SPECIFICATION FOR THE DESIGN, SUPPLY AND INSTALLATION OF HIGHMAST LIGHTING

REVISIONS		
REV	**DATE**	**APPROVED**
00	**October 2012**	**S.SEWDAYAL**
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1.0 SCOPE

1.1 This specification covers Transnet National Ports Authority requirements for the design, manufacture and supply of all equipment and materials for and the complete installation and testing on site of high mast lighting.

2.0 REFERENCES

2.1 The following publications and drawing (latest editions and amendments) are referred to herein.

2.1.1 South African Bureau of Standards

SANS 10142	- Code of practice for the wiring of premises.
SANS 1411	- PVC insulated electrical cables and flexible cords.
SANS 475	- Floodlighting luminaires.
SANS 1033	- Solid filler wires for gas-shielded metal arc welding of mild steel and medium-high tensile steel.
SANS 556-1	- Low-voltage switchgear part 1: circuit-breakers
SANS 556-2	- Low-voltage switchgear: earth leakage circuit breakers
SANS 10225	- The design and construction of lighting mast
SANS 10162	- Welding of structural Steel
SANS 455	- Covered electrodes for the manual arc welding of carbon and carbon manganese steels
SANS 121	- Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.
SANS 50025	- Hot rolled products of structural steel
SANS 60947-2	- Low-voltage switchgear and controlgear Part 2: Circuit-breakers
SANS 10389-1	- Artificial lighting of exterior areas for work and safety
SANS 10064	- The preparation of steel surfaces for coating

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2.1.2 British Standards Institution

BS 7668	- Weldable structural steels Hot finished structural hollow sections in weather resistant steels.
BS 5135	- Metal-arc welding of carbon and carbon manganese steels.
BS 721	- Worm gearing.

2.1.3 Transnet Ltd.

CME 35	- Specification for steel wire ropes.

Lubricants and petroleum fuels standing and advisory committee Circular No. 1

3.0 APPENDICES

The following appendices form part of this specification:

3.1 Appendix No. 1 – Painting specification.
3.2 Appendix No. 2 – Statement of compliance.

4.0 METHOD OF TENDERING

4.1 Tendering shall be in accordance with Tender Form included in the tender documents.

4.2 Tenderers shall submit their main offers in accordance with the requirements of this specification. Deviations from the requirements of this specification, which are of a minor nature and do not depart materially, will be considered at the discretion of Transnet National Ports Authority. The acceptance of alternative tenders will be considered only if a main tender is submitted as part of the tender document.

4.3 The "Technical Data Sheet" of this specification shall be completed in detail, for each offer. Alternative offers shall be clearly marked "Alternative Offer No. _____".

4.4 All Technical Data Sheets shall be signed by the Tenderer and returned.

4.5 All documents forming part of the Tender shall be firmly bound. No loose documents will be considered.

4.6 Failure to comply with the above requirements may preclude a tender from consideration

4.7 The Tenderer shall submit complete and detailed information concerning their offers. This information shall include descriptions and drawings of the various items of equipment offered, as well as full photometric data issued by the South African Bureau of Standards, for the luminaires they propose using.

4.8 The Tenderer shall allow for the supply, off-load, handling on site, erection, installation and testing of all items of equipment and material necessary for the complete lighting installation. This shall include the termination of the existing supply.

4.9 The total price tendered shall not include for a maintenance cage, power tool and winch.

5.0 SERVICE CONDITIONS

5.1 The lighting may be installed in areas where high humidity, high temperature, high wind, heavy rain, severe hail and high incidence of lightning are encountered and where corrosive conditions including the presence of sulphur dioxide, prevail.

5.1.1 Equipment installed shall be suitable for efficient operation under these conditions.

6.0 ELECTRICITY SUPPLY SYSTEM

6.1 The electricity supply system will be 3 phase, 4 wire, 50 Hz, alternating current with earthed neutral, at a nominal voltage of 400/230 V.

6.2 The voltage may vary within the range of 95% to 105% of the nominal and equipment installed shall be suitable for efficient operation at any voltage within this range.

7.0 STANDARD OF WORK, EQUIPMENT AND MATERIALS

7.1 All work shall be carried out in a neat and orderly manner to the satisfaction of Transnet National Ports Authority, and all equipment shall be easily accessible for maintenance purposes. Electrical work shall conform to the requirements of SANS 10142 and those laid down in this specification.

7.2 Equipment and materials used, shall be of high-quality design and manufacture, and shall comply with the relevant specifications and recommendations mentioned in this specification.

7.2.1 Where equipment and material does not comply with the relevant specifications it shall be submitted to Transnet National Ports Authority's NEC Supervisor for approval.

7.3 Every reasonable precaution and provision shall be incorporated in the design of the equipment for the safety and security of the system and of those concerned with its operation and maintenance.

8.0 OUTLINE OF SCHEME

Nil

9.0 MASTS

9.1 The mast shall be constructed in the form of a tapering enclosed column of polygonal or circular cross-section.

9.2 The design of the mast shall be adequate to resist a wind loading produced by a wind speed of 150km/h, measured at a height of 10 meters above ground level and acting on the projected area of the mast, luminaires and luminaire mounting carriage. The maximum permissible deflection at the top of the mast shall not exceed 2,5% of the height of the mast under wind loading produced by a wind speed of 100km/h. Provision shall be made in the mast design for minimising wind excited oscillation.

9.2.1 Tenderers shall submit with their offer as well as dimensioned drawings of the mast structure including door opening strengthening and base plate connection details, signed by a registered professional structural engineer.

9.3 The masts shall be designed for mounting on a reinforced concrete foundation by means of a base flange secured to a bolt cage into the foundation. The base flange shall be free from laminations and the welded connection to the mast, shall fully develop the strength of the section. Means shall be provided to enable masts to be adjusted from deviations from the vertical.

9.3.1 The space between the top of the concrete foundation and the underside of the base flange shall be filled with a suitable compound after provision of a vermin proof drainage hole. The cable entry pipes shall not be obstructed.

9.4 All steel used in the manufacture of the masts, luminaire mounting carriages, maintenance cages, etc., shall comply with the requirements of SANS 1431 grades 43A or 50.

9.5 Each mast shall be equipped with a suitable head frame accommodating mast top equipment associated with the raising and lowering gear. The head frame shall be designed to effectively seal the top of the mast against the ingress of water.

9.5.1 Problems are being experienced at certain locations with birds nesting in the vicinity of the shaft opening at the top of the mast, resulting in a build up of debris in the base of the mast. Tenderers shall describe with the aid of sketches/drawings, means adopted to avoid this problem in masts offered.

9.6 An opening shall be provided in the side of the mast to give easy access to a power distribution board, cable termination and the raising and lowering operating mechanism. The opening shall be protected by a lockable, close fitting, hinged door, incorporating a vermin proof ventilation opening and shall be effectively sealed against the weather Tenderers shall submit weatherproofing details with their tender documents.

9.6.1 The sides of the base compartment opening under 9.6 above, shall be suitably reinforced with fully welded steel sections to restore the section modulus and prevent buckling.

9.7 Brackets or mounting plates, drilled to template shall be welded into the mast to

support the winch and mast electrical equipment.

9.8 An M12 hex head stainless steel screw shall be welded to the main body of the mast in a readily position, directly adjacent to, and level with the underside of the distribution board within the base compartment, for earthing purposes.

9.9 Access shall be provided through the bottom of the mast and foundation for looping the supply cables into and out of the mast. Non-ferrous pipes shall be used for this purpose.

9.10 Welding shall be in accordance with BS 5135, general requirements for the metal-arc welding of mild, or high tensile steel. It shall be carried out by qualified welders to the satisfaction of Transnet National Ports Authority's Structural Engineer. Site welding will not be allowed without the written approval of the Technical Officer.

10.0 FOUNDATIONS

10.1 The contractor shall be responsible for the design and installation of the foundations required for all the new high masts/ light poles. The foundations shall be designed to resist overturing from wind loading as stipulated in 9.2 or SANS 10255, which ever is greater.

10.2 In areas were high masts/ light poles need to be mounted onto the quay wall, the contractor shall design a suitable anchorage system capable of resisting the wind load criteria stipulated in section 9.2.

10.3 All designs done by the contractor shall be submitted to the project manager for review and acceptance prior to any works being carried out on site.

11.0 RAISING AND LOWERING SYSTEM

11.1 Each mast shall be provided with a carriage for mounting of the luminaires. The carriage shall be in two halves joined by bolted flanges to permit removal from the erected mast. It shall be possible to raise the luminaire carriage to the top of the mast for normal operation and lower it to the base of the mast for maintenance purposes. This shall be achieved by means of three independent suspension ropes operated from a winch mounted in the base of the mast, the ropes being contained within the mast and passing over pulleys in the head frame to the carriage. The suspension ropes shall be permanently under tension and locking of the luminaire carriage in the raised position by means of a latching device at the top of the mast will not be acceptable.

11.1.1 The design of the carriage shall be such that the structure embodies as far as possible the necessary mountings and housings for individual luminaire,

control gear units and terminal boxes. All mountings shall be of rigid construction and fixings for control gear units and terminal boxes shall be such that those units can be readily removed and are easily accessible for maintenance purposes without adjustment of floodlight aiming angles.

11.1.2 The carriage shall operate in conjunction with suitable guides located on the head frame, to ensure automatic and precise alignment of the carriage in the final stages of the raising operation and to guard against any fouling of suspension ropes and electrical cables.

11.1.3 The carriage shall be provided with a soft rubbing surface to prevent damage to the mast protection during raising and lowering.

11.1.4 The luminaires and control gear shall be mounted so as to balance the carriage as far as possible and the suspension system shall ensure that the luminaire carriage is supported in a horizontal position throughout the raising and lowering operation.

11.1.5 A visible means of indication that the luminaire carriage has reached the fully raised position shall be provided in the base compartment of each mast.

11.1.6 One specially designed bracket for clamping on to the mast directly above the door opening to support the luminaire carriage in the lowered position for maintenance purposes shall be supplied per contract.

11.2 The suspension rope pulley shall be fitted with self-lubricated, maintenance free bearings, protected against the ingress of moisture and dirt and designed for operation over the life of the mast without further attention.

11.2.1 The pulley shall be machine grooved to a depth of not less than 1,5 times the diameter of the rope. The grooves shall be finished smoothly and be free from surface defects liable to damage the rope. The contour of the bottom of the groove shall be circular over an angle of approximately 120°. The radius of this part of the groove shall be larger than the radius of the rope by 0,8mm.

11.2.2 The diameter of the pulleys at the bottom of the groove shall not be less than 17 times the diameter of the rope.

11.2.3 The shafts on which the pulleys revolve shall be of large diameter to reduce the bearing loadings below normal design ratings. The shafts shall be positively secured in the head frame assembly to prevent rotation and shall be manufactured from stainless steel.

11.2.4 Pulleys carrying ropes or electric cables shall be provided with close fitting guards to retain the ropes or cables in the grooves when operating either loaded or slack. The guards shall be securely located against movement. Arrangements shall be made to ensure that the electric cables and steel wire ropes are separated before passing over their respective pulleys.

11.2.5 Pulleys shall be easily accessible to personnel standing on the floor of a maintenance cage in the fully raised position.

11.3 All pulleys, etc., at the top of the mast shall be protected against the ingress of water by means of a removable cover securely attached to the head frame and overlapping the equipment. The use of covers depending only on the security of gaskets for weatherproofing will not be acceptable.

11.4 Suspension and winch ropes shall be manufactured of AISI grade 316, flexible, stranded, stainless steel not less than 6mm diameter, in accordance with Specification No. CME 35 (rope detail as per table 39), with a factor of safety of not less than 10.

11.4.1 Thimbles shall, where possible, be secured by “Talurit” compression splices applied by means of a hydraulic tool. If this, for some reason, is not possible, three stainless steel “Crosby” type clamps per thimble may be used. “Crosby” clamps used shall be easily visible for inspection purposes.

NB: The saddle portion of the “Crosby” clamp must be placed against the wire under tension and not against the loose end.

11.4.2 Suspension ropes shall be easily removable and replaceable for inspection purposes. Tenderers shall provide clear instructions how this can be done.

11.5 All pulleys and bearings shall be manufactured from non-corrodible materials.

11.5.1 If non-metallic suspension rope pulleys are used, these shall be manufactured of glass filled nylon.

11.5.2 Each suspension rope pulley shall have a factor of safety of at least 10.

11.6 All equipment in contact with stainless steel wire ropes shall be entirely suitable for use in close contact with stainless steel, without the danger of electrolytic reaction occurring.

11.7 It shall be possible to fit a maintenance cage to the raising and lowering system, in place of the luminaire carriage, to enable two men to be hoisted to the top of the mast in complete safety for painting and maintenance purposes. The two halves of the maintenance cage shall be diametrically opposite one another. Use of the maintenance cage shall not necessitate the re-aiming of floodlighting luminaires.

11.7.1 Safety devices shall be incorporated in the construction of the maintenance cage to ensure it will not fall in the event of failure of the raising and lowering equipment. Tenderers shall submit drawings and describe fully; the type of equipment offered and include a separate price for the maintenance cage in their tender documents.

11.8 All bolts, nuts, pins, etc., associated with the luminaire carriage, maintenance cage and raising and lowering equipment shall be manufactured from stainless steel and locked by means of nylon inserts or spilt pins. Nylon inserts shall only be used in nuts that will not require removal in the normal course of maintenance. Pins shall be turned out of solid steel bar and wherever spring washers are used over elongated holes, a suitable flat washer shall be provided between the spring washer and the hole.

11.9 Special attention shall be given to the safety, reliability, and protection against corrosion of the entire suspension system, including raising and lowering gear and ancillary equipment, all of which shall meet with the approval of Transnet National Ports Authority's Supervisor before installation.

12.0 PROTECTION AGAINST CORROSION

12.1 Mast luminaire carriages, maintenance cage and all ferrous parts associated therewith, shall be hot dip galvanized in accordance with SANS 121. The mass of galvanized coating shall determine in accordance with the non-destructive method under clause 6,5 of the aforementioned specification.

12.2 All welding, drilling, punching, stamping, cutting and bending of parts shall be completed and all burns removed before the galvanizing process is carried out.

12.3 A paint treatment shall be applied to all exterior galvanized surfaces in accordance with the requirements detailed in Appendix 1.

12.4 Stringent precautions shall be taken to protect finished surfaces from damage during transport and assembly.

13.0 WINCH

13.1 Provision shall be made in the base of the mast to accommodate a removable twin drum, totally enclosed, oil-bath type winch.

13.2 The winch shall be used for raising and lowering of the luminaire carriage and maintenance cage. The winch shall have a factor of safety of not less than 6.

13.3 The winch shall be of light weight construction and mounted on a suitable frame for easy transfer from one mast to another. It should also be easily coupled and uncoupled and removable through the door opening provided at the base of the mast. The design and mass of the unit shall allow easy handling and attachment to the mast by not more than two men. The total mass of the winch, including wire ropes and mounting frame shall not exceed 75kg.

13.4 Winches mounted outside the mast and connected to the suspension ropes through the door opening, will not be acceptable.

13.5 Each luminaire carriage suspension rope shall be secured independently in the base of the mast, prior to removal of the winch. The method of securing the ropes shall be such that there will be no deflection of the ropes from the vertical in any direction.

13.5.1 After fixing, the suspension ropes shall remain under tension to ensure that the luminaire carriage is retained in its fully raised position. This shall not be achieved by any kind of adjustment after the ropes have been secured.

13.5.2 This method of transferring the tension from each winch drum to the lock position must be safe. Pins used shall be of such a design that they lock automatically in position and cannot be removed while the hoist ropes are under tension

13.5.3 Single drum winch and compensating pulley arrangement will not be acceptable. The two suspension ropes shall be attached independently to each of the twin drum winch ropes.

13.5.4 Tenderers shall fully describe the method used for transferring the tension from the winch to the lock position and vice versa, prior to removal or replacement of the winch.

13.6 The winch shall be of the worm-gear type, self –sustaining at all loads and operating speeds, without the use of brakes or clutches. It shall have a gear ration of at least 50:1 and be suitable for both hand and power operation.

13.7 The winch shall be fitted with a safety device to ensure that the drum is locked positively when the cranking handle or power tool is removed from the drive shaft. The safety device shall be applied automatically.

13.8 Winch drums shall be machine grooved to ensure a tidy rope lay. The bottom of the groove shall be circular over an angle of approximately 120°. The radius of the groove shall be larger than the radius of the rope by not less than 0,8mm. The drum grooves shall be finished smoothly and be free from surface defects liable to damage the rope. The drum grooves shall be pitched so that there is a clearance between neighbouring turns of rope.

13.9 The rope anchorage on the drum shall be such that it is possible to inspect the termination of the rope in service without dismantling any part of the winch. It shall be so designed that the first and all successive rope lays are reeled on the drum in regular and tidy layers without any undue bending of the rope at the first turn.

13.10 The drum shall be so designed as to prevent the rope layers from stacking one

on top of the other against the flange and to prevent rope on any layer forcing its way down into lower layers.

13.11 The design of the winch and installation shall allow at least five turns of the rope to remain on the drum when the winch rope is fully extended under normal operating and maintenance conditions.

13.12 The winch shall incorporate a separate gearbox for each drum.

13.13 Worm gearing shall comply with the requirements of BS 721.

13.14 A test certificate. Stating the safe working load of the winch and issued by a recognised testing authority, shall be supplied with each winch.

13.15 Winches shall be fitted with a label and rating plate of a permanent nature in an easily visible position.

13.15.1 The label shall carry the Manufacturer's or Supplier's name and type number, serial number, test certificate number, safe working load, maximum allowable speed of operation at the safe working load, recommended lubricant and year of manufacture or supply.

13.16 The lubricant for the winch shall be selected from Transnet's standard list, and Tenderer's recommendations are to be based on the "Lubricants and Petroleum Fuels Standing Advisory Committee Circular No. 1". (Failure to complete form CSS 80 correctly could disqualify an offer).

13.17 Tenderers shall quote separately for the twin drum winch.

13.18 Tenderers shall include a separate quotation for the supply of an electric power tool, incorporating a torque limiting device, for operation of the winch. The power tool shall be suitable for operation on a 230 volt, 50Hz, single phase supply.

13.18.1 The operational speed of, and torque developed by, the power tool shall match the requirements of the winch and suspension system. Should a multi-speed power tool, having speeds in excess of the aforementioned operational speed, be supplied, positive means shall be provided on the power tool to prohibit its use at any speed greater than that recommended.

13.18.2 It shall be possible to support the power tool accurately and securely in its operating position for remote control at a distance of 5 meters from the mast base. The remote control switch shall incorporate a push button requiring constant pressure for operation.

13.18.3 All the equipment shall be of robust construction, suitable for site use and shall be complete with interconnecting cables and plug.

13.19 An operating handle, incorporating a torque limiting device, shall be supplied for

manual operation of the winch.

13.20 The torque limiting devices shall be adjusted according to their function up to a maximum value of 40 Nm. The adjustment shall be so arranged that it cannot readily be altered during normal use of the tools on site.

14.0 LUMINAIRES AND CONTROL GEAR

14.1 The tenderer shall supply and install luminaires as detailed in drawings.

15.0 DISTRIBUTION BOARD AND MAST CABLING

15.1 All terminal blocks and cabling shall be inspected for damage and replaced if necessary.

15.2 A totally enclosed power distribution board of flame retardant reinforced fibreglass construction shall be mounted in an easily accessible position in the compartment of the mast.

15.2.1 The board shall be provided with a front cover panel secured by captive type screws and allowing only operating toggles of switches/circuit breakers to protrude.

15.3 The distribution board shall be equipped as follows:

15.3.1 One adequately rated, triple pole, moulded case, main isolating switch.

15.3.2 Three adequately rated, single pole, moulded case circuit breakers for control of the luminaires.

15.3.3 One 15 amp, 3 pin, industrial type, switched socket outlet for control of the power tool.

15.3.4 One 15 amp, single pole neutral, moulded case circuit breaker with integral 20 mA earth leakage protection device for control of the switched socket outlet under clause 15.3.3. The earth leakage unit shall comply with the requirements of SANS 556-2.

15.3.5 One three phase, neutral and earth socket outlet for connection of the supply cable to the luminaires and protected by the circuit breakers under clause 15.3.2 above.

15.3.6 An adequate number of terminals of suitable size, allowing only one wire per terminal for looping of the incoming and outgoing supply cables. These terminals shall be provided with bridge pieces connecting any number of adjacent terminals together to form a busbar.

15.3.6.1 Terminals shall be of the rail mounted clip-on type, with flash-barriers between terminals.

15.3.7 An insulated neutral terminal block with sufficient ways for the number of circuits employed.

15.3.8 An adequately rated earthing bar.

15.3.9 Grommeted access holes in the bottom of the board for cable entry.

15.4 All wiring in the distribution board shall be neatly arranged to run horizontally and vertically and shall be supported and fixed at regular intervals.

15.5 All moulded case circuit breakers shall comply with the requirements of SANS 556 and SANS 60947-2. They shall be rated for 250 volts and have a breaking capacity of “6kA”.

15.6 The main switch under clause 15.3.1 shall be of the same manufacturers as the moulded case circuit breakers specified. The switch shall be capable of carrying a fault current of 1 000 A for 1 second without welding of the contracts or other damage to the unit.

15.7 Each control unit on the distribution board shall be clearly labelled by means engraved or printed labels of metal or plastic or other approved material, firmly attached to the board and indicating in both official languages the designation of each circuit controlled. Labels of embossed adhesive tape are not acceptable.

15.8 A flexible, multicore, heavy duty trailing cable shall be installed between the distribution board in the base of the mast and the luminaire carriage, for the power supply to the luminaires. The cable shall be entirely suitable for the bending and load carrying stresses involved.

15.9 Guiding pulleys in the head frame shall be of adequate diameter and shall have a cable retaining groove sized to match the cable diameter, to ensure that the cable is not subjected to abrasion or undue straining during raising and lowering operations.

15.10 The cable shall be securely clamped at the luminaire carriage, the other end being secured to the suspension cable in an approved manner, to ensure that the lower end returns to the mast base during the luminaire raising operation and does not become entangled with suspension ropes.

15.11 The cable shall be so installed that it can be replaced from ground level without

lowering the mast or the use of special equipment. Tenderers shall provide clear instructions on how this can be done.

15.12 Both ends of the cable shall be fitted with adequately rated, 3 phase, neutral and earth, plug-in connectors to match the socket outlet under clause 15.3.5 and a socket outlet mounted in/on a weatherproof, corrosion resistant terminal box on the luminaire carriage.

15.13 The socket outlet, plug-in connector combinations on the distribution board and luminaire carriage shall be of the weatherproof type. When connected, the plug-in connectors shall be retained in position by suitable locking devices. The equipment shall be Maréchal, or equal approved manufacture.

15.14 When in the lowered position, testing of the luminaires shall be effected via a three meter length of flexible cable, of equal manufacture and cross-sectional area to that supplying the luminaires, and fitted with plug-in connectors on both ends to suit the socket outlets on the distribution board and luminaire carriage. One such cable shall be provided per contract.

14.15 The terminal box on the luminaire carriage shall contain fixed terminal blocks of "KLIPPON", or equal manufacture, for connection of the cabling to the luminaires. Cabling between the terminal box and control gear provided in the construction of the luminaire carriage, or galvanised steel conduits. Any cabling exposed to the effects of ultraviolet radiation, shall be silicon insulated.

15.16 All metalwork, including luminaires, control gear units and the luminaire carriage shall be bonded to the earth core of the luminaire supply cable.

15.17 The following label in both official languages shall be affixed to the distribution board in a prominent position:

"Luminaire socket outlet and plug to be isolated and disconnected before lowering the luminaire carriage".

