

- Strip footings.
- Bases.
- Walls in foundations.
- Outer face of walls flushes with perimeter of concrete structure.
- Rectangular columns in foundations.
- Edges not exceeding 300mm high
- Rough Formwork to Circular Columns

b) **Smooth formwork (degree of accuracy ii)**

4.4.2.b.1 Smooth Formwork to sides:

- Inner face of shaft walls.
- Edges not exceeding 300mm high

c) **Movement joints etc.**

4.4.2.c.1 Expansion joints with soft board between vertical concrete surfaces:

12mm Joints not exceeding 300mm high.

d) **Saw cut joints**

3.2 x 50mm and 6.4 x 20mm saw cut joints in two operations in top of concrete.
Seal Sikaflex-11FC or similar approved, on backing chord to manufacturer's specification
Horizontal toggle construction joints through concrete including thick cement slurry to one face.
Surface beds not exceeding 300mm thick.

e) **Reinforcement (provisional)**

High tensile steel reinforcement to structural concrete work:
In various diameters and lengths
Mild steel reinforcement to structural concrete work
In various diameters and lengths
High tensile steel reinforcement to structural concrete work
Fabric reinforcement:
Fabric reinforcement type as specified on structural drawings.

f) **Forming key to concrete for plaster, mosaic tiles and other finishes**

4.4.2.f.1 Where rough formwork has been used, surfaces of concrete to receive plaster, mosaic tiles and other finishes, shall, immediately after the formwork has been removed, be well wetted and wire brushed whilst the concrete is still green and then slushed over with 2:1 cement grout to form a key for the finish, all to the approval of the *Supervisor*. The slushing is to be allowed to set hard before the finish is applied.

4.4.2.f.2 Where smooth formwork is used, surfaces of the concrete to receive plaster, mosaic tiles and other finishes shall be hacked, on the distinct understanding that hacking of concrete shall be at no extra cost to the *Employer*.

4.4.2.f.3 Surfaces of concrete receiving plaster or other finishes shall not be plastered or finished until the *Supervisor* has signified his opinion in writing that the surfaces are suitable to receive plaster or other finishes.

g) **Sleeve Pieces and Ties**

- 4.4.2.g.1 Where it is necessary to leave plugs or holes in beams, slabs or any other reinforced concrete, all such plugs or holes must be situated in positions approved by the *Supervisor* before concreting. Where it is necessary to carry pipes, bolts, wires or any other fittings through reinforced concrete members, approved pipe sleeves must be provided and placed in position before concreting.
- 4.4.2.g.2 Where waste, ventilation water, heating or other pipes under 100mm diameter pass through concrete slabs and beams, galvanised mild steel sleeve pieces or diameters shown or required shall be cast into such concrete slabs and beams.
- 4.4.2.g.3 Chases shall be formed in edges of slabs or slots shall be formed in the slabs, or sizes required, where two or more pipes pass through together.
- 4.4.2.g.4 All necessary bolts, plugs, brackets, cramps, etc. shall be cast into the concrete as the work proceeds.
- 4.4.2.g.5 Where brickwork abuts against concrete, the brickwork is to be tied to the concrete with galvanized hoop-iron ties 1.6m thick by 32mm wide and approximately 600mm long to every third course of brickwork with one end of each tie cast approximately 150mm deep into the concrete. Where such fixing is impossible, i.e. where steel formwork is used, the ties are to be gun-nailed against concrete with steel nails to less than 38mm long.

h) **Bagged Finish to Concrete**

- 4.4.2.h.1 Concrete surfaces to receive bagged finish shall be prepared by removing sharp projections and making good defects with 3:1 cement mortar. Finish by rubbing over the whole area with wet rough sacking and cement grout to obtain an even surface.

i) **Power Floated Finish**

- 4.4.2.i.1 Power floated finish to floors etc. means that surfaces shall be floated c/mechanically to a smooth and even finish before the concrete has set. Small areas inaccessible to the machine are to be floated by hand. Under no circumstances is cement mortar to be added while floating the concrete.

j) **"No Fines" Concrete**

- 4.4.2.j.1 "No-fines" concrete, for grading flat concrete roofs and the like to falls, shall be in the proportion of 12 parts 19 iron cubical stone to 1 part cement mixed with 20 litres water per bag of cement and be laid to falls of not less than 15mm per linear metre for mastic asphalt and not less than 20mm per linear metre for sheet roof covering. For heavy load applications special mix designs may be required.

4.4.2.j.1.1 Fillets against up stands:

- 4.4.2.j.1.1.1 Form triangular fillets, size 100 x 100mm, in corners with walls, kerbs, etc. neatly mitred at angles, stopped where necessary and finished smooth ready to receive waterproofing.

4.4.2.j.1.2 To raised floor, bases, etc.:

- 4.4.2.j.1.2.1 No-fines" concrete for raised floors, bases, etc. shall be in the proportions specified. Finished smooth with 3:1 sand/ cement screed to receive waterproofing.

k) **Precast Concrete**

4.4.2.k.1 **Materials**

Cement, water, aggregates and reinforcement shall be as described under: **CONCRETE, FORMWORK AND REINFORCEMENT.**

4.4.2.k.2 **Concrete**

4.4.2.k.2.1 Concrete shall be as described under: **CONCRETE, FORMWORK AND REINFORCEMENT** and, unless otherwise specified. Class E concrete shall be used but with coarse aggregate of an appropriate size.

4.4.2.k.3 **Smooth Finish**

4.4.2.k.3.1 Where described as "finished smooth from the mould" such surfaces shall have a layer of fine stuff composed of 1:4 (1 part cement and 4 parts clean fine sand by volume) packed against the faces of the mould before placing the concrete backing. The concrete backing shall be disposed into the moulds in a wet state (not dry pressed) while the facing is still wet.

4.4.2.k.3.2 Projections shall be rubbed off the faces shall be of even colour and free from blemishes, cracks and other imperfections. Salient angles shall be arras rounded.

4.4.3 **STEEL WORK**

a) **Codes and Standards**

ANSI/AWS D1.1	Structural Welding Code - Steel
BS-EN 287 Part 1	Approval testing of welders/fusion welding
BS-EN 288 Part 3	Specification and approval of welding procedures for metallic materials
BS 5135:	Metal arc welding of carbon and carbon manganese steels
BS 4360/SANS 50025	Weldable structural steel
BS 2573 Part 1:	Classification, stress calculations and design of structures
BS 3923:	Methods for ultrasonic examination of welds
BS 2600:	Radiographic examination of fusion welded butt joints in steel
DIN 1026	Metric channels
ISO R657	Angles
SANS 10094	The use of high strength friction grip bolts and nuts
SANS 135	ISO metric bolts, screws and nuts (hexagon and square) (coarse thread free fit series)
SANS 136	ISO metric precision hexagon-head bolts and screws, and hexagon nuts (coarse thread medium fit series)
SANS 435	Mild steel rivet

b) **Structural Steelwork**

4.4.3.b.1 All structural steelwork shall be such as to provide a robust and rigid structure requiring the minimum of maintenance and providing a long service life.

- Non-hollow structural sections and plate used on the structure, in conjunction with the hollow section framework, must comply with the relevant requirements of this specification.
- All steel sections shall be manufactured in accordance with the following standards :-

Weldable structural steel:	BS 4360/SANS 50025
I and H sections:	BS 4 Part 1
Metric channels:	DIN 1026
Structural steel, hot rolled sections:	BS 4 Part 1
Angles:	I SO - R657
Hot finished hollow sections:	BS 4848 Part 2
Cold formed sections:	BS 6363
Forgings:	BS 29
Steel castings:	BS 3100
Cast iron:	BS 1452

c) **Welding**

- 4.4.3.c.1 All the provisions of BS 5135 shall be complied with as far as applicable.
- 4.4.3.c.2 Weld joints shall be such that crevices, overlaps, pockets, arc strikes and dead ends do not exist.
- 4.4.3.c.3 All joints shall be completely seal welded in accordance with BS 5135. Special care must be taken to prevent the ingress of moisture into the tubular members by ensuring that each such tubular member is airtight. "Stitch" welding will not be permitted. Only continuous welding will be accepted.
- 4.4.3.c.4 Weld cracks, undercut, or pock marks will not be accepted.
- 4.4.3.c.5 All welds on the load bearing frame structure, containers, piping, pipe line flanges, etc., shall be continuous and shall be visually inspected for cracks and other discontinuities.
- 4.4.3.c.6 Welds on the main chords must be tested ultrasonically in accordance with BS 3923 or X-rayed in accordance with BS 2600 and those on minor joints by the dye-penetrant method. The equipment required for these tests must be supplied by the *Contractor* and the testing done at his cost.
- 4.4.3.c.7 Steel, except in minor details, which has been partially heated, shall be properly annealed. (Electrically welded structural members excepted.)
- 4.4.3.c.8 All brackets, clamps, lugs, straps, suspenders, etc. required for attaching mechanical and electrical equipment must be welded on prior to erection and special precautions must be taken not to damage welds or puncture tubes during erection.
- 4.4.3.c.9 The welding of all rails shall be done by an approved method.
- 4.4.3.c.10 Welding shall only be carried out by a coded welder according to SANS 10044, BS-EN 287 Part 1 and BS-EN 288 Part 3 or ANSI/AWS D1.1.
- 4.4.3.c.11 All parts to be welded shall be thoroughly cleaned and dried before welding. The welding will only be done in dry surroundings and all steps taken to prevent hydrogen embrittlement.
- 4.4.3.c.12 Where materials of different compositions are joined by welding, especially carbon steel to chrome steel, the filler welding method and post welding treatment shall be such that embrittlement and other degradation of both steel and filler is prevented.
- 4.4.3.c.13 It must be ensured that welded joints are ductile.

d) **Fasteners**

- 4.4.3.d.1 All bolts, nuts and rivets shall be manufactured in accordance with the following standards:

Commercial bolts and nuts Grade 4.6:	SANS 135
Precision bolts and nuts Grade 8.8:	SANS 136
Friction Grip Bolts and nuts Grade General:	SANS 10094
Rivets:	SANS 435

