protection modes. The associated switching element

14.2.4. (MCB/Fuse) (to insure a safe end of life) shall be the same brand as the SPD to insure a good coordination.

14.2.5. Surge arresters technical specifications:

14.2.5.1. Class of test (IEC 61643-1) II

14.2.5.2. Max. discharge current: Imax/pole (8/20µs) ≥ 40kA

14.2.5.3. Nominal current In / pole ≥ 20kA

14.2.5.4. Nominal voltage Un 230 / 400V

14.2.5.5. Maximum continuous AC voltage Uc 275 / 255V

14.2.5.6. Protection level Up at 20kA ≤ 1.5 kV

14.2.5.7. Protection level Up at 3kA (Class 3 test)

14.2.5.8. Pluggable :Yes

14.2.5.9. Visual status indicator: Yes

14.2.5.10. Safety reserve: Yes

14.2.5.11. Remote indicator :Yes

14.3. Data line / Telecom line

14.3.1. The selection of the surge protection device shall be according the IEC 62305 recommendations and therefore shall be a type C2 SPD.

14.3.2. The SPD shall be pluggable type for easy maintenance and shall provide the dialling tone returns when the cartridge is withdrawn in case of end of life.

14.3.3. The cartridges, whatever the nominal voltage, shall be adaptable onto different base. The base shall be chosen according to the connection of thewire: it can be RJ11, RJ45 or screw connection. The connections to the earthshall be either by a DIN rail contact or by a screw terminal.

14.3.4. The SPD dimension shall not exceed 12.5 mm wide to save space. The SPD shall use two level of protection: the first one by GDT, the second one by zener diode. These two levels shall be coordinated and shall provide common and differential mode protection.

14.3.5. Low current surge arresters technical specifications:

14.3.5.1. Class of test (IEC 61643-21): C2

14.3.5.2. Nominal voltage Un According to the Max.voltage of signal

14.3.5.3. Maximum continuous AC voltage Uc (L-N / N-G): According to the Max. voltage of signal

14.3.5.4. Loading current: 140mA

14.3.5.5. Max. discharge current: Imax / line (8/20µs) ≥ 10kA

14.3.5.6. C2 Nominal discharge current In / line (8/20µs) ≥ 5kA

14.3.5.7. Protection level Up (L-L / L-G): According to the Max. voltage of signal

14.3.5.8. Pluggable: Yes

15. ANTI-CONDENSATION HEATERS

15.1. Anti-condensation 220 Volt heaters shall be provided for all compartments. A switch with thermostat shall be provided to control the heaters.

15.2. The wiring from the heater elements to terminals shall be high temperature insulation covered, a suitable compression type gland shall be fitted for the incoming 231V supply.

16. INDICATING INSTRUMENTS

16.1. A flush mounted, industrial grade, 96 mm square voltmeters and ammeter conforming to SABS 1299 shall be mounted near the centre top of the front panel and connected to measure the busbar voltage and current.

16.2. The calibrated scale length shall be a minimum of 70 mm. Means shall be provided for zero adjustment from the front without any dismantling of the indicating instrument.

16.3. A voltmeters selector switch with phase to phase, phase to neutral, and "off" position shall be provided.

16.4. An ammeter selector switch shall be provided with an "OFF" position.

16.5. Meters shall indicate by means of colours the relevant phase that it is metering.

17. CURRENT TRANSFORMERS

17.1. Current transformers shall comply with BS 3938.

18. MECHANICAL CABLE GLANDS

18.1. Cable glands shall be of the compression type, manufactured in brass and/or bronze, and suitable for termination of earth-continuity conductor type cables where applicable.

18.2. The gland body shall incorporate a knurled cone for clamping the armouring and an integrally cast earth lug, complete with earthing screw.

18.3. All metal portions of the gland shall be electroplated for corrosion resistance.

18.4. The glands shall be supplied complete with weatherproof neoprene shrouds.

18.5. Entries for multi-core PVC, PVC, wire armoured, PVC sheathed cables shall comprise cone grip mechanical type glands mounted on robust gland plates.

18.6. The board shall be supplied complete with all glands for all outgoing and incoming circuits as indicated on the drawing.

19. LIGHT SENSITIVE CONTROL UNIT

19.1. Light sensitive control units shall be supplied by others.

19.2. A suitably rated single pole over-riding switch, for over-riding the unit in 19.1, and moulded case

circuit breaker shall be provided, when called for in the drawings or appendices hereto.

19.3. The switch and circuit breaker shall be wired to a suitable terminal strip, mounted within the distribution board, to facilitate connection of the light sensitive control unit when installed.

20. EARTHING

20.1. The components shall be effectively bonded to the main frame of the distribution board, which shall also be bonded to the main earth bar. Earthing shall comply with SANS-10142 code of practice for the wiring of premises.

21. CABLING AND WIRING

21.1. All cables and wires used shall be stranded, 600/1000 V grade and comply with SABS 150, except where special cables have been otherwise specified.

22. LABELS

22.1. Labels shall be provided comprising conspicuous engraved black lettering on white background secured with rivets or screws on or adjacent to the items concerned, and worded in English.