16.0 CABLES

16.1 The contractor shall supply and install 4-core, ECC, PVC cables.

16.2 The contractor shall also supply and install a suitable earthing cable at each mast.

16.3 The cable shall be installed in cable ducts and sleeves provided by others.

17.0 CABLE LAYING

17.1 The cable shall be installed in cable ducts and sleeves.

18.0 EARTHING AND LIGHTNING PROTECTION

18.1 The contractor shall supply and install earthing and lightning protection to the masts as per SANS 10313.

18.2 The incoming and outgoing cable termination and earthing arrangement at each mast shall be as shown.

18.3 The earthing core of the cable supplying the luminaires (clause 15.8) shall be connected to the earthing bar in the distribution board.

18.4 Lighting protection is required at all masts.

18.4.1 Each mast shall be equipped with a lightning conductor in the form of a galvanised steel rod screwed into the top of the head frame, through the head frame cover.

18.4.1.1 The minimum dimensions of the conductor shall be 12mm diameter and 600mm long.

18.4.1.2 The actual length of the conductor shall be adequately to afford a zone of protection to the luminaire carriage and ancillary equipment by an imaginary line drawn from the top of the rod at an angle not exceeding 45° from the downward vertical.

18.4.2 Depending on the mast location the earth termination shall be effected either by an earth rod, or mast to rail bond, or both.

18.4.2.1 Each mast shall be equipped with a mast to rail bond and spark gap.

18.5 The gusset arrangement and 50mm diameter hole through the foundation shown shall be included in the tender price and provided at each mast.

18.6 The earth rod described in clauses 18.7 to 18.9 below, shall be included in the tendered price for installation at all masts.

18.6.1 Should earth rods for any reason not be required. Adjustment will be effected at the rates.

18.7 The earth rod shall be of the “Taper Lock Cadweld” type, consisting of a heavy copper exterior, molecularly bonded to a high strength steel core. The copper shall have a minimum thickness of 0,25mm

18.8 Rods shall be supplied in 1 meter lengths of 16mm diameter and joined together by the taper lock method to ensure that soil contact is maintained throughout the length of the coupled rods.

18.9 Tenderers shall allow a length of 3 meters of rod per mast. Should this length be insufficient to obtain the earth resistance specified, and then further lengths will be paid for at the relevant rate.

18.10 Rods shall be driven into the ground in a professional manner to ensure that no unnecessary vibrations are set up. The manufacturer's recommended rod driving practice shall be closely followed.

18.11 The resistance to earth, measured by an earth resistance tester shall not exceed 10 ohms. Salt or other corrosive substances shall not be used to reduce earth resistivity. Shale or Silica Gel or other approved substances may be used.

19.0 ERECTION OF MASTS

19.1 Inspection of assembled masts prior to erection and witnessing of the load tests under clauses 19.5.1 and 19.5.2 are required and the successful tenderer shall advise Transnet National Ports Authority's Technical Officer at least 28 days in advance of his anticipated date of erection, to enable the necessary arrangements to be made.

19.2 Before commencing the erection of the masts, the successful tenderer shall consult with the Transnet National Ports Authority's Technical Officer, regarding the precautions necessary to avoid interference with, and danger from, electrification overhead wires.

19.3 Masts and other equipment awaiting erection shall be stored on site in such manner to ensure that all regulations are complied with and no danger to trains working, or personnel, results.

19.4 After erection of painted masts, all damage to paint work shall be repaired according to the requirements.

19.5 On completion of the installation, the successful tenderer will be required to carry out the following test at each mast:

19.5.1 The test to consist of hoisting a test load, equal to 1,25 times the mass of the luminaire carriage complete with all luminaires through the full height of the mast, holding in the uppermost position and lowering again. The results of the tests shall be recorded on RMD 9 log sheets.

19.5.2 The aforementioned test shall be carried out using masses supplied by the successful tenderer and assisted by an approved authority.

20.0 DRAWINGS AND INSTRUCTION MANUAL

20.1 The successful tenderer will be required to furnish 3 prints each of detailed

dimensioned drawings of the masts, luminaire carriages, winch, raising and lowering mechanism and maintenance of all equipment on completion of the installation.

20.2 The drawings and instructions shall be supplied in properly bound manuals with durable covers.

21.0 PACKING

21.1 All equipment shall be packed in such a manner that it will be adequately protected against damage during transport and handling.

22.0 INSPECTION

22.1 Transnet National Ports Authority reserves the right to inspect the equipment during or after manufacture and to be represented at any tests.

23.0 ILLUMINANCE TESTS

23.1 On completion of the installation the successful tenderer will be required to carry out, in collaboration with the Transnet National Ports Authority Technical Officer, luminance tests at a sufficient number of locations in the area covered by the lighting installation.

23.2 To comply with the requirements of clause 13 of SANS 10389-1, initial (100hr) values measured, shall not be less than 20 lux in all areas.

24.0 COMPLETION OF CONTRACT

24.1 The installation will not be accepted as complete until the winch, maintenance cage, power tool, luminaire carriage support bracket and manuals have been delivered to the Transnet National Ports Authority Technical Officer or his authorised representative on site

25.0 SPARES

25.1 Tenderers shall submit a separate list of recommended spares. Individual prices shall be given for each item and tenderers shall comment on the future availability of spares from locally held stock.

26.0 GUARANTEE

26.1 The Contractor must 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 six calendar months, calculated from the date that the

completed electrical installation is accepted by Transnet National Ports Authority.

26.2 Any defects that may become apparent during the guarantee period must be rectified to the satisfaction of and free cost to Transnet National Ports Authority.

26.3 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 Ports Authority of such defects.

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

APPENDIX 1

PAINTING SPECIFICATION FOR LIGHTING MASTS

1. PAINTING OF MASTS

1.1. The preparation and painting of masts shall comply with SANS 10064 and BS 5493 respectively. Colours shall be in accordance with SANS 1091.

1.2. The primer coating shall be equal or similar to Plascon “Plascoguard Gehophon” GW 5, Dulux “Sigmacover”’ or Chemrite Coatings “Carboline 193 HB”.

1.3. The two coats covering the primer surface shall be equal or similar to Plascon “Plascothane Recoatable Enamel” CPC series; Product data sheet U-8B, Dulux “Sigmadur Gloss HB”, or Chemrite Coatings” Caroboline 133 HB”. Colours shall be as specified in clause 1.8.

1.4. All paints shall be stirred and mixed to a homogeneous condition incorporation the whole contents of the paint container. Mixed paint shall be kept mixed and in good condition throughout, stirring when necessary to keep the pigment in suspension. Thinning shall only be undertaken in accordance with manufacturer’s recommendations and directions. Partially used containers shall be resealed to prevent evaporation of solvent.

1.5. Galvanised surfaces shall be scrubbed with steel wool soaked in a cleaning solution to remove the protective film against formation of white rust and all other foreign matter and also to provide a key for adhesion of the primer. Protective clothing, gloves and masks must be used by workers during this cleaning process. Rinse the cleaned surface copiously with water.

1.6. All painted surfaces, prior to application of the following coat, shall be sound, dry and free from oil, grease and other contamination. Any unsound paint to be removed completely, the surface prepared as in clause 1.2 above and repainted coat for coat as specified below.

1.7. After preparation of the galvanised surfaces apply one coat of primer by spraying to give a dry film thickness of 80 microns to all surfaces with the exception of the mast interior which need not be painted. Allow to dry for a minimum period of 4 hours before overcoating.

1.8. The primed surface shall then be painted in accordance with clause 1.4. One coat of colour G12 (Dark Admiralty Grey), by suitable airless spray equipment to give a dry film thickness of 75 – 100 microns for this coat. An overall final coat colour H30 (French Grey), to give a dry film thickness of 25 – 35 microns shall be applied. The total dry film thickness of the primer and two successive coats shall be between 180 – 215 microns.

1.9. Paints shall be applied under suitable conditions of light, temperature, humidity and ventilation. At time of overcoating, the painted surface shall be clean, dry, sound and free of misses and defective paint. Each coat of paint shall be applied as a continuous, even film of uniform thickness.

1.10. Painted steel shall not be handled until the paint has dried except where necessary in turning for painting of stacking for drying. Paint damaged in handling shall be scraped off and touched up by replacing each coat of paint scraped off. Painted steel shall not be transported or packed for transport until paint is dry.

1.11. When loading at the manufacturer's premises and when off-loading at the erection site, components shall be handled with hessian covered slings in order to cause minimum damage to paintwork. During transportation, the components shall be placed on wooden dunning and securely fastened to prevent sliding and other movement.

1.12. Prior to erection of masts, damaged areas of paint shall be repaired by spot cleaning in a manner that will minimise damage to sound paint. Bared areas shall be spot primed and spot painted with the materials specified, to restore all coats.

1.13. During erection, mast shall be handled with hessian covered slings to minimise damage to paintwork. After erection, paintwork shall be repaired in the manner described above.

APPENDIX 2

STATEMENT OF COMPLIANCE
(TO BE COMPLETED BY TENDERER)

This tender complies with specification TPD: 010A-HIGHMASTSPEC-A in all respects.

SIGNATURE: _____ DATE: _____

This tender complies generally with specification TPD: 010A-HIGHMASTSPEC-A but differs from it on the following points.

_____

_____

_____

_____

_____

SIGNATURE: _____ DATE: _____

Transnet National Ports Authority

SPECIFICATION FOR THE MAINTENANCE AND UPGRADE OF HIGHMAST LIGHTING STRUCTURES

REVISIONS		
REV	**DATE**	**APPROVED**
00	**March 2012**	**S.Sewdayal**
00	**October 2022**	**S.Sewdayal**

INTRODUCTION

This specification covers the maintenance of high mast structures.

INDEX

1.0 SCOPE

1.1 This specification covers Transnet National Ports Authority requirements for the design, manufacture and supply of all equipment and materials for maintenance, installation and testing on site of high mast lighting.

2.0 REFERENCES

2.1 The following publications and drawing (latest editions and amendments) are referred to herein.

2.1.1 South African Bureau of Standards

SANS 10142	- Code of practice for the wiring of premises.
SANS 1411	- PVC insulated electrical cables and flexible cords.
SANS 475	- Floodlighting luminaires.
SANS 1033	- Solid filler wires for gas-shielded metal arc welding of mild steel and medium-high tensile steel.
SANS 556-1	- Low-voltage switchgear part 1: circuit-breakers
SANS 556-2	- Low-voltage switchgear: earth leakage circuit breakers
SANS 10225	- The design and construction of lighting mast
SANS 10162	- Welding of structural Steel
SANS 455	- Covered electrodes for the manual arc welding of carbon and carbon manganese steels
SANS 121	- Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.
SANS 50025	- Hot rolled products of structural steel
SANS 60947-2	- Low-voltage switchgear and controlgear Part 2: Circuit-breakers
SANS 10389-1	- Artificial lighting of exterior areas for work and safety
SANS 10064	- The preparation of steel surfaces for coating
SABS CKS 42	- Straight mineral bearing and gear oil
SABS CKS 74	- Hypoid gear oil
SABS CKS 443	- Extreme pressure gear oil.

2.1.2 British Standards Institution

BS 7668	- Weldable structural steels Hot finished structural hollow sections in weather resistant steels
BS 5135	- Metal-arc welding of carbon and carbon manganese steel.
BS 721	- Worm gearing.

2.1.3 Transnet Ltd.

CME 35	- Specification for steel wire ropes.

Lubricants and petroleum fuels standing and advisory committee Circular No. 1

3.0 APPENDICES

The following appendices form part of this specification:

3.1 Appendix No. 1 – Painting specification.
3.2 Appendix No. 2 – Statement of Compliance.

4.0 METHOD OF TENDERING

4.1 Tendering shall be in accordance with Tender Form included in the tender documents.

4.2 Tenderers shall submit their main offers in accordance with the requirements of this specification. Deviations from the requirements of this specification, which are of a minor nature and do not depart materially, will be considered at the discretion of Transnet National Ports Authority. The acceptance of alternative tenders will be considered only if a main tender is submitted as part of the tender document.

4.3 The "Technical Data Sheet" of this specification shall be completed in detail, for each offer. Alternative offers shall be clearly marked "Alternative Offer No. _____".

4.4 All Technical Data Sheets shall be signed by the Tenderer and returned.

4.5 All documents forming part of the Tender shall be firmly bound. No loose documents will be considered.

4.6 Failure to comply with the above requirements may preclude a tender from consideration

4.7 The Tenderer shall submit complete and detailed information concerning their offers. This information shall include descriptions and drawings of the various items of equipment offered, as well as full photometric data issued by the South African Bureau of Standards, for the luminaires they propose using.

4.8 The Tenderer shall superimpose the number of luminaires per mast, vertical and azimuth aiming angles, as per existing.

4.9 The Tenderer shall allow for the supply, off-load, handling on site, erection, installation and testing of all items of equipment and material necessary for the complete lighting installation. This shall include the termination of the existing supply.

4.10 The Tenderer shall submit a lump sum price for the complete installation specified.

4.11 The total price tendered shall not include for a maintenance cage, power tool and winch.

5.0 SERVICE CONDITIONS

5.1 The lighting may be installed in areas where high humidity, high temperature, high wind, heavy rain, severe hail and high incidence of lightning are encountered and where corrosive conditions including the presence of sulphur dioxide, prevail.

5.1.1 Equipment installed shall be suitable for efficient operation under these conditions.

6.0 ELECTRICITY SUPPLY SYSTEM

6.1 The electricity supply system will be 3 phase, 4 wire, 50 Hz, alternating current with earthed neutral, at a nominal voltage of 400/230 V.

6.2 The voltage may vary within the range of 95% to 105% of the nominal and equipment installed shall be suitable for efficient operation at any voltage within this range.

7.0 STANDARD OF WORK, EQUIPMENT AND MATERIALS

7.1 All work shall be carried out in a neat and orderly manner to the satisfaction of Transnet National Ports Authority, and all equipment shall be easily accessible for maintenance purposes. Electrical work shall conform to the requirements of SANS 10142 and those laid down in this specification.

7.2 Equipment and materials used, shall be of high-quality design and manufacture, and shall comply with the relevant specifications and recommendations mentioned in this specification.

7.2.1 Where equipment and material does not comply with the relevant specifications it shall be submitted to Transnet National Ports Authority's Technical Officer for approval.

7.3 Every reasonable precaution and provision shall be incorporated in the design of the equipment for the safety and security of the system and of those concerned with its operation and maintenance.

8.0 OUTLINE OF SCHEME

As per attached drawings and detailed works instructions

9.0 MASTS

9.1 The mast shall be constructed in the form of a tapering enclosed column of polygonal or circular cross-section.

9.2 The design of the mast shall be adequate to resist a wind loading produced by a wind speed of 150km/h, measured at a height of 10 meters above ground level and acting on the projected area of the mast, luminaires and luminaire mounting carriage. The maximum permissible deflection at the top of the mast shall not exceed 2,5% of the height of the mast under wind loading produced by a wind speed of 100km/h. Provision shall be made in the mast design for minimising wind excited oscillation.

9.2.1 Tenderers shall submit with their offer, a full set of design calculations, as well as dimensioned drawings of the mast structure including door opening strengthening and base plate connection details, signed by a registered professional engineer.

9.3 The masts shall be designed for mounting on a reinforced concrete foundation by means of a base flange secured to a bolt cage into the foundation. The base flange shall be free from laminations and the welded connection to the mast, shall fully develop the strength of the section. Means shall be provided to enable masts to be adjusted from deviations from the vertical.

9.3.1 The space between the top of the concrete foundation and the underside of the base flange shall be filled with a suitable compound after provision of a vermin proof drainage hole. The cable entry pipes shall not be obstructed.

9.4 All steel used in the manufacture of the masts, luminaire mounting carriages, maintenance cages, etc., shall comply with the requirements of SANS 1431 grades 43A or 50. No steel section used in the construction of the mast shaft shall be less than 5mm in thickness.

9.5 Each mast shall be equipped with a suitable head frame accommodating mast top equipment associated with the raising and lowering gear. The head frame shall be designed to effectively seal the top of the mast against the ingress of water.

9.5.1 Problems are being experienced at certain locations with birds nesting in the vicinity of the shaft opening at the top of the mast, resulting in a build up of debris in the base of the mast. Tenderers shall describe with the aid of sketches/drawings, means adopted to avoid this problem in masts offered.

9.6 An opening shall be provided in the side of the mast to give easy access to a power distribution board, cable termination and the raising and lowering operating mechanism. The opening shall be protected by a lockable, close fitting, hinged door, incorporating a vermin proof ventilation opening and shall be effectively sealed against the weather. When the mast is installed, the opening shall face a direction parallel to adjacent tracks. Tenderers shall submit weatherproofing details with their tender documents.

9.6.1 The sides of the base compartment opening under 9.6 above shall be suitably reinforced with fully welded steel sections to restore the section modulus and prevent buckling.

9.7 Brackets or mounting plates, drilled to template shall be welded into the mast to support the winch and mast electrical equipment.

9.8 An M12 hex head stainless steel screw shall be welded to the main body of the mast in a readily position, directly adjacent to, and level with the underside of the distribution board within the base compartment, for earthing purposes.

9.9 Access shall be provided through the bottom of the mast and foundation for looping the supply cables into and out of the mast. Non-ferrous pipes shall be used for this purpose.

9.10 Welding shall be in accordance with BS 5135, general requirements for the metal-arc welding of mild or high tensile steel. It shall be carried out by qualified welders to the satisfaction of Transnet National Ports Authority's Structural Engineer. Site welding will not be allowed without the written approval of the Technical Officer.

10.0 FOUNDATIONS

10.1 Existing mast foundations shall be assessed for suitability to be re-used for the refurbished or replaced high masts.

10.2 For instances where a high mast needs to be relocated or the exiting foundation is deemed not suitable for re-use, the contractor shall design the new foundation and submit the design and drawings to the project manager for review and acceptance.

11.0 RAISING AND LOWERING SYSTEM

11.1 Each mast shall be provided with a carriage for mounting of the luminaires. The carriage shall be in two halves joined by bolted flanges to permit removal from the erected mast. It shall be possible to raise the luminaire carriage to the top of the mast for normal operation and lower it to the base of the mast for maintenance purposes. This shall be achieved by means of three independent suspension ropes operated from a winch mounted in the base of the mast, the ropes being contained within the mast and passing over pulleys in the head frame to the carriage. The suspension ropes shall be permanently under tension and locking of the luminaire carriage in the raised position by means of a latching device at the top of the mast will not be acceptable.

11.1.1 The design of the carriage shall be such that the structure embodies as far as possible the necessary mountings and housings for individual luminaire, control gear units and terminal boxes. All mountings shall be of rigid construction and fixings for control gear units and terminal boxes shall be such that those units can be readily removed and are easily accessible for maintenance purposes without adjustment of floodlight aiming angles.

11.1.2 The carriage shall operate in conjunction with suitable guides located on the head frame, to ensure automatic and precise alignment of the carriage in the final stages of the

raising operation and to guard against any fouling of suspension ropes and electrical cables.

11.1.3 The carriage shall be provided with a soft rubbing surface to prevent damage to the mast protection during raising and lowering.

11.1.4 The luminaires and control gear shall be mounted so as to balance the carriage as far as possible and the suspension system shall ensure that the luminaire carriage is supported in a horizontal position throughout the raising and lowering operation.

11.1.5 A visible means of indication that the luminaire carriage has reached the fully raised position shall be provided in the base compartment of each mast.

11.1.6 One specially designed bracket for clamping on to the mast directly above the door opening to support the luminaire carriage in the lowered position for maintenance purposes shall be supplied per contract.

11.2 The suspension rope pulley shall be fitted with self-lubricated, maintenance free bearings, protected against the ingress of moisture and dirt and designed for operation over the life of the mast without further attention.

11.2.1 The pulley shall be machine grooved to a depth of not less than 1, 5 times the diameter of the rope. The grooves shall be finished smoothly and be free from surface defects liable to damage the rope. The contour of the bottom of the groove shall be circular over an angle of approximately 120°. The radius of this part of the groove shall be larger than the radius of the rope by 0,8mm.

11.2.2 The diameter of the pulleys at the bottom of the groove shall not be less than 17 times the diameter of the rope.

11.2.3 The shafts on which the pulleys revolve shall be of large diameter to reduce the bearing loadings below normal design ratings. The shafts shall be positively secured in the head frame assembly to prevent rotation and shall be manufactured from stainless steel.

11.2.4 Pulleys carrying ropes or electric cables shall be provided with close fitting guards to retain the ropes or cables in the grooves when operating either loaded or slack. The guards shall be securely located against movement. Arrangements shall be made to ensure that the electric cables and steel wire ropes are separated before passing over their respective pulleys.

11.2.5 Pulleys shall be easily accessible to personnel standing on the floor of a maintenance cage in the fully raised position.

11.3 All pulleys, etc., at the top of the mast shall be protected against the ingress of water by means of a removable cover securely attached to the head frame and overlapping the equipment. The use of covers depending only on the security of gaskets for weatherproofing will not be acceptable.

11.4 Suspension and winch ropes shall be manufactured of AISI grade 316, flexible, stranded, stainless steel not less than 6mm diameter, in accordance with Specification No. CME 35 (rope detail as per table 39), with a factor of safety of not less than 10.

11.4.1 Thimbles shall, where possible, be secured by “Talurit” compression splices applied by means of a hydraulic tool. If this, for some reason, is not possible, three stainless steel “Crosby” type clamps per thimble may be used. “Crosby” clamps used shall be easily visible for inspection purposes.

NB: The saddle portion of the “Crosby” clamp must be placed against the wire under tension and not against the loose end.

11.4.2 Suspension ropes shall be easily removable and replaceable for inspection purposes. Tenderers shall provide clear instructions how this can be done.

11.5 All pulleys and bearings shall be manufactured from non-corrodible materials.

11.5.1 If non-metallic suspension rope pulleys are used, these shall be manufactured of glass filled nylon.

11.5.2 Each suspension rope pulley shall have a factor of safety of at least 10.

11.6 All equipment in contact with stainless steel wire ropes shall be entirely suitable for use in close contact with stainless steel, without the danger of electrolytic reaction occurring.

11.7 It shall be possible to fit a maintenance cage to the raising and lowering system, in place of the luminaire carriage, to enable two men to be hoisted to the top of the mast in complete safety for painting and maintenance purposes. The two halves of the maintenance cage shall be diametrically opposite one another. Use of the maintenance cage shall not necessitate the re-aiming of floodlighting luminaires.

11.7.1 Safety devices shall be incorporated in the construction of the maintenance cage to ensure it will not fall in the event of failure of the raising and lowering equipment. Tenderers shall submit drawings and describe fully; the type of equipment offered and include a separate price for the maintenance cage in their tender documents.

11.8 All bolts, nuts, pins, etc., associated with the luminaire carriage, maintenance cage and raising and lowering equipment shall be manufactured from stainless steel and locked by means of nylon inserts or spilt pins. Nylon inserts shall only be used in nuts that will not require removal in the normal course of maintenance. Pins shall be turned out of solid steel bar and wherever spring washers are used over elongated holes, a suitable flat washer shall be provided between the spring washer and the hole.

11.9 Special attention shall be given to the safety, reliability and protection against corrosion of the entire suspension system, including raising and lowering gear and ancillary

equipment, all of which shall meet with the approval of Transnet National Ports Authority's Supervisor before installation.

12.0 PROTECTION AGAINST CORROSION

12.1 Mast luminaire carriages, maintenance cage and all ferrous parts associated therewith, shall be hot dip galvanized in accordance with SANS 121. The mass of galvanized coating shall determine in accordance with the non-destructive method under clause 6,5 of the aforementioned specification.

12.2 All welding, drilling, punching, stamping, cutting and bending of parts shall be completed and all burns removed before the galvanizing process is carried out.

12.3 If specified, paint treatment shall be applied to all exterior galvanized surfaces in accordance with the requirements detailed in Appendix 1.

12.4 Stringent precautions shall be taken to protect finished surfaces from injury or damage during assembly.

13.0 WINCH

13.1 Provision shall be made in the base of the mast to accommodate a removable twin drum, totally enclosed, oil-bath type winch.

