BHARAT HEAVY ELECTRICALS LIMITED
High Pressure Boiler Plant
Trichy-620014

SPEC NO: FBC&HRSG:47MFT:010/REV00

SPECIFICATION FOR MASTER FUEL TRIP VALVE (MFTV) (GUILLOTINE TYPE ISOLATION GATES)

REVISION HISTORY

REV. No	PAGE	REVISION HISTORY	DATE	Prpd	Revd / Appd
00		Original release	09/11/2009		

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OFFER WITHOUT CE MARKING WILL NOT BE ACCEPTABLE.

CONTENTS

i. Separate blower for each gate to be provided.

j. Close Bonnet with bolt & nut has to be provided for withdrawal chamber also.

k. Stainless steel fasteners & Gaskets (asbestos free) shall be provided.

2.3.1 Gate drive mechanism

a) The electrical actuator shall have provision for local manual operation from floor level, by means of a hand wheel. The force required to operate the gate shall be limited to 35 kgf (maximum) at the rim of the hand wheel.

2.3.2 Seals

a. Guillotine Gates shall be provided with suitable seals viz. leaf / bulb seal etc thus providing sealing chamber for supply of seal air

b. Seal air requirements (for 100% sealing efficiency) shall be provided by seal air blower. Separate blower as a part of gate is advisable (refer Annexure-III). For seal air parameter refer Annexure-I.

c. Entry side i.e port and bonnet seals to be provided to create a seal air chamber

d. All around Continuous seal air chamber to be ensured

e. Outlet of seal air blower to be provided with isolation valve for on line maintenance of seal air blower.

2.4 ELIGIBILITY

Bidders / their collaborator having experience in :

Engineering, Manufacturing and supply of similar Gates/Dampers of same / larger size / operating parameters for coal fired boiler which have completed minimum two years of trouble free operation in any two power plants in India / abroad are only eligible for bidding. Bidder to provide necessary documents to meet the eligibility criteria

2.5 The guillotine isolation gates shall be supplied with CE marking.

3.0 EXTENT OF SUPPLY

The extent of supply stated herein is not necessarily exhaustive and shall not relieve the supplier from his responsibilities to provide goods & services necessary to satisfy the purchaser's performance criteria & required life, to be complete for installation & to be fit for purpose, safe, reliable, easily maintained and efficient in operation.

The extent of supply is as per quantity indicated in Annexure-I

1.0 APPLICATION

Power operated Gas tight Guillotine type isolation Gates along with their drives are provided at coal feeding tracts before the combustion chamber in coal fired boilers for the circulating fluidized bed (for location refer Annexure-II).

2.0 SPECIFICATION & SALIENT FEATURES :

2.1 The specification covers the design, manufacture, testing, and packing for shipment of isolation gate with actuator for the specified duty conditions. Erection supervision may be included as an optional requirement, separately.

2.2 Guillotine Gates are operated by Electrical Actuators (As indicated in Annexure-1)

2.3 GUILLOTINE GATES :

2.3.0 General

a. The Guillotine Gates are located in dusty atmosphere. Vendor to make necessary provisions in the drive systems arrangement in the selection and arrangement of drive system to ensure trouble free operation under dirty operating conditions.

b. The Gate shall have a guaranteed gas tightness efficiency (on flow) of not less than 99.5 % along the duct (flow direction) as well as from the duct to atmosphere or from atmosphere to the duct, depending on the pressure in both gate open & gate closed condition, without the use of seal air.

c. The Gate blade & seals shall be totally out of coal flow path when the gate is in open / close condition hence coal particle which is abrasive in nature.

d. Gate located in vertical duct and the blade is moving horizontally. Vendor has to provide suitable arrangements to take care of the dead load of the gate blade.

e. Gate blade thickness to be selected suitably to withstand high temperature differentials across the gate blade in closed condition (to avoid warping etc., of the gate blade)

f. The gate is supported on upstream and downstream duct through flanges. The extended portion (i.e. super structure) is either to be suitably supported on upstream duct or design the extended portion suitably without any additional supports. If any additional supports required, the support & its details are to be provided by the vendor.

g. Seal air blowers are to be mounted in the gate itself as shown in Annexure-III. If not possible to locate the blowers in the gate itself, blowers without any interference may be mounted in floor elevation 22700 (Refer Annexure-II for further details). For both the conditions seal air blowers shall not be affected by the temp of the flow medium. Necessary steps shall be taken care by Vendor.

h. Seal air to be supplied both open and closed position of the gate seal air blower, piping and all other accessories are part of vendor scope. Exact floor plan will be furnished after award of contract. Tentatively 15meter of seal air pipe to be considered by vendor for estimation for each gate.

7.0 MISCELLANEOUS

OVERALL TRANSPORT LIMITATIONS IN INDIAN ROAD (FOR GUIDANCE):

Width = 3500 mm (normal) & 5000mm (under special condition)
Length = 13000 mm
Height = 3000 mm
Weights = 20000 kg

Vendor shall submit shipping bill of material with packages, identified with over all size, quantity and weight. Over all dimensions shall be as per transport limitations furnished above.

The actuator and accessories may be shipped along with Gate in Separate packages. Instructions to mount them at site shall be submitted. Gate and accessories are to be painted and packaged to take care of corrosion due to sea voyage and rough handling at port & site.

8.0 DOCUMENTS :

Vendor shall submit the following document and drawing in English

8.1 DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER

a) General arrangement drawing with major dimensional details and sufficient cross sectional views for clear understanding of gates indicating the space requirement.
b) Bill of material and material specification
c) Typical Quality plan as per BHEL format (format enclosed in Annexure-VII) including material, fabrication, assembly, bought out items.
d) Type of sealing arrangement
e) All necessary documents / calculations as mentioned in the specifications
f) Comments / deviation for the specification
g) Scope of supply clearly indicating terminal points and exclusions
h) Detailed test procedure for leak tightness is to be submitted for approval with drawing showing the test set up and sample calculations
i) Start-up / commissioning spares, recommended spares list for two years trouble free operation and its cost
j) Document submission schedule
k) Experience list (Reference list) of the Vendor for the application indented and capacity of the Gate supplied.
l) Typical O&M manual

8.2 Documents to be submitted after ordering before manufacturing

a) Revised Quality plan (if any)
b) Test Setup & procedure for Leak tightness test
c) Detailed dimensional General drawing of the total system with cross sectional details
d) Specification for bought out items

4.0 TERMINAL POINTS

The terminal points for the extent of supply shall be

a) Inlet side flange & Outlet side flange (i.e. companion flanges) of Gate with fasteners.
b) Electrical & Limit switch terminal box of the actuator for the Gate
c) Electrical and limit switch terminal box of actuator for seal air isolation valve
d) Blower with seal air piping.

5.0 GENERAL REQUIREMENTS

(i) Seal Material: - Inconel or other superior material which are corrosion resistant and have requisite flexural strength to act as seals at the specified operating parameters.

(ii) Actuator shall be selected in such a way that 40 % of starting torque of actuator shall be matched with maximum torque requirement.

(iii) Actuators are directly mounted on the drive shaft (refer Annexure-III enclosed).

(iv) Time for full opening or full closing not exceeding **one** minute.

(v) Seal air chamber shall be designed such that there is no coal accumulation in the seal air chamber even during gate open condition can be provided.

(vi) The operating temperature is 920 Deg C as given in the annexure –I vendor has to select suitable material to match the operating condition Vendor to submit necessary documents / calculations to prove the suitable of materials for the above operating condition.

(vii) One set of Seals to be supplied as mandatory spares.

(viii) Same material is to be selected for both frame and blade.

(ix) Material used in a existing installation is given for reference. Slide gate materials as per DIN standard is furnished in the table, equivalent material to be used.

SL.No	EQUIPMENT PART LIST	DIN MATERIALS
1	WORKING FRAME	1.4828 X15 Cr Ni Si 20-12 HEAT RESIITING STEEL
2	SLIDE GATE BLADE	1.4828 X15 Cr Ni Si 20-12 HEAT RESIITING STEEL

6.0 TESTING

The Gates/Dampers should be tested in horizontal position at manufacturer's works for operation and leak tightness with & without seal air to prove the guaranteed leak tightness. **This will be witnessed by BHEL representatives.**

For testing the leak tightness, a plenum chamber is to be pressurized to the operating pressure with Gate blade in closed position. Detailed test procedure for leak tightness is to be submitted for approval with drawing showing the test set up and sample calculations. This should be submitted along with the offer.

OFFER WITHOUT CE MARKING WILL NOT BE ACCEPTABLE.

8.3 Documents to be submitted before dispatch

a) Complete inspection / test records of Gate & Actuator
b) Leak test results with & without seal air
c) Raw material Test Certificates
d) Packing drawing & specification

8.4 Documents to be submitted along with Dispatch

a) Shipping list / supply schedule
b) List of spares dispatched
c) O&M manual
   i. 2 Nos of Hard copies
   ii. The CD (2 Nos) should contain only the PDF format of the O&M manual as in the hard copy in duplicate.
   iii. The manual should be in correct A4 size and the drawings are in A3 size only. If the drawings are large in size then it should be reduced in A3 size and inserted in the manual.
   iv. O&M manual should be submitted to BHEL Trichy within a month after all drawings / documents approval in **both French and English language**.
d) Erection and commissioning procedure indicating the sequence (in English for Damper & Actuator)
e) Do's and Don'ts
f) Check list

9.0 PAINTING :

Refer Annexure-IV for painting

For coating refer PCS-3 of doc no. 319000-00000-SP-2300-0001/Rev 04 and for shade use aluminum color (color as per RAL 9006)

10.0 PACKING AND SHIPPING :

Refer Annexure-VIII for painting

For Foreign vendor :

For packing and shipping refer Doc No. 319000-00000-WI-GPC0-0001/Rev 04 & Doc No. 319000-00420-P0 0150 0003 0006 00 & ISPM No 15.

For indigenous vendor

Normal packing and is to be sent to BHEL Trichy.

Note: Packing and forwarding cost to be given separately.