- 4.4.3.d.2 All friction grip fasteners shall be hot dip galvanised, including high tensile bolts (and their nuts and washers), structural rivets and Huck bolts.
- 4.4.3.d.3 All holding down bolts and nuts 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.
- 4.4.3.d.4 Bolts and set screws shall be locked in an approved manner and shall not be stressed in tightening to beyond the recommended loads.
- 4.4.3.d.5 The quality of friction grip bolts, nuts and washers, bolt lengths, sizes of holes, tightening standards, surface condition of clamped components, shop and site assembling and acceptance inspection of friction grip joints shall comply with the latest edition of SANS 10094. Certificates shall be supplied for all bolts of grade 8.8 and 10.9.
- 4.4.3.d.6 All bolt and rivet holes must be accurate to size and location, the centres of holes shall not be placed nearer the edge of a plate than 1,5 diameters with an extra allowance of 3mm for sheared edges. All holes in the structural work shall be drilled or otherwise punched to a diameter not exceeding 1,5mm less than the diameter of the finished hole on the die side, and afterward reamed out to the exact size
- 4.4.3.d.7 Where possible the adjoining parts forming a connection shall be drilled or reamed together, with holes not exceeding 1,5 mm diameter the rivet or bolt for which it is made. No rough or broken edge shall be left around any of the holes.
- 4.4.3.d.8 For turned and fitted bolts, the holes shall be accurately drilled or reamed; the diameter of the hole shall not exceed the finished diameter of the bolt by more than 0,25mm.
- 4.4.3.d.9 The holes, after assembly of the parts, shall be true throughout the thickness of all the parts and perpendicular to the axis of the member.
- 4.4.3.d.10 Rivets shall be cup-headed or countersunk as required, unless otherwise specified. No rivet head shall contain less metal than does a length of the rivet equal to 1,25 times its diameter. All loose and defective rivets shall be cut and replaced by sound ones; also others when required for the purpose of examining the work. Rivets shall be driven with pressure tools whenever possible and pneumatic hammers shall be used in preference to hand driving.
- 4.4.3.d.11 All field rivets must be supplied with shanks of suitable length for pneumatic riveting.
- 4.4.3.d.12 Bolts shall be of such a length as to accommodate a full nut when tightening up, and project at least two thread pitches beyond the nut. Excessive projection of threads beyond the nuts should be avoided.
- 4.4.3.d.13 All bolts having countersunk heads shall have strong feathers forged on the neck and head to prevent turning and the bolt holes shall be cut to receive same. All nuts and bolts (excluding countersunk bolts) shall be furnished with circular washers of sufficient thickness, the outside diameter being at least twice the nominal diameter of the bolt, and washers fitted correctly.
- 4.4.3.d.14 Where bolt heads or nuts are seated on bevelled surfaces of beams or channel flanges, bevelled washers must be inserted.

e) **Joints and Mating Surfaces of Members**

- 4.4.3.e.1 Mating surfaces of members to be joined by high tensile steel bolts in friction grip shall be cleaned and primed as specified for the rest of the steelwork. Mating surfaces shall lay flat against each other to eliminate gaps which may allow ingress of water. After joining, the edges shall be sealed with an approved brand of Butyl/ Rubber sealing compound by means of a suitable caulking gun, or shall be seal welded.

4.4.3.e.2 Other joints shall be formed by one of the following methods:

4.4.3.e.2.1 The mating surfaces of members shall be blast cleaned, primed and protected prior to sub-assembly by the liberal application of caulking compound. While the compound is still wet, the members shall be bolted together and caulking compound which is squeezed out shall be completely removed.

4.4.3.e.3 The mating surfaces shall be protected with the full corrosion protection system as specified, the surfaces joined together and the joint so formed shall be sealed with butyl rubber sealer.

4.4.3.e.4 After being cleaned and primed the surface shall be joined together and the joint so formed shall be seal welded.

4.4.3.e.5 The primer coating on mating surfaces must be applied not more than 4 hours after cleaning and the edges must be sealed within 3 weeks of assembly of the part.

f) **Fabricated Parts**

4.4.3.f.1 All fabricated parts shall be properly fitted during assembly to result in properly aligned equipment having a neat appearance. Fabrications of load bearing members shall have no abrupt changes in cross section and regions of severe stress concentration. All sharp corners accessible by personnel during erection or operation shall be ground, rounded, or removed by other methods. Burrs, welding spatter and stubs of welding wire shall be removed.

4.4.4 **CORROSION PROTECTION (SPECIFICATION HE9/2/8 - [Version 16] - July 2002)**

a) **Scope**

4.4.4.a.1 Corrosion protection of Structural steelwork in coastal area (within 10km from coast).

b) **Specifications**

4.4.4.b.1 The specification covers 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):

- SANS 10064 "Preparation of steel surfaces for coating"
- SABS 121 "Hot-dip (galvanized) zinc coatings"
- SANS 1091 "National colour standards for paint"
- BS 5493 "Code of practice for protective coating of iron and steel structures against corrosion"

c) **Types of Corrosion Protection to be used.**

4.4.4.c.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.

4.4.4.c.2 The paint manufacturer shall guarantee the paint for at least 10 years.

4.4.4.c.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.

4.4.4.c.4 Tenderers must ensure that the different coats they offer in their tenders are compatible with each other.

- 4.4.4.c.5 The coating of proprietary items must be done according to Clause d.
- 4.4.4.c.6 All galvanized components including bolts and nuts but excluding walkway gratings, must be painted with the specified system, unless otherwise approved.
- 4.4.4.c.7 The following coating systems must be used unless otherwise specified in the main specification:-

Substrate	Coat No	Generic Description	Approved Brand Products	Dry Film Thickness (µm)
3CR12 steel	1	Surface tolerant epoxy primer	DULUX /SIGMA Sigmacover primer INTERNATIONAL (PLASCON) Intergard 269 STONCOR (CHEMRITE COATINGS) Carboline 193 Primer	65-75
	2	Two component recoatable, polyurethane finish (Gloss)	DULUX / SIGMA Sigmadur gloss INTERNATIONAL (PLASCON) Interthane 990 STONCOR (CHEMRITE COATINGS) Carboline 134	65-75
Galvanized Steel	1	Surface tolerant epoxy primer	DULUX /SIGMA- Sigmacover primer INTERNATIONAL (PLASCON) Intergard 269 STONCOR (CHEMRITE COATINGS) Carboline 193 Primer	65-75
	2	Two component recoatable, polyurethane finish (Gloss)	DULUX /SIGMA- Sigmadur gloss INTERNATIONAL (PLASCON) Interthane 990	65-75

			STONCOR (CHEMRITE COATINGS) Carboline 134	
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Substrate	Coat No	Generic Description	Approved Brand Products	Dry Film Thickness (µm)
Mild steel	1	Two component self curing inorganic zinc ethyl silicate OR two component zinc rich polyamide cured epoxy primer	DULUX /SIGMA- Sigma MC60 OR Sigma-cover primer INTERNATIONAL (PLASCON) Interzinc 233 OR Interzinc 52 or 53 STONCOR (CHEMRITE COATINGS) Carbo Zinc 11 OR Carbo-line 658 Primer	65-75
	2	Flexible recoatable high build polyamide cured MIO epoxy	DULUX/SIGMA – Sigmacover CM MIO INTERNATIONAL (PLASCON) Interseal 010 MIO STONCOR (CHEMRITE COATINGS) Carboline 190 HB M.I.O. or Carboline 193 M.I.O.	125-150

	3	Two component recoatable, polyurethane finish (Gloss)	DULUX/SIGMA Sigmadur gloss INTERNATIONAL (PLASCON) Interthane 990 STONCOR (CHEMRITE COATINGS) Carboline 134	65-75
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- 4.4.4.c.8 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.
- 4.4.4.c.9 Paint contractors must have a quality management system which must be submitted to the *Project Manager* for approval before commencement of the work.
- 4.4.4.c.10 Galvanizing shall be done to SANS 121 heavy duty hot dip galvanizing to a thickness of at least 85µm. Electroplated components in zinc or cadmium are not acceptable.
- 4.4.4.c.11 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.
- 4.4.4.c.12 High tensile bolts for friction grip joints must be hot dip galvanized and painted. High tensile bolts must be certificated after galvanizing.
- 4.4.4.c.13 The full paint system shall be applied to all surfaces which are to be covered with wear pads, linings etc.
- 4.4.4.c.14 For steelwork which will be transported over long distances and erected on site the two pack epoxy primers is preferred.

d) **Propriety Items**

- 4.4.4.d.1 Proprietary items 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:
- 4.4.4.d.1.1 A cross cut test must be done to SANS SM159 to determine if the original coating adheres correctly to the substrate;
- 4.4.4.d.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;

- 4.4.4.d.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;
- 4.4.4.d.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.
- 4.4.4.d.1.5 Should any undue dissolving or lifting occur, a suitable intermediate or barrier coat must be applied before the finishing coat is applied.
- 4.4.4.d.1.6 Proprietary items which failed the cross cut test and which generally have inadequate protection shall be dismantled and the full corrosion protection specification applied.

e) **Surface Preparation**

- 4.4.4.e.1.1 All steel surfaces shall be detergent washed and fresh water rinsed to remove all oil, grease and surface contaminates before shot blasting.
- 4.4.4.e.1.2 Sharp edges shall be radiused and major roughness of welds shall be removed by grinding. Welding spatter and flux shall be removed.
- 4.4.4.e.1.3 Components manufactured from hot rolled steel sections and steel plate shall be blast cleaned to base metal in accordance with SANS 10064 grade SA2½ - very thorough blast cleaning, to remove all mill scale, rust, weld spatter etc.
- 4.4.4.e.1.4 " Sharp" chilled iron shot, chilled iron grit, or granular abrasive slag is to be used to produce a proper degree of surface roughness.
- 4.4.4.e.1.5 Blast profile shall be determined by micrometre profile gauge, Keane-Tator surface profile comparator or Testex press-o-film.
- 4.4.4.e.1.6 The profile height shall be between 40 and 50µm at any point.
- 4.4.4.e.1.7 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.
- 4.4.4.e.1.8 When wet blasting is done the primer shall be applied before oxidization starts or surface contamination occurs.
- 4.4.4.e.1.9 Components manufactured from 3CR12 steel shall be lightly abraded. The components shall then be passivized 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.
- 4.4.4.e.1.10 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.

f) **Joints and Mating Surfaces of Members**

- 4.4.4.f.1.1 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.