13.2 The winch shall be used for raising and lowering of the luminaire carriage and maintenance cage. The winch shall have a factor of safety of not less than 6.

13.3 The winch shall be of light weight construction and mounted on a suitable frame for easy transfer from one mast to another. It should also be easily coupled and uncoupled and removable through the door opening provided at the base of the mast. The design and mass of the unit shall allow easy handling and attachment to the mast by not more than two men. The total mass of the winch, including wire ropes and mounting frame shall not exceed 75kg.

13.4 Winches mounted outside the mast and connected to the suspension ropes through the door opening, will not be acceptable.

13.5 Each luminaire carriage suspension rope shall be secured independently in the base of the mast, prior to removal of the winch. The method of securing the ropes shall be such that there will be no deflection of the ropes from the vertical in any direction.

13.5.1 After fixing, the suspension ropes shall remain under tension to ensure that the luminaire carriage is retained in its fully raised position. This shall not be achieved by any kind of adjustment after the ropes have been secured.

13.5.2 This method of transferring the tension from each winch drum to the lock position must be safe. Pins used shall be of such a design that they lock automatically in position and cannot be removed while the hoist ropes are under tension

13.5.3 Single drum winch and compensating pulley arrangement will not be acceptable. The two suspension ropes shall be attached independently to each of the twin drum winch ropes.

13.5.4 Tenderers shall fully describe the method used for transferring the tension from the winch to the lock position and vice versa, prior to removal or replacement of the winch.

13.6 The winch shall be of the worm-gear type, self –sustaining at all loads and operating speeds, without the use of brakes or clutches. It shall have a gear ration of at least 50:1 and be suitable for both hand and power operation.

13.7 The winch shall be fitted with a safety device to ensure that the drum is locked positively when the cranking handle or power tool is removed from the drive shaft. The safety device shall be applied automatically.

13.8 Winch drums shall be machine grooved to ensure a tidy rope lay. The bottom of the groove shall be circular over an angle of approximately 120°. The radius of the groove shall be larger than the radius of the rope by not less than 0,8mm. The drum grooves shall be finished smoothly and be free from surface defects liable to damage the rope. The drum grooves shall be pitched so that there is a clearance between neighbouring turns of rope.

13.9 The rope anchorage on the drum shall be such that it is possible to inspect the termination of the rope in service without dismantling any part of the winch. It shall be so designed that the first and all successive rope lays are reeled on the drum in regular and tidy layers without any undue bending of the rope at the first turn.

13.10 The drum shall be so designed as to prevent the rope layers from stacking one on top of the other against the flange and also to prevent rope on any layer forcing its way down into lower layers.

13.11 The design of the winch and installation shall allow at least five turns of the rope to remain on the drum when the winch rope is fully extended under normal operating and maintenance conditions.

13.12 The winch shall incorporate a separate gearbox for each drum.

13.13 Worm gearing shall comply with the requirements of BS 721.

13.14 A test certificate. Stating the safe working load of the winch and issued by a recognised testing authority, shall be supplied with each winch.

13.15 Winches shall be fitted with a label and rating plate of a permanent nature in an easily visible position.

13.15.1 The label shall carry the Manufacturer's or Supplier's name and type number, serial number, test certificate number, safe working load, maximum allowable speed of operation at the safe working load, recommended lubricant and year of manufacture or supply.

13.16 The lubricant for the winch shall be selected from Transnet's standard list, and Tenderer's recommendations are to be based on the "Lubricants and Petroleum Fuels Standing Advisory Committee Circular No. 1". (Failure to complete form CSS 80 correctly could disqualify an offer).

13.17 Tenderers shall quote separately for the twin drum winch.

13.18 Tenderers shall include a separate quotation for the supply of an electric power tool, incorporating a torque limiting device, for operation of the winch. The power tool shall be suitable for operation on a 230 volt, 50Hz, single phase supply.

13.18.1 The operational speed of, and torque developed by, the power tool shall match the requirements of the winch and suspension system. Should a multi-speed power tool, having speeds in excess of the aforementioned operational speed, be supplied, positive means shall be provided on the power tool to prohibit its use at any speed greater than that recommended.

13.18.2 It shall be possible to support the power tool accurately and securely in its operating position for remote control at a distance of 5 meters from the mast base. The remote control switch shall incorporate a push button requiring constant pressure for operation.

13.18.3 All the equipment shall be of robust construction, suitable for site use and shall be complete with interconnecting cables and plug.

13.19 An operating handle, incorporating a torque limiting device, shall be supplied for manual operation of the winch.

13.20 The torque limiting devices shall be adjusted according to their function up to a maximum value of 40 Nm. The adjustment shall be so arranged that it cannot readily be altered during normal use of the tools on site.

14.0 LUMINAIRES AND CONTROL GEAR

14.1 The tenderer shall supply and install luminaires as detailed in drawings.

15.0 DISTRIBUTION BOARD AND MAST CABLING

15.1 All terminal blocks and cabling shall be inspected for damage and replaced if necessary.

15.2 A totally enclosed power distribution board of flame retardant reinforced fibreglass construction shall be mounted in an easily accessible position in the compartment of the mast.

15.2.1 The board shall be provided with a front cover panel secured by captive type screws and allowing only operating toggles of switches/circuit breakers to protrude.

15.3 The distribution board shall be equipped as follows:

15.3.1 One adequately rated, triple pole, moulded case, main isolating switch.

15.3.2 Three adequately rated, single pole, moulded case circuit breakers for control of the luminaires.

15.3.3 One 15 amp, 3 pin, industrial type, switched socket outlet for control of the power tool.

15.3.4 One 15 amp, single pole neutral, moulded case circuit breaker with integral 20 mA earth leakage protection device for control of the switched socket outlet under clause 15.3.3. The earth leakage unit shall comply with the requirements of SANS 556-2.

15.3.5 One three phase, neutral and earth socket outlet for connection of the supply cable to the luminaires and protected by the circuit breakers under clause 15.3.2 above.

15.3.6 An adequate number of terminals of suitable size, allowing only one wire per terminal for looping of the incoming and outgoing supply cables. These terminals shall be provided with bridge pieces connecting any number of adjacent terminals together to form a busbar.

15.3.6.1 Terminals shall be of the rail mounted clip-on type, with flash-barriers between terminals.

15.3.7 An insulated neutral terminal block with sufficient ways for the number of circuits employed.

15.3.8 An adequately rated earthing bar.

15.3.9 Grommeted access holes in the bottom of the board for cable entry.

15.4 All wiring in the distribution board shall be neatly arranged to run horizontally and vertically and shall be supported and fixed at regular intervals.

15.5 All moulded case circuit breakers shall comply with the requirements of SANS 556 and SANS 60947-2. They shall be rated for 250 volts and have a breaking capacity of “6kA”.

15.6 The main switch under clause 15.3.1 shall be of the same manufacturers as the moulded case circuit breakers specified. The switch shall be capable of carrying a fault current of 1000 A for 1 second without welding of the contracts or other damage to the unit.

15.7 Each control unit on the distribution board shall be clearly labelled by means engraved or printed labels of metal or plastic or other approved material, firmly attached to the board and indicating in both official languages the designation of each circuit controlled. Labels of embossed adhesive tape are not acceptable.

15.8 A flexible, multicore, heavy duty trailing cable shall be installed between the distribution board in the base of the mast and the luminaire carriage, for the power supply to the luminaires. The cable shall be entirely suitable for the bending and load carrying stresses involved.

15.9 Guiding pulleys in the head frame shall be of adequate diameter and shall have a cable retaining groove sized to match the cable diameter, to ensure that the cable is not subjected to abrasion or undue straining during raising and lowering operations.

15.10 The cable shall be securely clamped at the luminaire carriage, the other end being secured to the suspension cable in an approved manner, to ensure that the lower end returns to the mast base during the luminaire raising operation and does not become entangled with suspension ropes.

15.11 The cable shall be so installed that it can be replaced from ground level without lowering the mast or the use of special equipment. Tenderers shall provide clear instructions on how this can be done.

15.12 Both ends of the cable shall be fitted with adequately rated, 3 phase, neutral and earth, plug-in connectors to match the socket outlet under clause 15.3.5 and a socket outlet mounted in/on a weatherproof, corrosion resistant terminal box on the luminaire carriage.

15.13 The socket outlet, plug-in connector combinations on the distribution board and luminaire carriage shall be of the weatherproof type. When connected, the plug-in connectors shall be retained in position by suitable locking devices The equipment shall be Maréchal, or equal approved manufacture.

15.14 When in the lowered position, testing of the luminaires shall be effected via a three meter length of flexible cable, of equal manufacture and cross-sectional area to that supplying the luminaires, and fitted with plug-in connectors on both ends to suit the socket outlets on the distribution board and luminaire carriage. One such cable shall be provided per contract.

15.15 The terminal box on the luminaire carriage shall contain fixed terminal blocks of equal or similar approved to “KLIPPON”, for connection of the cabling to the luminaires. Cabling between the terminal box and control gear provided in the construction of the luminaire carriage, or galvanised steel conduits. Any cabling exposed to the effects of ultraviolet radiation, shall be silicon insulated.

15.16 All metalwork, including luminaires, control gear units and the luminaire carriage shall be bonded to the earth core of the luminaire supply cable.

15.17 The following label in both official languages shall be affixed to the distribution board in a prominent position:

"Luminaire socket outlet and plug to be isolated and disconnected before lowering the luminaire carriage".

16.0 CABLES

16.1 The contractor shall supply and install 4-core, ECC, PVC cables.

16.2 The contractor shall also supply and install a suitable earthing cable at each mast.
16.3 The cable shall be installed in cable ducts and sleeves provided by others.

17.0 CABLE LAYING

17.1 The cable shall be installed in cable ducts and sleeves.

18.0 EARTHING AND LIGHTNING PROTECTION

18.1 The contractor shall supply and install earthing and lightning protection to the masts as per SANS 10313.

18.2 The incoming and outgoing cable termination and earthing arrangement at each mast shall be as shown.

18.3 The earthing core of the cable supplying the luminaires (clause 15.8) shall be connected to the earthing bar in the distribution board.

18.4 Lighting protection is required at all masts.

18.4.1 Each mast shall be equipped with a lighting conductor in the form of a galvanised steel rod screwed into the top of the head frame, through the head frame cover.

18.4.1.1 The minimum dimensions of the conductor shall be 12mm diameter and 600mm long.

18.4.1.2 The actual length of the conductor shall be adequately to afford a zone of protection to the luminaire carriage and ancillary equipment by an imaginary line drawn from the top of the rod at an angle not exceeding 45° from the downward vertical.

18.4.2 Depending on the mast location the earth termination shall be effected either by an earth rod, or mast to rail bond, or both.

18.4.2.1 Each mast shall be equipped with a mast to rail bond and spark gap.

18.5 The gusset arrangement and 50mm diameter hole through the foundation shown shall be included in the tender price and provided at each mast.

18.6 The earth rod described in clauses 18.7 to 18.9 below, shall be included in the tendered price for installation at all masts.

18.6.1 Should earth rods for any reason not be required. Adjustment will be effected at the rates.

18.7 The earth rod shall be of the “Taper Lock Cad weld” type, consisting of a heavy copper exterior, molecularly bonded to a high strength steel core. The copper shall have a minimum thickness of 0,25mm

18.8 Rods shall be supplied in 1 meter lengths of 16mm diameter and joined together by the taper lock method to ensure that soil contact is maintained throughout the length of the coupled rods.

18.9 Tenderers shall allow a length of 3 meters of rod per mast. Should this length be insufficient to obtain the earth resistance specified, and then further lengths will be paid for at the relevant rate.

18.10 Rods shall be driven into the ground in a professional manner to ensure that no unnecessary vibration are set up. The manufacturer’s recommended rod driving practice shall be closely followed.

18.11 The resistance to earth, measured by an earth resistance tester shall not exceed 10 ohms. Salt or other corrosive substances shall not be used to reduce earth resistivity. Sanica Gel or other approved substances may be used.

19.0 LOWERING AND RAISING OF MAST:

19.1 Supply a suitable size crane and all rigging equipment as well as the qualified rigger to lower and raise the pole.

19.2 Ensure that no damage occurs on the neighbouring structures as well the lighting structure.

19.3 A nylon sling capable of carrying weight more than three tons shall be used for the lowering and the raising of the high mast structure.

20.0 CLEANING AND SURFACE PREPARATION OF ALL COMPONENTS:

20.1 All surface shall be detergent washed and fresh water rinsed to remove oil and grease.

20.2 Sharp edge shall be radiused and major roughness of welds shall be removed by grinding. Weld spatter and flux shall be removed.

20.3 All bolts, nuts, pins, etc., associated with the luminaire carriage, maintenance cage and raising and lowering equipment shall be manufactured from stainless steel and locked by means of nylon inserts or split pins. Nylon inserts shall only be used in nuts that will not require removal in the normal course of maintenance.

21.0 REMOVAL & REPLACEMENT OF MOUNTING RING

21.1 Inspect and repair the mounting ring. The repairs on the ring shall be according to the SANS 10064, and SANS 121.

22.0 REMOVE AND REFURBISH EXISTING MOUNTING RING

22.1 Inspect and repair corrosion and treat rust spots on the mounting ring.

23.0 REMOVE, CLEAN, RE-LAMP AND RE INSTALL EXISTING LUMINARE

23.1 All surfaces shall be detergent washed and fresh water rinsed to remove oil and grease.

23.2 All the light fittings shall be re-lamped with appropriate lamps.

23.3 The contractor shall repair the light fitting and replace all the mounting bolts.

23.4 All removed lamps will store together and disposed appropriately. The contractor shall submit a certificate of disposal at the end of contract.

24.0 REMOVAL & REPLACEMENT OF LUMINARE COMPLETE WITH LAMPS

24.1 Remove and replace luminaries where the luminaries.

24.2 All the lamps of the removed luminaries shall be removed and disposed appropriately.

24.3 Disposal certificate shall be issued to the project manager at the end of construction or maintenance.

24.4 Replacement luminaires shall comply with requirement of SANS 475.

25.0 REFURBISHMENT OF HEADGEAR WINCH AND PULLEYS

25.1 Check oil level, winch drums as well as the pulleys.

26.0 REPAIR AND REFURBISH HIGH MAST DOOR

26.1 Clean, remove rust and paint the door.

27.0 LUBRICATION OF MOVING COMPONENTS AND FOUNDATION BOLTS.

27.1 Lubricate all the foundation bolts as well as the associated nuts.

28.0 REMOVAL & REPLACEMENT SPLITTER BOXES

28.1 Remove and replace the splitter box.

29.0 REMOVAL & REPLACEMENT OF HOIST CABLE

29.1 Inspect and replace the hoist cables. The replacement cable shall be of AISI grade 316 flexible, stranded and stainless steel not less than 6mm.

30.0 REPLACEMENT OF ALL SILICON CABLE FEEDS FROM SPLITTER BOXES INCLUDING THE PROVISION OF GLANDS

30.1 Replace all silicon cable from the splitter box.

31.0 PAINTING OF COMPLETE HIGH MAST STRUCTURE

31.1 All surfaces shall be detergent washed and fresh water rinsed to remove oil and grease.

31.2 Sharp edge shall be radiused and major roughness of welds shall be removed by grinding. Weld spatter and flux shall be removed.

31.3 The painting of the mast shall be in accordance with APPENDIX No.1

32.0 REMOVAL & REPLACEMENT OF EARTH SPIKES

32.1 Test and install new earth spikes.

33.0 REMOVAL & REPLACEMENT OF ELECTRICAL DISTRIBUTION BOARD

33.1 Remove and install an electrical distribution board.

33.2 A total enclosed power distribution board of flame retardant reinforced fibreglass.

34.0 ELECTRICAL COMPLIANCE CERTIFICATION

34.1 Contractor to test installation and issue a compliance certificate.

35.0 ISSUE OF RMD 9 CERTIFICATE

35.1 Contractor to test and issue RMD9 certificate.

APPENDIX 1

PAINTING SPECIFICATION FOR LIGHTING MASTS

1. PAINTING OF MASTS

1.1. The preparation and painting of masts shall comply with SANS 10064 and BS 5493 respectively. Colours shall be in accordance with SANS 1091.

1.2. The primer coating shall be equal or similar to Plascon “Plascoguard Gehophon” GW 5, Dulux “Sigmacover”’ or Chemrite Coatings “Carboline 193 HB”.

1.3. The two coats covering the primer surface shall be equal or similar to Plascon “Plascothane Recoatable Enamel” CPC series; Product data sheet U-8B, Dulux “Sigmadur Gloss HB”, or Chemrite Coatings” Caroboline 133 HB”. Colours shall be as specified in clause 1.8.

1.4. All paints shall be stirred and mixed to homogeneous condition incorporation the whole contents of the paint container. Mixed paint shall be kept mixed and in good condition throughout, stirring when necessary to keep the pigment in suspension. Thinning shall only be undertaken in accordance with manufacturer’s recommendations and directions. Partially used containers shall be resealed to prevent evaporation of solvent.

1.5. Galvanised surfaces shall be scrubbed with steel wool soaked in a cleaning solution to remove the protective film against formation of white rust and all other foreign matter and also to provide a key for adhesion of the primer. Protective clothing, gloves and masks must be used by workers during this cleaning process. Rinse the cleaned surface copiously with water.

1.6. All painted surfaces, prior to application of the following coat, shall be sound, dry and free from oil, grease and other contamination. Any unsound paint to be removed completely, the surface prepared as in clause 1.2 above and repainted coat for coat as specified below.

1.7. After preparation of the galvanised surfaces apply one coat of primer by spraying to give a dry film thickness of 80 microns to all surfaces with the exception of the mast interior which need not be painted. Allow to dry for a minimum period of 4 hours before overcoating.

1.8. The primed surface shall then be painted in accordance with clause 1.4. One coat of colour G12 (Dark Admiralty Grey), by suitable airless spray equipment to give a dry film thickness of 75 – 100 microns for this coat. An overall final coat colour H30 (French Grey), to give a dry film thickness of 25 – 35 microns shall be applied. The total dry film thickness of the primer and two successive coats shall be between 180 – 215 microns.

1.9. Paints shall be applied under suitable conditions of light, temperature, humidity and ventilation. At time of overcoating, the painted surface shall be clean, dry, sound and free of misses and defective paint. Each coat of paint shall be applied as a continuous, even film of uniform thickness.

1.10. Painted steel shall not be handled until the paint has dried except where necessary in turning for painting of stacking for drying. Paint damaged in handling shall be scraped off and touched up by replacing each coat of paint scraped off. Painted steel shall not be transported or packed for transport until paint is dry.

1.11. When loading at the manufacturer's premises and when off-loading at the erection site, components shall be handled with hessian covered slings in order to cause minimum damage to paintwork. During transportation, the components shall be placed on wooden dunning and securely fastened to prevent sliding and other movement.

1.12. Prior to erection of masts, damaged areas of paint shall be repaired by spot cleaning in a manner that will minimise damage to sound paint. Bared areas shall be spot primed and spot painted with the materials specified, to restore all coats.

1.13. During erection, mast shall be handled with hessian covered slings to minimise damage to paintwork. After erection, paintwork shall be repaired in the manner described above.

APPENDIX 2

STATEMENT OF COMPLIANCE
(TO BE COMPLETED BY TENDERER)

This tender complies with specification TPD: 010B-HIGHMASTSPEC-B in all respects.

SIGNATURE: _____ DATE: _____

This tender complies generally with specification TPD: 010B-HIGHMASTSPEC-B but differs from it on the following points.

_____

_____

_____

_____

SIGNATURE: _____ DATE:_____

Transnet National Ports Authority

EEAM-Q-008 SPECIFICATION FOR CORROSION PROTECTION

Contents

1. SCOPE

1.1. This specification covers Transnet Port Terminals requirements for protective coating of iron and steel structures, electrical motors, gear boxes etc. against corrosion and must be read in conjunction with the main specification as well as the following (latest editions):-

SABS 064	"Preparation of steel surfaces for coating"
SABS 763	"Hot-dip (galvanized) zinc coatings"
SABS 1091	"National colour standards for paint"
BS 5493	"Code of practice for protective coating of iron and steel structures against corrosion"

2. TYPES OF CORROSION PROTECTION TO BE USED

2.1. The coatings specified in this specification are chosen according to BS 5439, Table 3, part 9, to ensure that the condition of the surface will be at least RE2 on the European scale of degree of rust, after 10 years in an environment of frequent salt spray, chemicals and polluted coastal atmosphere. During the 10 years, the normal maintenance painting will be done.

2.2. The paint manufacturer shall guarantee the paint for at least 10 years.

2.3. Should a tenderer wish to offer coating systems other than those specified, as an alternative, he shall submit full technical details and a list comparing all appropriate details of the alternatives proposed, with the original specified.

2.4. Tenderers must ensure that the different coats they offer in their tenders are compatible with each other.

2.5. The coating of proprietary items must be done according to Clause 3.

2.6. All galvanized components including bolts and nuts but excluding walkway gratings, must be painted with the specified system, unless otherwise approved.

2.7. The paint manufacturer's recommendations for the application of the different coating systems, curing time before handling or application of subsequent coats, health and safety recommendations etc. must be carefully adhered to.

2.8. Paint contractors must have a quality management system which must be submitted to the Engineer for approval before commencement of the work.

2.9. Galvanizing shall be done to SABS 763 heavy duty hot dip galvanizing to a thickness of at least 85· m. Electroplated components in zinc or cadmium are not acceptable.

2.10. All mounting bolts, nuts, washers and brackets as well as all fixing bolts, studs nuts and washers shall be of stainless steel. Fixing rivets shall be of either stainless steel or brass.

2.11. High tensile bolts for friction grip joints must not be galvanised and must be primed and painted after installation. High tensile bolts must be certified.

2.12. The full paint system shall be applied to all surfaces which are to be covered with wear pads, linings etc.

2.13. For steelwork which will be transported over long distances and erected on site the two pack epoxy primers is preferred.

3. PROPRIETARY ITEMS

3.1. Proprietary items such as gearboxes, motors, brakes etc. must either be painted according to this specification or where the coating system is equal to or exceeds this specification sufficient proof of the coating system applied must be provided. Items which are nearly equal to this specification shall be given a finishing coat according to this specification's thicknesses and final colours and to the following procedure:-

3.1.1. A cross cut test must be done to SABS SM159 to determine if the original coating adheres correctly to the substrate;

3.1.2. The original coating shall be rubbed down to remove any smooth finishing to form a suitable key for the finish coat and any damaged areas prepared and patch primed with a suitable primer;

3.1.3. The item must then be detergent washed to remove any foreign matter, taking care that no dust, solvent etc. contaminates any working part of the item;

3.1.4. A test shall be done on the existing coat to ensure that the finish coat will not react with and cause undue dissolving and lifting of the existing coat. This can be done by applying a small quantity of the finishing coat thinners.

3.1.4.1. Should any undue dissolving or lifting occur, a suitable intermediate or barrier coat must be applied before the finishing coat is applied.

3.1.5. Proprietary items which failed the cross cut test and which generally have inadequate protection shall be dismantled and the full corrosion protection specification applied.

4. SURFACE PREPARATION

4.1. All steel surfaces shall be detergent washed and fresh water rinsed to remove all oil, grease and surface contaminates before shot blasting.

4.2. Sharp edges shall be radiused and major roughness of welds shall be removed by grinding. Welding spatter and flux shall be removed.

4.3. Components manufactured from hot rolled steel sections and steel plate shall be blast cleaned to base metal in accordance with SABS 064 grade SA2½ - very thorough blast cleaning, to remove all mill scale, rust, weld spatter etc.

4.3.1. “Sharp” chilled iron shot, chilled iron grit, or granular abrasive slag is to be used to produce a proper degree of surface roughness.

4.3.2. Blast profile shall be determined by micrometer profile gauge, Keane-Tator surface profile comparator or Testex press-o-film.