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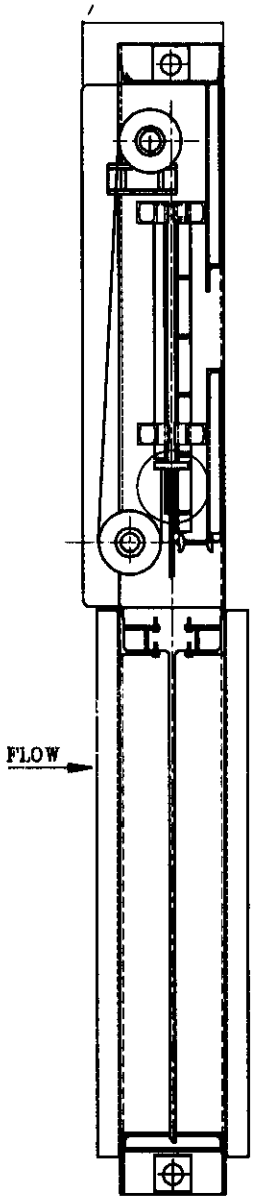
ANNEXURE-I

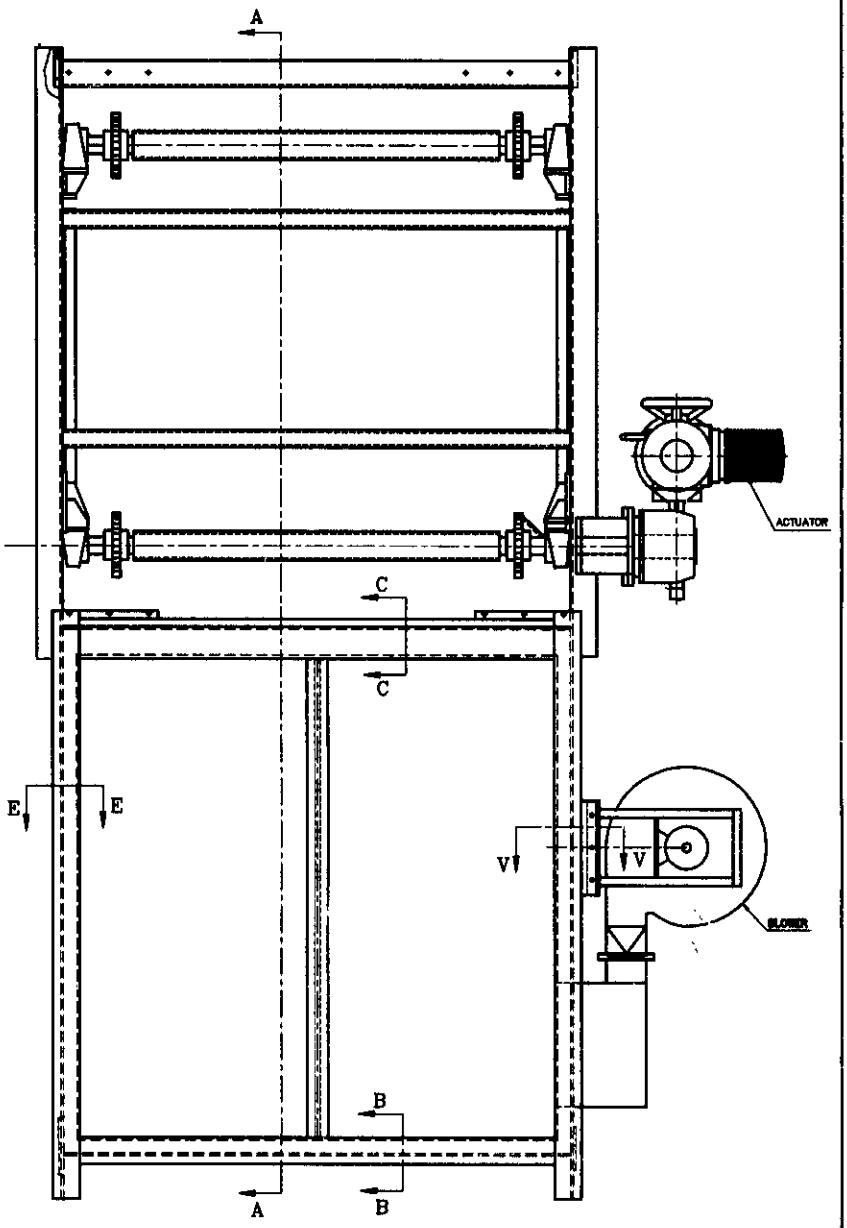
Parameters :

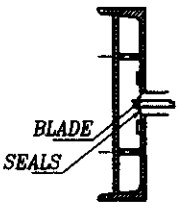
Sl.NO.	DESCRIPTION	UNIT	PARAMETERS
1	Location (Refer Annxure-2 for location of gate)	--	**Out door** **Located in Coal feeding tracts before the combustion chamber.** **(Rotary Valve out let gate)**
2	Type	-	Guillotine gate
3	Duct cross-sectional area	Length X width in mm	Duct Length – 1100mm (Stroke) Duct Width – 600mm
4	Quantity	No.	**04 RH (of sl.no.2) PER BOILER**
5	Gate width Face to Face	Mm	400
6	Function	-	ON/OFF Isolation
7	Drive for Operating the Gate	-	Electrical
8	Coal flow Direction	-	Vertically downward from rotary feeder
9	Movement of Gate Blade Open / close		Horizontal
10	Design Pressure	mm WC	**+2500**
11	Operating Pressure (consider 25% additional margin for actuator selection)	mm WC	**+1000**
12	Site Altitude	m (above MSL)	100
13	Design Temperature	°C	**920**
14	Maximum ambient temperature	°C	50
15	Minimum ambient temperature	°C	15
16	Seal Air Supply	-	**Separate Blower integral of gate OR floor mounted (Refer Annexure-III)**
17	Seal Air pressure	mm WC	**1000+150**
18	Sealing Efficiency without Seal Air	%	99.5
19	Sealing Efficiency with Seal Air	%	**100**
20	Flowing Medium	-	**Coal Partials (Lignite) upstream of the gate & flue gas from downstream of the gate.**
21	Coal Density	Kg/cu.m	**800**

ANNEXURE – III



SECTION–AA





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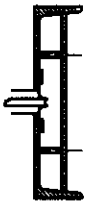

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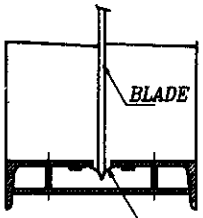

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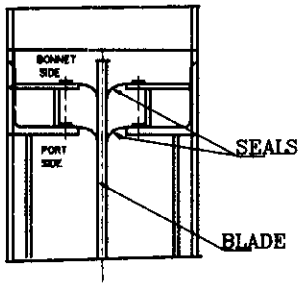


SECTION–CC

ANNEXURE-IV
(Painting Specification)

1. Doc No. 319000-00000-SP-2300-0001/Rev 04 - Protective coatings – 42 Pages
2. Doc No 319000-HT-KNS-PM 0014 / Rev 01 - Color scheme – 2 Pages

Revision History

Rev. No.	Revision Date	Revision Detail
00	23 Jun 2006	Issued for Execution
01	21 Aug 2006	Added PCS for Power Station
02	05 Nov 2007	Issued for Execution
03	09 Jan 2008	Re-Issued for Execution
04	09 May 2008	Revised as marked. Main changes affect the following painting codes in Appendix A: PCS-1A, PCS-5 and PCS-8A (new).

Table of Contents

Appendices:

Appendix A Protective Coating Procedure

Appendix B Finish Colour Coating

1. Scope of Document

This document covers the design philosophy and minimum technical requirements for the surface preparation, the application of protective coatings and inspection and quality control of these operations for the *Koniambo Nickel Project*. Application of protective coatings shall include, but shall not be limited to wharf structures, steelwork, pipework, tanks, pumps and fittings. It shall be used with the equipment datasheets and other documents of the Material Requisition (hereafter referred to as the "MR").

2. General

The service to be offered during coating operations by the coating manufacturer, in particular the practical experience of the technical representative nominated to be responsible for the project, should be stated in addition to guarantees of the technical representative's ready availability to fulfil the various services as they become necessary under this Specification.

The Contractor shall provide evidence of successful history in similar size projects. Preference shall be given to Contractor's certified to ISO 9002 or equivalent or in the process of holding certification.

Prior to work commencing the procedure associated with the surface preparation and application of each coating will, be carried out in the presence of the Contractor, the Applicator (if a separate sub-contractor under the control of the Contractor), HT (Hatch-Technip) and if necessary a Technical Representative of the coating manufacturer. The procedure shall be approved by HT.

Work subsequently found to be carried out in an operation that has not been approved will be redone or improved to enable it to comply with this Specification. Approval for this remedial work shall be at the sole discretion of HT.

The work of surface preparation and the application of protective coatings and the inspection thereof shall be carried out in accordance with this Specification, the coating manufacturer's written technical literature and if necessary under the guidance of a technical representative of the coating manufacturer. Any conflict between these requirements shall be brought to the attention of HT for resolution, prior to work commencing.

The following surfaces are not to be blasted or painted unless directed by HT:

- Machined surfaces.
- Stainless Steel, Aluminium and Titanium.
- Non-ferrous surfaces.
- Surfaces exposed to abrasion or wear.
- Oil and bearing seals.
- Identification tags and nameplates.
- Pulley grooves.
- Rotating surfaces.
- Grease injectors.
- Valve stems.

- Piping which has not been pressure tested.
- Electrical cables.
- Tank internal surfaces (Refer to Tank Lining Specification for tank internal corrosion protection).

The Contractor shall maintain written records of the work in order to maintain complete traceability of all work and materials utilized. These records shall be in accordance with ISO 12944-8: Annex B.

3. Codes, Standards and Registration

3.1 General

The surface preparation for and the protective coating itself shall comply with the requirements of New Caledonian laws, regulations, codes and standards as well as French codes and standards (AFNOR - Association Francaise de Normalisation). Where other Codes and Standards are used, (by Vendors fabricating worldwide), painting procedure shall be submitted to HT to assess their equivalence with French codes and standards. 04

High and ultra high pressure blasting with water shall be shall be carried out in accordance with the requirements set down by 'The Society for Protective Coatings' (SSPC) or the 'National Association of Corrosion Engineers' (NACE) standards.

3.2 Codes and Standards

The following list of standards or equivalent shall be used unless otherwise required by New Caledonian requirements. Relevant Standards that cover these operations are, but not restricted to the following:

EN ISO 12944:1998	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Part 1 - General introduction Part 2 - Classification of environments Part 3 - Design considerations Part 4 - Types of surface and surface preparation Part 5 - Protective paint systems Part 6 - Laboratory performance test methods Part 7 - Execution and supervision of paintwork Part 8 - Development of specifications for new work and maintenance
EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles. Specification and test methods.
ISO 4628 - All Parts	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 1: General introduction and designation system Part 2: Assessment of degree of blistering Part 3: Assessment of degree of rusting Part 4: Assessment of degree of cracking

	Part 5: Assessment of degree of flaking Part 6: Rating of degree of chalking by tape method Part 7: Assessment of degree of chalking by velvet method Part 8: Assessment of degree of delamination and corrosion around a scribe Part 10: Assessment of degree of filiform corrosion
EN ISO 8501-1 2001	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
ISO 8502-2:2005	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 2: Laboratory determination of chloride on cleaned surfaces
ISO 8502-3:1992	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ISO 8502-4:1993	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 4: Guidance on the estimation of the probability of condensation prior to paint application
EN ISO 8502-5:1998	Preparation of steel substrates before application of paints and related products. Tests for the assessment of surface cleanliness. Part 5 : measurement of chloride on steel surfaces prepared for painting (ion detection tube method)
ISO 8502-6:1995	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 6: Extraction of soluble contaminants for analysis - The Bresle method
ISO 8502-9:1998	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 9: Field method for the conductometric determination of water-soluble salts
EN ISO 8503:1995 – All Parts	Preparation of steel substrates before application of paints and related products. Surface roughness characteristics of blast-cleaned steel substrates. Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel. Comparator procedure Part 3: Method for the calibration of ISO surface profile comparators and for the determination of surface profile Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile
ISO 8504-2:2000	Preparation of steel substrates before application of paints and related products - Surface preparation methods - Part 2: Abrasive blast-cleaning
ISO 2808:1997	Paints and varnishes - Determination of film thickness
ISO 2409	Paints and Varnishes - Cross-Cut Test
ISO 4624:2002	Paints and varnishes - Pull-off test for adhesion
ASTM D4752	Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub

ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
SSPC-SP 1	Solvent Cleaning
SSPC-SP 10 / NACE No. 2	Near White Blast Cleaning
SSPC-SP 12 / NACE No. 5	Surface Preparation and Cleaning of Metals by Water jetting Prior to Recoating
NF A91-124	Metallic coatings - Galvanization by immersion in molten zinc (hot-dip galvanizing) - Adhesion test methods

4. Coating Systems

Acceptable manufacturers of coating materials are Carboline, Hempel, International, Jotun, PPG Protective Coatings (Ameron or Sigma). Other manufacturers must be approved in writing by HT. 04

Coating materials shall be from the worldwide range of these manufacturers. Proven performance data and track records shall be submitted to HT for approval of the paint products/systems. 04

The names of the materials stated in this specification are to be regarded as those which designate the minimum acceptable type, quality and performance.