22.2. Labels of embossed tape or labels secured with adhesive are not acceptable.

22.3. All fuse-switches, circuit breakers, isolators, contactors, relays, etc., shall be clearly designated.

22.4. The terminals of all outgoing circuits shall be provided with labels to correspond with the labelling of the units on the panel of the distribution board.

22.5. All terminal connections shall be provided with durable tags or clips, on which shall be clearly and indelibly marked, the identifying code letters of each wire. Such code letters shall correspond to those used on the wiring diagram.

23. PAINTING

23.1. All surfaces of the distribution board shall be light orange to SABS 1091 colour No. B26. (Transnet orange; Pantone 165C / 021U; Coats 50/50; Vermilion MW52; RAL 2004 rein orange; Trichromatic 70% magenta, 90% yellow), unless otherwise specified.

23.2. All surfaces shall be cleaned according to the appropriate method described in SABS 064 for the particular surface to be cleaned, the contamination to be removed and the primer to be applied.

23.3. Blast cleaning of components shall be in accordance with clause 4.3 of SABS 064 to a degree of cleanliness of at least Sa2 for inland exposure components and Sa 1/2 for coastal exposure components. See Table 1 of SABS 064 for the appropriate profile.

23.4. Sheet metal that cannot be blast cleaned shall be cleaned by pickling according to clause 4.6 of SABS 064.

23.5. Components that shall be powder coated shall be cleaned and prepared by the surface conversion process according to clause 5 of SABS 064 to a medium-weight classification of table 2 of that specification.

23.6. Oil and accumulated dirt on steel components where no rusting is present shall be removed according to clause 3 of SABS 064.

23.7. The powder-coating process shall be in accordance with SANS 1242 - type 4 : Corrosion-resistant coatings for interior use and using the thermosetting type high gloss coating.

23.8. All specified coatings shall be applied according to the relevant specification and the manufacturer's instructions shall be followed.

23.9. Coatings shall not be applied under conditions that may be detrimental to the effectiveness of the coating or the appearance of the painted surface.

23.10. When examined visually the finished products shall have a uniform appearance as far as gloss is concerned and shall show no sign of damage. Damaged areas shall be repaired coat for coat to obtain the desired finish.

24. ADDITIONS AND MODIFICATIONS TO EXISTING DISTRIBUTION BOARDS

24.1. Where the contractor needs to make modifications or additions to existing distribution boards, the following minimum criteria shall be adhered to :

24.1.1. Re-labelling and proving of existing circuits in accordance with security of existing terminations to be confirmed

24.1.2. Isolation barriers, cover blanks to be in place where required

24.1.3. Panel modification in terms of architraves, DB covers, and the closing of redundant openings to be undertaken by an accredited switchboard manufacturer.

24.1.4. Wiring to be examined for integrity correct sizing and tidied and/or replaced and neatened as required.

24.1.5. A certificate of compliance shall be issued for the full distribution board and not the additions only.

25. INSPECTION

25.1. Transnet National Port Authority reserves the right to carry out inspection of any items of equipment and work at any time during the manufacture at manufacturer's works and to be present at any tests.

25.2. A final inspection by Transnet National Port Authority before delivery to site is required.

26. TESTS

26.1. All prescribed tests as referred to in the standard specifications may be called for at the discretion of Transnet Group Capital.

26.2. Transnet National Port Authority also reserves the right to carry out any check tests on the equipment.

26.3. Notwithstanding the successful completion of tests, the tenderer shall still be responsible for the efficient operation of the equipment.

26.4. The tenderer shall bear all costs for any tests, which shall be required.

27. GUARANTEE

27.1. The Contractor shall undertake to repair all faults due to bad workmanship and / or faulty materials and to replace all defective apparatus or materials during a period of twelve (12) calendar months, calculated from the date of delivery.

27.2. Any defects that may become apparent during the guarantee period shall be rectified to the satisfaction of, and free of cost.

27.3. The Contractor shall undertake work on the rectification of any defects that may arise during the guarantee period within 7 days of his being notified by Transnet National Port Authority of such defects.

27.4. Should the Contractor fail to comply with the requirements stipulated above, Transnet National Port Authority will be entitled to undertake the necessary repair work or effect replacement of defective apparatus or materials, and the Contractor shall reimburse Transnet National Port Authority the total cost of such repair or replacements, including the labour costs incurred in replacing defective material.

28. SPARES

28.1. The tenderer shall state whether a complete range of spares is held in stock by their local representatives for subsequent purchase by Transnet National Port Authority as and when required.

WITNESSES

1. …….. ……
TENDERER

2. …… ……
DATE

Transnet National Port Authority
Design Services

APPENDIX 1

STATEMENT OF COMPLIANCE
(TO BE COMPLETED BY TENDERER)

This tender complies with specification TPD-002-DBSPEC in all respects.

SIGNATURE : _____ DATE : _____

This tender complies generally with specification TPD-002-DBSPEC but differs from it on the following points.

_____

_____

_____

_____

_____

SIGNATURE : _____ DATE : _____

Transnet National Port Authority