4.3.3. The profile height shall be between 40 and 50· m at any point.

4.4. Good quality blast cleaning and spray painting equipment shall be used. Air used for spraying and blast cleaning shall be free from all traces of oil, water and salinity. Water and oil traps must be fitted to all equipment.

4.5. Wheel abrading equipment shall not be used unless an angular profile the same as clause 4.3.3 is achieved.

4.6. When wet blasting is done the primer shall be applied before oxidization starts or surface contamination occurs.

4.7. Components manufactured from 3CR12 steel shall be lightly abraded. The components shall then be passivated by using a mixture of 10 - 15% nitric acid in water which is rinsed off after 10 - 15 minutes. The surface shall be neutralized to pH 7 before it is coated.

4.8. Hot-dip galvanized components, galvanized bolts and nuts etc. shall be lightly abraded with a galvanizing pre-cleaner. The components shall then be washed with detergent and water and washed down with clean water until a water break free surface is achieved. Allow to dry thoroughly.

5. JOINTS AND MATING SURFACES OF MEMBERS

5.1. Mating (faying) surfaces of members which have to be joined by high tensile steel bolts in friction grip shall be cleaned according to Clause 4 and painted with primer only.

5.1.1. After being assembled joints so formed shall be seal welded and painted or after the intermediate coat was applied the edges shall be sealed with an approved brand of paintable flexible sealant or mastic (e.g. Butyl rubber, polyurethane sealer or two component epoxy), by means of a suitable caulking gun.

5.2. All rivets, bolts, welds, sharp edges etc. must be covered with a "stripe coat" of the primer or intermediate coat specified to ensure the correct dry film thickness on sharp edges, as well as sealing of bolt threads to head etc.

5.3. All other mating surfaces must be sealed with an approved brand of flexible Butyl rubber, paintable Silicone, polyurethane sealer or two component epoxy sealer, and joined while still wet. All excess compounds must be completely removed.

6. PAINTING PROCEDURES

6.1. Directly before the application of paint, the area to be painted shall be degreased with a suitable degreaser and left to dry.

6.2. Paint shall only be applied under the following conditions:-

6.2.1. There is adequate light.

6.2.2. The steel temperature is between 5 and 50°C and at least 3°C above the dew point of the air.

6.2.3. The relative humidity of the air is between the limits specified by the paint supplier.

6.2.4. Wind does not interfere with the method used and sand and dust cannot be blown onto wet paint.

6.3. Steelwork shall be supported on trestles, at least 900 mm off the ground for painting purposes.

6.4. An adequate number of test readings shall be taken per square meter in order to determine the dry film thickness.

6.4.1. The paintwork shall be acceptable if the average of the test readings taken falls within or exceeds the ranges given.

6.4.2. Paintwork shall not be acceptable if any single test reading is less than the specified minimum thickness.

6.5. An ultrasonic or electronic magnetic flux thickness measurement gauge shall be used, but in case of dispute, destructive testing shall be applied. He painted steelwork shall present a clean, neat appearance of uniform colour and gloss as applicable to the paint used. Each coat of paint shall be applied as a continuous, even film of uniform thickness. More than one application of paint may be required to achieve the dry film thicknesses specified or to obliterate the colour of the previous coating.

6.6. The use of thinners or solvents at any stage of the work is prohibited, unless specified by the paint manufacturer.

6.7. Precautions shall be taken to prevent coatings from being applied to equipment nameplates, instrument glasses, signs etc.

7. FIELD TOUCH-UP PAINTING

7.1. Damaged and unpainted areas, fasteners, welds, etc. shall be cleaned by wire brushing with hand tool or power tool in a manner which will minimize damage to sound paint. Grinding will not be allowed. Rust spots shall be cleaned to bright metal. Thick edges of old paint abutting on bare metal surfaces shall be feathered by scraping and sanding.

7.1.1. Where welding is required on areas already coated with the coating system, the coat should be stepped back for ± 30mm around the weld area.

7.2. The paint shall be applied to match the original coats in accordance with the manufacturer's recommendations for the specific paint system.

Note: Inorganic zinc primers shall not be re-covered with an inorganic primer, but only with an organic zinc primer.

7.3. Areas of damaged galvanizing shall be repaired with an approved cold galvanizing product or metal sprayed by the wire spraying process with Zinc, and then touched up with the specific paint system.

8. GENERAL

8.1. All walkways, floors, maintenance platforms etc. must be painted with a durable, non skid coating of the appropriate colour.

8.2. Exposed machined surfaces must be coated with a strippable corrosion inhibitor (e.g.Tectyl).

8.3. Where different materials will be in contact with each other and galvanic corrosion can occur the contact areas of the materials must be isolated from each other or the joints made water proof to prevent ingress of moisture.

8.4. All components must be designed with corrosion prevention in mind and specifically the following:-

8.4.1. No entrapment of dirt, product, moisture etc.

8.4.2. No areas must be inaccessible for maintenance such as too narrow gaps etc.

8.4.3. Large flat areas rather than complicated shapes and profiles.

8.4.4. No sharp corners and discontinuous welds.

9. MAINTENANCE PAINTING OF STRUCTURES

9.1. Areas which are only lightly corroded must be cleaned by means of high pressure water blasting or wire brushing by power tool.

9.1.1. Alternatively, the Noxyde paint system can be used, consisting of two to three coats of water based Noxyde paint to achieve a DFT of 350 to 400 microns. Where the Noxyde system is used on areas other than slightly corroded structural areas, the following additional requirements must be observed:

9.1.1.1. Very smooth surfaces (e.g. 3CR12, stainless steel or hot-dip galvanized components, bolts, nuts and fittings, and HT bolts): Parts must be thoroughly degreased using OptiDegreaser, washed down with potable water, and immediately when dry, a single coat of OptiPrimeAqua applied.

9.1.1.2. Paintable flexible sealant/mastic: Only sealant approved by the paint manufacturer may be used, and an initial coat of OptiPrimeAqua applied over it before the further coats of Noxyde are applied.

9.1.1.3. Bolted/rivited connections: After blasting or and/or cleaning as required, apply a coat of OptiPrimeAqua and an additional stripe coat of Noxyde, in contrasting colour, to all bolt/nut and plate edges and crevices.

9.2. The adhesion of old coatings must be verified by doing a cross cut adhesion test on selected areas.

9.3. The compatibility of the new paint system on the old coating must be tested and guaranteed in writing by the paint supplier.

9.4. The work and coating system must be guaranteed for a minimum of 12 months.

9.5. All heavily corroded areas must be shot blasted to minimum SA2 and the three coat system indicated in clause 2.6 applied.

9.6. Areas where the old coating is still sound need only be high pressure cleaned with a suitable solvent and coated with one of the primers suggested in clause 10.2 (as tie coat) and then with one of the top coats suggested in clause 2.6 to get the appropriate colour and finish. The minimum dry film thickness of this tie coat must be 75 microns and top coat must be 50 microns, but the previous coating colour shall be completely obliterated to present a uniform colour.

Note: Inorganic zinc primers shall not be re-covered with an inorganic primer, but only with an organic zinc primer.

9.7. Repairs to the insides of all the enclosed sections of the booms as well as the insides of the crane legs, sill beams, cross beams, pylon cross bracing members etc. shall be done as above but the top coat need not be applied.

SPECIFICATION FOR LOW VOLTAGE DISTRIBUTION BOARDS

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

REVISIONS		
REV	**DATE**	**APPROVED**
01	**AUGUST 2020**	**S.Sewdayal**

INDEX

1. SCOPE

This specification covers Transnet National Ports 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 064	The preparation of steel surfaces for coating
SANS 10111	Engineering Drawings.
SANS 10142	Wiring of premises Part 1: Low voltage installations
SANS 10313	Protection against lightning - Physical damage to structures and life hazard

Specifications

SANS 60947	Low-voltage switchgear and control gear
SANS 156	Moulded-case 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:

Ambient temperature:	-5° C to +45° C (daily average +35° C).
Relative humidity:	As high as 95%
Lightning conditions:	Severe, with a maximum lightning ground flash density of eleven (11) flashes per km² per annum.
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 95% to 105% 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 Ports 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 delatching 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 switch gear 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 – 1:2006. 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 - 1:2006). 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 CHARACTISTICS.

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 catagory 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 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 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.

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 Ports 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 Ports 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 National Ports Authority.

26.2. Transnet National Ports 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 Ports Authority of such defects.

27.4. Should the Contractor fail to comply with the requirements stipulated above, Transnet National Ports 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 Ports 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 Ports Authority as and when required.

WITNESSES

1. …….. ……
TENDERER

2. ……. …….
DATE

Transnet National Ports Authority

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 Ports Authority

SPECIFICATION FOR THE SUPPLY AND INSTALLATION OF MEDIUM VOLTAGE AND LOW VOLTAGE ELECTRICAL CABLES

REVISIONS		
REV	DATE	APPROVED
02	August 2020	S.Sewdayal

INDEX

1.1 SCOPE OF WORK

The scope of this specification covers the minimum requirements for the supply installation, testing and commissioning of medium and low voltage cables, instrumentation cables, cable racking, trenching, sleeves and earthing reticulation on Transnet sites on behalf of Transnet National Ports Authority.

Contractors are 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. Failure to comply may render the contractor liable for corrections at his own cost.

These Standards and Codes of Practice should be read in conjunction with all other Specifications and drawings as issued for a particular contract. Where discrepancies occur, these must be brought to the attention of Transnet National Ports Authority in writing before commencement of work. In the event of any conflict between the contents of any documents forming part of a contract (as listed in the Master Index) and this document, the former shall prevail.

1.2 APPLICATION TO WORK ACTIVITIES

The Standards and Codes of Practice contained herein apply to all installations requiring Medium and Low voltage Electrical and Instrument Cabling, Racking, Trenching Sleeves and Earthing Reticulation and include amongst others the following standards:

- Supply of electrical and instrument cable trenches
- Supply, installation of electrical and instrument ladder racking reticulation
- Supply, installation of electrical and instrument dropper reticulation
- Supply, installation and termination of electrical and instrument cabling
- Cable Tagging and Core Identifying standards for electrical and instrument cabling
- Supply, installation of instrument and electrical earthing

2. STANDARDS AND REFERENCES

2.1 The requirements of the materials, design, layout, fabrication, assembly, erection, examination, inspection and testing of equipment and facilities on site shall be in accordance with the relevant sections of codes: -

(a) SANS 10142-1	2017	Code of Practice for the Wiring of Premises
(b) SANS 121	1999	Hot-dip (galvanized) zinc coatings (other than on Continuously Zinc-coated sheet and wire
(c) SANS 1507	2001	Electric cables with extruded solid dielectric insulation For Fixed Installations (300/500 V to 1 900/3 300)
(d) SANS 1574	2001	Electric cables - Flexible cords and flexible cables
(e) ASME/ANSI.B31.3	2016	Chemical Plant and Petroleum Refinery piping
(f) ASME/ANSI.B31.4	1998	Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia and Alcohols
(g) SANS 10089-2	2001	The Petroleum Industry Part -2: Electrical Code
(h) SABS 10089 – 2	2017	Installation and Maintenance of Electrical Equipment used in Explosive Atmospheres.
(i) SANS 10198	2004	The Selection, Handling and Installation of Electric Power Cables rating not exceeding 33KV Part 1: Definations and statutory
(j) API 2003	2016	Protection against ignitions arising out of static, Lighting and stray currents
(k) SANS 10313	1999	The Protection of structures against lightning
(l) SANS 10086-1	1997	Earthing of Low Voltage (LV) distribution systems
(m) IEC 79-14		Intrinsic Safety Principles and hazardous areas
(n) SANS 97	2001	Electric cables impregnated paper-insulated metal Sheathed cables for voltages 3.3/3.3Kv to 19/33Kv(Tests after installation)
(o) SANS 60079-7	1990	Apparatus with increased safety (EX e) for use in Explosive gas atmosphere
(p) SANS 808	2013	Cable glands for use on flameproof enclosures (Ex d)

(q)	SANS 10108	2017	The classification of hazardous locations and the Selection of apparatus for use in such locations
(r)	IEC79-11	2007	Intrinsic Safety Principles and hazardous areas
(s)	SABS 150	1986	Machine made textile floor coverings ,determination Thickness
(t)	SANS 1339	2015	Electric cables-cross-linked polyethylene (XLPE) Insulated Cables for rated voltages 3,8/6.6Kv to 19/33Kv
(u)	IEC 60-1		High voltage techniques
(v)	DIN EN 61386-24	1994	Conduit systems for cable management - Part 2-4: Particular requirements for conduit systems buried underground.
(w)	BS EN50086-2-4	1994	Specification for conduit systems for cable management. Particular requirements. Conduit systems buried underground

a) Government, local authorities or other statutory bodies' regulations, laws, requirements or customs which are more stringent than those specified in this project specification.

2.2 The following standard specifications are to be used for reference purposes and need to be noted by Contractors in order to signify familiarity and compliance with the requirements. It is expected of Contractors that they be familiar with the applicable clauses and that these will be adhered to in the execution of any work in terms of this specification. Contractors will be required to confirm that they are able to meet these requirements.

a) SANS 10108: 2017 The Classification of hazardous locations and the selection Of electrical apparatus for use in such locations

b) The Occupational Health & Safety (OHS) Act No. 85 of 1993.

c) SABS 0314 Flameproof Enclosures for Electrical Apparatus

d) SABS 0549 Intrinsically Safe Electrical Apparatus

e) API Manual of Petroleum Measurement Standards Chapters 4 to 12
IP Chapter 10 and Papers 2 and 3

f) SANS 61241-1-1: 1999 Enclosures for electrical apparatus for use in class II Divisions 1 and 2 locations (dust –ignition –proof or hose Proof or both)

g) BS 5490 Classification of degrees of protection provided by enclosures

h) Safety Regulations for Contractors

i) Technical Instruction No. 16 - Contractors Work Permit Procedures.

j) VDE Standards

2.3 Where no specific rules, regulations, codes or requirements are contained in this specification nor covered by the above mentioned codes, the contractor shall, in consultation with Transnet National Ports Authority, adhere to internationally accepted modern design and engineering practices in the Electrical and Petrochemical Industry.

3.0 SERVICE CONDITIONS

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

3.1.1 Ambient/Environnent Conditions :

3.1.1.1	Altitude	:	Sea level.
3.1.1.2	Ambient temperature	:	-5° C to +45° C (daily average +35° C).
3.1.1.3	Relative humidity	:	As high as 96%
3.1.1.4	Lightning conditions	:	Severe, with a maximum lightning ground flash density 11 flashes per km^2 per annum.
3.1.1.5	Exposure conditions	:	Salt laden, industrial atmosphere as well as hazardous Gases and dust atmosphere.

3.1.1.6 Electrolytic corrosion conditions prevail in all the areas owing to the proximity of direct current traction system and cathodic protection schemes.

3.1.2 Electrical Conditions:

3.1.2.1 The system of supply will be three phase, 3 wire, 50 Hertz, 11KV alternating current for medium voltage and three-phase, 4 wire, 50 Hz 400 Volts alternating current for low voltage.

3.1.2.2 The voltage may vary within the range of 95% to 105% of the nominal and all cable shall be suitably rated.

4.0 RESPONSIBILITY FOR WORK, SAFETY

4.1 The Contractor shall be responsible for all aspects associated with the provision of the cables. This includes items such as supply of testing cable, to test the cables prior to commissioning, provision of site office and storage facilities.

4.2 Occupational Health and Safety Act (Act No 85 of 1993) must be complied with in all respects during the execution of this contract. The onus shall be on the contractor to ensure that staff under his control adheres to the provisions of the act at all times.

5.0 ELECTRICAL CABLE SPECIFICATION

This part of the specification covers the general specification of electrical cables to be used on Transnet sites on behalf of Transnet National Ports Authority.

5.1 TYPES OF CABLE

5.1.1 CROSS-LINKED POLYETHYLENE (XLPE)

5.1.1.1 Cross-linked Polyethylene (XPLE)-insulated cables shall be individually screened, 3 core, stranded copper conductor, type A, cable manufactured in accordance with SANS.1339: 2015. The cable is to be supplied with an overall graphite coating to the outer PVC sheath.

5.1.1.2 The cable shall have embossed on the outer P.V.C. sheath next to the **S.A.B.S.** mark the following letters:

T/G/B

Where T = TRANSNET STANDARD G = GRAPHITE COATED B = BEDDING TEST

Only the above mentioned cable shall be accepted.

5.1.1.3 The cable shall be capable of withstanding continuous operational temperatures up to 90^{O} C.

5.1.1.4 Completed cable runs are subjected to the following tests:-

a. As laid down in SANS 1339:2015 (Appendix "E" paragraph E-1.4)

b. Anti-electrolysis insulation, applied between armouring and earth, tested at 10kV D.C. for one minute. Bedding shall be tested at 4kV D. C. for one minute.

All the above tests shall be carried out in the presence of the Engineer

5.1.2 PAPER INSULATED

5.8.2.1 Fully impregnated hygroscopic paper insulated, Helically lapped, insulated, Three core, Stranded copper conductors, Outer layer numbered for core identification, Seamless pure lead sheath, Covered with bitumen impregnated paper, Single steel wire armoured, extruded plastic sheathed, Operational voltage 6.35 to 11kV.

5.1.2.2 The cable shall have embossed on the outer P.V.C. sheath next to the **S.A.B.S.** mark the following letters:

T/G/B

Where: T = TRANSNET STANDARD
G = GRAPHITE COATED
B = BEDDING TEST

Only the above mentioned cable shall be accepted.

5.1.2.3 The cable is to be supplied with the P.V.C. outer sheath impregnated with a high quality graphite powder coating.

5.1.2.4 Type general purpose copper woven taped screened (Table 19) cable manufactured in accordance with SANS 97: 2001 is required.

5.1.2.5 The cable shall be capable of withstanding continuous operational temperatures up to 70 / 80^{O} C.

5.1.2.6 Completed cable runs are subjected to the following tests

a. As laid down in SANS 97 2001

b. Anti-electrolysis insulation, applied between armouring and earth, tested at 10Kv D. C. for one minute. Bedding shall be tested at 4Kv D.C. for one minute.
All the above tests shall be carried out in the presence of the Engineer

5.1.3 LOW VOLTAGE PVC CABLE

5.1.3.1 Low voltage cables shall be PVC insulated cables with ECC, and shall comply with SANS 1507: 2001.

5.1.3.2 Earth continuity conductors shall be single core PVC insulated copper cables, and shall comply with SANS. 1507: 2001.

5.1.3.3 The cable shall be capable of withstanding continuous operational temperatures up to 70^{O} C.

5.1.3.4 Electrical LV Power cabling installed in hazardous locations (flammable environment) running between Equipment located in the field, LV Panels or Motor Control Centre Panels, Valve Panels and Distribution Boards shall comprise of steel wire armoured, earth continuity conductor (ECC), PVC Insulated, four core cable, as follows:

Conductors:

Core Size : 2/3/4 core - Rated as per application (SANS 10142-1)
Stranded untinned copper, 7 strands minimum

PVC Insulated, Insulation Breakdown Voltage to withstand 2 kV 50Hz RMS for a 1 min period.

Insulation Colours: Coloured RD-BL-YE/WT-BK (not numbered)

Lay Twist to be 40 – 60 mm (i.e. 16-25 twist per metre)

Inner Jacket: Extruded fire retardant black PVC with rip cord for jacket removal.

Minimum thickness 1.2mm

Outer Jacket: Overall weatherproof thermoplastic PVC jacket – fire retardant and UV resistant (Carbon black added).

Jacket thickness: 1.5mm. Jacket to be totally bonded to a steel wire armoured sleeve.

Fire retardant, low halogen (20% Halogen, Blue Stripe) plastics to be used in non-ventilated areas. Fire retardant, high halogen (100% Halogen, Red Stripe) plastics may be used in ventilated areas. Fire retardant, no halogen (0% Halogen, White Stripe) plastics not required to be used.

5.1.3.5 Electrical Control cabling running between the Equipment located in the field, Control System Marshalling Cabinets, LV Panels and Incomer Breaker panels will comprise of steel wire armoured, PVC Insulated, multi-core cable, as follows :

Conductors:

Core Size: 7 core – 1.5 mm^2 (Valve Actuators)
12 core – 1.5 mm^2, 19 core – 1.5 mm^2 (Switchgear)

Stranded untinned copper, 7 strands minimum

PVC Insulated, Insulation Breakdown Voltage to withstand 2 kV 50Hz RMS for a 1 min
Insulation Colours: 7 core and less – coloured BL-YE/WT-RD-GR-BK-BR-PR/OR (Not numbered)
12 core and more – black, conductors to be numbered
Lay Twist to be 40 – 60 mm (i.e. 16-25 twist per metre)

Inner Jacket: Extruded fire retardant black PVC with ripcord for jacket removal.
Minimum thickness 1.2mm up to 7 core, 1.5mm for 12 and 19 core

Outer Jacket: Overall weatherproof thermoplastic PVC jacket – fire retardant and UV resistant.
Jacket thickness 1.5mm up to 7 core, 2.0mm for 12 and 19 core
Jacket to be totally bonded to a steel wire armoured sleeve.

Fire retardant, low halogen (20% Halogen, Blue Stripe) plastics to be used in non-ventilated areas. Fire retardant, high halogen (100% Halogen, Red Stripe) plastics may be used in ventilated areas. Fire retardant, no halogen (0% Halogen, White Stripe) plastics not required to be used.

5.1.3.6 Completed cable runs are subjected to the following tests as laid down in SANS 10142-1: 2017.Insulation resistance test between Phases, Phases and Neutral, Phases and ECC, Neutral and ECC.

5.1.4 INSTRUMENTATION CABLING

5.1.4.1 Instrument Cabling as defined within this, and other Transnet National Ports Authority Specifications includes the following types of cabling:

1. PVC SWA Multicore instrument cables running between Instrument Junction Boxes in the field and PLC Cabinets (IS and non-IS rated)
2. PVC SWA Multicore instrument cables running between instruments in the field and PLC Cabinets (IS and non-IS rated)
3. Dekabon armoured instrument cables running between Junction Boxes in the field and the instruments themselves (IS and non-IS rated)

5.1.4.2 All Instrumentation Cabling will comply in all respects to the specifications as contained in the Scope of Work attached to an Order. In the absence of cable specifications being detailed in the Scope of Work attached to an Order, the following cable specifications will apply.

5.1.4.3 Instrument cabling will be marshalled on Instrument racking and trenching as defined elsewhere within this specification.

5.1.4.4 Instrument multi-core cabling running between the Field Junction Boxes and the Control System Marshalling Cabinets will comprise of steel wire armoured, PVC Insulated, individual and overall screened multi-core cable. Note that Transnet has standardised on 1 pair, 2 pair, 8 pair and 16 pair cable – prior approval from Transnet will be required to deviate from these specifications.

Conductors:
Core Size : 1.0 mm^2

Stranded untinned copper, 7 strands minimum

PVC Insulated, Insulation Breakdown Voltage to withstand 2 kV 50Hz RMS for a 1 min.

Insulation Colours : Black and White

Multi-pair cores to be numbered (numeric on both conductors of the pairs)
Lay Twist to be 40 – 60 mm (i.e. 16-25 twist per metre)

Shield/Screen:
Individual & overall screened – plasticised aluminium foil (100%) coverage
Stranded tinned copper drain wire 0.5 mm^2

Inner Jacket

Extruded fire retardant black PVC with rip cord for jacket removal.
Minimum thickness 1.2mm up to 8 pair, 1.5 mm for 16 to 36 pair

Outer Jacket

Overall weatherproof thermoplastic PVC jacket – fire retardant and UV resistant (Carbon Black added).
Jacket thickness 1.5mm up to 8 pair, 2.0 mm for 16 to 36 pair.
Jacket to be totally bonded to a steel wire armoured sleeve.

Fire retardant, low halogen (20% Halogen, Blue Stripe) plastics to be used in non-ventilated areas.
Fire retardant, high halogen (100% Halogen, Red Stripe) plastics may be used in ventilated areas.
Fire retardant, no halogen (0% Halogen, White Stripe) plastics not required to be used.