Mixed systems will be rejected, except previously agreed in writing by HT. All materials used in a coating system, shall be of the one brand and brands shall not be interchanged, or inter-mixed at any stage. 04

Coating applied in a mixed system without previous approval will be subject to removal in its entirety and the item recoated in accordance with this Specification. 04

4.1 Alternative Coating Systems

Acceptance of any alternative coating system is subject to agreement in writing by HT.

Experimental coatings or coating procedures or techniques shall not be used.

Any alternative coating system must be documented in full and have a proven service life at least equal to that expected from the specified coating system.

Notwithstanding any agreement to alternative coating systems or brands in connection with this clause, such alternative coatings shall comply in all other respects with this Specification. If the alternative coating is found to be unacceptable, the specified system shall be adopted at no additional cost to the Owner.

5. Materials

All materials used in a coating system shall carry the manufacturer's assurance of compatibility in the coating sequence as specified.

All approved coating materials and thinners shall be brought to the place of the coating application in unopened containers as supplied by the manufacturer. For site application, containers shall be labelled in accordance with New Caledonia laws and regulations and shall include a Material Safety Data Sheet (MSDS) written in French and English. 04

Before commencing application of any coating, the manufacturer's Certificates for each consignment of material delivered to the job shall be checked and the following data verified for compliance with the requirements of this Specification.

- Description of material.

- Vendor's Reference Number.
- Batch Number.
- Quantity in Batch.
- Date of Manufacture.
- Manufacturer's stated Expiry Date.

Mixing, thinning and application instructions as nominated by the coating manufacturer and/or herein specified shall be adhered to and no other addition to the mixed coating shall be used.

Where necessary, the addition of thinners to any coating shall be as recommended by the manufacturer and shall only be of the type and quantity recommended.

The manufacturer's serialised batch reference number shall confirm the age of all coating materials to be three months or less.

All materials after purchase shall be handled and stored in accordance with the Koniambo Chemical Products Procedure (319000-00000-PP-SEHS-0004). All materials after delivery to the shop or site must be stored in a cool dry place, out of direct sunlight and in accordance with the coating manufacturer's recommendations. Where necessary, thinners and paints containing flammable substances shall be stored in accordance with the requirements of New Caledonia Law and any other relevant statutory requirements. After construction any flammable paints, thinners or related materials shall be stored in the designated Flammable Storage Area. Storage areas shall be in an area that prevents environmental contamination.

Any spillage of paints, thinners or associated materials shall be cleaned up and immediate measures taken to prevent environmental contamination. Adequate controls to protect the environment shall be implemented before the commencement of work.

Also, the following HSE issues shall be checked prior to selection of any coating material: 04

- Coatings shall be free from heavy metals, such as arsenic, barium, cadmium, lead, mercury, silver, chromium, and selenium. (However, zinc coatings containing barium sulfate and less than 0.02% lead are acceptable),
- Coatings containing substances recognized for being carcinogenic (e.g. chromate pigments, coal tar) are prohibited,
- Coating components containing aromatic amines are prohibited,
- All coating product shall be free from asbestos,
- Coating products shall comply with the VOC regulation of the place of application,
- Exposure of paint products, solvents or diluents to temperature equal or above their flash point, exposure to heat source, flame source, electrical arc, etc. is strictly prohibited,

Painting Subcontractor shall provide a waste management procedure (abrasive, paint products and containers). 04

6. Surface Preparation

6.1 General

The proposed method of cleaning to be employed for the Project shall be approved by HT prior to the commencement of any cleaning operations.

All steelwork designated to be painted shall be prepared and painted as specified herein. Wear resistant materials shall not be blasted or painted on the wearing surface. Non-wearing surfaces shall be prepared and painted as per this specification.

All surfaces to be coated showing traces of oil, grease or other contaminant shall be thoroughly cleaned with an approved solvent, preferably with an approved emulsifying degreasing agent and washed with clean water before commencement of work. Clean contaminated surfaces in accordance with SSPC-SP-1. Check for contamination and re-clean until surfaces are free of contamination.

All sharp edges and corners, feathering at saw cuts or sharp irregularities shall be ground to a radius of approx. 2.0 mm. Burrs, surface scale, slag, weld spatter and other surface defects such as cracks, laminations and slag inclusions shall be repaired before the commencement of blast cleaning operations. All sharp irregularities, burrs, surface scale, slag and spatter on welds, whether apparent before or after blast cleaning, shall be removed before the commencement of coating application. 04

However, if there is a minor area or section of burrs, surface scale, slag or weld spatter then the paint contractor is expected to be able and willing to remove these before commencement of work. Where these defects are substantial than the paint contractor shall make HT aware of the problem and not begin work. It is not expected that the paint contractor replace the role of a welding inspector.

Field weld regions, no less than 50 mm from the end to be welded, may have the surface prepared prior to welding. After welding the surface shall be prepared to the standard stated below, taking care not to damage any coatings outside of the field weld region.

Procedural tests shall be carried out to establish a suitable technique for achieving the required degree of cleaning and surface profile on each kind of work. Provided this technique is then adhered to, with satisfactory results on smooth non-pitted steel, HT will accept that the required profile amplitude has been achieved throughout.

All galvanized surfaces to be painted shall be prepared and painted in accordance with this Specification and only performed on surfaces as indicated on datasheets or as directed by HT.

All materials used to mask areas requiring protection from blasting and painting operations shall be removed upon completion of blasting and painting activities.

6.2 Abrasive Blast Cleaning

Abrasive blast cleaning shall be carried out in accordance with ISO 8504-2, Class Sa 2½ (near white metal) as a minimum.

The types and sizes of abrasive and the equipment and procedure, for each kind of works shall be such that the required standard of cleaning can be achieved on any surface and that the required standard of profile can be guaranteed on sample surfaces originally smooth and un-pitted.

Where dry blast cleaning techniques are employed, the use of silica sand, flint or ilmenite is NOT permitted. Testing for contamination of abrasive material will be performed before blasting commences and meet the following requirements: 04

- Contain less than 1% free silica.

- Be free of harmful quantities of toxic metals.
- Contain less than 10 ppm water soluble chlorides.
- Contain less than 20 ppm of soluble sulphates.
- Be free of clay, limestone, shells, undersize and oversize particles, organic materials, and other detrimental foreign materials.

The grit blasting Contractor must obtain a certificate from the abrasive supplier that the abrasive meets these requirements. A copy of this certificate must be submitted to HT prior to the commencement of work.

All steelwork shall have a blast cleaned surface with a profile of not less than 35 µm or greater than 50 µm (or as detailed in the procedure sheets) as measured by a probe type surface profile gauge, or as established by the use of a comparator gauge. Approved sets of reference plates may be used for the routine estimation of surface roughness.

HT shall be notified of any areas of steelwork and piping that are inaccessible to blasting and coating. HT will advise the action to be taken.

The compressed air supply used for abrasive blast cleaning shall be free of water and oil. The design of the compressed air system used for blasting should be such that all available technology is adopted to eliminate moisture, oil and other contaminants associated with high-pressure compressed air. The use of a refrigerated air drier, or other suitable method of cooling the compressed air supply, is highly recommended. A blotter test shall be performed once per day to verify the purity of the air. The filtration systems of the compressed air supply shall be inspected and approved prior to the commencement of any surface preparation work. These systems shall be cleaned at least once a week and may be supervised by HT. In no case shall compressed air with a temperature in excess of 110°C be allowed. Air pressure at the blast nozzle must not be less than 690 kPa(g), and shall be regularly checked with a pressure gauge.

Blast cleaning shall NOT be conducted when:

- The steel surface is less than 3°C above the dew point. 04
- The relative humidity of the surrounding air is greater than 85%.

A psychrometer shall at all times be available to operators to determine the relative humidity and the relative humidity shall be checked and recorded before the commencement of all blasting operations and at other times as deemed necessary.

Blast cleaning shall be permitted only during daylight hours except that rough blasting is permissible, with prior approval from HT, during the night if the surfaces cleaned during the night shift are re-blasted to the specified standard in daylight.

Maximum speed and most effective cleaning are obtained by systematic, even blasting. Manual work should be blocked out in squares and each square blasted evenly until complete.

When blasting is carried out in the open, for example on site repair of protective coating after site welding, it shall not be performed in areas close to other painting operations or where spent blast media may impinge on soft or freshly painted surfaces. Ensure that all nearby equipment is protected effectively from overblast or overspray to prevent damage or ingress of grit, particularly to rotating parts and equipment.

All welded areas and appurtenances shall be given special attention for removal of welding flux, particularly in confined areas.

Welding spatter, slivers and all surface defects including cracks, surface laminations, porosity and deep pitting, likely to be detrimental to the protective coating system, exposed before or during abrasive blast

cleaning operations, shall be removed by grinding and re-blasting the affected area. If grinding is not able to repair the defects in accordance with the relevant fabrication requirements other repair processes shall be performed as necessary prior to regrinding and re-blasting. After re-blasting the surface shall be checked again for defects.

Immediately after blasting operations are completed, the steel surface shall be brushed down with fibre bristles or blow down with clean dry compressed air, giving particular attention to corners, intersections and horizontal areas where settlement of dust would be most likely to occur.

After blasting, test surfaces for soluble salts. This testing is required as a final acceptance test of prepared surfaces. Soluble salts shall be kept below the level specified by the manufacturer. Where the level of soluble salts is not specified by the manufacturer then the level of soluble salts present shall not exceed 10 ppm for soluble chlorides and 20 ppm for soluble sulphates. Surfaces which exceed these amounts shall be cleaned as per section 6.4 of this specification.

If in the opinion of HT these methods do not satisfactorily remove all contaminants from the surface of the steelwork, particularly horizontal surfaces, then vacuum cleaning of the steel shall be carried out at no additional cost to the Owner.

Blasting operators shall at all times wear recognised safety clothes and helmets. Helmets shall be ventilated with clean cool air served through an approved filter and regulator capable of removing all impurities and smell from the air supply.

Blasting equipment shall be fitted with dead man control to start and stop the flow of abrasive. Also, earthing of blasting nozzle and item/substrate to be blasted is of the responsibility of the Subcontractor. 04

6.3 Whip Blasting

Whip blast cleaning is required when:

- Recoating very hard coatings such as epoxies. For example, when localized repair is required, the area adjacent to the repair has to be whip blasted to provide an adequate key for the coating system being applied.
- Supplier's minimum recommended recoating interval is exceeded during application of 2-pack coating systems.
- Coating of hot dip galvanized surfaces.

To achieve a clean whip blast finish the following procedures shall be used:

- Air blasting pressure not exceeding 275 kPa.
- Abrasive grades between 0.2 – 0.5 mm.
- Abrasive material – clean dry media.
- Blast nozzle held at about 45° to the surface at a distance of 300 – 400 mm from the surface.

6.4 Water Jetting

High or ultra-high pressure water jetting may be permitted where steelwork has been previously grit blasted and/or painted. This method is recommended for the removal of salt contamination.

Such preparation shall be carried out in accordance with the recommendations and requirements of SSPC-SP 12 / NACE No. 5.

The wash water is to be of potable quality and a soluble salt remover, such as Chlor Rid, shall be added to the water at a remover/water ratio as specified by the manufacturer. The water and remover shall be mixed at the specified ratio in a pre-mixer tank.

Attention is drawn to the dangers associated with the use of high pressure water lances, particularly inside the confines of an operating refinery. The Contractor shall provide details of its proposed methodology to HT for review and acceptance prior to the commencement of any cleaning operations.