- 4.4.4.f.1.2 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.
- 4.4.4.f.1.3 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.
- 4.4.4.f.1.4 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.

g) **PAINTING PROCEDURES**

- 4.4.4.g.1.1 Directly before the application of paint, the area to be painted shall be degreased with a suitable degreaser and left to dry.
- 4.4.4.g.1.2 Paint shall only be applied under the following conditions:
- There is adequate light.
 - The steel temperature is between 5 and 50°C and at least 3°C above the dew point of the air.
 - The relative humidity of the air is between the limits specified by the paint supplier.
 - Wind does not interfere with the method used and sand and dust cannot be blown onto wet paint.
- 4.4.4.g.1.3 Steelwork shall be supported on trestles, at least 900 mm off the ground for painting purposes.
- 4.4.4.g.1.4 An adequate number of test readings shall be taken per square meter in order to determine the dry film thickness.
- 4.4.4.g.1.5 The paintwork shall be acceptable if the average of the test readings taken falls within or exceeds the ranges given.
- 4.4.4.g.1.6 Paintwork shall not be acceptable if any single test reading is less than the specified minimum thickness.
- 4.4.4.g.1.7 An ultrasonic or electronic magnetic flux thickness measurement gauge shall be used, but in case of dispute, destructive testing shall be applied. The 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.
- 4.4.4.g.1.8 The use of thinners or solvents at any stage of the work is prohibited, unless specified by the paint manufacturer.
- 4.4.4.g.1.9 Precautions shall be taken to prevent coatings from being applied to equipment nameplates, instrument glasses, signs etc.

h) **Colour Codes**

4.4.4.h.1.1 Machinery and equipment shall be painted in the following final colours:

	Area	Colour	Code No. [SABS 1091 and International No's]
	Mobile equipment (cranes, loaders etc.)		
	a) Structure, machinery and electrical houses, operator's cabins, chutes, hoppers etc.	Transnet White	RAL 9016
	b) Undercarriage, travel bogies, rubber tyred rims	Transnet dark grey	RAL 7024 (Graphitgrau) SABS 1091 GO4 (Bluegrey) BS 381C-633
	Industrial buildings, conveyor structures		
	a) Roofs and canopies	Pantone cool grey 10	RAL 7037 (Staubgrau)
	b) Painted walls	Pantone cool grey 3	RAL 7035 (Lightgrau) or SABS 1091 G62 (Pale grey)
	c) Steel columns, rafters, trusses	Pantone cool grey 5	RAL 7004 (Signalgrau)
	General		
	a) Guards	Golden yellow	SABS 1091-B49 RAL 1003
	b) Sheaves	Orange	RAL 2008
	c) Cable reels (Stainless steel	Orange	RAL 2008
	Machine buffers and parts of machine which could constitute a serious hazard	Golden Yellow (High Gloss) with Luminous green stripes in chevron pattern	SABS B49 and Luminous green

	Area	Colour	Code No. [SABS 1091 and International No's]
	e) Any exposed rotating part of machinery, electrical Switch-gear (other than starting and stopping devices and emergency stop control), electrical services e.g. conduit and allied fittings	Light Orange (High Gloss)	SABS 1091 B26 BS 381C-557
	f) Low voltage switchgear panels where orange is not aesthetically acceptable	Light grey	SABS 1091-G29 BS 381C-631
	g) Medium voltage cable trays, switchgear and motors (3,3 kV and up)	Oxford Blue	SABS FO2 BS 381C-105 RAL5003
	h) Starting devices, low voltage cable trays and switchgear	Mid Brunswick green (high gloss)	BS 381C-228 SABS1091-EO4 RAL6005
	i) Parts of stationary machinery (Electrical, motors, gearboxes, brakes, transformers, etc.)	Light Grey	SABS G29 BS 381C-631
	j) Hand levers, hand wheels, oiling points, handrails on walkways, ladders	Golden Yellow (High Gloss)	SABS 1091 B49 BS 381C-356
	k) Stopping devices, grease points , motor fan covers and danger signs (not symbolic safety signs for which see SABS 1186)	Signal red (High Gloss)	SABS 1091 A11 BS 381C-537 RAL3001
	l) Walkways (non slip surfaces) (galvanized gratings not to be painted)	Shop floor green	
	m) Informatory signs and notices (not symbolic safety signs for which see SABS 1186)	White on Emerald Green (High Gloss)	White on SABS 1091 E14 BS 381C- 228
	Area	Colour	Code No. [SABS 1091 and International No's]

	Pipe lines		
	a) Reclaim water piping	Aluminium	
	b) Slurry pipe lines	Dark admiralty grey	SABS 1091-G12
	c) Fire protection piping	Signal red	SABS 1091-A11
	d) Washwater drain pipes	Light grey	SABS 1091-G29
	e) Instrument air	White with Strong blue band	White and SABS 1091-F11
	f) Plant air	White with Flag blue band	White and SABS 1091-FO4
	g) Potable water	Grass green	SABS 1091-D14

4.4.4.h.1.2 Colour bands for pipes shall be 75 mm wide for pipe sizes up to 150 mm diameter and 100 mm wide for 150 mm and above. The colour bands shall be applied to the pipe flanges, valves, junctions, walls or structures etc. in such a manner that the pipe may be easily identifiable. On straight sections the maximum spacing shall be 100 x the pipe diameter.

i) **Field Touch-up Painting**

4.4.4.i.1.1 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.

4.4.4.i.1.2 Where welding is required on areas already coated with the coating system, the coat should be stepped back for ± 30 mm around the weld area.

4.4.4.i.1.3 The paint shall be applied to match the original coats in accordance with the manufacturer's recommendations for the specific paint system.

- 4.4.4.i.1.4 Note: Inorganic zinc primers shall not be re-covered with an inorganic primer, but only with an organic zinc primer.
- 4.4.4.i.1.5 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.

j) **General**

- 4.4.4.j.1.1 All walkways, floors, maintenance platforms etc. must be painted with a durable, non-skid coating of the appropriate colour.
- 4.4.4.j.1.2 Exposed machined surfaces must be coated with a strippable corrosion inhibitor (e.g. Tectyl).
- 4.4.4.j.1.3 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.
- 4.4.4.j.1.4 All components must be designed with corrosion prevention in mind and specifically the following:
- No entrapment of dirt, product, moisture etc.
 - No areas must be inaccessible for maintenance such as too narrow gaps etc.
 - Large flat areas rather than complicated shapes and profiles.
 - No sharp corners and discontinuous welds.
- 4.4.4.j.1.5 Parts of equipment which are exposed to high temperatures must be coated with the following system:-

	Coat No	Generic Description	Approved Brand Products	Dry Film Thickness (µm)
	1	Two component self curing inorganic zinc ethyl silicate	DULUX /SIGMA- Sigma MC60 INTERNATIONAL (PLASCON) Interzinc 233 STONCOR (CHEMRITE COATINGS) Carbo Zinc 11	65-75
	2	Single component high temperature moisture curing silicone with aluminium flakes	DULUX/SIGMA – Sigmatherm Silicate INTERNATIONAL (PLASCON) Intertherm 50 STONCOR (CHEMRITE COATINGS)	40

			Carboline 1248	
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k) **Maintenance Painting of Structures**

4.4.4.k.1 Areas which are only lightly corroded must be cleaned by means of high pressure water blasting or wire brushing by power tool and the following system applied:-

	Coat No	Generic Description	<i>Approved Brand Products</i>	Dry Film Thickness (µm)
	1	Surface tolerant two pack epoxy primer with aluminium pigments	Dulux/SIGMA Aluprimer STONCOR (CHEMRITE COATINGS) Carbomastic 15 INTERNATIONAL (PLASCON) Intergard 468,	125-150
	2	Same as first coat OR micaceous iron oxide (MIO) epoxy	DULUX/SIGMA – Sigmacover CM MIO INTERNATIONAL (PLASCON) Interseal 010 MIO STONCOR (CHEMRITE COATINGS) Carboline 190 HB M.I.O. or Carboline 193 M.I.O.	125-150
	3	Two component recoatable, polyurethane finish (Gloss)	DULUX/SIGMA Sigmadur gloss <i>INTERNATIONAL (PLASCON) Interthane 990 STONCOR (CHEMRITE COATINGS) Carboline 134</i>	65-75

4.4.4.k.2 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:

- 4.4.4.k.2.1 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.
- 4.4.4.k.2.2 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.
- 4.4.4.k.2.3 Bolted/riveted 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.
- 4.4.4.k.3 The adhesion of old coatings must be verified by doing a cross cut adhesion test on selected areas.
- 4.4.4.k.4 The compatibility of the new paint system on the old coating must be tested and guaranteed in writing by the paint supplier.
- 4.4.4.k.5 The work and coating system must be guaranteed for a minimum of 12 months.
- 4.4.4.k.6 All heavily corroded areas must be shot blasted to minimum SA2 and the three coat system indicated in clause 4.5.5.k.1 shall be applied.
- 4.4.4.k.7 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 4.5.5.k.1 (as tie coat) and then with one of the top coats suggested in Clauses 4.4.5.c.7 Coat 2 and 4.4.5.h.1.1 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.
- 4.4.4.k.8 Note: Inorganic zinc primers shall not be re-covered with an inorganic primer, but only with an organic zinc primer.
- 4.4.4.k.9 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.

4.5 Electrical engineering *Works*

4.5.1 Scope of work

- a) The scope to be carried out by the *Contractor* shall include but not be limited to the following items of work as summarised below, covers the supply, delivery, installation, commissioning and handover of the following packages of electrical infrastructure:
 - 4.5.1.a.1 Supply, delivery and installation of medium voltage (MV) infrastructure inclusive of MV cables and associated terminations and *Works* in the new Port of Ngqura.
 - 4.5.1.a.2 Supply, delivery and installation of Mini-Substations, LV Kiosks, Perimeter and street lighting poles and other associated plant in the proposed new Port of Ngqura.
 - 4.5.1.a.3 Supply, delivery and installation of low voltage (LV) infrastructure inclusive of all LV cables, distribution boards and LV switchgear in the proposed new Port of Ngqura.

- 4.5.1.a.4 Supply, delivery and installation of electrical lighting, power points supply and distribution boards.
- 4.5.1.a.5 Design, supply and installation of Lightning protection and Earthing of the building structure.
- 4.5.1.a.6 Supply, delivery and installation of 316 stainless steel mounting brackets and cantilevers, 316 STAINLESS STEEL PIPES 110mm Dia, hardware assemblies and the like.
- 4.5.1.a.7 Supply, delivery, installation, testing and commissioning of power supply to the existing pump-station, including monitoring cables and SCADA integration with minisubstation.
- 4.5.1.a.8 The supply, installation and commissioning of a SCADA system at the mini-substations in accordance with the Employers drawing NO: 1124367-1-273-E-LA-0002-01-OA-TD.
- 4.5.1.a.8.1 The contractor's scope includes the hardware components, internal wiring of all SCADA components contained within the mini-substations and any software required for the proper functioning of these components.
- 4.5.1.a.8.2 The communication protocol is IEC 61850 and subsidiary protocols.
- 4.5.1.a.8.3 The contractor is required to submit detailed designs drawings to the Employer's Electrical Engineer for acceptance.

4.5.2 General

- 4.5.2.a.1 Wherever the word "equipment" is read in the *Employer's* Specifications contemplated in 4.6.3 below the meaning is "Plant" and vice versa.
- 4.5.2.a.2 TNPA electrical personnel shall perform all the required switching and control work permits.
- 4.5.2.a.3 The *Contractor* shall submit a notification of switching to the *Project Manager* seven days prior to the required work being performed.

4.5.3 Standard of work, Plant & Materials

- 4.5.3.a.1 The electrical installation shall conform to the requirements of the latest edition and amendments of SANS 10142 -1 and SANS 10142-2 and any additional requirements thereto, described in this specification.
- 4.5.3.a.2 Where the local supply authority requirements differ from those specified herein, the *Employer's* Electrical Engineer through the *Project Manager* shall be approached for a decision.
- 4.5.3.a.3 All Plant 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.
- 4.5.3.a.4 All Plant and Material shall comply with the relevant National or International standard specification. Where Plant does not comply it shall be submitted to the *Employer's* Electrical Engineer through the *Project Manager* for acceptance.