IS Circuits: Jacket colour light blue Non IS Circuits: Jacket colour black.

5.1.4.5 Individual Instrument cabling running between the Field Junction Boxes and the individual field mounted Instruments will comprise of Dekabon armoured, PVC Insulated, individual and overall screened multi-core cable. Note that Transnet has standardised on 1, 2, 4 and Triad cable prior approval from Transnet will be required to deviate from these specifications.
(Note that this specification only applies to cabling running on racks above the ground, all Instrument cables running in trenches will need to comply with the Instrument Multi-core Cable Specifications detailed above).

Conductors:
Core Size : 1.5 mm^2
Stranded untinned copper, 7 strands minimum
PVC Insulated, Insulation Breakdown Voltage to withstand 2 kV 50Hz RMS for a 1 min
Insulation Colours : Black and White
Multipair cores to be numbered (alphanumeric on both conductors of the pairs)
Lay Twist to be 40 – 60 mm (i.e. 16-25 twist per metre)

Shield/Screen:
Individual & overall screened – plasticised aluminium foil (100%) coverage
Stranded tinned copper drain wire 0.5 mm^2

Inner Jacket

Extruded fire retardant black PVC with ripcord for jacket removal.
Minimum thickness 1.2mm

Outer Jacket

Overall weatherproof thermoplastic PVC jacket – fire retardant and UV resistant (Carbon black added).
Jacket thickness 1.5mm.
Jacket to be totally bonded to an inner waterproof aluminium sleeve, with a ripcord under the sleeve for jacket removal.

Fire retardant, low halogen (20% Halogen, Blue Stripe) plastics to be used in non-ventilated areas. Fire retardant, high halogen (100% Halogen, Red Stripe) plastics may be used in ventilated areas. Fire retardant, no halogen (0% Halogen, White Stripe) plastics are not required to be used.

IS Circuits: Jacket colour light blue Non IS Circuits: Jacket colour black.

6.0 CABLE TERMINATIONS

6.1 Medium and Low Voltage cables shall be terminated to busbars and switchgear in the panels, distribution boards and kiosks using suitable cable lugs. Cable earth wires shall be brought into

glands on gland plates. The insulation between cable armouring and cable earth wires shall be maintained at terminations. The separate earth conductor cable shall terminate to the main earth bar.

6.2 All materials necessary for installing all cable terminations shall be provided by the Contractor and the cost thereof shall be included in the tender price.

6.3 **Glanding**

6.3.1 All instrument and electrical cables will be glanded at both ends using the appropriate sized gland and will include associated adaptors, washers, ferrules, bands, etc. Provision for all glands, adaptors, washers, ferrules, bands etc. shall be included in the Tenderer's offers. All cable glands shall comply with the following specification, unless otherwise specified in the Scope of Work attached to an Order:

6.3.2 Dekabon Armoured Cabling (Instrumentation)
Increased Safety Ex"e" rated compression gland, IP68 rated, complete with UV resistant black shroud where required, in accordance with SANS 60079-7 1990.

6.3.3 PVC SWA Cabling (Instrument & Electrical motors)
Increased Safety Ex"e" rated non-compression gland, IP68 rated, complete with SWA protection (CCG Corrosion Guard or similar), in accordance with SANS 60079-7 1990.

6.3.4 PVC SWA Cabling (Ex"d" rated Valve Actuators)
Flameproof Ex"d" rated non-compression gland, IP68 rated, complete with SWA protection (CCG Corrosion Guard or similar), in accordance with SANS 808: 2013.

6.3.5 PVC SWA Cabling (Electrical and PLC Panels located within buildings rated as Safe Areas in terms of Hazardous Area Classifications SANS 10108: 2017)
Non-Flameproof rated, non-compression gland, IP68 rated, complete with UV resistant (black) shroud where required.

All glands will be waterproof and in the case of Hazardous Areas, correctly rated in terms of the Explosion Proof Classification of the equipment housings to which they are installed.

6.4 Termination

6.4.1 All cables will be terminated at field instrumentation, electrical equipment, field junction boxes, switchgear panels and control room marshalling cabinets according to manufacturers specifications, instrument hook-up diagrams and control system specifications as provided/approved by Transnet.

6.4.1.1 Instrument Dekabon Cabling

- Outer Dekabon armouring shall be stripped back to the entry point into the associated termination/junction box. Protrusion of cable sheath/armouring into termination/junction box (through the compression gland) shall be a minimum of 15mm and a maximum of 50mm.

- Cable pair inner aluminium foil shall be stripped back to the point at which the individual cores leave the PVC Trunking to be terminated onto the respective terminal rails. Ends of the inner foil shall be neatly taped/heat shrunk so as to prevent unravelling.

- Individual cable ends shall be sealed with the use of heat shrink tubing applied over the cable sheath/armouring at the point of entry into the termination/junction box/panel, in order to protect the cable and prevent the ingress of moisture.

- Both cable overall (drain wire) and individual screens shall be insulated with the use of appropriately sized green coloured sleeving, to prevent inadvertent contact with metallic surfaces.

- All individual cable cores (including spares) will be left long enough to accommodate 200mm slack, i.e. taking into account the routing via the trunking.

- Excess lengths of individual cable cores will be neatly folded and tied within the trunking provided. All spare cores shall be terminated into terminals so provided.

- Termination of individual cable cores in the termination strips will be such that all Control System related cabling will be terminated to one side of termination strips, whilst all field instrumentation/equipment cabling will be connected to the other side of termination strips.

In the case of Field Junction Boxes with dual terminal strips, multi-core cabling will be glanded in the centre of the gland plate and terminated into terminal rails provided, running from the centre PVC Trunking outwards. Individual Instrument cables will then be terminated into the terminal rails provided, running from the outermost PVC Trunking inwards.

In the case of Field Junction Boxes with single terminal strips, multi-core cabling will be glanded on the right side of the gland plate and terminated into terminal rails provided, running from the right hand side of the panel inwards. Individual Instrument cables will then be terminated into the terminal rails provided, running from the left hand side of the panel inwards.

- All cables connected to individual instruments/equipment will be provided with a single loop of minimum diameter of 150mm. All loops will be neatly strapped.

- All cores (including spares) will be terminated into allocated termination strips/rails in the respective Instrumentation, Termination and Field Junction Boxes

6.4.1.2 **Instrument PVC SWA Multi-core Cabling**

- Cable SWA armouring shall be stripped back to the entry point into the associated marshalling cabinet/junction box and shall be glanded in such a manner so as to ensure electrical continuity with the gland. When terminated in hazardous areas, cable armouring shall be bonded to the panel equi-potential bonding system via means of earthing rings provided as an integral part of the gland. Contact between the gland and the gland plate shall not be considered as sufficient for bonding purposes.

- Protrusion of cable inner PVC sheaths into the marshalling cabinet will be a minimum of 25mm and a maximum of 50mm.

- Cable inner aluminium foil shall be stripped back to the point at which the individual cores leave the PVC Trunking to be terminated onto the respective terminal rails. Ends of the inner foil shall be neatly taped/heat shrunk so as to prevent unravelling.

- Cable ends shall be sealed with the use of heat shrink tubing applied over the cable inner sheath at the point of entry into the termination/junction box/panel, in order to protect the cable and prevent the ingress of moisture.

- Both cable overall and individual screens shall be insulated with the use of appropriately sized green coloured sleeving, to prevent inadvertent contact.

- All individual cable cores (including spares) will be left long enough to accommodate 200mm slack, i.e. taking into account the routing via the trunking.

- Excess lengths of individual cable cores will be neatly folded and tied within the trunking provided. All spare cores shall be terminated into terminals so provided.

- Termination of individual cable cores in the termination strips will be such that all Control System related cabling will be terminated to one side of termination strips, whilst all field instrumentation/equipment cabling will be connected to the other side of termination strips.

In the case of Field Junction Boxes with dual terminal strips, multi-core cabling will be glanded in the centre of the gland plate and terminated into terminal rails provided, running from the centre PVC Trunking outwards. Individual Instrument cables will then be terminated into the terminal rails provided, running from the outermost PVC Trunking inwards.

In the case of Field Junction Boxes with single terminal strips, multi-core cabling will be glanded on the right side of the gland plate and terminated into terminal rails provided, running from the right hand side of the panel inwards. Individual Instrument cables will then be terminated into the terminal rails provided, running from the left hand side of the panel inwards.

- All cores (including spares) will be terminated into allocated termination strips/rails in the respective Instrumentation, Termination and Field Junction Boxes

6.4.1.3 **Electrical Power and Control Cabling (Low Voltage)**

- Cable SWA armouring shall be stripped back to the entry point into the associated equipment housing/termination box/panel and shall be glanded in such a manner so as to ensure electrical continuity with the gland. When terminated in hazardous areas, cable armouring shall be bonded to the panel equi-potential bonding system via means of earthing rings provided as an integral part of the gland. Contact between the gland and the gland plate shall not be considered as sufficient for bonding purposes.

- (Option 1) Cable inner PVC sheath shall be cut back at the point of entry into the equipment housing/termination box/panel, protrusion of the inner sheath into the associated switchgear cabinet/equipment housings shall be a minimum of 25mm and a maximum of 50mm. Heat shrink tubing shall be applied at the point of entry into the equipment housing/termination box/panel, in order to protect the cable and prevent the ingress of moisture.

  (Option 2) Where cables are glanded into panels, cable inner PVC sheaths may be taken directly into trunking/marshalling arrangements, with the inner PVC sheaths cut back at point of termination. Note that in this instance, heat shrink need not be applied at the point of entry into the cabinet.

- All individual cable cores (including spares) will be left long enough to accommodate 200mm slack, i.e. taking into account the routing via the trunking.

- Excess lengths of individual cable cores will be neatly folded and tied within the trunking provided.

- Termination of individual cable cores in the termination strips will be such that all Starter related cabling will be terminated to one side of termination strips, whilst all field cabling will be connected to the other side of termination strips.

- All cables connected to individual instruments/equipment will be provided with a single loop of minimum diameter of 150mm. All loops will be neatly strapped.

6.5 Cable Core Lugging

All individual cable cores will be neatly terminated. Appropriately sized lugs will be attached to all core ends, using the appropriate crimping tool (not side cutters or ordinary pliers). The colouring of crimps will match the size of the associated cable core. All cable lugs utilised shall comply with the following specification, unless otherwise specified in the Scope of Work attached to an Order:

- Instrument Cables - bootlace ferrules
- Electrical Power Cables -spade lugs for compression terminals, ring lugs for screw terminals (pin lugs are not acceptable)

- Electrical Control Cables - spade lugs for compression terminals, ring lugs for screw terminals (pin lugs are not acceptable)

6.6 **Cable Screening – Instrument Cabling**

6.6.1 **Individual Screens**

6.6.1.1 All Individual Instrument Cable Pair Screens shall be terminated into terminals provided within the Instrument Termination Boxes as well as the Field Junction Boxes, and shall be grounded to a common insulated earth rail to be provided in each of the Control System Marshalling Cabinets, alongside the Termination Rails provided. Individual Screens shall be terminated in such a manner so as to be continuous from the Instrument/Instrument Termination Box to the Control System Marshalling Cabinets i.e. individual instrument cables as well as multi-pair cables.

6.6.1.2 Individual screen terminals shall be insulated in the Termination Boxes and Field Junction Boxes provided, thus ensuring that the individual cable pair screens are not grounded at instrument/equipment ends, i.e. to prevent common mode noise. Where Instrument Cables terminate directly into Instrument housings, individual screens shall be cut back and insulated within the Instrument housing using heat shrink sleeving, to prevent inadvertent contact with any conducting surfaces.

9.6.1.3 All individual screen earth rails in the Control System Marshalling Cabinets will be connected to the existing panel Instrument Earth bar via means of a 25mm insulated earth cable, which shall in turn be connected at two points via means of PVC Cu 70mm^2 insulated earth cables (Yellow/Green in colour), to the Instrument Earth bar located within the control room.

6.6.2 **Overall Screens**

6.6.2.1 All Instrument Cable Overall Screens/Drain wires shall be terminated to insulated earth bars provided within the Field Junction Boxes, and shall be earthed to a common electrical earth bar to be provided in each of the Control System Marshalling Cabinets. Overall Screens /Drain Wires shall be cut back and insulated within the Instrument Termination Boxes and Instrument housings (where applicable) to prevent inadvertent contact with the Termination Box housing, utilising heat shrink sleeving. Overall Screens shall be terminated in such a manner so as to be continuous from the Instrument Junction Box to the Control System Marshalling Cabinets.

6.6.2.2 The electrical earth bar shall be earthed to the Cabinet Frame, and connected at two points via means of PVC Cu 70mm^2 insulated earth cables (Yellow/Green in colour), to the Electrical Earth bar located within the control room.

6.7 **Cable Screening – Electrical Cabling (Power & Control)**

6.7.1 All electrical cable screens/drain wires (where applicable) will be grounded to a common electrical earth bar to be provided in each of the Control System Marshalling Cabinets/Switchgear Cubicles. The electrical earth bar shall be earthed to the Cabinet Frame, and connected at two points via means of PVC Cu 70mm^2 insulated earth cables (Yellow/Green in colour), to the Electrical Earth bar located within the control and switchgear rooms.

7 ADDITIONAL REQUIREMENTS FOR EX IA/IB INSTALLATIONS

7.1 All I.S. (Ex ia/ib Intrinsically Safe) Installations shall be in strict compliance with IEC 79-14 Electrical Installations in Hazardous Areas, and in particular Chp 12 "Additional Requirements for type protection Intrinsic Safety", inclusive of the under mentioned items.

7.2 **Clause 12.2.**

In installations with Zone 1 and 2 classifications, IS apparatus and the intrinsically safe parts of associated apparatus shall comply with at least category "ib". Note that Transnet has standardised on category "ia" protection, and permission will need to be sought in writing for relaxation to "ib".

7.3 **Cables – General**

Where multi stranded cables are used in a hazardous area, the ends of the conductor shall be protected against separation of individual strands, by means of cable lugs.

Where cable screens are required, these shall be connected to earth at one point only, normally in the non-hazardous area. (Refer to Section 9.6 and 9.7 of this specification).

Cable armouring shall normally be bonded to the equi-potential bonding system via the cable entry devices (glands), at the end of each cable run. Where interposing Junction Boxes exist or other apparatus, the armouring shall be similarly bonded to the equi-potential bonding system at these points. In this regard and where earthing rings are provided as an integral part of the gland, use of these is recommended in serving this function. Contact between the gland and the gland plate shall not be considered as sufficient for bonding purposes.

Conductors of intrinsically safe circuits and non-intrinsically safe circuits shall not be carried in the same cable.

Conductors of intrinsically safe circuits and non-intrinsically safe circuits in the same bundle or duct shall be separated by an intermediate layer of insulated material or by an earthed metal partition. No segregation is required if metal sheaths or screens are used for intrinsically safe or non-intrinsically safe circuits. Note that Transnet has standardised on physical separation regardless of whether the cabling is screened or not, and permission will need to be sought in writing for relaxation.

7.4 Cables – Marking

Un-armoured Cables containing intrinsically safe circuits shall be marked. If outer sheaths are marked by colour, the colour used shall be light blue. Note that whilst armoured cabling is not required to be marked in terms of IEC79-14, Transnet has standardised on the principle of marking all cable outer sheaths carrying intrinsically safe circuits by colour (light blue), whether armoured or not, and that this will need to be complied with in all instances.

7.5 Cable Insulation Tests

All cables carrying intrinsically safe circuits shall be proven to be capable of withstanding an RMS AC test voltage of twice the normal voltage of the intrinsically safe circuit with a minimum of 500 V between the armouring and screens joined together and the individual conductors. Tests shall be conducted in accordance with manufacturer's specifications. Where no such method is available, tests shall be carried out as follows:

- Voltage shall be an ac voltage of sinusoidal waveform at a frequency of between 48 and 62 Hertz
- Voltage shall be derived from a transformer of at least 500 VA output

- Voltage shall be increased steadily to the specified value in a period of not less than 10 seconds and maintained for a period of not less than 60 seconds.

7.6 **Cable Termination**

All terminals shall be reliably separated from non-intrinsically safe circuits (for example by a separating panel or gap of at least 50mm). Terminals of intrinsically safe circuits shall be marked as such. Transnet has standardised on marking by colour - the specified colour being light blue. All terminals, plugs and sockets shall satisfy the requirements of IEC79-11: Sections 6.3.1 and 6.3.2 respectively (6mm creepage and clearance rules 4mm to earth).

7.7 **Zone 1 Installations - Surge Protection**

All equipment installed in Zone 0 areas and exposed to hazardous potential differences (e.g. lightning surges), shall have a surge protection device installed between each non-earth bonded conductor/core and the local earthed structure as near as is practically possible. The surge protection device shall be capable of diverting a minimum peak discharge current of 10kA (8/20 microsecond impulse according to IEC60-1, 10 operations). The bonding connection between the protection device and the structure shall have a minimum cross sectional area equivalent to 4 mm^2 copper.

Note that Transnet has extended these requirements to include all analogue transmitters installed in the field, whether in hazardous areas or not, and will need to be complied with in all instances.

8. CABLE JOINTS

8.1 MEDIUM VOLTAGE CABLE JOINTS

8.1.1 The contractor shall give the Engineer advance notice of his intention to do jointing of medium voltage cables to enable arrangements to be made for measuring and inspection.

8.1.2 The complete cable installation, including all joints shall be fully insulated from earth throughout.

8.2 LOW VOLTAGE CABLE JOINTS

8.2.1 The low voltage cable through joints shall be of the epoxy resin filled type. The low voltage joints shall be constructed according to manufacturer's instructions.

9. CABLE ROUTES

9.1 All low voltage cables and associated earth continuity conductors shall be installed as shown in layout drawings.

10. SURVEY OF ROUTE

10.1 The drawings showing the proposed cable route listed in the "Schedule of Drawings" shall not be taken to show the precise final cable route. The Contractor shall within 30 days after being awarded the Contract carry out a final route survey, which shall include digging test holes, and using the routes shown on the drawings as a general guide, to determine a suitable route.

10.2 The Contractor shall submit details of the cable routes selected in final survey to the Engineer for approval. No excavation of any section of the cable route shall commence until the Engineer has authorised the commencement of work on the section concerned.

10.2.1 After completion of all cable laying and jointing and before commissioning of any cable the Contractor shall carry out a final "as laid" survey of the cable routes and hand to the Engineer cable route plans. The cable route plans shall include the following information:

(i) Overall length of each cable.

(ii) Centre to centre distances between all joints and between final joints and terminations of each cable including auxiliary cables.

(iii) Accurate indications of the position of each cable joint and cable marker preferably by triangulation, i.e. indicating two distances to each joint or marker from structures not likely to be moved such as permanent buildings, bridge piers, etc.

(iv) Tables showing all information regarding each high-voltage cable necessary for cable fault location by the reflected pulse method.

(v) Soil thermal resistivity and temperature values as determined on final survey shown on the plans at the positions where they were determined.

11. EXCAVATIONS

11.1 Excavations shall be carried out in strict compliance with the specification for works on, over, under or adjacent to a railway line No. E.7 (July 1998) (Part 1) that forms part of the tender documents.

11.2 The procedure and the order of doing the work shall be subject to the approval of the Engineer.

11.3 The Contractor shall, before trenching commences, familiarise himself with the route and conditions on site. The Contractor shall be advised of any known buried services such as cables, pipes, etc., in the vicinity of the cable route. However, the Contractor shall at all times exercise care to ensure that any uncharted services are not damaged.

11.4 Power driven mechanical excavators may be used for trenching operations provided that they are not used in close proximity to other cables, water mains, or any other plant liable to be damaged by the use of such plant. Their use along sections of the route shall in each case be subject to approval of the Engineer.

11.5 Trenches shall be as straight as possible and each trench shall be excavated to the dimensions indicated in this specification. The Contractor shall provide shuttering for use in places where danger exists should the sides of the trench collapse. The strength of such shuttering must be adequate especially where railway tracks in proximity are concerned and the shuttering must be braced across the trench. Provision of shuttering will be paid for per metre length of shuttered trench.

11.6 The bottom of each cable trench shall be as firm as conditions permit and be of smooth contour.

11.7 In sections where the soil or water level conditions indicate that the cable trench will endanger rail tracks or any nearby structures, the Contractor must restrict the length of continuous open trench to a distance to be indicated by the Engineer.

11.8 The Contractor shall take all reasonable steps to ascertain if the cables will be liable to be subjected to chemical or other damage or electrolysis action and shall submit his recommendations for approval, of any precautionary measures to be taken, in such instances.

11.9 The material excavated from each trench shall be placed adjacent to the trench in such a manner as to prevent nuisance or damage to adjacent ditches, railway lines, drains, gateways and other properties and shall be stacked so as to avoid undue interference with traffic. Where, owing to certain considerations, this is not permissible, the excavated materials shall be removed from the site and be returned for refilling the trench on completion of laying.

11.10 Surplus material shall be disposed of by the Contractor at his cost. Where the possibility exists that railway line ballast may be fouled by excavated material or material brought on site, the Contractor shall take precautions as directed by the Engineer.

11.11 The Contractor shall not trench beneath any railway line without departmental supervision. Should the contractor wish to carry out such work the Engineer must be advised not less than 14 working days before hand to arrange for the necessary supervision. The cost of such supervision shall not be charged to the Contractor.

11.12 Prior to laying the cable, the trench shall be inspected thoroughly by the Engineer or his authorised representative to ensure that it is free from all objects likely to damage the cable either during or after cable laying operations. Cable laying shall not proceed unless the Engineer or his authorised representative is satisfied with the condition of the trench.

11.13 When trenching, the Contractor shall take all precautions necessary to prevent damage to any other cables, water mains, roads, pavements, drainage systems, building or any structure etc. Should any of the above be damaged by the Contractor's staff, it shall be reported immediately to the Engineer, who shall arrange for the necessary repairs. The Contractor is responsible for the cost of repairs.

11.14 Should it be necessary for any reason to remove accumulated water or other liquid from the trench, this shall be done by the Contractor at his expense and should be taken into account at the time of tendering. The Contractor is to provide all pumps and appliances required to carry out this operation. Water or any other liquid removed shall be disposed of without creating any nuisance or hazard.

14.15 Trenching procedure shall be programmed in advance with the Engineer and the programme approved by the Engineer shall not be departed from save with his consent.

11.16 Programming of trenching shall be on the basis of the Contractor giving the Engineer an assurance that any length of trench opened on a particular day will be back-filled and compacted to an adequately firm surface on the same day where possible. If it is anticipated that trenching will remain open for longer periods, the Contractor shall first obtain the approval of the Engineer. No new sections of trenching shall commence if previously uncompleted sections still exist. Under no circumstances may sections greater than 300 metres be opened.

Where such approval is given, the onus shall be on the Contractor to safeguard the works to the satisfaction of the Engineer during the extended period such trenches remain open. Where cables have already been laid, but not covered, steps shall be taken by the Contractor to protect cables and the personnel around.

11.17 The near side of any cable trench shall preferably not be less than 2500mm from any adjacent railway line. Approval from the Engineer will be required if the above clearances cannot be achieved. The conditions of clause 13.1 shall apply.

11.18 The removal of obstructions along the cable routes shall be subject to the approval of the Engineer and shall be paid for at pre-agreed rates.

11.19 The area traversed by the cable routes has been used for many years. It is inevitable that there will be uncharted services. On encountering any such service the Contractor shall promptly advise the Engineer who shall direct what action shall be taken.

11.20 Transnet National Ports Authority reserves the right to alter any cable route or portion thereof in advance of cable laying. Payment in respect of any additional or wasted work involved shall be at scheduled rates.

11.21 Any existing electrical cables obstructing the cable routes shall be removed or deviated as appropriate by the Contractor. The work shall be paid for at scheduled rates.