This methodology statement shall provide the following information as a minimum:

- Details of type and capacity of all equipment proposed.
- Safety plan for the management of blasting operation including the number of personnel involved in controlling access to the pumping equipment and work area.
- Details of protection barriers proposed to isolate the worksite from adjacent work areas and personnel.
- Details of controls proposed for the containment of waste water and materials as well as any other environmentally unfriendly by-products of the cleaning operations.
- Proposed method of protecting adjacent unaffected steelwork etc. from damage or contamination by debris and spent water.
- Details of the inhibitor proposed in order to eliminate flash rusting.

6.5 Other Methods of Cleaning

If the Contractor wishes to propose a method of cleaning and/or preparation not covered by this Specification, a request for approval, specifying all details and preferable providing test samples, shall be submitted to HT for review and acceptance. No work, using the proposed methodology, shall be performed prior to receiving acceptance of the alternative process from HT in writing.

In particular, power tool cleaning to SSPC-SS11 (white metal) is acceptable to field welded joints. 04

6.6 Care of Abrasive Blast Cleaned Surfaces

Blast cleaned surfaces shall be kept free of any contamination and shall not be touched by bare hands and to this end, operators shall wear clean gloves. Any areas inadvertently touched or handled shall be re-blasted immediately.

Abrasive blast cleaned surfaces showing scale, sharp gouges, surface scale, surface laminations or other surface defects that become apparent after blast cleaning shall be repaired by chipping or grinding before the prime coating is applied. The surface under the defect thus removed shall be cleaned to a class Sa 2½ minimum finish and where necessary further blast cleaning shall take place to ensure compliance with this Specification. No extra payment will be made for any work that may be necessary or may be ordered to satisfy these conditions of the Specification.

The application of the prime coat to abrasive blasted surfaces shall commence within four hours of the commencement of blasting, and shall be completed on that day and while the surface temperature of the steelwork is at least 3°C above the dew point. 04

Generally, surfaces that are blast cleaned mid-morning, prior to the midday break, shall be primed prior to that break, and similarly, surfaces blast cleaned in the afternoon shall be primed prior to cessation of that day's work.

Any work blast cleaned and left overnight uncoated, or any surface which shows any trace of discolouration from any cause shall be re-blasted before the prime coat is applied. Any surface that needs to be re-blasted as a result of being left overnight shall be at the Contractor's expense.

For steelwork abrasive blast cleaned in or near the open, any wetting from rain during or after cleaning but before prime coating shall result in the whole segment of steelwork affected being re-blasted at the Contractor's expense.

6.7 Pipework

Gasket contact surfaces and raised faces on pipe and equipment flanges shall be protected from projection of abrasive. 04

Surfaces that do not require painting, such as stainless steel surfaces, non-metallic surfaces, piping joints which have not been pressure tested and valve stems shall not be abrasive blast cleaned. 04

Field weld margins, 50 mm or advised otherwise, may be abrasive blast cleaned prior to welding and installation but, shall not be coated until after installation. After installation the field weld margin shall be cleaned and re-blasted prior to coating.

All materials used to mask areas requiring protection from blasting and painting operations shall be removed upon completion of blasting and painting activities.

HT shall be notified of any areas of steelwork and piping that are inaccessible to blasting and coating. HT will advise the action to be taken.

7. Application of Coatings General

The provisions of this clause shall apply to the application of all protective coatings in the workshop and/or on site.

Under no circumstances shall coatings be applied over moisture on the surface of the metal or previous coating.

Effective controls shall be established to preclude blasting, priming or top coating operations in unsuitable weather. These controls shall be subject to interpretation and approval by HT, who shall be empowered to order work to be performed or not performed.

Work shall NOT be performed in the following circumstances:

- If the surface is wet or likely to become wet after blasting or before prime coating or finish coating.
- On surfaces where condensation is likely to form, for instance when the surface temperature of the steel is less than 3 °C above the dew point of the surrounding air. 04
- When the relative humidity of the surrounding air is greater than 85%.
- When the ambient temperature, or the temperature extremes of the surface to be coated, exceeds 40 °C or is less than 10 °C (except otherwise recommended by the Coating Manufacturer).

The Applicator(s) shall provide test panels for each coating system prepared, primed and finish coated in accordance with this Specification. Destructive testing for coating thickness and adhesion shall first be carried out on test panels. Where the coating fails on a test panel, then articles coated with that coating shall be tested.

HT may carry out spot proof tests to gauge physically the coating thickness by using a Tooke Gauge to cut into a small section of coating. Two tests may be carried out for each section coated, the test piece being taken from the same area as the test for adhesion. If the tests indicate that such areas do not

comply with the Specification any necessary repair and/or re-coating shall be carried out at the expense of the Contractor.

Repairs to a coating to enable it to comply with the Specification shall be carried out to the entire satisfaction of HT using only those techniques, materials and procedures which have been reviewed and accepted in writing by HT.

Not withstanding any of the above, any area of defective coating which is not suitable for repair or over coating, shall be re-blasted and re-coated in accordance with this Specification. 04

Excluding inorganic zinc coatings, coatings shall be allowed to cure as specified in the manufacturer's data sheets before application of successive coatings. Inorganic zinc coatings shall be tested for complete hydrolysis before application of successive coatings. 04

After the application and curing of each section of coating, carried out in a continuous operation, it shall be checked and the result recorded. Coatings shall be checked for dry film thickness, adhesion, pinholing and 100% visually scanned for other defects, to the steel and/or coating layers. Tests shall be carried out for each section of the work and shall be performed in accordance with the requirements of the applicable standards. 04

Paint thickness in this Specification, unless noted otherwise, refers to minimum dry film thickness.

Coating thickness shall not exceed the maximum thickness recommended by the Coating Manufacturer. In case of excessive over thickness, the Contractor's proposal for removal of the excess coating and/or reinstatement in accordance with this Specification shall be reviewed and accepted in writing by HT prior to the rework commencing. All rework shall be carried out to HT's satisfaction. 04

Where proof coating thickness tests and adhesion tests are made and reveal that the coating complies with the Specification, the test area shall be repaired as herein specified for local scratch damage to each of the relevant coatings. The cost of this work shall be included in the Contractor's relevant schedule unit price.

For field application, no coating shall be applied until the surface preparation / previous coating has been inspected and accepted by HT. 04

Field welds shall not be primed closer than 50 mm to a welding surface unless approved by HT and a weldable primer is used. Inaccessible surfaces of steel parts that cannot be primed after bolting shall be primed prior to bolting or welding.

7.1 Application of Prime Coatings

All steelwork requiring a prime coat as per the requirements of the Coating Specifications in Appendix A shall receive a complete prime coat in the workshop or on site. Bolt holes shall be coated completely through thickness of the material.

Machined surfaces, Stainless Steel, Aluminium, Titanium, ceramic surfaces, surfaces exposed to abrasion or wear, oil and bearing seals, identification tags and nameplates, pulley grooves, rotating surfaces and grease injectors shall be masked prior to the commencement of prime coating application.

After the steelwork has received the surface preparation specified herein, and accepted by HT, the prepared surfaces shall have the prime coating applied within the time limits previously specified. Coating material that has been mixed for longer than three hours shall be discarded, even if still liquid.

The applied coating shall be smooth and uniform without runs, beads, pinholes or other imperfections. Areas of coating that exhibit defects of a sudden or local nature, or insufficient film build, shall be blast cleaned and recoated in accordance with this Specification.

Except for inorganic zinc silicate primers, areas which exhibit insufficient film build of an overall nature may be sprayed with a further coat to achieve the minimum specified dry film thickness, provided that the surface is clean, dry, free from dry spray or other foreign matter, and that the adequacy of the existing surface profile to achieve proper adhesion by the overcoat is established on a test area. 04

Areas exhibiting low film thickness, which after inspection is considered inadequate for the adhesion of a further coat of primer, shall be re-blasted and the coating re-applied in accordance with this Specification.

7.1.1 Steelwork at ambient temperature

Surfaces included, but not limited to, are structural steelwork, pipework, tank externals, pumps and fittings operating at a surface temperature of less than 105°C.

Prime coating shall be a two component, polyamide-cured zinc epoxy coating containing no less than 80% in weight of metallic zinc in the dry film. 04

The coating shall be applied by conventional air atomised or airless spray equipment to achieve a minimum dry film thickness of 50 µm, using even parallel passes at a constant distance from the surfaces, overlapping each previous pass by 50%. All edges, corners, holes, welds, bolt heads, nuts and washers etc. shall be stripe coated by brush immediately prior to the full application by spray.

The two part primer shall be mixed, using mechanical equipment, in strict accordance with the manufacturer's written instructions. In order to achieve full cure and chemical resistance, thinning rates shall be strictly controlled and only as recommended by the manufacturer. Thinners shall not be added until after the components have been thoroughly mixed and any relevant induction period observed. Under no circumstances shall freshly catalysed material be added to coating material that has been mixed for some time.

7.1.2 Steelwork Subject to Chemical Splash

Surfaces included or excluded shall be identified on the datasheets or equipment specific specification.

Prime coating shall be a two component, polyamide-cured, adhesion promoting, epoxy primer able to withstand a pH range between 3 and 10. Where steelwork will be subject to chemical splash, vapour and/or condensate, coating application shall be applied as for steelwork. However, particular attention must be made to ensure that all areas that are normally prone to coating failure, e.g. corners and edges, weld areas, bolt heads, nuts and washers, ends of structural sections and edges of gusset plates etc., are completely envelope coated and that the entire surface is free from pinholes.

7.1.3 Steelwork Subject to Elevated Temperature

Steelwork that is subject to temperatures in excess of 105°C but, less than 400°C shall receive a complete prime coat in the workshop. Bolt holes shall be coated completely through the thickness of the material.

Surfaces shall be prepared by abrasive blast cleaning as previously specified herein, except that the surface profile shall be not less than 40 µm or more than 55 µm. After acceptance of the preparation by HT, the steel surfaces shall be coated with the prime coating within the time limits previously specified herein.

Prime coating shall be a two-component, moisture curing, inorganic zinc-rich ethyl silicate coating containing no less than 80% in weight of metallic zinc in the dry film. 04

The coating shall be applied by conventional air atomised spray equipment to achieve a minimum dry film thickness of 65 µm in one coat, using even parallel passes at a constant distance from the surface, overlapping each previous pass by 50%. 04

The two component primer shall be mixed, using mechanical equipment, in strict accordance with the manufacturer's written instructions. Immediately following mixing, coating material shall be transferred to an agitated pressure pot where it will be kept in continuous motion so that the zinc component is kept in suspension until application is complete.

Attention is drawn to the curing regime of ethyl silicate prime coatings. These coatings require the uptake of moisture from the time of mixing until the completion of cure. In order to ensure effective curing, the relative humidity in the vicinity of coating operations, from the time of mixing and application up to the completion of initial cure, must be above 60%. This requirement must be strictly observed in order to prevent the premature failure of the coating.

Complete hydrolysis shall be checked by MEK-rub test as per ASTM D4752 before recoating. 04

Coating material that has been mixed and agitated for longer than six hours shall be rejected even if still liquid.

The applied coating shall be smooth and uniform without runs, beads, pinholes, mud-cracking or other imperfections. Areas of coating that exhibit defect of a sudden or local nature of insufficient film build shall be blast cleaned and recoated in accordance with this Specification. 04

7.1.4 Steelwork – Hot Dip Galvanized

Steelwork items which have been designated to be hot dip galvanised shall be prepared as previously detailed in section 6 of this Specification.

All edges and corners shall be ground to a minimum radius of 2.5 mm and all sharp irregularities, burrs, surface shell, slag and spatter on welds, whether apparent before or after preparation, shall be removed before the commencement of coating application.

After cleaning, items shall be hot dip galvanised in accordance with requirements of NF A91-124 and NF EN ISO 1461. 04

A minimum coating mass of 680 g/m² shall be achieved on all articles. It is not necessary to achieve specified coating deposit on the inside of hollow section members.