4.5.4 Generic Specifications

TPD-007-MVSWITCHSPEC	Technical specification for indoor medium/high voltage (1kV to 33kV) alternating current switchgear and control gear
TPD-003-CABLESPEC	Technical specification for medium and low voltage cables
TPD-001-EL&PSPEC	Technical specification for electrical installations to building other than dwelling houses.
TPD-002-DBSPEC	Technical specification for low voltage distribution boards
TPD-010B-HIGHMASTSPEC	Technical specification for the maintenance and upgrade of highmast lighting structure.
TPD-014-TRANSFORMERSPEC	Technical specification for the supply, delivery and installation of distribution transformers.
TPD-004-EARTHINGSPEC	Technical specification for earthing and the protection of buildings and structures against lightning.
TPD-008-MINISUBSPEC	Specification for the design, supply, delivery and installation of Mini-Substations

4.5.5 Service Conditions

- a) The Plant and Material shall be designed and rated for continuous operation under the following conditions.

4.5.5.a.1 Ambient/Environment Conditions:

All Plant and Material offered shall be rated for continuous operation under the following conditions:

- Altitude : 0 to 1800m Above Sea Level
- Ambient temperature : -5°C to +40°C (daily average +35°C)
- Relative humidity : As high as 96%
- Lightning conditions : Severe, with a maximum lightning ground flash density of 11 flashes per km² per annum.
- Salt laden and corrosive industrial Chemical and dust laden nature.
- Frequent Heavy rains driven by wind reaching speeds of 120Km/h and above.

4.5.6 Lightning Conditions

- a) All lightning protection Plant and Material offered shall be rated to withstand the following conditions:
- Current : The peak lightning current and it's rate of rise of rise shall be regarded as severe when $i_{max} = 200kA$.
 - Voltage : The highest cloud potential shall be assumed to be More than 100MV, where; $Q = CV$, where Q is Assumed at 100C and C to be 10^{-7}

4.5.7 Normative References

- a) The following publications and specifications (latest edition) shall apply where contextually correct:

SANS 62305	PROTECTION AGAINST LIGHTNING.
SANS 10064	CODE OF PRACTICE FOR THE PREPARATION OF STEEL SURFACES FOR COATING.
SANS 10086	INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT USED IN EXPLOSIVE ATMOSPHERES.
SANS 10108	THE CLASSIFICATION OF HAZARDOUS LOCATIONS AND THE SELECTION OF ELECTRICAL APPARATUS FOR USE IN SUCH LOCATIONS.
SANS10142	THE WIRING OF PREMISES
SANS 10199	THE DESIGN AND INSTALLATION OF EARTH ELECTRODES

SANS152	LOW VOLTAGE AIR BREAK SWITCHES, CONNECTORS, SWITCH DISCONNECTORS, FUSE COMBINATION UNITS.
SANS 156	MOULDED CASE CIRCUIT BREAKERS.
SABS 163	WALL AND APPLIANCE SWITCHES.
SANS 164-1	PLUGS AND SWITCH SOCKET OUTLETS FOR HOUSEHOLD AND SIMILAR PURPOSES
SABS 165	LAMP HOLDERS
SANS 172	LOW VOLTAGE FUSES
SABS 314	FLAMEPROOF ENCLOSURES FOR ELECTRICAL APPARATUS
SABS 743	LOW VOLTAGE ISOLATING TRANSFORMERS
SANS 767-1	EARTH LEAKAGE PROTECTION UNITS.
SABS 763	HOT DIP ZINC (GALVANISED) COATINGS
SABS 784	METAL ENCLOSED BUSBAR TRUNKING SYSTEMS
SANS 890-1	BALLASTS FOR FLUORESCENT LAMPS:
SANS 908	METER CABINETS

SABS 950	NON-METALLIC CONDUIT AND FITTINGS.
SANS 1091	NATIONAL COLOUR STANDARDS FOR PAINTS.
SANS 1012	ELECTRIC LIGHT DIMMERS
SANS 1041	TUBULAR FLUORESCENT LAMPS FOR GENERAL SERVICES
SANS 1065-1	METAL CONDUITS AND FITTINGS FOR ELECTRICAL WIRING.
SANS 1085	WALL OUTLET BOXES.FOR ENCLOSURE OF ELECTRICAL ACCESSORIES
SANS 1119	INTERIOR LUMINARIES FOR FLUORESCENT LAMPS.
SABS 1180	ELECTRICAL DISTRIBUTION BOARDS
SABS 1197	METALLIC WIRE WAYS FOR INSTALLATION IN FLOORS
SANS 1507	ELECTRIC CABLES WITH EXTRUDED SOLID DIELECTRIC INSTALLATION FOR FIXED INSTALLATIONS
SANS 1274	COATINGS APPLIED BY THE POWDER-COATING PROCESS.
SANS 1278	INTERIOR LUMINAIRES FOR LOW PRESSURE SODIUM VAPOUR AND HIGH INTENSITY: DISCHARGE LAMPS

SANS 1279	FLOODLIGHT LUMINAIRES
SABS IEC 439	LOW VOLTAGE SWITCHGEAR
SABS IEC 309	PLUGS, SOCKET OUTLETS AND COUPLERS FOR INDUSTRIAL PURPOSES
SABS IEC 742	ISOLATING TRANSFORMERS AND SAFETY ISOLATING TRANSFORMERS

4.5.8 Perimeter and Street lighting

- a) This scope of work carried out by the electrical contractor shall cover, but is not limited to the following:
- b) Installation of new 15m medium mast poles with new LED light fittings.
Installation of new 10m street light base pole with new LED street light fittings.
- c) New Low voltage cables from the new proposed substation low voltage panel.
- d) Supply and installation of Earthing and Lightning Protection for the 15m medium masts.
- e) New Medium and Low Voltage Cabling
- f) The contractor shall supply deliver and install new 4-core PVC Insulated PVC bedded SWA PVC sheathed 600/1000V Low voltage cables from the new proposed substation low voltage panel and from various mini-substation low voltage side to the dedicated loads.
- g) The Contractor shall Supply, Deliver, offload and Install a 50mm², 3 core, 11kV XLPE insulated, galvanised steel wire armoured and PVC sheathed copper cable from the 11kV Mini-Substation panel feeders in the Main-Substation to the 11kV/400V 630kVA Mini-Substations as per SANS 101980-4, drawing no.1124367-1-203-E-LA-0001-01-0A-TD and drawing no.1124367-1-273-E-LA-0007-01-0A-TD.
- h) The Contractor shall Design, Supply, Deliver, offload and Install 11kV/400V 630kVA Mini-Substations as per SANS 101980-4, drawing no.1124367-1-203-E-LA-0001-01-0A-TD, drawing no.1124367-1-273-E-LA-0002-01-0A-TD and drawing no.1124367-1-273-E-LA-0007-01-0A-TD.

4.5.9 Installation of New Medium Masts

- a) The contractor shall supply deliver and install new 15m scissor medium mast poles including light fittings as indicated on drawing no 1124367-1-004-E-LA-0001-0A-PM
- b) The contractor shall supply the mast poles that have internal distribution boards

- c) The masts shall be of light weight construction and a base plate shall be welded to the bottom end of the lowest section with correctly drilled holes to suit the foundation bolt cage cast into the foundation.
- d) The mast shall have a suitable cross arm bracket or spigot for the mounting of streetlight luminaires or side entry streetlight fitting in a symmetrical orientation shall be fitted to the top of the mast. The mast pole shall be equipped with a flexible 3-core trailing cable. The trailing cable shall be run from the junction box below the mast through to the mast DB and terminated there.

4.5.10 Installation of new street light poles

- a) The *Contractor* shall supply, deliver and install new 10m street light poles (fibreglass) including light fittings as per drawing no. 1124367-1-0003-E-LA-0001-01-0A-PM to 1124367-1-0003-E-LA-0001-05-0A-PM.
- b) The street light pole shall be of lightweight construction and where the poles are mounted in a concrete foundation and a base plate.
- c) The poles shall have the access opening with and access door cover manufactured from glass filled nylon impregnated in the same colour as the surface coat. The door shall be secured in the pole with two stainless steel Allen head captive screws into M4 inserted into the pole.
- d) The pole shall come with a pole that has a cable entry of minimum of 34mm diameter and a depth of 40mm below ground surface.
- e) The pole should be able to withstand a wind pressure of 500Pa inclusive of 0.20m² luminaire area with less than a 5% deflection of the mounting height.
- f) The pole must have a hot dipped galvanised gland plate, terminal block and DIN rail for mounting a miniature circuit breaker inside the access opening

4.5.11 Medium Mast Distribution Board

- a) The distribution boards shall be designed and constructed according to drawing no. 1124367-004-E-LA-0001-01-0A-PM to 1124367-004-E-LA-0001-04-0A-PM and specification no. TPD-002-DBSPEC; "The specification for the design and manufacturing of low voltage distribution boards.
- b) The distribution board shall be fully enclosed IP30 rated and shall be provided for mounting on the inside of the mast. It shall be fully wired and ready for connection to the incoming supply cables.
- c) The enclosure shall be built inside the medium mast pole and manufactured from minimum 1.6mm 3cr12 and shall be outdoor type (IP67).

4.5.12 Site Assembly and erecting of medium mast poles

- d) The contractor shall supply and deliver the medium masts to site.
- i) The masts poles shall be designed to be mounted onto a concrete foundation by means of a base plate bolted to a bolt group cast into the concrete.

- e) The use of levelling bolts below the base plate to achieve this is acceptable and recommended.

4.5.13 Erecting of street light poles

- a) The contractor shall supply and deliver fibreglass street light poles to site and be manufactured according to SABS 1749.
- b) The street light poles on a dual carriage road shall be designed to be mounted onto a concrete foundation. The pole shall have a hot dipped galvanised flange plate that can bolted to a foundation which is designed to withstand the forces the pole will experience in service and as per drawing no. 1124367-1-003-E-LA-0001-01-0A-PM. To drawing no. 1124367-1-003-E-LA-0001-03-0A-PM.
- c) The street light poles on a single carriage road shall be designed to be mounted in the ground with a 300x300x1.6mm hot dipped galvanised base plate complete with 2 x hot dipped galvanised steel hook bolts and nuts.

4.5.14 Working loads

- a) The masts shall be designed in accordance with the SABS 0225 (1991) Code of Practice for Design and Construction of Lighting Masts. The following site factors shall be considered:

wind speed	40m/s
Terrain Category	2
Altitude	0

4.5.15 Spigot

- 4.5.15.a.1.1 The spigot shall be sufficient to accommodate the mounting and connection of 1 x 213W 96 LEDs light fitting on the 15m medium mast and 1 or 2 x 53W 16 LEDs light fittings on a 10m street light pole. The spigot shall before galvanising thereof be equipped with holes for bolts, mounting plates etc. for the mounting of LED light fittings.