11.22 The bottom of the trench shall be filled with 200mm of suitable soil sifted through a 6mm mesh and levelled off. Only soil with a satisfactory thermal resistivity may be used for this purpose and ash which occurs on the route shall not be used. Where no suitable soil is available in proximity,

imported fill shall be arranged. The manufacturer's assurance is required that the current rating of cables is not reduced by the ground conditions.

12.0 TRENCH/EXCAVATION SPECIFICATION

Separate Trenches shall be supplied to cater for the following cable types:

12.1 ELECTRICAL HV/MV TRENCHES

Trench Dimensions	:	1200 mm deep by 500 mm wide (two cables), add300m width for additional cables
River Sand Bedding	:	PVC Piping – 75 mm above pipe, 50mm under pipe
	:	Direct Burial – 100 mm
Identification	:	PVC or Concrete Interlocking Tiles at a depth of 350mm
Cable Markers	:	Concrete with engraved anodised aluminium ID plates Cable Marker Colour – Brilliant Green
Cabling	:	Medium and High Voltage Power Cabling > 400 VAC
Separation	:	400 mm (LV cabling), 800mm (Instrument cabling)

12.2 ELECTRICAL LV TRENCHES

Trench Dimensions	:	800 mm deep by 300 mm wide
River Sand Bedding	:	PVC Piping – 75 mm above pipe, 50mm under pipe

		Direct Burial – 100 mm
Identification	:	Polythene Marker Tape (150mm wide, yellow and Marked with the words “Electric Cable” at a depth of 350mm
Cable Markers	:	Concrete with engraved anodised aluminium ID plates. Cable Marker Colour – Black
Cabling	:	Low Voltage Power Cabling 400 VAC/230 VAC (e.g. Actuators, Aux Motors, DB circuits)
	:	Control Cabling (E.g. MV Breaker Inter-tripping cables, Actuator control signals, Aux Motor local stop/start panels etc.)
Separation	:	400 mm (HV/MV cabling), 800mm (Instrument cabling)

12.3 INSTRUMENT TRENCHES

Trench Dimensions	:	500 mm deep by 300 mm wide
River Sand Bedding	:	PVC Piping – 75 mm above pipe, 50mm under pipe
	:	Direct Burial – 100 mm
Identification	:	PVC Tiles / Polythene Marker Tape (150mm wide, yellow ‹ed with the words “Electric Cable” at a depth of 350mm
Cable Markers	:	Concrete with engraved anodised aluminium ID plates Cable Marker Colour – Light Blue
Cabling	:	Instrument Multi-core & Single Pair Cabling (IS and non IS)

Separation : 800mm (HV/MV/LV Electrical cabling)

13. CABLE LAYING

13.1 CABLES BURIED UNDERGROUND.

13.1.1 HV, MV, LV AND Instrument cables shall be spaced as indicated in Table 1 below. Pilot cables shall be laid beside the associated power cable. Cables crossing beneath railway tracks, roads, etc., shall be enclosed in 150mm diameter uPVC pipes. Where more than one length of pipe is required for a crossing, uPVC couplings with PVC glue, shall be used to prevent water from penetrating the joint. Cable pipes must maintain or exceed the specified cable spacing.

Table 1

CABLE	MINIMUM SPACING BETWEEN CABLES
MV TO MV	300mm
MV TO LV	400mm
LV TO LV	300mm
MV TO instrumentation	800mm
LV TO instrumentation	800mm

13.1.2 All pipes laid beneath the railway lines, roads, pavements shall be laid with their tops not less than 900mm below the formation level, and shall where possible extend at least 2000mm on either side of the centre of the outer most line. Where there is more than one line crossed and in the case of roads and pavements at least 900mm on either side of the road and 1 or pavement. All pipes shall be graded for water drainage the required grade is 75mm in 30m.

13.1.3 All Low voltage cables shall be laid at a depth of 750mm. All cable depth measurements shall be made to the top of the cable when laid direct in the ground, otherwise to the top of the duct concerned.

13.1.4 Except where ducts, tunnels or pipes are provided and unless instructed to the contrary by the Engineer, the Contractor shall lay the cables direct in the ground.

13.15 Rollers may be used during the laying of cables, but they shall have no sharp projecting parts liable to damage the cables. They shall be carefully placed in the trench or duct in such a manner that they will not readily capsize during cable laying operations.

13.1.6 The Contractor shall ensure that all cable is laid in the same direction. No crossing of conductors inside through joints or end boxes will be permitted.

13.1.7 Where cables have to be drawn around corners, skid plates shall be used for this purpose and these plates shall be well lubricated. The skid plates shall be securely fixed between rollers and shall be constantly examined during the cable laying operations.

13.1.8 Cable shall be visually inspected for damage during and after laying.

13.1.9 Cable pulling and laying shall preferably be done manually whenever possible. Mechanical means such as winches and the like may only be used subject to the Approval of the Engineer. No cable shall be subjected to a tension exceeding that stipulated by the cable manufacturer.

13.1.10 In the event of mechanical means of cable pulling being approved, the Contractor shall establish means of communication between the operator of the winch or other pulling device and the persons tending the drum from which the cable is being run off, to the satisfaction of the Engineer.

13.1.11 The contractor shall be wholly responsible for making his own arrangements for transporting all materials to and from and on the working sites.

13.1.12 At locations where cables run under concrete bridges, the cables shall be supported on suitable brackets secured on the side of concrete wall. These brackets shall be spaced a maximum of 500mm apart. Brackets and fixing material shall be of robust design and shall meet with Engineer's approval. Drawing of proposed bracket shall accompany tender. Brackets shall be galvanised in accordance with SANS 121:1999, and thereafter painted to the satisfaction of the Engineer.

14.0 CABLES LAID IN DUCTS, CABLE TRAYS AND LADDERS

14.1.1 Cables installed in ducts shall be supported by cable ladder installed along the walls of the ducts or installed on the duct floor. If the cable ladder is installed on the duct floor, it shall be supported at +/- 50mm from the duct floor.

14.1.2 Cables installed in perforated cable trays and cable ladder shall be secured by means of heavy duty cable ties, cable clamps, etc.

14.1.3 Where medium and low voltage cables share the same wire-ways a reasonable space shall be left between the medium voltage and low voltage cables.

15.0 CABLE SLEEVING

15.1 All areas subject to vehicle traffic, rail crossings and paved areas shall be sleeved.

15.2 Sleeves shall be designed and installed so as to ensure 25 % spare capacity.

15.3 Sleeve Specifications

Material	:	PVC or PHD Polyethylene
Dimensions	:	100 mm OD min
Standards	:	DIN EN 61386-24: 1994 , BS EN50086-2-4:1994

16.0 DRAW BOXES

16.1 Where cable sleeves are utilised and to facilitate the hauling of cables, brick draw boxes shall be provided at all trench junctions, complete with concrete slab, as detailed below:

Draw box Dimensions (min)	:	Internal 450 mm square, 3 courses of stock brick deep.
Base & Top	:	Concrete 50mm thick

17. COVERING, BACKFILLING AND REINSTATEMENT

17.1 Filling in of trenches shall not be commenced until the Engineer or his authorised representative has inspected and approved the cables in situ in the section of trench concerned. Such inspection shall not be unreasonably delayed.

17.2 Where in the opinion of the Engineer, the soil on site is unsuitable for riddling or backfilling, the Contractor shall arrange for the importation of approved material. A 75mm thick layer of soil sifted through a 6mm mesh shall be laid above the high-tension cables and consolidated by hand ramming only. The conditions of clause 13.20 apply in this case also.

17.3 All excavations made (whether for the purpose of cable laying, joint bays or trial holes) shall be back-filled in 150mm layers, the earth in each layer being well rammed and consolidated and sufficient allowance being made for settlement. The back-filling shall be completed to the satisfaction of the Engineer.

15.4 The refilled trench shall be maintained by the Contractor at his expense in a thoroughly safe condition for the duration of the contract. In the case of tarmac surfaces, until such time as this surface has been restored.

17.5 All backfilling of road crossings shall be mechanically rammed by means of approved type of mechanical power driven rammer.

17.6 The replacement of made up surfaces, such as roads, pavements, tarred aprons, verandas, floors, etc., necessitated by trenching or other works shall be arranged by the contractor at his cost. The price thereof shall be included in the tender price.

17.7 Concrete cable protection slabs shall be laid on top of the 75mm layer of soil referred to in clause 15.2 before the trenches are backfilled. Cable protection slabs shall be laid close butted, convex end to concave end, directly above each cable throughout the underground portion except where otherwise protected such as by pipes, etc. Three coloured slabs to drawing PPD-PA-9 shall be provided to give the indication of the route in the case of a change of direction. Only unbroken cable protection slabs, and those actually laid will be paid for.

17.8 When back filling of cable trench has reached a level, after consolidation, approximately 150mm below the normal level of the surface of the surrounding area the Contractor shall lay a continuous

plastic cable warning tape directly above each cable for the full length of the cable trench before completing the backfilling.

17.9 Concrete cable markers shall be provided and installed by the Contractor at his cost. The price thereof shall be included in the tender price. Initial cable markers shall be installed as close as possible to cable terminations, thereafter at approximately 60m intervals and at cable joints, also on either side of crossings of oil pipelines and at ends of underground cable pipes.

17.10 Changes of direction and joints in cable runs shall be indicated by installing two markers at such positions in an understandable manner to be finalised on site. The markers shall be coloured orange with oxide mixed into the concrete. Cable markers shall project approximately 25mm above normal ground level except where projecting cable markers could be a hazard to pedestrians such as in shunting yards, walkways, pavements, etc. In such cases the cable markers shall be flush with the surface.

17.11 If more than one cable is laid in one trench, only one row of cable markers shall be placed on the centre line of the trench to define the general route of the cables.

18. CABLE TESTING AND TEST DATA

18.1 All tests on completed cables shall be carried out in the presence of a representative of Transnet National Ports Authority. Not less than 14 working days notice of the Contractor's intention to carry out such tests shall be given to the Engineer.

18.2 On completion of the jointing and termination of cables, the 11kV cables are to be subjected to the test laid down in paragraph E-1.4 of Appendix E of SANS 1339:2015 and the low voltage type cables to be tested for insulation and loop resistance.

18.3 The anti-electrolysis insulation of each 11kV cable run complete, shall withstand for 1 minute, a test voltage of 10kV D.C., applied from the cable armouring to earth. The bedding shall withstand a test voltage of 4kV D.C. between screen and armouring for 1 minute.

18.4 As a graphite coating is required to be applied to the PVC oversheath (in accordance with British Standard), a D.C. voltage test will be carried out on all cables after installation. The D.C. voltage test can only be carried out on the installed system if the joints are suitably insulated from earth, otherwise the D.C. voltage test should be carried out prior to jointing.

18.5 The contractor shall obtain written confirmation from the manufacture of all cables, joints and terminations -etc. that the test that Transnet National Ports Authority requires the contractor to carry out in terms of this specification meets with the manufacturers approval. Such confirmation must be obtained prior to any, tests commencing.

18.6 The electrical Contractor shall on completion of the tests submit three copies of all test Results. The costs of all the tests mentioned above shall be borne by the contractor

18.7 In addition the cable manufacturer shall provide test sheets of each manufactured cable drum length together with the cable drum numbers which shows all the test results.

18.8 Transnet National Ports Authority reserves the right to carry out any further tests deemed necessary itself, using either the Contractor's instruments and cable, or its own, or both. The costs of such tests shall not be charged to the Contract.

18.9 **Cable Testing – Low Voltage Cables (< 1 kV)**

Each individual core of all cables (including spares) will be checked for continuity and insulation breakdown, in accordance with SABS 150 **(**PVC):

- Insulation Resistance shall be measured with a 1000V Megger and the readings tabulated And certified.
- Similarly, earth continuity resistance shall be measured and recorded.
- All cables will be checked for correct termination.

18.10 **Cable Testing – Medium Voltage Cables (< 22 kV)**

Each section of laid and jointed cable shall be tested, in accordance with SANS 97 (PILC/SWA):

- Insulation Resistance shall be measured with a 1000V Megger, followed by the relevant Pressure test .Readings shall be tabulated and certified.
- AC test voltage must be applied to each phase in turn for one minute, or alternatively the

DC test voltage for fifteen minutes .Leakage current shall be measured and recorded for Each test.

- All cables will be checked for correct termination.

19. MEASUREMENTS OF CABLES

19.1 All measurements for payment purposes shall be made jointly by representatives of the Contractor and Transnet National Ports Authority and shall be agreed and approved by both parties.

19.2 Measurements of cable length shall be made from centre to centre of cable joints and to the cable ends and will exclude any wastage due to jointing and terminating.

19.3 Measurements of trench width and depth shall be made to the nearest 50mm and shall not take into account subsidence or unnecessarily large excavations. No allowance shall be made where trenches have to be widened at the bottom to accommodate cables, cable Joints and protection slabs.

APPENDIX 1

STATEMENT OF COMPLIANCE
(TO BE COMPLETED BY TENDERER)

This tender complies with specification TPD: 003-CABLESPEC in all respects.

SIGNATURE: _____ DATE: _____

This tender complies generally with specification TPD: 003-CABLESPEC but differs from it on the following points.

_____

_____

_____

_____

_____

_____

_____

SIGNATURE: _____ DATE: _____

Transnet National Ports Authority

SPECIFICATION FOR EARTHING AND THE PROTECTION OF BUILDINGS AND STRUCTURES AGAINST LIGHTNING.

REVISIONS		
REV	**DATE**	**APPROVED**
02	**August 2020**	**S.Sewdayal**

INDEX

1.0 SCOPE

1.1 This specification covers Transnet National Ports Authority (TNPA) requirements with respect to the protection of buildings and structures against lightning and the requirements for air terminal systems, down conductors and earthing of installation of this specification

1.2 This specification applies to assessing, testing and upgrading of existing lightning protection systems and earthing on existing buildings and structures.

2.0 STANDARDS, SPECIFICATIONS AND CODES OF PRACTICE

2.1 The following publications (latest editions and amendments) are referred to herein.

South African National Standards and International Electro-technical Commission Standards

2.2 In designing the lightning protection system (LPS), the design process as discussed in SANS 62305-3, section E.4 shall be followed. Furthermore, for the design or upgrade of LPS for the existing structures, the contractor/ designer must evaluate the need for protection and cost effectiveness of implementing the protection measures as per the procedure discussed in SANS 62305-2.

2.3 The requirements of the materials, design, layout, fabrication, assembly, erection, examination, inspection and testing of an earthing system on site shall be in accordance to the relevant sections of codes listed below:-

SANS 10313	-	The protection of structures against lightning.
SANS 10089-1	-	Electrical Code for Petroleum Industries
SANS 10121	-	Cathodic Protection of Buried and Submerged Structures
SANS 10142	-	Code of practice for the wiring of premises
SANS 10123	-	The Control of Undesirable Static Electricity
SANS 10198-12	-	Installation of Earthing System
SANS 10199	-	The design and Installation of an Earth Electrode

SANS 10200	-	Neutral Earthing in Medium Voltage Industrial Power Systems
SANS 10292	-	Earthing of Low Voltage Distribution Systems
SANS 1063	-	Earth Rods and Couplers
SANS IEC 61000-5	-	Electromagnetic Compatibility (EMC) Part 5: Installation and Mitigation Guidelines Section 2: Earthing and Cabling
SANS IEC 61312-1	-	Protection against Lightning Electromagnetic Impulse (LEMP) Part 1: General Principles
SANS IEC 61312-2	-	Protection against Lightning Electromagnetic Impulse (LEMP) Part 2: Shielding of Structures, Bonding inside Structures & Earthing
SANS IEC 61312-4		Protection against Lightning Electromagnetic Impulse (LEMP) Part 4: Protection of Equipment inn Existing Structures
SANS IEC 61024-1	-	Protection of Structures against Lightning Part 1: General Principles
SANS IEC 61024-1-1	-	Protection of Structures against Lightning Section 1: Guide A – Selection of Protection Levels for Lightning Protection Systems
SANS IEC 61024-1-2	-	Protection of Structures against Lightning Part 1-2: Guide A – General Principles Guide B – Design, Installation, Maintenance and Inspection of Lightning Protection Systems
SANS IEC 62305 -1	-	Protection against Lightning Part 1: General Principles
SANS IEC 62305 -2	-	Protection against Lightning Part 2: Risk Management
SANS IEC 62305 -3	-	Protection against Lightning Part 3: Physical Damage to Structures and Life Hazard
SANS IEC 62305 -4	-	Protection against Lightning Part 2: Electrical and Electronic Systems within Structure

OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993 (ACT 85 OF 1993).

2.4 Statutory Requirements

a. The contractor shall ensure that the installation satisfies the requirements of all relevant South African Statutory Regulations.

b. Where applicable, equipment items shall carry the SABS mark to demonstrate compliance with the regulations.

3.0 SERVICE CONDITIONS

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

3.1.1 Ambient/Environment Conditions :

3.1.1.1	Altitude	:	Sea level.
3.1.1.2	Ambient temperature	:	-5° C to +45° C (daily average +35° C).
3.1.1.3	Relative humidity	:	As high as 96%
3.1.1.4	Lightning conditions	:	Severe, with a maximum lightning ground flash density (Ng) Refer to SANS 10313, Table C.1 for specific Ng values
3.1.1.5	Exposure conditions	:	Salt laden, industrial atmosphere as well as hazardous gases and dust atmosphere.

3.1.1.6 Electrolytic corrosion conditions prevail in all the areas owing to the proximity of direct current traction system and cathodic protection schemes.

4.0 EQUIPMENT AND MATERIALS

4.1 Equipment and materials to be used, shall be of high quality, and shall comply with all relevant specifications, codes as mentioned in this specification as well as the Occupational Health and Safety Act of 1993(Act 85 of 1993).

4.2 Where equipment and material does not comply with the relevant specifications it shall be submitted to Transnet National Ports Authority's Engineer for approval.

4.3 All materials used for the lightning protection system shall withstand the electric and electromagnetic

effects of lightning current and predictable stresses without being damaged.

4.4 Materials and sizes shall be chosen bearing in mind the possibility of corrosion of either the lightning protection system or the structure to be protected.

4.5 Components of the lightning protection system may be manufactured from the materials listed in SANS 10313, provided they have sufficient electrical conductivity and corrosion resistance

5.0 LIGHTNING PROTECTION REQUIREMENTS

5.1 The contractor shall carry out the installation in accordance with SANS 10313: Code of Practice for the protection of structures against lightning and the requirements of this specification.

5.2 Where the local supply authority requirements differ from those specified herein Transnet National Ports Authority's Electrical Engineer shall be approached for a decision.

5.3 All equipment and material shall comply with the relevant National or International standard specification. Where equipment does not comply it shall be submitted to the Transnet National Ports Authority Electrical Engineer for approval.

5.4 The system of protection will be finials/air terminals, down conductors and earth spike or roof conductors, down conductors and earth spike.

5.5 The earth resistance for separate earth electrodes if down conductors are not connected to a ring earth shall be not exceed the following;

Rt = 10 Ohm for category A structures
Rt = 15 Ohm for category B and C structures.

6.0 DESIGN OF LIGHTNING PROTECTION

The designer of lightning protection shall take into consideration the following principles and requirements during the design of the system.

6.1 GENERAL PRINCIPLES

6.1.1 **Basic Principles of Lightning Protection:** the requirements of the basic principles of lightning protection as detailed in SANS 10313 shall be taken into consideration to ensure proper protection of structures against lightning.

6.1.2 **Evaluation of Risk:** The risk of lightning stroke shall be evaluated as described in SANS: IEC 62305-2, and the lightning protection system shall be designed to ensure that the loss or injury to human and loss of service to public is below minimum allowable values specified in SANS: IEC 62305-2.

6.1.3 **Effective height of a structure (He):** The effective height of the highest point shall be determined by considering the average height of building, trees and structures and land profile of the surrounding area.

6.1.4 **Ground flash density (Ng):** The ground flash density (Ng) for general buildings, structures and installations shall be estimated from the average ground flash density given in table C.1 of SANS 10313 as a general guide. For important structures and installations the value of the ground flash density shall be determined on the basis of at least 5 lightning years, or from existing records

6.1.5 **Number of flashes to structure per 100 year (Nt):** The number of flashes to structures per 100 year shall be determined taking into consideration type and the height of the structure as described in SANS 10313.

6.2 HAZARD CATEGORY

6.2.1 Buildings and structures where lightning protection system will be installed shall be categorised prior to the installation. Hazard categories are based on the nature of the building, its content and occupancy.

6.2.2 The Hazard categories are classified for the protection of buildings structures against lightning. This classification is dependent on location of the structure to be protected, the classifications are categorised as below;

Category A: High Hazard

Category A1: Structures and areas containing explosives of Category Z.

Category A2: Structures and areas classified as

a) Division 0 areas in accordance with SANS 10089: Part II, or
b) Class I, Division 0 locations in accordance with SANS 10108-2.

Category A3: Strategic control and communications installations such as airport towers

Category A4: Thatched-roof structures of historic values or that contain irreplaceable works of art or like values.

Category B: Medium Hazard

Category B1: Structures and areas containing explosives of Category X or Y.

Category B2: Structures and areas classified as
a) Division 1 or 2 areas in accordance with SANS 10089, Part II, or
b) Class I, Division 1 or 2 locations, or Class II, Division 1 location in accordance with SANS 10108.

Category B3: All structures not included in Category A and to which the public normally has access or which are of historic value.

Category B4: Large temporary structures used for exhibitions and entertainment.

Category B5: Thatched roof dwelling houses.

Category B6: Communications towers, water towers and reservoirs.

Category B7: Caravans and Yachts.

Category B8: Buildings and areas used for livestock, fuel or flammable material.

Category C: Low Hazard

Category C1: Small buildings that are infrequently occupied.

Category C2: Dwelling houses other than thatched-roof houses.

Category C3: Farm buildings, other than those included in category B8.

6.3 ZONES PROTECTION AND SHIELDING ANGLES

6.3.1 The zone of protection shall be the area covered by either one of the following types of protection:

a) Single Vertical air terminal
b) Single horizontal air terminals
c) Area between two or more air terminals
d) Area between roof conductors.

6.3.2 The shielding angles Þ and ß are given in SABS 10313, Code of practice for the protection of buildings and structures against lightning.

6.3.3 The zone protection for Shielding Angles on Steep Slopes and High Ridges is not considered effective beyond a horizontal distance from the nearest air terminal of greater than 2He, where He is the effective height of the part of the air terminal above its immediate surroundings.

6.3.4 In roof areas away from the edges of tall structures (generally of He > 50m), shielding angles given in SANS 10313 can be used appropriate to hazard category of the roof area so protected and the effective height He of the air terminal above the roof area.

6.4 SELECTION OF AIR TERMINAL

6.4.1 Mast Protection: An air terminal consisting of one or more masts that cover the structure or area to be protected with the appropriate shielding angle will, with the possible exception of a few weak lightning strokes, successfully intercept lightning strokes.

6.4.2 Air Terminals as Part of the Structure: An air terminal as part of the structure may be one or more of the following:

a) A continuous metal roof.
b) A metal roof structure supporting a metal roof
c) The metal reinforcement in the roof of a reinforced concrete structure with peripheral conductors and finials where necessary.

d) Roof conductors and finials, where necessary, on a non-conducting roof.
e) Finials in chimney, gable ends, parapet walls, etc.

6.4.3 Air Terminal Systems For Category A Hazards: The protection is based on the principle that a primary air terminal system must be provided for the interception of major lightning strokes with, if necessary a secondary air terminal system for the interception of those weak lightning strokes that might penetrate the protection of the primary air terminal system. The secondary air terminal system shall not be intended to carry currents of major lightning strokes.

One of the following lightning protection systems shall be used as detailed in SANS 10313.

- Mast protection used as a primary air terminal
- Metal roof used as primary air terminal system
- Reinforced concrete structure used as primary air terminal system.