After galvanising the surface of articles shall be smooth and uniform with no defects, holidays, surplus zinc deposits, or other residues.

Galvanized surfaces that have been nominated for a top colour coating shall be whip blasted after galvanizing. The surface shall be assessed as per this specification and accepted by HT before the next coat is applied. The prime coat shall be a two component, polyamide-cured, adhesion promoting, epoxy prime coating with a dry film thickness of 50 µm.

7.1.5 Pipework

Where uninsulated pipework is expected to operate with a surface temperature less than 105°C, the prime coating shall be the same as for Steelwork.

Where uninsulated pipework is expected to operate with a surface temperature greater than 105°C but, less than 400°C the prime coating used shall be the same as for Steelwork Subject to Elevated Temperatures. 04

Where insulated pipework is expected to operate with a surface temperature less than 200°C, the prime coating shall be an epoxy-phenolic coating, at dry film thickness of 100µm. 04

Where insulated pipework is expected to operate with a surface temperature greater than 200°C but, less than 400°C the prime coating used shall be the same as for Steelwork Subject to Elevated Temperatures. 04

Gasket contact surfaces and raised faces on pipe and equipment flanges shall not be coated and shall be protected from paint projection. 04

Piping joints which have not been pressure tested shall remain uncoated until pressure testing is performed. 04

Piping with stamped piece marking shall have the stamped area masked off after application of the prime coat. When assembled the masking shall be removed, the primed steel surface prepared and the appropriate finish coat applied.

Piece marking using paints or permanent markers to an already coated surface shall be done using materials which are compatible to the painting system.

The coated pipework shall never be placed in direct contact with another coated pipe: provision for protection shall be made during coating application, storage, transport and installation at the project site.

7.1.6 Power Station Equipment

The internal surfaces must be free of scale and corrosion after erection to ensure that the plant cleaning and flushing requirements are reduced significantly. During fabrication, all material is blast cleaned as specified in section 6.2.

There are various temporary rust preventive products available on the market, one of them is described below, but alternate can be submitted to HT approval: 04

Apply one coat of temporary protective solvent phosphate based compound such as, Henkel Technologies' Paintgrip 253, to the internal surfaces of all equipment within the total water/steam cycle, i.e., steam, feedwater and condensate piping, feedheaters, condensers, vessels, etc. within the Boiler and STG plants. This compound will provide protection for a period of approximately 6-9 months undercover. Internal weld seams, on completion, to be brushed cleaned and coated.
Painted components are not to be exposed to the weather. Rainfall will remove the coating and surface corrosion will be rapid.
The Paintgrip 253 will tend to wash off during the hydro testing. Following hydro testing all openings are capped and secured against ingress of moisture. Paintgrip 253 is not harmful to the normal boiler feedwater chemical treatments and will be removed in the initial operation of the plant.

For the protection of external surfaces of low alloy steel piping and vessels in the high temperature areas of the plant (temperature between 450°C and 560°C), particularly those containing Cr, Mo, Nb, Ni, etc., the use of coating products containing zinc, lead, copper or tin is not permitted. Titanium ester containing paints or silicone-based coatings paints are acceptable in this case. 04

04

For flanges, flange nuts & bolts, flange bolt holes and flange faces (excluding the raised face) apply one coat of Molybond's 1PX1 coating system, or equivalent. 04

7.2 Application of Finish Coating

All steelwork shall have a finish coating applied. The finish coating shall be as specified in the Coating Specifications in Appendix A.

Before the specified finish coating is applied, the entire surface coated with the prime coat shall be checked for contamination by dust, foreign matter or other contaminant. The finish coating shall only be applied to thoroughly clean and dry surfaces. Finish coating shall be applied within the manufacturer's specified maximum overcoating time of the primer coat.

Any contamination of the surface shall be rectified to the satisfaction of HT, by thoroughly washing with clean water or other method approved by HT, depending on the degree and type of contamination.

The finish coating shall be mixed in strict accordance with the manufacturer's written instructions. Pot life of a mixed coating shall be as specified by the coating manufacturer.

The coating may be applied by airless or conventional air atomising spray equipment to achieve a minimum dry film thickness as specified in the protective coating system, using even parallel passes at constant distance from the surface, overlapping each previous pass by 50%. When this coating is to be applied over an ethyl silicate zinc primer, attention is drawn to the necessity to apply a tack coating (or tie-coat) initially to seal the prime coating pores, with further passes to achieve the nominated minimum dry film thickness. Reduction/thinning of the material to produce a tack coating consistency shall be in accordance with the manufacturer's recommendations.

All edges, corners, holes, bolt heads, nuts and washers, etc. shall be stripe coated by brush immediately prior to the full application by spray.

The finished surface shall be smooth and uniform without runs, sags, beads, pinholes, curtaining, bubbles or other imperfections. Any such defect that occurs shall be removed by sanding the defective coating and the surface shall be recoated in those areas with the same material, all to the satisfaction of HT.

Areas which sustain damage or scratching shall be repaired in accordance with the requirements of this Specification.

Where the metal substrate has been exposed and depending on the size of the area damaged, the damaged area shall be abrasive blast cleaned or disc sanded to bright metal and prime and finish coats applied in accordance with this Specification.

Notwithstanding the above provisions, the primer repair coating shall be the original primer. If the area to be repaired is of a substantial nature rather than a local scratch, the proposed repair procedure shall be such that the adjacent finish coating is 'washed' off of a margin of undamaged primer to avoid sandwiching of repair prime coating between finish coats.

7.2.1 Steelwork at ambient temperature

Finish coating to steelwork shall be two component, high solids, high build, polyamine-cured epoxy coating with a dry film thickness of 200 µm. If exposed to solar radiation, a UV resistant 50µm-thick topcoat is to be applied (see appendix A) 04

7.2.2 Steelwork Subject to Chemical Splash

Finish coating shall be two component, high solids, high build, polyamine-cured epoxy coating, applied in two separate coats with a dry film thickness of 125 µm for each coat. In order to achieve the best possible protection against chemical splash each coat shall be allowed to cure completely before the next coat in accordance with the manufacturer's recommendations for the atmospheric conditions at the time of application.

Particular attention must be made to ensure that all areas that are normally prone to coating failure, e.g. corners and edges, weld areas, bolt heads, nuts and washers, ends of structural sections and edges of gusset plates etc., are completely "envelope" coated and that the entire surface is free from pinholes and holidays.

7.2.3 Steelwork Subject to Elevated Temperatures

Surfaces of steelwork which are subject to temperatures in excess of 105°C that are exposed to the elements i.e. wind, rain or airborne chlorides, shall receive a finish coat, applied in the workshop prior to delivery to site.

Finish coating shall be a heat resistant silicone-based coating, with a dry film thickness of 40 µm, applied in two coats.

Any contamination of the surface, including white zinc salts formed on the surface of cured inorganic zinc prime coating, shall be entirely removed to the satisfaction of HT by brushing with fine bristles, thoroughly washing with clean water or other method approved by HT, depending on the degree of contamination.

Surfaces of steelwork which are subject to temperatures in excess of 105°C that are under insulation shall have a coating of inorganic zinc silicate with a dry film thickness 75 µm. This coat shall be applied, cured and tested before any insulation is installed.

7.2.4 Steelwork Subject to Marine Environment (immersion or splash zone)

All steelwork, other than galvanised steelwork, including piles, fender piles, headstocks, beams etc forming part of a wharf structure shall have a high solids polyamine-cured epoxy coating with a dry film thickness of 400µm in two coats of 200µm each, as identified in Appendix A, Coating Specification PCS-5. 04

7.2.5 Steelwork Subject to Marine Atmosphere with Coloured Top Coat

Finish coating shall be two component, high solids, high build, polyamine-cured epoxy coating, with a dry film thickness of 200 µm. If exposed to solar radiation, a UV resistant 50µm-thick topcoat is to be applied (see Appendix A). 04

7.2.6 Steelwork – Hot Dip Galvanized

For steelwork that has been nominated for a top colour coating and prepared in accordance with section 7.1.5. The finish coating shall be a two component, high build, re-coatable aliphatic isocyanate-cured, acrylic polyurethane finish coating with a minimum dry film thickness of 50 µm.

7.2.7 Pipework

Where uninsulated pipework is expected to operate with a surface temperature less than 105°C, the finish coatings shall be the same as for Steelwork. Where uninsulated pipework is expected to operate with a surface temperature greater than 105°C the finish coating used shall be the same as for Steelwork Subject to Elevated Temperatures.

Where insulated pipework is expected to operate with a surface temperature less than 200°C, the finish coating shall be an epoxy-phenolic coating, at dry film thickness of 100µm. 04

Surfaces of pipework which are subject to temperatures in excess of 105°C that are under insulation shall have a coating of inorganic zinc-rich silicate containing no less than 80% in weight of metallic zinc in the dry film, at a dry film thickness of 75 µm. This coat shall be applied, cured and tested before any insulation is installed. 04

7.3 Application of Colour Coating to Steelwork

All steelwork specified as being colour coded which has been prime and finish coated shall have a colour coating applied in the workshop prior to delivery to site. Colour coating shall be an isocyanate polyurethane coating. This is a UV-resistant finish coating and shall be applied to all steelwork with a surface operating temperature of less than 105°C and exposed to outdoor sunlight.

Colours to be used for pipework shall be in accordance with the Project's specification for Piping Marking and Identification (319000-00000-JSD-1300-0013).

Before the colour coating is applied the entire surface coated with the finish coating shall be checked for contamination by dust, foreign matter or other contaminant. The colour coating shall only be applied to thoroughly clean surfaces.

Any contamination of the surface shall be entirely removed prior to application of the colour coating, by a thorough washing with clean water, or other method which has been approved in writing by HT, depending on the degree of contamination.

The colour coating shall be mixed in strict accordance with the manufacturer's instructions. Any coating material which has been mixed for longer than four hours shall be discarded even if still liquid.

The coating may be applied by airless or conventional air atomising spray equipment to achieve a minimum dry film thickness of 50 µm. 04

The finished surface shall be smooth and uniform without runs, sags, beads, pinholes, curtaining, bubbles or other imperfections. Any such defect that occurs shall be removed by sanding the defective coating and the surface shall be recoated in those areas with the same material.

Areas which sustain damage or scratching shall be reinstated in accordance with the requirements of this Specification.

7.4 Coatings to Internal Surfaces of Sealed and Box Sections

7.4.1 Internal Surfaces – Limited Access

The internal surfaces of large, fully sealed, fabricated hollow enclosures or members that are critical load carrying members including but not limited to:

- Main portal frame for stackers.
- Internal surfaces of bins and conveyor chutes which are not lined.
- Main box girders for travelling equipment, including cranes and reclaimers.
- Bolted access covers with gasket seals.
- Covers which are seal welded in place.

These hollow enclosures should have limited access, in most cases via a manway.

The surface shall be abrasive blast cleaned and have a prime coating applied as previously specified for steelwork. Coating may be initially applied as a pre-weld prime coating, in order to reduce abrasive blasting and associated cleaning internally, however, coating shall be brought up to specified standard after fabrication is completed, particularly at weld out areas where damage will be most severe.

7.4.2 Internal Surfaces – Unlimited Access

The internal surfaces of steel sections which have unlimited future access, for example access ways, control rooms, electrical switch rooms, etc, shall be abrasive blast cleaned and coated as previously specified for steelwork.