4.5.16 Corrosion Protection of the Medium Mast poles

- a) All material used in the pivot construction shall be of AISI grade 316 stainless steel.
- b) Steel used in construction of the mast shall have an ultimate tensile strength of between 460 and 680MPa and identical to SABS 1431 grade 355WA.
- c) All parts of the masts shall be hot dipped galvanised to SABS ISO 1461 specifications and test certificates shall be provided if required.
- d) No drilling, machining or welding shall be performed on the masts after galvanising.

4.5.17 Corrosion Protection for the street Light poles

- a) The fibreglass poles finishing shall be a gel coat that complies with SANS 1749 and is applied to a uniform thickness of between 250 and 500 microns, providing a weatherproof, UV resistant, flame resistant and strong surface for the colour.

4.5.18 Low Voltage cabling

- a) The Contractor shall supply and install low voltage cabling, 4 core PVC insulated from the new substation low voltage panel and the new various Minisubstations to feed the new 15m medium mast lighting and 10m street light poles as indicated on drawing:112. The design shall be submitted to TCP Electrical engineer for acceptance.
- b) The low voltage cabling shall be installed according to specification TPD-003-CABLESPEC: "Technical specification for the installation of medium and low voltage cables".
- c) The sleeve pipes for Low Voltage cables to the new street light poles shall be installed at least 800mm below ground level.

4.5.19 MEDIUM VOLTAGE CABLES

- a) The *Contractor* shall supply, deliver and install and terminate similar or equal approved to Aberdare 50mm² 3-core XLPE insulated medium voltage cable 6.35/11kV, SWA, ECC, PVC insulated copper cable from the Ngqura Main Substation to the minisubstations as indicated in the List of Drawings.
- b) The contractor shall supply and install EN50181 termination kits at the Ngqura Main Substation end, and at all ring terminations at the minisubstations locations as indicated in the List of drawings,
- c) The contractor shall install MV Cable in the MV servitudes directly in the ground and in sleeves under and across roads where and as indicated in the List of Drawings, and the Requirements of TPD-003-CABLESPEC
- d) The contractor shall joint all cables at intervals required by the installations, and clearly mark the joint locations using an appropriate cable marker as per TPD-003-CABLESPEC.
- e) Where cable enters the Ngqura Main Substation and the minisubstations, the contractor shall ensure that the cable is securely restrained and secured using a combination of cable clamps and cable ties/straps. Cable Ties/Straps alone is not appropriate and will not be accepted by the Employer.

4.5.20 SCADA

- a) The *Contractor* shall supply and install a multi core fibre blow duct with blow chambers to house fibre optic communications cable and protection fibre cable.
- b) The Contractor shall install Fibre Optic Communications cable in the fibre blow with all necessary splices and joints.

The Contractor shall install Protection Fibre cable in the fibre blow duct for future use and current protection system use if deemed appropriate by the Protection System design as per the contractor's Protection Engineer. The Contractor shall Splice and join this Fibre Cable as appropriate to the installation requirements.

- c) The *Contractor* shall supply and integrate all IEC 61850 compliant instruments and their IO signals to the existing SCADA system and HMI at the Ngqura Main Substation.

- d) The Contractor shall provide all necessary Software Licenses and IO Tags necessary for the expansion of the existing SCADA, and transfer ownership to the *Employer*.
- e) The Contractor shall terminate all fibre cables to instruments as appropriate, and provide end terminations where required for future use.
- f) The contractor shall Test, Commission and demonstrate the functionality of all the added SCADA components.

4.5.21 Earthing and Lightning protection

- a) The Contractor shall supply and install lightning protection to the medium mast and lighting poles in accordance to specification No. TPD: 004-EARTHINGSPEC; "Transnet Projects Specification for lightning protection and earthing". This component of work shall be undertaken by a specialist earthing and lightning protection contractor.
- b) The mast shall be provided with a M12 earth bolt welded to the mast with stainless steel nuts. The incoming electrical supply earth conductor and all other electrical equipment shall be connected to the earth bolt.
- c) Earthing electrode and couplers shall be manufactured from stainless steel and in accordance to SABS 1063.
- d)
- e) The earth electrode resistance shall not be more than 2 ohms.

4.5.21.e.1 Compliance Certificate

- 4.5.21.e.1.1 The *Contractor* is required to test the installation in the presence of the *Employer's* Engineers and issue compliance certificates for lightning protection and earthing systems (SABS 0313) for all work done to the satisfaction of the *Employer's* Engineers
- 4.5.21.e.1.2 The *Contractor* is required to test the installation in the presence of the *Employer's* Engineers and issue compliance certificates for Low Voltage and Medium Voltage Installations (SANS 10142) for all work done to the satisfaction of the *Employer's* Engineers
- 4.5.21.e.1.3 The contractor shall submit a fully completed and valid compliance certificates to the Employer.

5 List of Drawings

5.1 Drawings issued by the *Employer*

This is the list of drawings issued by the *Employer* at or before the Contract Date and which apply to this contract.

Note: Some drawings may contain both *Works* Information and Site Information.

Drawing number	Revision	Title
1124367-1-273-E-LA-0002-01	OA	Substation SCADA system network topology layout
1124367-1-283-E-LA-0001-01	OA	Main and access road lighting orientation and aiming angles
1124367-1-283-E-LA-0001-02	OA	Main and access road lighting orientation and aiming angles
1124367-1-283-E-LA-0001-03	OA	Main and access road lighting orientation and aiming angles
1124367-1-283-E-LA-0001-04	OA	Main and access road lighting orientation and aiming angles
1124367-1-283-E-LA-0001-05	OA	Main and access road lighting orientation and aiming angles
1124367-1-283-E-LA-0002-01	OA	Minisubstations Cable route Layout
1124367-1-285-E-LA-0001-01	OA	Security fence and Perimeter road lighting orientation and aiming angles
1124367-1-285-E-LA-0001-02	OA	Security fence and Perimeter road lighting orientation and aiming angles
1124367-1-285-E-LA-0001-03	OA	Security fence and Perimeter road lighting orientation and aiming angles
1124367-1-285-E-LA-0001-04	OA	Security fence and Perimeter road lighting orientation and aiming angles
1124367-1-285-E-LA-0002-01	OA	Proposed minisubstations single line diagrams layout
1124367-1-285-E-LA-0003-01	OA	Security fence and CCTV power reticulation layout

1124367-1-285-E-LA-0003-02	OA	Security fence and CCTV power reticulation layout
1124367-1-285-E-LA-0003-03	OA	Security fence and CCTV power reticulation layout
1124367-1-285-E-LA-0003-04	OA	Security fence and CCTV power reticulation layout
1124367-1-285-E-LA-0003-05	OA	Security fence and CCTV power reticulation layout
1124367-0-000-C-LA-0001-01	OA	Locality Layout 1
1124367-0-000-C-LA-0002-01	OA	Key Plan Layout 1
1124367-1-003-C-LA-0003-01	OA	Proposed Layout Services (Sheet 1 of 6)
1124367-1-003-C-LA-0003-02	OA	Proposed Layout Services (Sheet 2 of 6)
1124367-1-003-C-LA-0003-03	OA	Proposed Layout Services (Sheet 3 of 6)
1124367-1-003-C-LA-0003-04	OA	Proposed Layout Services (Sheet 4 of 6)
1124367-1-003-C-LA-0003-05	OA	Proposed Layout Services (Sheet 5 of 6)
1124367-1-003-C-LA-0003-06	OA	Proposed Layout Services (Sheet 6 of 6)
1124367-1-003-C-DE-0013-01	OA	Cross Sections – Access Road – Sheet 1 of 2
1124367-1-003-C-DE-0013-02	OA	Cross Sections – Access Road – Sheet 2 of 2
1124367-1-003-C-DE-0014-02	OA	Long Section: Comms & Electrical
1124367-1-000-C-DE-0012-01	OA	Electrical / Communication
1124367-1-000-C-DE-0012-02	OA	Electrical Mini Sub Layout
15552_C_COM_C_002_01	OA	Duct Trench Details
1124367-1-004-C-LA-0004-01	OA	Proposed Layout : Fence & Security Road(Sheet 1 Of4)

1124367-1-004-C-LA-0004-02	OA	Proposed Layout : Fence & Security Road(Sheet 2 Of4)
1124367-1-004-C-LA-0004-03	OA	Proposed Layout : Fence & Security Road(Sheet 3 Of4)
1124367-1-004-C-LA-0004-04	OA	Proposed Layout : Fence & Security Road(Sheet 4 Of4)
1124367-1-004-C-LA-0004-05	OA	Long Section: Fence & Security Road-East
1124367-1-004-C-LA-0004-06	OA	Long Section: Fence & Security Road-East
1124367-1-004-C-LA-0004-07	OA	Long Section: Fence & Security Road-East
1124367-1-004-C-LA-0004-08	OA	Long Section: Fence & Security Road-West
1124367-1-004-C-LA-0004-09	OA	Long Section: Fence & Security Road-West
1124367-1-004-C-LA-0004-10	OA	Long Section: Fence & Security Road-West
1124367-1-004-C-DE-0004-11	OA	Cross Section: Fence & Security Road-East
1124367-1-004-C-DE-0004-12	OA	Cross Section: Fence & Security Road-East
1124367-1-003-S-DE-0001-01	OA	Main Road and Access Road 10m Light Pole Base Details
1124367-1-006-S-DE-0002-01	OA	Perimeter Fence 3m CCTV Mast Details
1124367-1-006-S-DE-0001-01	OA	Perimeter Fence 9m CCTV Mast Details
1124367-1-006-S-DE-0003-01	OA	Perimeter Fence 15m Light Pole Base Details

SECTION 2

6 Management and start up

6.1 Management meetings

It is the *Employer's* specific intention that the Parties and their agents use the techniques of partnering to manage the contract by holding meetings designed to pro-actively and jointly manage the administration of the contract with the objective of minimising the adverse effects of risks and surprises for both parties.

Depending on the size and complexities of the *works*, it is probably beneficial for the *Employer* to hold a weekly risk register meeting (Clause 16.2). This could be used to discuss safety, environmental, compensation events, subcontracting, overall co-ordination and other matters of a general nature. Separate meetings for specialist activities such as programming, engineering and design management, may also be warranted.