6.5 MASTS AND CATENARY CONDUCTORS OVER THE STRUCTURE TO BE PROTECTED

6.5.1 GENERAL

6.5.1.1 A lighting protection system consisting of free standing masts separate from the structure provides the highest degree of protection, subject to the correct positioning of the mast and to the correct choice of shielding angle.

6.5.1.2 The number and height of masts (and, where necessary, the provision of the catenary conductors between the masts) shall be based on cost, aesthetics, shielding angles and mechanical consideration

6.5.2 CLEARENCE FROM STRUCTURES

6.5.2.1 A safe clearance distance shall be kept between the mast and the catenary conductor strung between the masts and the structure to be protected by the mast or the catenary conductor. The clearance distance depends to various factors detailed in SANS 10313.

6.5.2.2 Where a common earth electrode is provided for mast and structures in close proximity, the following clearance distance “d” shall be maintained with a minimum of 100 m.

a) Between the mast and any point of structure: d ≥ 0,06.h m.
b) Between the catenary conductor and any part of the upper surface of the structure: d ≥ 0,1. (L/2) m for Category A hazard, and d ≥ 0,06. (L/2) m for Category B and C hazards.
c) Between a network of conductors and any part of the upper surface of the structure:
d ≥ 0,1.(D + (L – D)/N) m for Category A hazard, and
d ≥ 0,06. (D + (L – D) / n) m for Category B and C hazards.

Where L = length of path measured from the base of one mast along the catenary conductor to the base of the other mast between which the catenary conductor is suspended, m.
D = spacing between the mesh of the network measured along the catenary conductor, m
h = height of structure, m
n = number of cross bonds between two catenary conductors.

6.5.2.3 Where the earth electrode of a mast is separate from the metal water main, other services or the earth electrode of a structure, the following clearance distance "d" shall be maintained with a minimum of 1.00 m:

a) Between the mast and any point of the structure: d ≥ 0,06.h + 0,1. Rs m.
b) Between a horizontal catenary conductor and any part of the roof of the structure:
d ≥ 0,06.)L/2) + 0,1. Rs m.

Where Rs = numerical value of the earth electrode resistance of the mast or, where masts are connected together by a catenary conductor, of the mast thus connected together, measured in ohms.

6.5.2.4 The minimum clearance distance "d" where the structure has no earth electrode and has limited water or electricity supply, shall be maintained within the following minimum clearance distances:

a) d ≥ 1, 00 m between the mast or catenary conductor and any part of the structure.
b) D ≥ 0,1 Rs m between the mast and any water pipe or electric cable, whether buried or above ground unless the mast electrode is bonded to the metal pipe of the underground water main. If Rs is not known, the clearance distance D must be at least 3m.

6.5.3 MAST PROTECTION IN THATCHED ROOFS

6.5.3.1 Thatched roofs shall be protected by one or more free-standing masts only. The zone of protection of the masts must include gable ends, chimneys, antennas, vent pipes and any other metal objects.

6.5.3.2 Telephone wires, overhead services connections to the electricity supply, or other overhead metal wires or pipes, shall not enter the structure through or close to the thatch.

6.5.3.3 On remote chimneys or gable ends close to imaginary surface of the protection zone, install a finial and down conductor well away from the thatch.

6.5.3.4 Metal wires and metal-coated insulating sheets used in the construction of the thatched roof shall be bonded together and to the earthed metal water main or electrode of the structure.

6.5.3.4 Where metals used in the construction of the roof are not bonded and earthed, a minimum clearance distance c of 1m between metals of the roof and water pipes, vent pipes, tanks, gas pipes, antennas, telephone and bell wires, bugler alarms and electrical wiring and conduits shall be maintained.

7.0 INSTALLATION

7.1 AIR TERMINALS ON THE STRUCTURE TO BE PROTECTED.

7.1.1 The purpose of an air terminal on a structure to be protected shall be to intercept lightning strokes at preferential points of an air terminal, thereby:

a) Minimizing penetration of a lightning discharge current which could have followed a random path in the roof structure with possibility of a resultant fire.
b) Preventing the loosening of masonry or the cracking of precast panels or reinforced concrete.

7.1.2 The selection of the air terminal system and the position of down conductors shall be so selected such that at any likely point of incidence of lightning stroke, there are at least two parallel paths for the current to flow to earth.

7.1.3 Parallel routes shall not be necessary in the following cases.

a) An air terminal on a small structure having only one prominent point of incident.
b) Dead-ended conductors, i.e. those conductors of the air terminal for which it is not feasible to

provide a connection to a down conductor.

7.1.4 Where a peripheral roof conductor is required for the protection of the outer side edge of a structure, the conductor shall be installed as close to the edge as is practicable (preferable not more than 100mm from the outer edge)

7.1.5 Where buttresses or parapet walls are not already equipped with an air terminal in the form of continuous metal cladding or similar metalwork and peripheral conductors are to be provided at an effective height He of 15 m or more, finials shall be added on all exposed outer corners and at intervals not exceeding 30 m between outer corners. The finials shall be placed as close as possible to the outer edge, and so position the down conductors such that their connection to the peripheral conductor is close to the finial.

7.1.6 Concrete masonry chimneys or gables ends that are not protected with the appropriate shielding angle of another structure shall be protected by means of a finial or metal cap. Where the chimney or gable end is of masonry, a peripheral conductor along the gable or around the chimney shall be used instead.

7.1.7 Where it is not feasible to provide a down conductor at one end of an air terminal or a connection to another part of the lightning protection system, a dead ended conductor shall be used provided it is not longer than 10 m an generally flows a horizontal or downward course from the free end to end connected to the remaining part of the lightning protection system.

7.1.8 Where a dead-ended conductor partly flows an upwards course, the dead-ended conductor shall be not longer than 7.5 m. If the top of the protected part is considerably lower than the ridge conductor to which the dead-ended conductor is connected, a finial shall not be used at the free end, unless it is required for the enhancement of the protection of the surrounding area, in which case an additional down conductor at the free end is recommended.

7.1.9 Metal gutters shall be bonded along the outside perimeter of the roof to the nearest down conductor, or to the metal of the roof, where applicable.

7.2 METAL ROOFS AND NON-METAL ROOFS SUPPORTED BY METAL ROOF STRUCTURES

7.2.1 Structures having roofs covered with electrically continuous metal sheets do not require air terminals,

but shall be earthed by down conductors.

7.2.2 Sheet metal separated from each other by insulating strips or by epoxy or plastic coating s, may be regarded as providing continuous metal roof. However where sparking between such roofing is considered undesirable because of magnetic interference, all sheets adjacent to the ridge conductor or peripheral conductor shall be bonded.

7.2.3 A non-metal roof consisting of non-combustible roofing material held by metal fasteners to a roof supporting structure of metal construction may be considered to be a metal if the metal structure is earthed by down conductors, or supported by earthed metal columns, and spacing between roof beams does not exceed 15m for Category B and C hazards.

7.3 REINFORCED CONCRETE STRUCTURES

7.3.1 Reinforced steel shall not be used as parallel paths to enable lightning discharge current to flow safely to general mass of the earth.

7.3.2 Air terminals or finials and where necessary peripheral conductors shall be installed, taking into consideration the likely points of incidence of lightning and the path of the current through internal down conductors.

7.3.3 Where the outer support columns of the structure may be regarded as continuous from roof to basement, the peripheral and air terminal conductors shall be bonded to the internal or external down conductors.

7.3.4 Peripheral conductors and finials shall be used for medium height structures with reinforced concrete. Where the peripheral conductor is on a parapet wall that surrounds a metal roof or the air terminals of other structures, the other air terminal shall be connected to the peripheral conductor, preferably close to a down conductor. The peripheral conductor and other air terminal shall be connected to internal or external down conductor.

7.3.5 If the upper edge of the structure with chimneys and cooling towers and of medium height is not metal clad, horizontal conductors around the upper circumference of the structure, equipped with finials at intervals of not more than 15 m, with a minimum of two shall be installed.

7.3.6 On tall reinforced concrete structures, one of the following shall be installed in order to increase the protective efficiency, depending on the risk and the degree of protection required, height and slenderness of the structure:

a) At intervals of not more than 10 m, install oblique finials along the upper perimeter, pointing upwards and outwards such that the tip of each finial points outwards at an angle of 30° to the vertical through the outer edge of the structure, and is at least 400mm above the structure, each finial being connected to a peripheral conductor.
b) A horizontal conductor that follows the contour of the structure and that is so raised on oblique struts of length at least 500 mm that the conductor is displaced outwards at an angle of 30° to the vertical through the outer edge of the structure.
c) Oblique finials spaced as in (a) above, positioned on a horizontal conductor arranged as in (b) above and in line with the oblique struts, each finial pointing upwards and outwards at an angle of 30 to the vertical through the outer edge of the structure, and of length such that the tip of the finial is at least 800 mm above the outer edge of the structure.

Where the structure is slender, an air terminal as in (b) or (c) above is to be preferred to that in (a)

The air terminal shall be bonded to the internal down conductor at intervals not exceeding 10m, or where the circumference exceeds 60 m, at appropriate intervals not exceeding 30m with a minimum of six bonds.

7.4 FINIALS AND ROOF CONDUCTORS

7.4.1 Roof conductors and finials shall be installed along the ridges of the roof and on other projections, in accordance to SANS10313 – code of practice for the protection of structures against lightning.

7.4.2 Protruding metal objects shall be bonded in a horizontal or in a downwards direction to the nearest roof or down conductor where the distance between the metal object and the conductor is less than 7.5m otherwise provide a separate down conductor. In all cases where the pitch of the roof is less than 30°, metal gutters and roof conductors shall be bonded or eaves conductors shall be provided.

7.4.3 In the case of large roofs of non-conducting material, additional conductors shall be installed across the surface of the roof, perpendicular to the long side of the roof and at extremely equal spaces not

exceeding 15m. If the width of the roof exceeds 15m install conductors to form a grid at approximately equal spacing not exceeding 15m in either direction.

7.4.4 Roof conductors, finials and roof conductor grids shall be connected to the closest down conductor.

7.5.5 All roof conductors shall be manufactured from SABS approved single-core bare aluminium conductor with a minimum cross sectional area of 25mm^2.

7.5 DOWN CONDUCTORS

7.5.1 Down conductors shall be installed close to the point of the air terminal that are most likely to be struck by lightning and preferably run them vertically along the most direct route to the earth electrode.

7.5.2 At least two down conductors shall be provided in a building, such that in plan view no point of a structure is more than 15m from the nearest down conductor , except for masts and small structures having only one prominent point of incident, such as rondavels, these need only one down conductor.

7.5.3 Each down conductor shall be supplies with a separate earth electrode. This will reduce the current flow per down conductor, resulting in a lower voltage drop across the down conductor caused by the surge impedance of the conductor.

7.5.4 Down conductors shall not be placed close to doorways or entrances to buildings. Maintain a minimum clearance distance of the order of 1 m from the door and window frames, balustrades and other large metal objects.

7.5.5 Where down conductors deviate from a vertical route due to sharp bends and loops required to carry a conductor over eaves and parapet walls, shall be permitted, provided that all requirements stated in SANS 10313, are met.

7.5.6 Steel columns and internal metal storm water drain-pipes shall be used as down conductors only if they are joined by screwing, bolting or welding.

7.5.7 External metal stair cases, fire escapes or other large frames shall be used as down conductors if they are electrically continuous over their full height. If not electrically continuous they shall be bonded to the

lightning protection system at the top or at the bottom of the framework.

7.5.8 In the case of structures of Hazard Category A, Test joints shall be installed in down conductors at convenient heights above finished ground level.

7.5.9 Internal reinforcing steel of vertical concrete column, particularly those on the outer corners can be used as down conductors, provided that the reinforcement is electrically continuous.

7.5.10 Vertically discontinuous reinforcement shall be bonded between the reinforcement of each section to provide a continuous path to ground or an external down conductor shall be installed.

7.5.11 Large external metal frames, balconies and metal cladding on the top floors of tail structures (typically 30 floors or more) that may be exposed to direct lightning strokes must be bonded to the reinforcement of the structure or to a down conductor that is connected to the reinforcement of the roof.

8.0 STATUTORY REQUIREMENTS

8.1 The Contractor shall ensure that the installation satisfies the requirements of all relevant South African Statutory Regulations

8.2 Where applicable, equipment items shall carry the SABS mark to demonstrate compliance with the regulations.

9.0 RESPONSIBILITY FOR WORK

9.1 The tenderer shall be responsible for the complete installation of the lightning protection system including testing, earthing conductors, surge protection devices, spikes etc. as required for various buildings and structures. These installations shall include the review and the upgrading of the existing lightning protection systems. Due considerations shall be taken of the effects of lightning covered herein below in clause 8, in providing the lightning protection system.

9.2 The tenderer shall undertake to repair all faults due to bad workmanship and/or the use of faulty materials and to replace all defective materials within six months after the installation date.

9.3 The tenderer shall rectify all the defects to the satisfaction of Transnet National Ports Authority that may become apparent during the guarantee period.

9.4 The tenderer may be required to carry out builders work such as cutting of concrete columns and coring of holes for testing of the continuity of the existing steelwork or cabling. Good contact between reinforcing bars should be ensured.

10 APPLICABLE INFORMATION

10.1 **Electrical effect** – The current discharged through the earth electrode resistance produces a resistive volt drop which may raise the potential of the system to a high value relative to true earth.

10.2 **Side-flashing** – The point of strike may be raised to a high potential, and there is a risk of flashover from the protection system to any metal or in the structure.

10.3 **Thermal effect** – The thermal effect of a lightning discharge is confined to the temperature rise of the conductor through which the current passes.

10.4 **Mechanical effect** – When a high current is discharged along parallel conductors in close proximity or along a single conductor with sharp bends, a different mechanical effect is exerted by a lightning flash. This is due to a sudden rise of 30 000K in air temperature and the resulting explosive expansion of the adjacent air in the channel along which the charge is propagated.

11.0 PROTECTION AGAINST CORROSION

11.1 The tenderer shall ensure that atmospheric, chemical and or electrolytic corrosion of copper and other metals is prevented from occurring when used for the lightning protection system.

11.2 The contact surfaces of dissimilar metals shall be kept completely dry and protected against ingress of moisture to prevent the acceleration of electrolytic corrosion.

11.3 Although copper is highly resistant to many types of chemical attack, lead coating shall be recommended wherever subjected to severe corrosion due to presence of sulphur compounds.

11.4 Stainless steel material of similar grading shall not be used unless prior approval is obtained.

12.0 TECHNICAL REQUIREMENTS

12.2.1 General

a) A common integrated station earthing system shall be provided for electronic and electrical systems equipment, static and lightning protection in accordance with the requirements of this document.

b) A soil resistively survey shall be carried out by a specialist earthing consultant/contractor. The consultant/contractor shall prepare a detailed report on the conditions identified and provide the survey data recordings together with proposals, for a basis of the earthing system design.

c) Major electrical equipment such as switchgear, transformers, lighting boards, floodlight towers on poles, control panels etc. and associated metallic support frameworks, shall be connected to the station safety earth via Electrical Earth bars located nearby.

Use of embedded conductors within a power cable (spare core earth) may be utilised as the primary equipotential bonding system provided the following conditions are met: (SANS 10086-1:2001)

The embedded conductor has a cross-sectional area equal to those of the live and neutral conductors.

In addition, a second visual earth connection shall be provided to each item of electrical equipment, to prevent the potential to earth of such equipment rising above spark potential. (SANS 10089-2:2002)

d) The neutrals of generators and transformers shall be connected to the main earth grid either directly or via an earthing resistor, as required. Where neutrals of transformers are connected directly to earth, this shall be done via means of connections to both an individual earth rod located nearby as well as to the station earth mat by means of Electrical Earth bar located within the Switchgear Room.

e) Frames of motors shall be connected to the earthing system in accordance with the following table:

Motors kW Rating	Minimum Earth Conductor Size
Up to 30	16 mm^2
37 – 132	50 mm^2
150 – 175	70mm^2

Note:
In order to minimize the number of different sizes of earth conductor, the above three sizes only shall be used throughout, unless specifically stated otherwise.

f) Cables supplying lighting fixtures shall be 3 core for single-phase supplies and 5 core for 3 phase supplies, of which one core shall be used as the earth conductor.

g) Plant Infrastructure such as manifold piping, tanks and metallic support frameworks, shall be connected to the station safety earth, either directly or by means of Electrical earth bars located nearby.

h) Flanged joints in metallic pipelines shall be considered inherently continuous provided the surfaces of one of the bolts are cleaned and identified for earthing. Flanges of metallic pipelines that have insulated linings for purposes other than cathodic protection shall be bonded to ensure electrical continuity.

Pipelines shall only be connected to the earthing system where they enter and leave the battery limits.

i) Storage tanks that are not cathodically protected shall be earthed through at least two separate connections to the tank. Tanks shall be earthed in accordance with the relevant SANS code.

Electrically continuous structural steel columns may be used as down conductors by means of which elevated tanks, vessels, etc. shall be deemed to be connected to the earthing system.

All tank covers, gauge floats and stirrers etc. as well as all pipes entering the tanks shall be earthed.

The steel roof shall be in a direct electrical contact with, or bonded to the tank shell.

Earthed grids, gauges, gratings and the like placed in or across the inlets of tanks are not to be used as a means of static discharge. Individual bonding shall be made to the earthing system.

j) Cable trays and cable racks shall have continuous earth continuity. This shall be ensured by installing 10mm^2 earth straps across the racking fishplates (joints). Cable Trays shall be connected to the earthing system in two places - where they enter and leave the battery limits.

k) Earthing connections to all equipment and process plant shall comprise of welded earth bosses in compliance with SANS 10089 Part II regulation 5.1.4K with properly provided terminations i.e. 10mm diameter earth studs. Anchor bolts shall not be used.

Earth connections to all equipment shall be effectively bolted, using crimped lugs.
All cable connections shall be fitted with a “star” or serrated washer in addition to the back nut, to ensure good earth contact.

l) All earthing connections between the station earth system and respective earth bars/lightning protection systems shall where possible be made above ground, by means of bolts, crimped lugs and PVC taped.

All cable connections shall be fitted with a “star” or serrated washer in addition to the back nut, to ensure good earth contact.

Earth connection points shall be clearly labelled.

In cases where earth connection points are required to be made underground (e.g. to earth rods), inspection wells shall be provided comprising of pre-cast concrete/PVC surrounds complete with covers, to facilitate periodic inspection.

m) Earthing conductors rising through paving or other concrete work shall be run in suitable protective sleeves which shall project above finished level.

n) Earthing and bonding conductors shall be sized and installed in compliance with regulations detailed in the current SAIEE Standard Regulations for the Wiring of Premises and in SANS 10142 1&2 as applicable.

o) Extendable earthing rods shall be manufactured from stainless / copper clad / galvanized steel (dependant on soil acidity and chlorides and existence of cathodic protection systems) 16mm diameter, 1200 mm long sections, and shall have molecular bond between the two metals to prevent moisture ingress. Where it is necessary to join earth rods together, a non-ferrous corrosion resistant coupling device shall be used which shall prevent the ingress of moisture into the joint.

p) Lightning and static earthing protection shall be provided for all tall steel, masonry and concrete structures, towers, vessels, tanks etc, as well as all buildings used to house sensitive electrical/electronic equipment. Lightning protection systems shall be connected both to individual earth rods as well as bonded to the station earth mat. Where possible, the mesh method (as defined in SANS 10313) should be utilised in the protection of buildings against lightning strikes i.e. the use of masts and catenary conductors are to be avoided.

Tall steel structures such as towers or structure columns, provided they are electrical continuous, shall be considered inherently protected against lightning by their connection to the earth.

q) **The resistance of the common earthing system to the general mass of earth shall not exceed 1 Ohm.**

r) Where a separate system is installed for other than electrical equipment in remote locations, e.g. storage tanks; its resistance to the general mass of earth shall not exceed 7 Ohms. (Note: This applies only for Lightning Protection and remote valve chambers that are not connected to the Station Earth).

12.2.2 Station Safety Earth

In cases where a new Station Safety Earth Mat is required to be provided, the following specifications shall apply:

The **Earth Mat** shall consist of a completely buried, lattice network of 40x3mm, bare copper tape. All the crossover points of the lattice shall be braised or cad welded and protected with PVC insulation tape. Buried joints or splices shall not be clamped or bolted. The earth mat shall be buried, 1000mm minimum, below finished grade.

The interconnecting conductors shall be radially interconnected to form a common earthing system, for all electrical equipment, lightning protection and static earthing in accordance with relevant SANS requirements.

If required, additional earth electrodes may be installed to achieve the specified resistance, of the common earthing system to the general mass of earth. Where earth rods are paralleled in a group to reduce the earth resistance to the permissible value, they shall be spaced apart for a distance at least equal to their buried depth length.

12.3 Switchgear Room Building and Equipment

12.3.1 A Main Safety/Electrical Earth Bar comprising of a copper bar, 50mm x 5mm min shall be installed in the basement/false floor of the Switchgear Room. Where possible, this Earth Bar shall be designated as the Primary Test Point for the station earthing system with the following equipment directly connected:

- **Station Earth Mat**. Where possible, a minimum of four separate connections shall be taken into the Switchgear Room via separate routes from the Earth Mat, by means of 40mm x 3mm Cu Earth tape. Connection to the Main Safety Earth bar shall be made in two places by means of 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductor, to facilitate testing of the Earth System.
- **Transformers**. By means of 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductor

- **MV/LV Panels**. By means of dual 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductors
- **Generator**. By means of 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductor
- **Instrument Earth**. By means of dual 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductors
- **Manifold Earth**. By means of dual 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductors

Note that on existing sites, the earth mat has been connected to the station earthing system in multiple places (namely; the Switchgear Room, Control Room and Manifold), and thus designation of a single Primary Test point is not possible. Multiple test points have thus been defined as follows: Switchgear Room, Control Room and Manifold Mainline Pumps 1 & 4 (where possible).

12.3.2 All secondary earthing within the substation shall be attached to this station earth bar at appropriate demarcated points.

12.4 Control Room Building and Equipment

12.4.1 A secondary Safety/Electrical Earth Bar comprising of a copper bar, 50mm x 5mm min shall be installed in the basement/false floor of the Equipment/Control Room in an easily accessible position. Where possible, this Earth Bar shall be directly connected to the Main Safety/Electrical Earth bar located in the Switchgear Room, by means of dual 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductors.

Note that all marshalling and equipment panels shall have an electrical earth bar, separate from an insulated instrument earth bar, installed and to which all electrical equipment earths shall be connected.

12.4.2 An Instrument Earth Bar comprising of a copper bar, 50mm x 5mm min shall be installed in the basement/false floor of the Equipment/Control Room in an easily accessible position. Where possible, this Earth Bar shall be directly connected to the Main Safety Earth bar located in the Switchgear Room, by means of dual 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductors.

Note that all marshalling and equipment panels shall have an insulated instrument earth bar, separate from the electrical earth bar, installed and to which all clean/instrument earths shall be connected.

12.4.3 Instrument and Electrical Earth systems shall be clearly labelled.

12.5 Manifold Area and Equipment

12.5.1 All manifolds shall have an insulated manifold earthing system installed, comprising of the following specifications:

- 40mm x 3mm min flat copper tape, to run the entire length of the main electrical racking reticulation and supported off of insulators at distances of no more than 2m apart. Use of existing electrical racking reticulation supports shall be permitted. All joints will require to be braised. Earthing reticulation shall be installed in such a manner so as to be unobtrusive and yet accessible and shall be positioned so as to avoid obstruction to walkways and access routes.
- The Manifold Earth bar shall be connected to the main safety/electrical earth located in the Switchgear Room, by means of dual 70mm^2, 600-volt class, green coloured, PVC insulated, stranded copper conductors.

Note that on existing sites, the earth mat has been connected to the earthing system in multiple places (namely; the Switchgear Room, Control Room and Manifold), and thus designation of a single Primary Test point is not possible. Secondary test points have thus been defined where possible as follows: Switchgear Room, Control Room and Manifold Mainline Pumps 1 & 4.