7.5 Coating Selection Table

Surface	Material	Insulation	operating temperature	Coating system PCS-
STRUCTURAL STEEL, PIPEWORK, EQUIPMENT SUCH AS BINS & FEEDERS, STACKS, PRESSURE VESSELS, HEAT EXCHANGERS, STORAGE TANKS EXTERNAL, etc.	C.S.	Uninsulated	Up to 105°C	**1A (outdoor) 1 (indoor, no UV)**
			From 106°C to 400°C	**3**
			Above 400°C	**Not painted**
		Insulated	Up to 200°C	**8A**
			From 201°C to 400°C	**8**
			Above 400°C	**Not painted**
NON-FERROUS SURFACES – General and above 106°C –	G.S, S.S., Aluminium, etc	All	All	**Not painted**
NON-FERROUS SURFACES – Requiring color marking	G.S, S.S., Aluminium, etc	Uninsulated	Up to 105°C	**7**
ITEMS EXPOSED TO CHEMICAL SPLASH	C.S.	Uninsulated	Ambient	**2**
ITEMS EXPOSED TO MARINE ATMOSPHERE	C.S.	n.a.	Ambient	**4**
IMMERSED ITEMS (IMMERSION IN SEA WATER OR SPLASH ZONE), UNDER CATHODIC PROTECTION e.g. jetty piles	C.S.	n.a.	Ambient	**5**

8. Testing

The Contractor shall perform all necessary inspections to assure that the work is meeting all requirements of this Specification. Also, the Contractor shall provide at least twenty-four (24) hours notice prior to the commencement of any work.

Prime coating shall be tested for dry film thickness, hardness and adhesion as well as being visually scanned for other defects. Finish coating shall be checked for dry film thickness, adhesion and cure as well as being scanned visually for other defects. Silicone based coatings are exempt from adhesion and hardness testing. Tests shall be performed in accordance with the relevant sections of ISO 2808, ISO 4628, ISO 2409 and ISO 4624. The acceptance criteria for adhesion and hardness shall be as specified by the manufacturer of that particular coating system. The acceptance criteria for pinholing are 100% pinhole free coatings.

The procedure to be adopted for determining the average dry film thickness of the coating shall be as follows:

Using an approved electronic film thickness gauge, take a minimum of ten (10) readings at random for each five (5) square metres of coated area (the number of readings taken shall be dependent on the nature and size of the steelwork components) and calculate the mathematical average.

Not more than one (1) reading in each group of ten (10) readings of dry film thickness shall be more than 10% below the specified minimum dry film thickness.

If four (4) or more readings in each group of ten (10) readings of dry film thickness do not comply with the Specification, then the area will be rejected. Any proposal detailing the methodology to be adopted for re-blasting and re-coating, or over-coating, the rejected area to enable it to comply with this Specification shall be reviewed and accepted in writing by HT before any re-work is carried out. The re-work procedure shall be tested on a sample area first and no further re-work shall proceed until the test area is inspected and accepted and approval to proceed is given in writing by HT.

No coat shall anywhere exceed the specified minimum thickness by more than 50%.

Where coating thicknesses exceed this limit the Contractor's proposal for removal of the excess coating and/or reinstatement in accordance with this Specification shall be reviewed and accepted in writing by the Owner's representative prior to the rework commencing. All rework shall be carried out to the Owner's representative's satisfaction.

Where proof coating thickness tests and adhesion tests are made and reveal that the coating complies with the Specification, the test area shall be repaired as herein specified for local scratch damage to each of the relevant coatings. The cost of this work shall be included in the Contractor's relevant schedule unit price.

No coating shall be applied until the preparation / previous coating has been inspected and accepted by the Owner's representative.

8.1 Cleaned and Prepared Surfaces

Blast cleaned surfaces shall be tested for surface profile by measuring with a probe type surface profile gauge, or as established by the use of a comparator gauge or replica tape.

Approved sets of reference plates may be used for the routine quality control estimation of surface roughness.

After abrasive blast cleaning and removal of residual debris and spent blast media, the prepared surface shall be tested for residual dust, chlorides, soluble salts, mill scale and surface profile in accordance with

the relevant sections of ISO 8502. Residual dust shall be tested to ISO 8502-3. Soluble salts shall be tested to ISO 8502-6 and ISO 8502-9. Surface profile shall be tested to ISO 8503-2.

The acceptable level of salts (chlorides and sulphates) is defined by the coating manufacturer. Where this number is not specified then the acceptance value shall be less than or equal to 10 ppm for soluble chlorides and 20ppm for soluble sulphates. When an area of approximately 25 square feet has been cleaned and blasted, the surface is to be re-tested for soluble salt contamination. After soluble salt testing, if the level is non-compliant with the manufacturer's specification then the surface shall be re-blasted.

8.2 Testing of Prime Coatings

8.2.1 Steelwork Subject to Chemical Splash

As well as that specified above, prime coating on steelwork subject to chemical splash and/or chemical vapour and condensate shall undergo testing for pinholes and holidays in accordance with ASTM D5162.

All defects exposed shall be made good before the application of finish coating. Prior to carrying out any re-work, the Contractor's written procedure for re-instatement of defective coating shall be reviewed and accepted in writing by HT.

8.2.2 Steelwork Subject to Elevated Temperatures

Inorganic zinc primed surfaces shall be tested after curing and prior to application of finish coating. Curing shall be assessed by MEK-rub test in accordance with ASTM D4752. If at any time during the curing period the relative humidity has not exceeded 60% hydrolysis may be forced by spraying fresh clean water onto the primed surface.

The coating shall be tested for dry film thickness (as specified above for steelwork), hardness, cure and adhesion as well as being visually scanned for other defects such as mud cracking, etc. Silicone based coatings are exempt from hardness and adhesion testing.

Tests shall be performed in accordance with the relevant sections of ISO 2808, ISO 4628.

All defects exposed shall be made good before the application of finish coating. Prior to carrying out any re-work, the Contractor's written procedure for re-instatement of defective coating shall be reviewed and accepted in writing by HT.

8.2.3 Hot Dip Galvanised Articles

Galvanised coating shall be visually inspected for defects and tested for coating mass and adhesion in accordance with the procedures set out in NF EN ISO 1461 & NF A91-124. The maximum area of defects shall not exceed 0.1% of the surface area coated or 250 cm^2 whichever is the lesser. Individual defects shall not exceed 40 cm^2.

The Contractor's written procedure for re-instatement of defective coating shall be reviewed and accepted in writing by HT prior to carrying out any re-work.

8.2.4 Pipework

The pipe's coating shall be tested for defects prior to installation. All defects shall be repaired in accordance with this specification.

8.3 Testing of Finish Coatings

8.3.1 Steelwork Subject to Chemical Splash

As well as that specified above, finish coatings on steelwork subject to chemical splash and/or chemical vapour and condensate shall undergo testing for pinholes and holidays in accordance with ASTM D5162.

All defects exposed shall be made good. The Contractor's written procedure for re-instatement of defective coating shall be reviewed and accepted in writing by HT before any re-work is carried out.

8.3.2 Steelwork Subject to Elevated Temperatures

Coating shall be tested for dry film thickness (as specified above for steelwork), cure and adhesion as well as being visually scanned for other defects such as solvent blistering etc.

Tests shall be performed in accordance with the relevant sections of ISO 2808, ISO 4624, ISO 4628 and ASTM D5162.

All defects exposed shall be made good. The Contractor's written procedure for re-instatement of defective coating shall be reviewed and accepted in writing by HT prior to carrying out any re-work.

8.4 Testing of Coatings to Internal Surfaces

Coatings applied to internal surfaces of steelwork shall be measured and tested as previously specified for steelwork except that pre-weld primer shall be inspected and tested prior to fabrication and welding.

9. Rectification of Defects and Damage

Any defects or damage shall be repaired to ensure compliance with the Specification. Damage caused to any protective coating during the course of the Project, including fabrication, delivery, and construction or commissioning, shall be rectified by the Contractor that caused the damage.

In all cases, the Contractor that supplied an item as part of this Project shall be responsible for ensuring that sufficient touch-up materials, in compliance with all parts of this Specification, are available on-site for rectification of any defects or damage, irrespective of who caused the damage. This shall apply until the completion of the Project.

Areas of coating which sustain damage in the workshop or on site shall be blast cleaned and recoated as follows:

9.1 Before Finish Coating

Damaged areas shall be blast cleaned to ISO 8504 with a Sa 2½ minimum finish as specified herein and a further coat of primer applied in accordance with this Specification. Where blast cleaning is not practical, power-tool cleaning to grade St3 may be allowed subject to approval by HT.

9.2 After Finish Coating

Damaged areas shall be blast cleaned to ISO 8504 with a Sa 2½ minimum finish as herein specified, taking care to feather back finish coat only at the edge of the re-blasted area, to allow new prime coating to overlap existing prime coating. A further coat of primer shall be applied in accordance with this Specification. Finish coating shall not be reinstated until the curing time of the repair primer has been achieved according to the product technical data sheet.

Extreme care shall be taken during repair operations to avoid over-blast damage to areas of sound coating. Any area damaged by over-blasting shall result in those areas being blast cleaned back to the substrate and re-coated in accordance with this Specification.

9.3 Localised Scratches or Minor Area of Damage

Repair may be affect by feathering back finish coats by sanding, and applying a further coat of primer making sure that primer does not overcoat surrounding finish coats. Finish coat shall not be reinstated until the curing time of the repair primer has been achieved according to the product technical data sheet.

Care shall be taken when re-applying prime coating to avoid "sandwiching," prime coating between layers of finish coating by applying over surrounding sound finish coating.

9.4 Colour Coatings

Colour coating damage shall be repaired by feathering back loose or damaged coating to a sound edge. Where the intermediate coating has been exposed but not damaged, recoating shall consist of a further application of colour coating in accordance with this Specification.

Where the metal substrate has been exposed and depending on the size of the area damage, the damaged area shall be abrasive blast cleaned or disc sanded to bright metal and prime, finish and colour coatings applied in accordance with this Specification.

Notwithstanding the above provisions, the primer repair coating shall be the original primer. If the area to be repaired is of substantial nature rather than a local scratch, the proposed repair procedure shall be such that the adjacent colour and finish coatings are 'washed' off of a margin of undamaged prime and finish coatings to avoid sandwiching of repair prime coating and finish coating between sound finish or colour coats.

9.5 Repair of Galvanised Coatings

Any damage to galvanised coatings from handling, welding, etc. shall be repaired by abrasive whip blasting the damaged area and applying a cold galvanising compound approved by HT.

10. Coatings to Proprietary Equipment (Motors, Gearboxes, etc.)

10.1 Previously Unpainted Articles

10.1.1 Preparation

All equipment, gearboxes, associated motors and couplings, etc, and fittings which have not previously been painted shall be cleaned and if necessary degreased as specified for steelwork (Section 5).

After cleaning, articles shall be whip blasted to provide sufficient surface profile. Any sharp edges, fins or other defects of a sudden or local nature shall be ground smooth or made good in an approved manner.

Only dry blast cleaning techniques shall be used and all precautions, controls on weather conditions and care of articles after blasting shall be observed as herein specified for steelwork.

Extreme care shall be exercised when whip blasting around seals and glands for example. Extreme care shall also be exercised around any machined face where fit-up to adjacent components is required. In these instances areas shall be suitably masked and/or protected against damage before blasting commences.

10.1.2 Application of Prime Coating

Articles with a surface operating temperature less than 105°C, after they have been blast cleaned, inspected and approved, they shall be prime coated with a two component epoxy primer, to achieve a minimum dry film thickness of 50 µm.

The coating shall be applied in accordance with the coating manufacturer's recommendations and this specification.

Coating shall be smooth and uniform without runs, beads, pinholes or other imperfections. Any areas of coating which exhibit defects of a sudden or local nature or insufficient film build shall be blast cleaned and recoated in accordance with this Specification. Areas which exhibit insufficient film build of an overall nature may be sprayed with a further coat to achieve the minimum specified dry film thickness provided that the surface is clean and dry and that the adequacy of the existing surface profile to achieve proper adhesion by the overcoat is established on a test area. If the surface profile is inadequate for the adhesion of further coats the article shall be whip blasted and the coating reapplied in accordance with this Specification.