Types of Management Meetings

Title and purpose	Approximate time & interval	Location	Attendance by:
Risk register and compensation events	4 hours Weekly on (or at shorter intervals if required)	On site	<i>Project Manager, Supervisor, Contractor</i> and appropriate key persons
Overall contract progress and feedback	3 hours Every two weeks	On site	<i>Employer, Project Manager, Supervisor, Contractor</i> and appropriate key persons
Technical Meetings	1 hour Daily	On site	<i>Project Manager, Supervisor, Contractor</i> and appropriate key persons
SHE meetings	2 hours Every two weeks	On site	Appointed <i>Contractor</i> and appropriate key persons
Safety and environmental review meetings	1 hour Weekly	On site	Appointed <i>Contractor</i> and appropriate key persons

Meetings of a specialist nature may be convened as specified elsewhere in this *Works* Information or if not so specified by persons and at times and locations to suit the Parties, the nature and the progress of the *works*. Records of these meetings are to be submitted to the *Project Manager* by the person convening the meeting within five days of the meeting.

All meetings are to be recorded using minutes or a register prepared and circulated by the person who convened the meeting. Such minutes or register are not to be used for the purpose of confirming actions or instructions under the contract as these are to be done separately by the person identified in the conditions of contract to carry out such actions or instructions.

The *Contractor* attends management meetings at the *Project Manager's* request as set out in the table above. At these meetings the *Contractor* presents all relevant data including safety, health

and environmental issues, progress reports, quality plans, Sub *Contractor* management reports, as may be required.

6.2 Documentation Control

- 6.2.1 In undertaking the *works* all documentation requirements for the *works* shall be dealt with in accordance with document DOC-STD-0001 – Rev03 (*Contractor* Documentation Submittal Requirements). The control, maintenance and handling of these documents and drawings, using a suitable document control system, remain the sole responsibility of the *Contractor*.
- 6.2.2 The *Contractor* Documentation Schedule (CDS) is as contemplated in DOC-STD-0001 – Rev 03, as contained in the List of Annexures.
- 6.2.3 The *Contractor* documentation “Starter kit”, as contemplated in DOC-STD-0001 – Rev 03, will be issued at the kick-off meeting following award.
- 6.2.4 All contract correspondence is issued through document control. All hardcopy communication will be delivered to the *Employer* via the Lead Document Controller at the project site office document control department.
- 6.2.5 Each supplier of documentation and data to the Project is responsible for ensuring that all documentation and data submitted conforms to the Project Standards and data Quality requirements in terms of numbering, uniqueness, quality, accuracy, format, completeness and currency of information. Data not meeting the Project Standards and data Quality requirements will be cause for rejection and returned to the *Contractor* for corrective action and re-submission.
- 6.2.6 Should any change be made to documentation or data, which has already been submitted to the Project, then new or revised documentation or data shall be issued to replace the out-dated information.
- 6.2.7 All drawings supplied shall comply with the CAD Standards, i.e. ENG-STD-0001, contained in the List of Annexures.
- 6.2.8 It is the responsibility of all Project participants undertaking work on the Project to ensure they obtain and comply with the relevant requirements to suit their deliverables and Scope of Work.
- 6.2.9 The *Contractor* is to ensure that the latest version of the required application software and a suitable ‘IT’ Infrastructure is in place to support the electronic transmission of documentation.
- 6.2.10 Electronic files submitted to the Project shall be clear of known viruses and extraneous “macros”. The supplier of documentation is required to have, at all times, the latest generation of virus protection software and up-to-date virus definitions.
- 6.2.11 The *Contractor* shall be responsible for the supply of all Sub-Supplier/ *Contractor*/ Manufacturer, etc. documentation and data related to their package of work, and shall ensure that these Sub-Suppliers have the capability to supply the necessary documentation and data in the required time-frame and quality as outlined in the specified standards prior to awarding sub-orders.
- 6.2.12 The required number of copies shall as a minimum be three (3) (1x original + 2 x hard copies), with the corresponding PDF and ‘Native’ file formats upon final submission.
- 6.2.13 The *Contractor* shall apply “wet signatures” to the original Documentation before scanning the signed original and prior to formal submission to the Project.
- 6.2.14 Final issues of all documentation shall be supplied to the Project in “wet signature” format along with the associated corresponding electronic ‘native files’ and PDF renditions.
- 6.2.15 The *Contractor* shall ensure adequate resources are available to manage and execute the Document Control function as per the requirements of the Project. (*The Contractor* shall ensure that a dedicated Document Controller is available for the Project)

6.3 Procedure for Submission and Acceptance of *Contractor's* Design

- 6.3.1 The *Contractor's* documentation shall be issued to the *Project Manager* under cover of the *Contractor's* Transmittal Note indicating all Contract references (i.e. Project No, Contract No, etc.) as well as the *Contractor's* Project Document Number, Revision Number, Title and chronological listing of transmitted documentation. Formats of *Contractor* data submitted is dependent on the project procedure and shall be specified by the *Project Manager*, upon the notified request of the *Contractor*.
- 6.3.2 The *Contractor* shall deliver both hard copies and electronic media copies (CD Rom) to the *Project Manager* either at the address stated within the Contract Data or at the Project site office.
- 6.3.3 All electronic documentation shall be submitted by the *Contractor* in Adobe Acrobat (.PDF) and native file format
- 6.3.4 Acceptance of documentation by the *Project Manager* will in no way relieve the *Contractor* of his/her undertaking the *works* (including all incidental services required), the *Contractor* shall conform and adhere to the requirements of the *Contractor* Document Submittal Requirements Standard included within the Annexures (Refer DOC-STD 0001 Rev 03).

6.4 As-built Drawings, Operating Manuals and Data Packs

- 6.4.1 The *Contractor* provides the following:
- 6.4.2 Red Line/Final Documentation
- In undertaking the *works* (including all incidental services required), the *Contractor* shall conform and adhere to the requirements of the *Contractor* Document Submittal Requirements Standard included in the Annexures (Refer DOC-STD-0001 Rev 03).
 - All Red Line information to be signed off by the *Contractor's* responsible Professional/Technologist before issuing to TGC.
- a) Installation, Maintenance and Operating Manuals and Data Books
- 6.4.2.a.1 The *Contractor* provides manuals in an A4 hard covered, red, grease and waterproof binder, using 2 ring type binders. The manuals are well indexed and user friendly and include a summarized Table of Contents.
- 6.4.2.a.2 Drawings and charts larger than A4 are folded and those greater than A3 are enclosed in an A4 plastic pocket of adequate strength.
- 6.4.2.a.3 The *Contractor* submits the draft Table of Contents to the *Project Manager* for acceptance prior to the compilation and official submittal of the manuals.
- 6.4.2.a.4 The originals of all brochures shall be issued to the *Project Manager*. When a general brochure is applicable to a range of equipment, then the specific item, catalogue number or model number shall be stated, which is best achieved by introducing a separate index page, which cross-references the specific item to a tag number.
- 6.4.2.a.5 The address, phone numbers, fax numbers and reference numbers of all Sub-*Contractors* is provided
- Where manuals include drawings that still need to be revised to "As-Built" status, and such manuals are required prior to 'As-Built' status, the manual will not be considered to be in its final form until the "As-Built" version of each such drawing has been incorporated. The required number of copies of the manual (s) shall be as specified by the *Project Manager* and submitted per type or model number of equipment included in the contract, or as specified by the *Project Manager*.
 - All electronic copies (pdf) of Data Packs to be properly indexed.
 - A typical example of what the binder/file (s) shall be marked with on the spine and the front cover is as follows: -
 - Project No./Name
 - Manual Title, e.g. Installation, Maintenance and Operating Manual
 - FBS No. and Title
 - Manual Numbering (e.g. Volume 1 of 2, etc.)

- Contract Number
- *Contractor* Name
- Unless otherwise stated in the CDS, the required number of copies of all As-Built/Final/Data Packs shall be:
 - 3 x hard copies (Full size)
 - 3 x CD Roms with Adobe Acrobat (.pdf) and "Native" formats

6.5 Safety risk management

6.5.1 Health and Safety Standard

The *Contractor* must comply with the requirements of the Project Health and Safety Specification.

6.5.2 *Contractor's* General Requirements for Health and Safety

The *Contractor* is solely responsible for carrying out the work under the Contract having the highest regard for the health and safety of its employees, Transnet's employees and persons at or in the vicinity of the Site, the *works*, temporary work, materials, the property of third parties and any purpose relating to the *Contractor* carrying out its obligations under this Contract.

The *Contractor* must initiate and maintain safety precautions and programs to conform to all applicable Health and Safety laws or other requirements, including requirements of any applicable government instrumentality and client corporate, business unit and site requirements. The *Contractor* must, at its own cost, erect and maintain safeguards for the protection of workers and the public. The *Contractor* must manage all reasonably foreseeable hazards created by performance of the work. The *Contractor* must:

- Provide all things and take all measures necessary for maintaining proper personal hygiene, ensuring safety of persons and property and protecting the environment at or near the Site.
- Avoid unnecessary interference with the passage of people and property at or near the Site.
- Prevent nuisance and excessive noises and unreasonable disturbances in performing the Services.
- Be responsible for the adequacy, stability and safety of all of its site operations, of all its methods of design, construction and work and be responsible for all of the work, irrespective of any acceptance, recommendation or consent by TGC, its *Contractors*, employees, agents and invitees, or any Government Body.

Costs for the above are borne by the *Contractor*.

The *Contractor* must comply and is responsible for ensuring that all of its Sub-*Contractors* comply with the relevant legislation(s) and statutory regulations for health and safety, the Transnet Health and Safety requirements included in the Contract and other document pertaining to health & safety contained in the Programme Health & Safety Management System and include standards, policies, procedures, guidelines and safe work instructions.

6.5.3 *Contractor's* Health and Safety Management

The *Contractor* must prepare, implement and maintain a project-specific Health and Safety Management Plan. The plan must be based on the requirements set out in this specification as well as all applicable legislation. It must cover all activities that will be carried out on the project site(s), from mobilisation and set-up through to rehabilitation and decommissioning.