12.4.2 All process plant and equipment located within the manifold area shall be attached to this manifold earth bar at appropriate demarcated points, via appropriately sized insulated PVC copper cable (green/yellow colored insulation), as follows:

- All electrical equipment shall be earthed via two separate earths, namely via the power cable earth core back to the respective Starter Panel electrical earth bar, and secondly via a separate visual earth from the motor frame to the manifold earth bar. Use of cable armouring as an earth conductor is not acceptable.

- All instrument stands and field junction boxes shall be separately earthed via means of an insulated 16mm2 min PVC copper cabling.

- All process vessels (tanks, vessels and piping) and racking reticulation shall be earthed via insulated 70mm2 min PVC copper cabling in two separate places.

All earth conductors utilized shall comprise of stranded, PVC insulated copper conductors with crimped cable lugs. All connections shall be fitted with a “star” or serrated washer in addition to the back nut, to ensure good earth contact.

12.6 Earth System Identification Standards

12.6.1 Earth Bar Labels

Earth bars shall be clearly labelled according to their functionality (e.g. “EB xx” to denote an electrical earth bar, “IB xx” to denote an instrument earth bar, where xx denotes a unique consecutive number). The Functional Identifier “EB 00” shall always denote the Station Earth Mat.

In addition, earth bars designated as Test Points shall be labelled accordingly.

Labels shall comprise of equal or similar approved to Traffolyte engraved type, and fixed by means of stainless steel screws. Finish shall comprise of black letters against a white background, with text 40mm height.

Labels shall be readable/visible after the wiring has been done.

12.6.2 Earth cable Identification

Earth cables may be divided into two types, namely primary earth cabling running from subsystem earth bars directly or indirectly to the main station earth (and used for testing purposes), and secondary earth cabling running between the subsystem earth bars and equipment or infrastructure.

Only Primary earth cabling (i.e. those used for testing purposes) is required to be identified, by means of a Functional Identifier denoting both source and destination earth bars.

Identification numbers will comprise of the following specification:

- Equal or similar approved to Grafoplast Targa Metal TGT System (Carrier Rail 58mm in length) 316 Stainless Steel Markers, with punched text 6 mm height minimum, fastened onto the cable at both ends via means of Stainless Steel cable ties

Examples:

EB01 – EB00 Cable Identifier for Earth cable running between Electrical Earth bar EB01 and the Station Earth Mat

IB01 – EB00 Cable Identifier for Earth cable running between Instrument Earth bar IB01 and the Station Earth Mat

12.7 Testing

12.7.1 Earth Resistivity and Electrode Testing

It will be the Contractors responsibility to carry out all necessary earth resistivity tests on site, where applicable. Tests will be in accordance with the requirements of SANS.10199.

After all earth electrodes/trench earth's have been installed, an earth megger shall be used to test the earth resistance at the earth bar or connection point to the main station earth and the results recorded. Note that all ECC connections, and any other bonding material shall be disconnected from the earth connection point whilst the earth is being tested.

Earth Continuity Testing.

Earth continuity readings shall be measured and recorded from the earth bar to each item of equipment and process plant, and shall include all piping, vessels, transformers, motors, actuators, switchgear cabinets, marshalling enclosures and instrumentation.

12.7.2 The following are the maximum acceptable earth electrode resistances:

Electrical Earth

a) Main substation - <1 ohm
b) Miniature substations and kiosks - 1 ohms
c) Highmasts - 5 ohms.

Instrument Earth
a) Instrument Earth - < 1 ohm

13.0 INSPECTION AND GUARANTEE

13.1 Transnet National Ports Authority reserves the right to inspect the installation and the equipment to be used.

13.2 All lightning protection systems shall be inspected and certified by an accredited person after completion of the installation, to verify conformance as required by Code of Practice, SANS 10313.

13.3 All components of the lightning protection system shall be inspected to ensure that they are in good condition and are capable of performing their designed functions.

13.4 The tenderer shall ensure that all elements of the electrical installation have been incorporated into the protected space by bonding or extensions to the lightning protection system.

13.5 The mechanical condition of all conductors, bonds, joints and earth electrodes shall be checked and the observations noted.

13.6 The tenderer shall undertake to repair and replace all faults and faulty materials due to bad workmanship during a period of six months.

13.8 The tenderer shall be required to guarantee the installation for a period of twelve (12) months.

SIGNATURE OF TENDERER: ----------
DATE: ----------
TRANSNET NATIONAL PORTS AUTHORITY

ANNEXURE 1

STATEMENT OF COMPLIANCE
(TO BE COMPLETED BY TENDERER)

This tender complies with specification TPD: 004-EARTHINGSPEC in all respects.

SIGNATURE : _____ DATE : _____

This tender complies generally with specification TPD: 004-EARTHINGSPEC, but differs from it on the following points.

_____

_____

_____

_____

_____

_____

SIGNATURE : _____ DATE : _____

Transnet National Ports Authority

SPECIFICATION FOR PAINTING OF LIGHTING MASTS AND POLES

REVISIONS		
REV	**DATE**	**APPROVED**
00	**September 2023**	**S.Sewdayal**

INTRODUCTION

This specification covers the painting of lighting masts and poles

INDEX

1.0 SCOPE

1.1 This specification covers Transnet National Ports Authority's (TNPA) requirements for the painting of lighting masts and poles.

2.0 REFERENCES

2.1 The following publications and drawing (latest editions and amendments) are referred to herein.

2.1.1 South African Bureau of Standards

SANS 064	- The preparation of steel surfaces for coating
SANS 1091	- National Colour Standard

2.1.2 British Standards Institution

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

3.0 SERVICE CONDITIONS

5.1 The lighting may be installed in areas where high humidity, high temperature, high wind, heavy rain, severe hail and high incidence of lightning are encountered and where corrosive conditions including the presence of sulphur dioxide, prevail.

5.1.1 Equipment installed shall be suitable for efficient operation under these conditions.

4.0 STANDARD OF WORK, EQUIPMENT AND MATERIALS

4.1 All work shall be carried out in a neat and orderly manner to the satisfaction of Transnet National Ports Authority, and all equipment shall be easily accessible for maintenance purposes. Electrical work shall conform to the requirements of SANS 10142 and those laid down in this specification.

4.2 Equipment and materials used, shall be of high quality design and manufacture, and shall comply with the relevant specifications and recommendations mentioned in this specification.

4.2.1 Where equipment and material does not comply with the relevant specifications it shall be submitted to Transnet National Ports Authority's Technical Officer for approval.

4.3 Every reasonable precaution and provision shall be incorporated in the design of the equipment for the safety and security of the system and of those concerned with its operation and maintenance.

5.0 PAINT SPECIFICATIONS

5.1 Paint colours shall be in accordance with SANS 1091.

5.2 The primer coating shall be equal or similar to Plascon “Plascoguard Gehophon” GW 5, Dulux “Sigmacover”’ or Chemrite Coatings “Carboline 193 HB”.

5.3 The two coats covering the primer surface shall be equal or similar to Plascon “Plascon Poly-urethane Recoatable Enamel” CPC series; Product data sheet U-8B, Dulux “Sigmadur Gloss HB”, or Chemrite Coatings” Caroboline 133 HB”. Colours shall be as specified in clause 1.8.

5.4 All paints shall be stirred and mixed to a homogeneous condition incorporation the whole contents of the paint container. Mixed paint shall be kept mixed and in good condition throughout, stirring when necessary to keep the pigment in suspension. Thinning shall only be undertaken in accordance with manufacturer’s recommendations and directions. Partially used containers shall be resealed to prevent evaporation of solvent.

6.0 PREPARATION OF SURFACES

6.1 The preparation and painting of masts and poles shall comply with SANS 064 and BS 5493 respectively.

6.2 Galvanised surfaces shall be scrubbed with steel wool soaked in a cleaning solution to remove the protective film against formation of white rust and all other foreign matter and also to provide a key for adhesion of the primer. Protective clothing, gloves and masks must be used by workers during this cleaning process. Rinse the cleaned surface copiously with water.

6.3 All painted surfaces, prior to application of the following coat, shall be sound, dry and free from oil, grease and other contamination. Any unsound paint to be removed completely, the surface prepared as in clause 1.5 above and repainted coat for coat as specified below.

7.0 PAINT APPLICATION

7.1 After preparation of the galvanised surfaces apply one coat of primer by spraying to give a dry film thickness of 80 microns to all surfaces with the exception of the mast or pole interior which need not be painted. Allow to dry for a minimum period of 4 hours before overcoating.

7.2 The primed surface shall then be painted in accordance with clause 1.7. One coat of colour G12 (Dark Admiralty Grey), by suitable airless spray equipment to give a dry film thickness of 75 – 100 microns for this coat. An overall final coat colour H30 (French Grey), to give a dry film thickness of 25 – 35 microns shall be applied. The total dry film thickness of the primer and two successive coats shall be between 180 – 215 microns.

7.3 Paints shall be applied under suitable conditions of light, temperature, humidity and

ventilation. At time of overcoating, the painted surface shall be clean, dry, sound and free of misses and defective paint. Each coat of paint shall be applied as a continuous, even film of uniform thickness.

7.4 Painted steel shall not be handled until the paint has dried except where necessary in turning for painting of stacking for drying. Paint damaged in handling shall be scraped off and touched up by replacing each coat of paint scraped off. Painted steel shall not be transported or packed for transport until paint is dry.

8.0 LOADING AND OFFLOADING OF MASTS AND POLES

8.1 When loading at the manufacturer's premises and when off-loading at the erection site, components shall be handled with hessian covered slings in order to cause minimum damage to paintwork. During transportation, the components shall be placed on wooden dunning and securely fastened to prevent sliding and other movement.

8.2 Prior to erection of masts or poles, damaged areas of paint shall be repaired by spot cleaning in a manner that will minimise damage to sound paint. Bared areas shall be spot primed and spot painted with the materials specified, to restore all coats.

8.3 During erection, mast or poles shall be handled with hessian covered slings to minimise damage to paintwork. After erection, paintwork shall be repaired in the manner described above.

SPECIFICATION FOR THE SUPPLY OF LUMINAIRES FOR LIGHTING OF YARD AND HIGHMAST LIGHTING

REVISIONS		
REV	**DATE**	**APPROVED**
00	**September 2023**	**S.Sewdayal**

INTRODUCTION

This specification covers the supply of luminaires for lighting of yard and highmast lighting

INDEX

1.0 SCOPE

This specification covers Transnet National Ports Authority's (TNPA) requirements for the supply of LED floodlight luminaires.

2.0 REFERENCES

2.1 The following standards, publications, and books (latest editions and amendments) are referred to herein:

2.1.1 South African Bureau of Standards

SATS 17576:	Light-emitting diode products for interior lighting, streetlighting and floodlighting Performance requirements
SANS 121:	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.
SANS 475:	Luminaires for interior lighting, street lighting and floodlighting - Performance requirements
SANS 529:	Heat-resisting wiring cables
SANS 1088:	Luminaire entries and spigots
SANS 1507:	Electric cables with extruded solid dielectric insulation for fixed installations (300/500V to 1900/3300V) Part 3: PVC Distribution cables
SANS 1574:	Electric flexible cores, cords and cables with solid extruded dielectric insulation Part 3: PVC-insulated cores and cables
SANS 60529:	Degrees of protection provided by enclosures (IP Code)
SANS 60598-1:	Luminaires - Part 1: General requirements and tests
SANS 60598-2-5:	Luminaires Part 2-5: Particular requirements – Floodlights
SANS 61000-1-2:	Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena
SANS 61000-3-2:	Electromagnetic compatibility (EMC) Part 3-2: Limits — Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
SANS 9000:	Quality management systems – Fundamentals and Vocabulary

2.1.2 International Standards

CIE 121:	The photometry and gonio-photometry of luminaires.
IES LM-80-08:	Approved method: Measuring lumen maintenance of LED light sources.
IES TM-21-11:	Projecting long-term lumen maintenance of LED light sources.

2.1.3 Books

Mottier, P. (2010). *LED for Lighting Applications*. 2nd ed. Toronto Singapore: John Wiley & Sons, p.section 1. 2009

3.0 ANNEXURES

3.1 The following appendices form an integral part of this specification and shall be read in conjunction with it:

Annexure 1 - "Statement of Compliance"

This annexure shall be completed by all tenderers and signed. Where tenderers do not fully comply, all deviations shall be clearly indicated in the space provided. Failure to complete the statement of compliance will result in tenders being excluded.

4.0 SERVICE CONDITIONS

4.1 The lighting may be installed in areas where high humidity, high temperature, high wind, heavy rain, severe hail and high incidence of lightning are encountered and where corrosive conditions including the presence of sulphur dioxide, prevail.

4.1.1 Equipment installed shall be suitable for efficient operation under these conditions.

5.0 STANDARD OF WORK, EQUIPMENT AND MATERIALS

5.1 All work shall be carried out in a neat and orderly manner to the satisfaction of Transnet National Ports Authority, and all equipment shall be easily accessible for maintenance purposes. Electrical work shall conform to the requirements of SANS 10142 and those laid down in this specification.

5.2 Equipment and materials used, shall be of high quality design and manufacture, and shall comply with the relevant specifications and recommendations mentioned in this specification.

5.2.1 Where equipment and material does not comply with the relevant specifications it shall be submitted to Transnet National Ports Authority's Technical Officer for approval.

5.3 Every reasonable precaution and provision shall be incorporated in the design of the equipment for the safety and security of the system and of those concerned with its operation and maintenance.

6.0 LUMINAIRE CONSTRUCTION

6.1 The luminaire shall bear the SANS 60598-2-3 safety mark and shall comply with the specifications as per SABS ARP 035. The luminaire shall also bear the SANS 475 performance mark.

6.2 The luminaire housing shall consist of marine grade aluminium (EN 1706 AC-44300 grade) for the LED light source and LED power supply. A metallurgical (MTR) test report to be provided with the Tender. The housing shall be designed for LED light sources between 50W and 500W. A minimum 10kV/10kA field replaceable surge protection device with an indication LED shall be installed in the 7-pin NEMA socket of the floodlight.

6.3 The luminaire shall be IEC 60598-1 compliant and shall be of the totally enclosure type. Luminaires shall be delivered completely assembled with housing, driver, LED module and protector lens. It shall be designed to operate in an ambient temperature (Ta) environment of up to 25 deg C, without reducing the useful lifetime of 100 000 hrs at a lumen depreciation of not more than 30% (L70)

6.4 The luminaire housing shall be constructed using a hinging action on a spigot base casting.

6.5 The luminaires shall incorporate a marine grade aluminium heat sink for cooling the light source. No fans or liquids shall be used for the cooling of the light source. The design of the external surfaces of the luminaire shall prevent the accumulation of dirt and nesting of insects or ants, thus ensuring continuous effective cooling. Heat from the LED source shall be able to take the shortest path to the exterior by direct conduction that will not compromise the useful life of the LEDs.

6.6 The floodlight shall have cooling fins above the lamp compartment designed in such a manner as to allow maximum heat dissipation.

6.7 The cooling fins shall be designed to prevent the accumulation of dirt, thus ensuring the continuous effective cooling. The cooling rib height to width ratio may not exceed 0.7. Thermal protection shall be incorporated in the luminaire to prevent overheating.

6.8 The junction temperature of the power supply or driver shall follow the mentioned allowable temperature per specific value of the current passing through it.

Table 1: Allowable junction temperature

Junction current	**Allowable junction temperature (°C)**
1.5 A	135
1 A	150
700 mA	167
350 mA	185

6.9 The housing shall be secured using stainless steel latches, access screws and luminaire shall be supplied in raw aluminium finish.

6.10 Due attention shall be paid to the accessibility of parts and to other requirements necessary for efficient maintenance and cleaning, where required. If screws are used to secure covers, they shall be held captive when opened.

6.11 External components e.g. toggle clips, bolts, screws, nuts, washers shall be stainless steel grade 304.

6.12 The upgrading and/or service of the LED unit and the driver/power supply shall be possible without removing the whole luminaire but by means of replacing only the optical/gear compartment by means of a hinging mechanism, or other such simple method which does not require tools, to allow possible integration of future technological development of LEDs and power supply.

6.13 The LED's shall be high efficiency (> 122 lumens/watt: Absolute photometry) CRI > 70.

6.14 The luminaires shall be supplied with a NEMA 7pin socket suitable for a tele-

management control system.

7.0 HELICOILS

7.1 Inserted helicoils for the lamp holder housing and the gear compartment shall be used to prevent the corrosion of stainless-steel screws to the aluminium housing.

8.0 LAMP COMPARTMENT

8.1 The luminaires shall have aluminium housings of grade EN1706 AC-44300DF (or higher) aluminium alloy. This shall be substantiated by an independent metallurgical report confirming the grade of aluminium for the luminaires offered.

9.0 POWER SUPPLY

9.1 The power supply or driver compartment shall be so designed that there is sufficient space to permit replacement of components or repairs and reassembly without difficultly and without the removal of the luminaire from its mounting.

9.2 The power supply or driver shall be able to withstand surges of a minimum 10kV/10kA by means of an external inline fused surge protection device mounted on a 7 pin NEMA socket. This surge protection shall be easily replaceable and it shall fail in an open circuit mode to protect the luminaire from further surges.

9.3 The LED module driver(s) shall operate at a power factor of 0.95 or greater, and the harmonic distortion levels shall be limited so as to not cause interference on the electrical network.

9.4 The total harmonic distortion levels of the LED module driver(s) shall not exceed 8% limit as stipulated in SANS 61000-1-2:2009. The module driver shall comply with the mentioned limit to evade from severe light source flicker.

10.0 WIRING

10.1 The internal wiring of the luminaires shall be flexible and suitably insulated to withstand the voltage and the temperature encountered in service.

10.2 Wiring to the LED module compartment shall be suitably grommet, ensuring a perfect seal between compartments and protection of the wiring.

10.3 The supply terminals shall accept a minimum of 4mm² wires and be easily accessible. No part of the cover shall damage the supply wires when closed.

11.0 EARTHING

11.1 The power supply or driver compartment shall be so designed that there is sufficient space to permit replacement of components or repairs and reassembly without difficultly and without the removal of the luminaire from its mounting.

11.2 Luminaires shall be earthed as per Clause 13 of the Electrical Machinery Regulations of the OHSACT (Act 85 of 1993).

11.3 Metal parts of luminaires which may become alive in the event of insulation fault and which are not accessible when the luminaire is mounted, but liable to come into contact with the supporting surface, shall be permanently and reliably connected to an earthing terminal and shall withstand the test specified in SANS 60598-2-5.

11.4 Earthing terminals shall comply with clause 7.2 of SANS 60598-1. All parts of an

earth terminal shall be made of brass or other corrosion resistant metal and the contact surfaces shall be bare metal and not painted or varnished surfaces.

11.5 Earth connections shall be by means of suitable lugs in a manner avoiding all possibility of electrolytic corrosion.

12.0 LED LUMINAIRE REPORTS

12.1 The luminaires shall be type tested according to SANS 60598-1.
12.2 Test reports for SANS 475 performance mark shall be provided.
12.3 Test reports for SANS 60598-2-5 safety mark shall be provided.
12.4 Metallurgical test reports to confirm materials used for luminaire housing shall be provided.
12.5 LM-80 (Measuring Lumen Maintenance of LED Light Sources) certificate shall be provided.
12.6 LM-79 (Electrical and Photometric Measurements of Solid-State Lighting Products) certificate shall be provided.
12.7 TM-21 (LED Lifetime prediction extrapolation method) certificate shall be provided.
12.8 IP rating test reports for all items shall be offered in accordance with SANS 60529-1 annexure J, table J.1 and table J.2 stipulating degrees of protection indication by first and second numerical characteristic respectively.
12.9 A separate ambient temperature (Ta rating) test report shall be provided, in accordance with SANS 475.
12.10 The test reports shall be issued by SANS or IEC accredited test authority.

13.0 OPTICS

13.1 The luminaire shall be able to be equipped with a variety of lenses, providing the desired light distribution, ensuring a great diversity of light distributions for different applications.
13.2 Luminaires should be photo metered according to the C-Gamma system as detailed in CIE Publication No. 27.
13.3 The intensity distribution table, given in candela, should be converted by an accredited test facility and/or luminaire supplier into a suitable electronic format for use with any of the commercially available lighting computer programs.
13.4 A performance of the LED luminaires shall be verified by designing of an appropriate area as per SANS 10098, in accordance with design criteria submitted by the responsible engineer. The encrypted luminaire data files, in an electronic format, suitable for use with commercially available Design Software shall be readily available on request.

14.0 LUMINAIRE FRONT GLASS

14.1 The front glass shall be high impact acrylic, toughened, clear flat glass.
14.2 The LED's shall be protected by an impact resistant polycarbonate lens with an IK10 rating and be equipped with a high-performance lens to provide the lighting distribution required as per the lighting design.

15.0 LUMINAIRE SPIGOT

15.1 The luminaire can either be mounted with a stirrup or by means of a bottom entry

pole cap suitable for a 76mm diameter spigot. The stirrup shall be manufactured from 5 x 50mm hot dipped galvanized steel. The pole cap shall be manufactured from die cast aluminium and shall be bolted to the housing.

15.2 Luminaire spigot entries shall comply with SANS 1088.

16.0 INGRESS PROTECTION

16.1 The LED light source compartment shall have an Ingress Protection (IP) rating of IP66 to prevent corrosion, premature LED failure and maximum performance of the luminaire.

16.2 The LED light source compartment shall form a perfect seal preventing the entry of moisture, dust and insects into the LED compartment.

16.3 The power supply compartment shall have an IP66 ingress protection rating to ensure that the power supply components are protected against the ingress of dust and moisture, thus preventing corrosion and premature failure.

16.4 One-piece gasket, made of silicon sponge material, shall be fitted into a groove in the housing and shall be seated in a manner ensuring the integrity of the IP66 rating and shall not work loose during maintenance of the luminaire.

16.5 The luminaire shall have a degree of protection that complies with SANS 60598-1.

16.6 The IP ratings shall be certified by a SABS test report.

17.0 LUMENS OUTPUT AND POWER REQUIREMENTS

17.1 The light source shall have a colour temperature of 5500K.

17.2 The light source shall generate a minimum of 120 lumens per watt.

18.0 QUALITY MANAGEMENT SYSTEM

18.1 The assembly, design and testing of the LED luminaire shall be undertaken within an ISO 9001 certified factory, in South Africa

18.2 The Contractor's quality management system shall comply with the requirements of SANS 9000. The requirements in SANS 9000 shall be mandatory for items supplied against this specification.

19.0 PACKING

19.1 The luminaires shall be packed in such a manner that it will be protected during handling and transport by road, rail or sea as applicable. The movements of lamps and control gear shall be protected against vibration damage during transit.

19.2 When sea transport is involved, a dehydrating agent shall be provided where necessary.

20.0 RADIO DISTURBANCE

20.1 The floodlight shall comply with IEC 55015 “Limits and methods of measurements of radio disturbance characteristics of electrical lighting and similar equipment”.

21.0 GUARANTEE AND DEFECTS

21.1 The tenderer shall guarantee the equipment supplied by him in terms of this specification for a period of five years (60 months). The tenderer shall state his compliance herewith.

21.2 This guarantee shall cover all materials, parts, workmanship, performance and efficiency. The guarantee shall include all equipment supplied.

21.3 If any part/equipment fails during the 60-month guarantee period, the supplied shall immediately replace such part/equipment free of charge.

ANNEXURE 1

STATEMENT OF COMPLIANCE
(TO BE COMPLETED BY TENDERER)

This tender complies with specification TPD: 010A-HIGHMASTSPEC-A in all respects.

SIGNATURE : _____ DATE : _____

This tender complies generally with specification TPD: 010A-HIGHMASTSPEC-A but differs from it on the following points.

_____

_____

_____

_____

_____

SIGNATURE : _____ DATE : _____

Transnet National Ports Authority