10.1.3 Testing of Prime Coating

Primed surfaces shall be tested after curing and prior to top coating. Curing time shall be as recommended by the manufacturer.

Coating shall be tested for dry film thickness and adhesion as well as being visually scanned for other defects. Tests shall be performed in accordance with the relevant sections of ISO 2808, ISO2409 and ISO 4624.

10.1.4 Finish and Colour Coatings

All articles which have been primed shall have finish and colour coatings applied prior to installation.

Application of finish and colour coatings shall be as previously specified for steelwork.

Testing of both the finish and colour coatings shall be carried out in accordance with the procedure previously specified for the finish coating of steelwork.

10.2 Previously Painted Articles

All nominated equipment, gearboxes, associated motors and couplings and other proprietary fittings which have been supplied coated in the equipment manufacturer's high performance finish shall be cleaned and overcoated as herein specified.

Prior to application of coatings all articles shall be cleaned of all dust, grease, oil and other surface contaminants by washing with an approved solvent, preferably an emulsifying degreasing agent and then rinsed thoroughly with clean water.

10.2.1 Application of Barrier Coating

After previously painted articles have been cleaned and inspected they shall be coated with a quick drying high build anticorrosive barrier primer to achieve a minimum dry film thickness of 50 µm.

Coating may be applied by conventional air atomising or airless spray equipment. Where airless equipment is to be used set up shall consist of the following:

- Nozzle pressure: 15 MPa
- Nozzle orifice: 0.43 – 0.53 mm

Coating shall be allowed to cure for a minimum of 24 hours prior to the application of finish coatings.

10.2.2 Colour Coating

All articles which have been primed with barrier coating shall have colour coating applied prior to installation.

The application of finish colour coating shall follow Appendix B.

Testing of the colour coating shall be carried out in accordance with the procedure previously specified for the coating of steelwork.

Appendix A

Protective Coating Procedure Sheets

(Total No. Of Pages - 12)

Coating Specification PCS – 1

Project Location:	Steelwork – Non-insulated, up to 105°C – Not directly exposed to UV radiations
Item / Location:	Mine Site and Mine Industrial Area
Service Conditions:	Internal & External: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 40 – 70 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
5. Any surface showing flash rusting[§] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 40 - 70 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Two component, polyamide-cured, zinc-rich epoxy primer with a metallic zinc content of min. 80% w/w in dry film	50 µm	Full*	Brush Air Spray Airless Spray
2nd Coat Two component, high solids, high build epoxy coating	200 µm	Full*	Brush Air Spray Airless Spray

[§] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC/NACE standards.

* All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.
2. The coating surface is washed regularly, particularly during the dry season, with clean (preferably potable) water.

04

Coating Specification PCS – 8A

Project Location:	Pipework & Equipment
Item / Location:	Under Thermal Insulation (up to 200°C)
Service Conditions:	Internal: (Refer to System Notes)

Pre-treatment:

5. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
6. Grind all sharp edges and corners to a minimum radius of 2 mm.
7. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
8. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

6. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
7. The blast-cleaned surface shall have a roughness profile between 30 – 50 µm.
8. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
9. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
10. Any surface showing flash rusting[§] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 30 - 50 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Epoxy phenolic coating	100 µm	Full[`]	Air Spray Airless Spray
2nd Coat Epoxy phenolic coating	100 µm	Full[`]	Air Spray Airless Spray

** Due to HSE issues, coating products shall not contain aromatic amines.

§ When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

` All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

€ Application method as recommended by the coating manufacturer.

Notes:

3. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
4. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.

Coating Specification PCS – 9

Project Location:	Power Plant (indoor piping and equipment in hot service up to 560°C) 04
Item / Location:	Internals
Service Conditions:	Post Fabrication to Commissioning

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 40 – 70 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
5. Any surface showing flash rusting[$] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 40 - 70 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat heat resistant coating (free of zinc, lead, copper or tin) 04	50 µm 04	Full[•]	Air Spray Airless Spray

[$] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

[•] All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.

Appendix B
Finish Colour Coating
(Total No. Of Pages - 2)

COLOUR SELECTION

04

ITEM	COLOUR	Colour code
Structural and buildings		
All structural steel and Pipe Supports - up to 105°C - above 105°C	Traffic grey A Aluminum	RAL 7042 RAL 9006
Metal roofing (all buildings except noted otherwise)	Traffic white	RAL 9016
Metal siding (process, industrial and utility buildings)	Koniambo logo – Medium blue	Pantone PMS 286
Metal siding (administrative buildings)	Koniambo logo – Light blue	Pantone PMS 286 @ 40%
Metal cladding (conveyor enclosures)	Koniambo logo – Medium blue	Pantone PMS 286
Metal cladding (construction camp)	Traffic white	RAL 9016
Gridmesh, floor plates (ungalvanized)	Traffic grey B	RAL 7043
Handrails, Toe Plates, Kick Plates	Traffic yellow	RAL 1023
Equipment		
Monorails, cranes, hoists	Traffic yellow	RAL 1023
Elevators, hydraulic power unit, air compressor	Manufacturer's yellow	n.a.
Tanks	Traffic grey A	RAL 7042
Pressure vessels (air receiver, air compressor, gas storage)	Steel blue	RAL 5011
Bins and Feeders (hoppers, reagent, dried ore, baghouses, silos)	Pure Orange	RAL 2004
Heat exchangers	Manufacturer's blue	n.a.
Water pumps	Manufacturer's blue	n.a.
Stacks (Low Temperature)	Traffic grey A	RAL 7042
Stacks (High Temperature)	Aluminum	RAL 9006
Cooling tower	Traffic Blue	RAL 5017
Screens, Rakes, Clarifiers	Traffic grey A	RAL 7042
Slag pots, Mud guns, Furnace, Fume hoods, Laddle cars	Traffic grey A	RAL 7042
Fans	Traffic Blue	RAL 5017
Flash calciner, Furnace roof dome, Duct refinery lined	Steel blue	RAL 5011
Equipment Guards	Traffic yellow	RAL 1023
Fire fighting equipment	Traffic red	RAL 3020
Pipework		
[1]		

Note 1: Colours to be used for pipework shall be in accordance with the Project's specification for Piping Marking and Identification 319000-00000-JSD-1300-0013.

No deviation from the colors as specified above shall be allowed without written permission from the Owner's representative.

Coating Specification PCS – 3

Project Location:	Steelwork Subject to Elevated Temperatures from 105°C up to 400°C 04
Item / Location:	All Areas
Service Conditions:	Internal & External: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 30 – 50 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
5. Any surface showing flash rusting[§] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 30 - 50 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Zinc Rich Ethyl Silicate with a metallic zinc content of min. 80% w/w in dry film 04	65 µm 04	Full*	Air Spray Airless Spray
2nd Coat Heat resistant silicone coating	20 µm	Full*	Air Spray
3rd Coat Heat resistant silicone coating	20 µm	Full*	Air Spray

[§] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

* All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.
2. The coating surface is washed regularly, particularly during the dry season, with clean (preferably potable) water.

Coating Specification PCS – 4

Project Location:	Steelwork Subject to Marine Atmosphere with UV resistant Colour Top Coating
Item / Location:	Vavouto Port Site, Vavouto Plant Site and Industrial Area
Service Conditions:	Internal & External: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 40 – 70 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
5. Any surface showing flash rusting[§] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 40 - 70 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Two component, polyamide-cured, zinc-rich epoxy primer with a metallic zinc content of min. 80% w/w in dry film	50 µm	Full[*]	Brush Air Spray Airless Spray
2nd Coat Two component, high solids, high build polyamine-cured epoxy coating	200 µm	Full[*]	Brush Air Spray Airless Spray
3rd Coat UV-resistant polyurethane coating	50 µm	Full	Brush Air Spray Airless Spray

[§] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

[*] All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.
2. The coating surface is washed regularly, particularly during the dry season, with clean (preferably potable) water.

Coating Specification PCS – 5 04

Project Location:	Steelwork subject to Marine Environment (immersion or splash zone)
Item / Location:	Vavouto Port Site
Service Conditions:	External & Immersed: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 40 – 70 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
5. Any surface showing flash rusting[§] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 40 - 70 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Two component, high solids, high build, polyamine-cured epoxy coating ** 04	200 µm 04	Full[*]	Brush Air Spray Airless Spray
2nd Coat Two component, high solids, high build, polyamine-cured epoxy coating ** 04	200 µm 04	Full[*]	Brush Air Spray Airless Spray

04

** Due to HSE issues, coating products shall not contain aromatic amines.

§ When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

[*] All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.
2. The coating must be allowed sufficient time to cure fully before driving of the piles begins.

Coating Specification PCS – 6

Project Location:	Steelwork – Hot Dip Galvanised
Item / Location:	Steelwork – Stairs, Ladders, Handrails etc. All Areas
Service Conditions:	Internal & External: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 30 – 50 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall be blast cleaned, acid pickled, fluxed and hot dipped in a continuous operation.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Average Coating Mass Minimum g/m²	Application Method[€]
1st Coat Hot Dip Galvanise in accordance with the requirements of NF A91-124 and NF EN ISO 1460	85 µm	680	N/A

[§] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

[*] All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.
2. The coating surface is washed regularly, particularly during the dry season, with clean (preferably potable) water.

Coating Specification PCS – 7

Project Location:	Steelwork – Hot Dip Galvanised and Finish (Colour) Coated
Item / Location:	Steelwork – Machine Guards, Handrails etc. All Areas
Service Conditions:	Internal & External: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 30 – 50 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall be blast cleaned, acid pickled, fluxed and hot dipped in a continuous operation.
5. After Galvanizing abrasive 'whip' blast surfaces to be Finish (Colour) Coated, using fine garnet abrasive, to remove all oxides. Surface should be a uniform matte grey finish.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Hot Dip Galvanise in accordance with the requirements of NF A91-124 and NF EN ISO 1461	Refer PCS - 6	Refer PCS - 6	N/A
2nd Coat Two component, polyamide-cured, adhesion promoting, epoxy prime coating	50 µm	Full[*]	Brush Air Spray Airless Spray
3rd Coat Two component, high build, recoatable aliphatic isocyanate-cured, acrylic polyurethane finish coating	50 µm	Full[*]	Brush Air Spray Airless Spray

[§] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

[*] All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.
2. The coating surface is washed regularly, particularly during the dry season, with clean (preferably potable) water

Coating Specification PCS – 8

Project Location:	Pipework & Equipment
Item / Location:	Under Thermal Insulation (service temperature from 200°C to 400°C)
Service Conditions:	Internal: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 30 – 50 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
5. Any surface showing flash rusting[$] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 30 - 50 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Inorganic zinc silicate coating with a metallic zinc content of min. 80% w/w in dry film 04	65 µm 04	Full[•]	Air Spray Airless Spray

[$] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

[•] All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.

Coating Specification PCS – 1A

Project Location:	Steelwork – Non-insulated, up to 105°C with UV resistant Colour Top Coating
Item / Location:	Mine Site and Mine Industrial Area
Service Conditions:	Internal & External: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 40 – 70 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
5. Any surface showing flash rusting[$] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 40 - 70 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Two component, polyamide-cured, zinc-rich epoxy primer with a metallic zinc content of min. 80% w/w in dry film	50 µm	Full[*]	Brush Air Spray Airless Spray
2nd Coat Two component, high solids, high build epoxy coating	200 µm	Full[*]	Brush Air Spray Airless Spray
3rd Coat UV-resistant, polyurethane coating	50 µm	Full	Brush Air Spray Airless Spray

[$] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

[*] All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.
2. The coating surface is washed regularly, particularly during the dry season, with clean (preferably potable) water.