The plan must demonstrate the *Contractor's* commitment to health and safety and must, as a minimum, include the following:

- A copy of the *Contractor's* Health and Safety Policy; in terms of the OHS Act section 7;

- Procedures concerning Hazard Identification and Risk Assessment, including both Baseline and Task-Based Risk Assessments;
- Arrangements concerning the identification of applicable Legal and Other Requirements, measures to ensure compliance with these requirements, and measures to ensure that this information is accessible to relevant personnel;
- Details concerning Health and Safety Objectives – a process must be in place for setting objectives (and developing associated action plans) to drive continual improvement;
- Details concerning Resources, Accountabilities and Responsibilities – this includes the assignment of specific health and safety responsibilities to individuals in accordance with legal or project requirements, including the appointment of a *Project Manager*, Health and Safety Officers, *Supervisors*, Health and Safety Representatives, and First Aiders;
- Details concerning Competence, Training and Awareness – a system must be in place to ensure that each employee is suitably trained and competent, and procedures must be in place for identifying training needs and providing the necessary training;
- Communication, Participation and Consultation arrangements concerning health and safety, including Safety Observations and Coaching, Toolbox Talks, Daily Safe Task Instructions, project health and safety meetings, and notice boards;
- Documentation and Document Control – project-specific documentation required for the effective management of health and safety on the project must be developed and maintained, and processes must be in place for the control of these documents;
- Processes and procedures for maintaining Operational Control, including rules and requirements (typically contained in Safe Work Procedures) for effectively managing health and safety risks, particularly critical risks associated with working at heights, confined spaces, mobile equipment and light vehicles, lifting operations, hazardous chemical substances, etc.;
- Emergency Preparedness and Response procedures;
- Management of Change – a process must be in place to ensure that health and safety risks are considered before changes are implemented;
- Sub-*Contractor* Alignment procedures – a process must be in place for the assessment of sub-*Contractors* and suppliers with regard to health and safety requirements and performance (before any contract or purchase order is awarded);
- Measuring and Monitoring plans, including a plan for the measuring and monitoring of employee exposure to hazardous substances or agents (e.g. noise, dust, etc.) in order to determine the effectiveness of control measures;
- Incident Reporting and Investigation procedures describing the protocols to be followed with regard to incident reporting, recording, investigation and analysis;
- Non-conformance and Action Management procedures concerning the management of corrective actions;
- Performance Assessment and Auditing procedures concerning health and safety performance reporting, monthly internal audits to assess compliance with the project health and safety requirements, and daily site health and safety inspections; and
- Details concerning the Management Review process followed to assess the effectiveness of health and safety management efforts. Site Supervision

- The *Contractor* shall comply with OH&S Act – Section 8, 9, 13 and 16 and the Construction Regulations 2014.
- The *Contractor* must nominate and appoint a responsible person on site to whom the *Project Manager* may refer in connection with the *works*. Persons are nominated for all shifts worked or whilst any activity relating to the Contract is being performed on site, and must have the authority to bind the *Contractor* with respect to the Contract. (OH&S Act - 16 Section (2)).
- The *Contractor* must ensure that the performance of all specified *works* is supervised throughout by a sufficient number of qualified and competent appointed representatives of the *Contractor*, who have experience in the type of work specified. (OH&S Act – Construction Reg. 8 (1) and 8 (2.))
- Note: No work may commence and or continue without *Supervisory* Appointees present on site. The *Contractor's Site Supervisor* must be equipped with a mobile telephone with message bank and/or pager or an equivalent communication device so that communication throughout the Contract can be maintained at all times.
- The *Contractor's Site Supervisor* must provide a list of names and contact telephone numbers of all *Contractors* and Sub-*Contractor's* contact persons on Site. This list is updated as a new *Contractor* or Sub-*Contractor* employee commences on Site.
- The *Contractor's Site Supervisor* must keep a record of all employees, including date of induction, relevant skills and licences, and be able to produce this list at the request of the *Supervisor*.
- The *Contractor's Site Supervisor* must complete manning sheets describing the day's activities, labour numbers and classifications and issue these to the *Supervisor* prior to 9.00 am on a daily basis.
- The *Project Manager's Site Safety Representative* is notified of any new starter with evidence of induction and site specific induction prior to commencement of work.

6.5.4 *Contractor's* Safety Officer

The *Contractor* must appoint a full-time Health and Safety Officer for the duration of the contract who is registered with the SACPCMP (The South African Council for Project Construction Management Professions). If more than 100 employees are deployed on the project site(s) (directly or through sub-*Contractors*), at least two full-time Health and Safety Officers must be appointed, with an additional Health and Safety Officer appointed for every 100 additional employees thereafter.

The Health and Safety Officer must be on site when work commences at the start of the day and must remain on site until all activities for that day (including the activities of sub-*Contractors*) have been completed. A Health and Safety Officer must be present during all shifts, so if work is carried out over more than one shift per day, the *Contractor* must make provision for an additional Health and Safety Officer.

Each *Contractor* Health and Safety Officer shall be responsible for:

- Reviewing all applicable legal and project health and safety requirements and providing guidance to *Contractor* and sub-*Contractor* personnel (particularly the *Contractor's* Project Manager) to help ensure compliance at all times;
- Assisting with the implementation of effective hazard identification and risk management processes for all work to be carried out by the *Contractor*;
- Participating in the Baseline Risk Assessment for the *Contractor's* scope of work (prior to site establishment) and ensuring that identified control measures are implemented;
- Participating in all Task-Based Risk Assessments conducted for the work to be carried out by the *Contractor* and ensuring that identified control measures are implemented;
- Conducting *Contractor* health and safety induction training for all *Contractor* and sub-*Contractor* personnel;
- Compiling and maintaining all health and safety related documents and records required of the *Contractor*;
- Communicating relevant health and safety information to *Contractor* and sub-*Contractor* personnel (e.g. incidents and lessons learnt, leading practices, hazards, risks and control measures, etc.);
- Carrying out Safety Observations and Coaching (one per day);
- Evaluating (on a daily basis) the content of the Daily Safe Task Instructions (DSTI's) conducted by the *Contractor's* appointed *Supervisors*, and attending at least one DSTI each day;
- Attending monthly *Contractor* and Site Health and Safety Meetings;
- Assisting with the implementation of the *Contractor's* Health and Safety Management Plan and associated Safe Work Procedures;
- Carrying out Planned Task Observations on an ad hoc basis;
- Assisting with the implementation, testing and maintenance of an effective Emergency Response Plan for all *Contractor* and sub-*Contractor* activities;
- Responding to workplace incidents (as appropriate);
- Participating in incident investigations;
- Maintaining accurate health and safety statistics (for the *Contractor* and all sub-*Contractors*), and compiling health and safety performance reports as required;
- Auditing the health and safety management system and workplace activities of the *Contractor* and each sub-*Contractor* on a monthly basis to assess compliance with the project health and safety requirements; and

- Tracking and reporting on the implementation of corrective actions (arising from incident investigations, audits, inspections, etc.).

The *Contractor* must ensure that they have made adequate provision of safety officers as per the *Works* Information. The *Contractor* must ensure that the Health and Safety Officer is adequately equipped to enable him to perform his duties effectively. Each Health and Safety Officer must be provided with the following:

- A computer with access to all necessary systems, including access to e-mail and the internet;
- A mobile telephone on contract or with adequate pre-paid airtime; and
- A vehicle where required or instructed by a nominated project management representative (depending on the size and location of the project site(s)).
- A Health and Safety Officer must be computer literate, fluent in English, and must have the following minimum qualifications, training and experience:
- At least 5 years' experience as a Health and Safety Officer on construction projects;
- SAMTRAC or NEBOSH or Modern SHEQ Risk Management training course as a minimum qualification;
- Experience and appropriate training with regard to implementing and maintaining a health and safety management system compliant with national legislation or an international standard;
- Experience and appropriate training with regard to construction related hazard identification and risk management processes;
- Competence, experience and relevant training with regard to incident investigation procedures and causation analysis;
- Health and safety auditing experience and training;
- A valid First Aid certificate of competency;
- Fire prevention and protection training; and
- A valid Driving Licence (light motor vehicle).
- Registered as a Health and Safety Officer or Health and Safety Manager with SACPCMP depending on the size of the project and on the risk.
- Before placing a Health and Safety Officer on the project site(s), the *Contractor* must forward a copy of the person's CV to the nominated project management representative or to the Programme Health and Safety manager for review and acceptance. A proposed candidate may be rejected should he not meet the experience and/or qualification requirements, or due to poor work performance on previous projects.

6.5.5 *Contractor's* Safety Manual

The *Contractor* must provide a hard copy of its safety manual, policies and procedures to the *Project Manager* for acceptance prior to the commencement of any site work. The *Contractor* must ensure that his personnel, at all times, strictly observe and comply with the procedures set out therein. The *Project Manager* or the *Project Manager's* nominated Representative may from time to time request safety procedures applicable to the area of operations. The *Contractor* must forward to the *Project Manager* any updates or revisions to its safety manuals, policies or procedures as soon as practicable following revision or update.

The *Project Manager* may require the *Contractor* from time to time to supplement its safety manual, policies and procedures with guidelines and/or operating standards provided to the *Contractor* by the *Project Manager*. The *Contractor* must comply with such requests where the request is consistent with the requirements of the Contract. The *Contractor* must give prompt written notice to the *Project Manager* of any objection to the requested supplement, including

the reasons for objection. The *Project Manager's* rights under this Clause are not intended, and must not be construed, to relieve the *Contractor* from any obligations to ensure compliance with all provisions of this Contract.

6.5.6 Performance Measurement and Reporting

a) Health and Safety Statistics

The *Contractor* and each of its Sub-*Contractors* must complete and submit Health and Safety statistics to the *Project Manager* or the *Project Manager's* nominated representative, or as amended by the *Project Manager*, before mid-day on the Friday of each week. The *Contractor* must submit monthly Health & Safety Statistics before mid-day on the last day of each month to the *Project Manager's* nominated representative.

b) Safety Management Records

The *Contractor* must submit to the *Project Manager* for acceptance a schedule of the specific Health and Safety records it intends to maintain for the Contract. As a minimum, such records are as specified by applicable legislation. Copies are provided to the *Project Manager* or the *Project Manager's* nominated Representative if requested.

c) Field Technical/Safety Audit by the *Project Manager*

The *Project Manager* or the *Project Manager's* nominated Representative has the right to conduct audits/inspections of the Consultant, Professional Service Provider (PSP) and *Contractor* Safety Management Plan implementation, operations, equipment, emergency procedures, etc., at any time, and the *Contractor* must fully cooperate with the *Project Manager* or the *Project Manager's* nominated Representative during such audits/inspections. The *Project Manager's* rights under this clause does not, must not and will not relieve the Consultant, Professional Service Provider (PSP) and *Contractor* of its own obligations to conduct audits and reviews of its own Health and Safety performance.

Where such audits/inspections reveal deficiencies in the *Contractor* procedures, drills, training or equipment, or non-conformities with the *Contractor* accepted project Safety Management Plan, of a minor nature (Risk Rating of 6 or less), the *Contractor* must investigate the cause of the nonconformity and initiate corrective and preventive action to rectify such deficiencies and non-conformities and prevent recurrence as soon as practicable.

Where such audits/inspections reveal deficiencies of a major nature (Risk rating of 7 or greater), the *Contractor* must stop work on the operation/activity concerned, immediately investigate the cause of the nonconformity, and initiate corrective actions to rectify such deficiencies and non-conformities and to prevent recurrence. These corrective action plans is submitted to the *Project Manager* for review and comment within 24 hours of the audit finding.

Where such deficiencies include an unsafe practice or a breach of the statutory or the Contract's requirements, the *Project Manager* or the *Project Manager's* nominated Representative may in accordance with the General Conditions of Contract suspend the work associated with the unsafe practice or breach until the deficiency is rectified.

The *Project Manager* or the *Project Manager's* nominated Representative will establish a schedule of regular field safety audits which will be based on an audit tool aligned to the *Contractor* Safety Management Plan and site operations and activities. The *Contractor* audit conformance will be assessed as a percentage and where conformance is better than 90% it will be considered satisfactory and the *Contractor* must develop and implement an action plan within 4 weeks, to be reviewed at the next regular audit. Where the *Contractor* level of conformance is between 75 – 90%, a corrective action plan will be required to be developed and implemented within 2 weeks, and a follow up audit will be carried out. Where the *Contractor* conformance is less than 75% the *Contractor* must stop work until an investigation of the cause/s has been completed and corrective actions have been developed and implemented by the *Contractor*.

The *Contractor* must provide to the *Project Manager* or the *Project Manager's* nominated Representative, at a time to be agreed, but not to exceed monthly intervals, a regular status report on all outstanding corrective actions until they are successfully closed out.

d) Unsafe Act/Condition Auditing

The *Contractor* must implement a system to recognize, correct, and report unsafe acts/conditions (Unsafe Act/Condition Auditing) associated with all Site activities.

All such observations must be recorded and delivered to the *Employer's* Health and Safety Manager.

6.5.7 Involvement, Communication and Motivation

The *Contractor* and sub*Contractor's* workforce must, through their supervision, safety notice boards, toolbox meetings and daily pre-start meetings be kept aware of safety related matters.

a) Safety Meetings

The *Contractor* must implement and comply with OH&S Act, Section 19

The *Contractor* must conduct weekly safety meetings with his employees to foster safety awareness. Copies of minutes and action items arising from such Toolbox meetings is submitted or otherwise made available for review by the *Project Manager* or the *Project Manager's* nominated Representative.

Such meetings should at least address:

- Accident / safety incidents
- Hazardous conditions
- Hazardous materials / substances
- Work procedures
- Protective clothing / equipment
- Housekeeping
- General safety topics
- Job or work look-ahead issues
- Safety statistics
- Significant Safety Occurrences (SSO)

The *Contractor* must conduct at least one formal safety meeting per month and must maintain appropriate records of attendance and meeting content. Such records are made available to the *Project Manager's* Representative. In addition to Daily Safe Task Instructions, the *Contractor* must conduct at least weekly "tool box" meetings to discuss safety issues and procedures.

b) Pre Start Safety Briefings

The *Contractor* must hold documented Daily Safe Task Instructions with each work team before the start of each shift. Attendance records and brief topic notes is kept for auditing and record purposes. Safety Review Meetings

- The *Contractor* Site Manager and a Site Safety Representative must take part in weekly safety review meetings between the *Contractor* and the *Project Manager* or the *Project Manager's* nominated Representative.
- The *Contractor* must attend all project safety meetings as outlined in the Project Safety Management Plan.

c) Site Safety Review Committee

The *Contractor* complies with the requirements of the SSRC with respect to his own activities and others on the Site and Working Areas.

d) HAZOP Review

The *Contractor* participates in HAZOP reviews upon the instruction and direction of the *Project Manager*.

The reviews may include, but not be limited to, studies to ensure that the Plant is built and operated as designed and that personal safety, employee health and environmental protection systems conform to the *Employer's* and legislative requirements.

e) Job Safety Analysis

The *Contractor* completes a JSA prior to carrying out any operation on the Site and/or Working Area to the approval of the *Project Manager*.

f) Lines of Communication

The following personnel act on behalf of the *Project Manager* and may communicate directly with the *Contractor* and his key persons with respect to the SMP:

- Construction Manager (CM)
- Project Site Safety Manager (PSSM)

6.5.8 Roles and responsibilities

- The roles and responsibilities of the various personnel acting on behalf of the *Project Manager* with respect to the SMP and health and safety issues are as stated in the paragraphs following:
- Construction Manager
- The CM is responsible (in the context of the SMP only) for health and safety on the Site and Working Areas and reports to the *Project Manager*.
- The CM specific tasks (in the context of the SMP) are:
- Implement the safety management system
- Monitor compliance to the established safety management system
- Ensure risk is at an acceptable level
- Ensure Consultant Construction Management Team are competent
- Provide for:
- Planning, organisation, leadership and control
- Particular technical competencies for critical work
- Supervision and control on each shift
- Regular monitoring and assessment
- Workplace inspections
- Project Site Safety Manager
- The PSSM is responsible for ensuring that the *Contractor* complies with the SMP. The PSSM acts on behalf of the *Project Manager*.
- The PSSM specific tasks (in the context of the SMP) are:
- Define, in accordance with the HSSP, the:

- Safety program (instructions, training, meetings, inspections, incentive)
- Health and medical program
- Checks that *Contractors* have issued their Health and Safety plans, PPSPS and procedures before the beginning of work
- Organizes safety awareness campaigns
- Promotes communication on all health and safety matters (awards, incentives, meeting/inspections/audits reports)
- Checks conformance of equipment to technical requirements and regulations.
- Issues and address the site EHS activities reports
- Promotes everybody's best efforts to keep accident frequency and severity ratios at their lowest level
- Promotes a proper and continuous housekeeping of Plant and temporary facilities in order to create the most suitable conditions for workers to work and to be encouraged to follow HSE requirements
- Conducts *Worksite* EHS walks with all *Contractors*, and directs appropriate corrective actions
- Monitors that all factors likely to improve health and safety are taken into consideration, particularly those which lead to:
- Promoting personnel protection as an absolute requisite
- Investigating, identifying and neutralizing potential hazards
- Close coordination with all parties involved in construction in order to avoid overcrowded areas and dangerous operations
- Thorough preparation of work critical phases
- Close contacts to local EHS authorities
- Continuous follow-up in order to correct immediately unsafe acts and situations
- In case of accident, he takes actions necessary to:
- Initiate quick interventions of the emergency means.
- Check that first aid and evacuation of injured persons are properly carried out.
- Obtain a clear accident report from the sub-*Contractor* concerned.
- Report immediately to the Construction Manager.
- Investigate to identify the root causes of all incident and near misses.

6.5.9 Commissioning Safety Study

The *Project Manager*, through his Construction Management Team, will facilitate and coordinate a formal Commissioning Safety Study and ensure that required procedures are prepared prior to the commencement of the commissioning phase.

The Commissioning Safety Study will provide a final checkpoint for the completed work and is part of the process for ensuring that all necessary actions have been completed. The elements to be considered include:

- Mechanical and electrical integrity systems are in place (e.g. equipment tests and inspections of critical equipment, quality control procedures, etc.) which will confirm that construction, equipment and materials are in accordance with design specifications

- Formal hazard analyses for pre-commissioning and commissioning activities have been completed, appropriately documented and communicated, and are available to all personnel.
- Punch-list work has been sufficiently completed so that installations are safe to apply hazardous energy.
- Documentation relevant to any modifications has been created/updated.
- Safe operating, maintenance and emergency procedures are in place.
- Operating and maintenance manuals are available and training of commissioning employees has been completed.
- As Built drawings are available.
- A Commissioning Permit (to apply hazardous energy) is developed and implemented.

The *Project Manager* will ensure that after commissioning there is a formal documented hand over to operations and maintenance personnel and others who will be impacted by hazards that have been identified during project activities. This will involve communication of any changes to the process hazards, procedures and operating philosophy. Safe systems of work will be established and updated throughout the Project. Safe systems of work will be subject to on-going review to ensure their effectiveness. Site-wide Permits to Work will be used as the basis of safe systems of work for specified hazardous activities.

6.5.10 Working at Nights

A site specific health and safety management plan should be well documented and structured so that both *Employers* and employees can benefit from its use. The following are recommended components of a safety management plan for night time *Works*.

a) Site personnel responsibility

It should be determined and stated clearly in the site specific health and safety management plan the responsibility of each individual at construction site for night time *Works*. *Project Manager*, Engineers, Designers, Safety Officer and Site *Supervisors* as well as workers each have their specific responsibility to make sure the highest level of priority are given towards safety and health issues.

The *Contractor* must ensure adequate provision of safety officer personnel are present whenever working at night activities are taking place.

b) Permission to work at night

The *Contractor* shall apply in writing for permission to work at night and should be obtained from the relevant authority in this case the *Project Manager*, before construction *Works* at night is carried out. The *Contractor* should submit their application for work at night permit to the *Supervisor* and it is advisable to follow all requirements enforced by the authority to executing night time construction *Works*. It is recommended that Supervisor should also notify TNPA responsible personnel about intended night shift work.

c) Housekeeping

Accidents can occur as a result of poor housekeeping. Hazards at construction site are the same for both day and night shift while the risks of injury are much higher during night *Works* because of the inherent poor illumination. It is essential that the workplace is kept clean and tidy to ensure safety and prevent accidents.

d) Emergency Preparedness and Response (EPR)

Contractor should develop and implement the EPR that is specifically for night time environment and submit for approval before work at night is carried out. A well-established EPR can help both *Contractors* and employees to prepare; response and recover should a disaster occur.

e) Public safety

When construction *Works* involve public area, it is important to make sure the safety of the public. The *Contractor* must consider the following when planning for night time work; identify the hazards for example construction vehicle movement or too much glare from lighting equipment and plan for vehicular movement to not interrupt peak hours and make sure adequate supervision is provided for such movement.

Contractor must provide sufficient signage to warn the public and put barriers at a safe distance to keep the public away.

Set up a safe walk ways where it is unavoidable to work near or in public vicinity.

Arrange noisy equipment or machinery at farthest point from the public or adopt an engineering control to reduce the noise.

When overhead crane is operating near the public, clear off the area and make sure adequate supervision is in place.

Schedule for daily cleaning of the adjacent public road and filling up holes as well as uneven surfaces.

f) Types of Risks and factors affecting night time work

In order to decide when to conduct night time work, factors (parameters) affecting night time work must be identified. The *Contractor* must ensure the following factors are identified:

- Risk
- Illumination
- Nuisances
- Productivity
- Cost
- Safety

The *Contractor* must ensure that they implement the following step in an effective risk management program as to identify possible risks. Specific concerns related to night time work zones include poor visibility and work quality, staffing issues, unwanted noise and glare, decreased worker and driver alertness, impaired drivers, higher vehicle speeds, increased labour costs, materials and traffic control, and problems in logistics and supervision. These risks are categorized broadly as safety, cost/production and schedule, quality, organizational relationships, technical, construction, economic, and environmental.

g) Risk

Night time construction introduces numerous risks to a construction project. One clear set of examples is driver and worker fatigue and reduced visibility, which are factors that could increase safety risks. Other major factors contributing to the risks of night time work are human factors such as sleep, stress, work, social or domestic issues, and psychological characteristics, such as appetite and safety. Additional factors associated with the risks of night time construction work zones are reduced work space for machinery and equipment movement, inadequate lighting, high speed of traffic during the night, and long working hours. Working at night does not supersede the requirements of the Project Health and Safety Specification requirements that enforces compliance during day shift.

6.5.11 Document Control