Coating Specification PCS – 2

Project Location:	Steelwork Subject to Chemical Splash Environment pH ≥2 but ≤ 10 △04
Item / Location:	Vavouto Plant Site, Mine Site and all Industrial Areas
Service Conditions:	Internal & External: (Refer to System Notes)

Pre-treatment:

1. Remove all grease, oils, fats, etc. from the surfaces to be coated using an emulsifying degreasing agent in accordance with the requirements of ISO8504.
2. Grind all sharp edges and corners to a minimum radius of 2 mm.
3. Remove all welding slag, spatter and blend grind all sharp welds and high spots smooth.
4. Remove all salt deposits by jetting with clean (potable) water.

Surface Preparation:

1. Abrasive blast clean all surfaces to be coated in accordance with the requirements of ISO8504 to achieve a Sa 2½ minimum finish.
2. The blast-cleaned surface shall have a roughness profile between 40 – 70 µm.
3. After blast cleaning remove all dust and blast residue, by vacuum cleaning if necessary.
4. Blast cleaned surfaces shall have prime coating applied the same day, application shall begin within four hours of commencement of blasting.
5. Any surface showing flash rusting[§] shall be re-blasted to a Sa 2½ minimum finish, surface profile of 40 - 70 µm.

Coating System

Coating System	Dry Film Thickness minimum (µm)	Spot or Full Coat	Application Method[€]
1st Coat Two component, polyamine-cured epoxy primer ** △04	75 µm	Full[˙]	Brush Air Spray Airless Spray
2nd Coat Two component, polyamine-cured epoxy coating ** △04	125 µm	Full[˙]	Brush Air Spray Airless Spray
3rd Coat Two component, polyamine-cured epoxy coating ** △04	125 µm	Full[˙]	Brush Air Spray Airless Spray

△04

** Due to HSE issues, coating products shall not contain aromatic amines.

[§] When blast cleaning operations are carried out using wet blasting techniques (with rust inhibitor) or high or ultra-high pressure water jetting acceptance criteria shall be as per the requirements of the relevant SSPC / NACE standards.

[˙] All sharp edges, holes, bolts, nuts, etc. shall be stripe coated by brush immediately prior to the spray application of each coat.

[€] Application method as recommended by the coating manufacturer.

Notes:

1. Refer to manufacturers technical data sheets for the particular information relating to mixing, thinning, application, drying, curing and recoating. Where the substrate temperature and/or the relative humidity is outside those stated on the data sheet, the minimum/maximum recoat times will change.
2. Where coatings are applied by brush or roller it may be necessary to apply additional coat(s) to achieve the nominated dry film thickness.

System Notes:

The practise of good "house-keeping" will ensure that the optimum performance of this coating system is achieved if the following procedures are achieved as a minimum:

1. Isolated spills and leaks are cleaned up and/or repaired promptly and in any case before coating integrity is compromised or permanently degraded.
2. The coating surface is washed regularly, particularly during the dry season, with clean (preferably potable) water.

Project Memo

To: Jodi Everard

From: Michele Perigny

Date: 07-May-2008

Copies: Safwat Ibrahim, CA Lau

Subject: Koniambo Plant Colour Scheme

Client: XStrata Nickel

Project: Koniambo

1. Criteria for Colour Selection

The selection of colours for the Koniambo Plant considers the following criteria:

- Safety: international colour codes/standards
- Environmental: standardized colour scheme, neutral colours for Vavouto water towers
- Community: identity, pleasing, cultural sensitivities to certain colours
- Location: near the sea, hilly surroundings, green vegetation and red laterite soil
- Climate: tropical
- Company Image: corporate/logo colours

2. Proposed Colour Scheme

The Koniambo project is located in New Caledonia, on the coast of the Pacific Ocean, and within a tropical climate. As such light colours which are long lasting and heat reflective were chosen, especially for large surface areas such as building roofs.

The Koniambo logo colours shall be integrated to the building walls as a representation of proud project identity. There are two blues (medium and light) used in the logo. The medium blue shall be used for all Process Buildings (Met Plant, Coal Plant, Power Station), Industrial Buildings (Workshops, Warehouses, Wash Stations) and Utility Buildings (Substations, Pump rooms). The light blue shall be used for all Administrative and Amenities Buildings (Offices, Change rooms, Cafeteria, etc.) to differentiate the people related buildings.

As for other building elements such as handrails, floor plates, cranes, process equipment, pumps, fans vessels and stacks, they shall be painted according to safety colour code, company colour code or the manufacturer's colour which have been approved for the project as part of the Protective Coatings Specification (319000-00000-SP-2300-0001). The tanks shall be painted grey as a neutral colour matching the existing tank colour in the surrounding areas and on tribal lands.

The attached tables provide a complete colour scheme for the main building elements and equipment including the colour names, colour reference numbers and approximate colour rendering.

PROJET KONIAMBO
l'Usine du Nord
Nouvelle-Calédonie

Koniambo Plant Colour Scheme

DESCRIPTION	Colour Names	Colour References	Colour Approximation
ALL STRUCTURAL STEEL	Traffic Grey A	RAL 7042	
METAL ROOFING (all buildings except noted otherwise)	Traffic White	RAL 9016	
METAL SIDING (process, industrial and utility buildings)	Koniambo logo - Medium Blue	Pantone PMS 286	
METAL SIDING (administrative buildings)	Koniambo logo - Light Blue	Pantone PMS 286 @ 40%	
METAL CLADDING (conveyor enclosures)	Koniambo logo - Medium Blue	Pantone PMS 286	
METAL CLADDING (construction camp)	Traffic White	RAL 9016	
GRIDMESH, FLOOR PLATES	Traffic Grey B	RAL 7043	
HANDRAILING, KICK PLATES	Traffic Yellow	RAL 1023	
MONORAILS, CRANES, HOISTS	Traffic Yellow	RAL 1023	
ELEVATORS, HYDRAULIC POWER UNIT, AIR COMPRESSOR	Manufacturers' yellow		
TANKS	Traffic Grey A	RAL 7042	
PRESSURE VESSELS (air receiver, air compressor, gas storage)	Steel blue	RAL 5011	
BINS AND FEEDERS (hoppers, reagent, dried ore, baghouses, silos)	Pure Orange	RAL 2004	
HEAT EXCHANGER, WATER PUMP	Manufacturers'blue		
STACKS (low temperature)	Traffic Grey A	RAL 7042	
STACKS (high temperature)	Aluminium		
COOLING TOWER	Traffic Blue	RAL 5017	
SCREENS, RAKES, CLARIFIERS	Traffic Grey A	RAL 7042	
SLAG POTS, MUD GUNS, FURNACE, FUME HOODS, LADDLE CARS	Traffic Grey A	RAL 7042	
FANS	Traffic Blue	RAL 5017	
FLASH CALCINER, FURNACE ROOF DOME, DUCT REFUNERY LINED	Steel blue	RAL 5011	
SAFETY YELLOW	Traffic Yellow	RAL 1023	
SAFETY ORANGE	Pure Orange	RAL 2004	
SAFETY RED	Traffic Red	RAL 3020	
SAFETY BLUE	Traffic Blue	RAL 5017	
SAFETY GREEN	Traffic Green	RAL 6024	
SAFETY GREY (Medium)	Traffic Grey A	RAL 7042	
SAFETY GREY (Dark)	Traffic Grey B	RAL 7043	
SAFETY WHITE	Traffic White	RAL 9016	
SAFETY BLACK	Traffic Black	RAL 9017	

ANNEXURE-V
(Electrical Actuator specification)

1) Doc No. FBC&HRSG:CI:5312:OCEA -Specification For Electrical Actuators With Intigeral Starter – 13 Pages
2) Doc No. FBC&HRSG:CI:5312:OCEA -Annexure to Specification For Electrical Actuators With Intigeral Starter – 1 Page
3) Wiring Diagram (Terminal Plan) for Actuator with integral starter (Drg No 3-V-MISC-24227/Rev 0)- 1 Page

BHARAT HEAVY ELECTRICALS LIMITED
TRICHY - 620 014.

FBC & HRSG

ELECTRICAL, CONTROLS & INSTRUMENTATION

FBC&HRSG: CI: 5312:OCEA	REV 00	PAGE 01 OF 13

SPECIFICATION FOR ELECTRICAL ACTUATORS WITH INTEGRAL STARTER

REV NO	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
00		INITIAL ISSUE	Nitin	P.S.P	A.Swaminathan

TECHNICAL CONFIRMATIONS

(Fill up YES / NO take plain paper copies furnish along with offer)

THE ACTUATOR SHALL COMPLY/BE SUITABLE FOR

1.0	**MOTOR** MOTOR SUITABLE FOR 400V, 3ϕ, 50Hz, 3WIRE.	
1.1	All equipment shall comply with the requirements of French and New Caledonian Codes and Standards as well as all laws and regulations of local authorities. Where other Codes and Standards are used, they shall also satisfy the French and New Caledonian requirements. In the event of conflicting requirements between Codes and Standards, the French and New Caledonian requirements shall apply. Motors shall conform with: NF EN 60034 Rotating electrical machines. NF EN 60072 Dimensions and output series for rotating electrical machines. NF EN 60079 Electrical apparatus for explosive gas atmospheres. All information shall be based on International System (SI) unit of measure. All equipment presenting a risk or leading to a risk regarding the safety of workers have to comply with French Standards, Codes and regulations. This is mandatory by the NC Deliberation No 51/CP dated 10 May 1989, which technical provisions refer to the European Directive 92/104/EEC. The current edition of the French Codes shall be used for the design of all components of the project as stipulated by the New Caledonian law (Caledonian decree 1348 of 22 November 1985). When a Notified Body is required to verify the conformity with the French codes (or IEC codes that have been adopted by the European Union), it shall be the Supplier's responsibility and shall be at Supplier's expense (except when otherwise specified). The Notified Body that acts as a recognized third party, conversant with French and New Caledonian Codes, shall certify and stamp the certificate of conformity issued and signed by the Supplier	
1.2	MOTOR PAINTED WITH CORROSION RESISTANT EPOXY RESIN PAINT	
1.3	MOTOR INSULATION MINIMUM CLASS B (NON HYGROSCOPIC INSULATION WITH TROPICALISATION SUITABLE FOR CL.3.8)	

3.7	POSITION INDICATOR PROVIDED WITH ADJUSTABLE GEAR SETS & CHARTS.	
3.8A	ACTUATOR PROVIDED WITH SPACE HEATER SUITABLE FOR 240V AC, 1ϕ, 50Hz IN LIMIT SWITCH COMPARTMENT.	
3.8B	ACTUATOR SUITABLE FOR OPEN IN DAMP DUSTY POLLUTED, ATMOSPHERES OF 100% RELATIVE HUMIDITY AND AMBIENT TEMP.OF -20°C TO +50°C.	
3.9A	ACTUATOR PROVIDED WITH COMMON TERMINALS AND EACH TERMINAL SUITABLE FOR 2X2.5 SQ MM WIRE.	
3.9B	INTERNAL WIRING IS DONE AS PER **3-V-MISC-24227** BUT WITH 400VOLTS. WIRING DIAGRAM SHALL BE PASTED INSIDE TB COMPARTMENT.	
4.0	**ACTUATOR SHALL BE PROVIDED WITH TWO POTENTIOMETER TYPE POSITION INDICATORS FOR OPEN & CLOSE.**	
4.1	ONE NO. ELECTRONIC POSITION TRANSMITTER SUITABLE FOR 24V DC, 2 WIRE, 4-20mA SHALL BE PROVIDED FOR INCHING DUTY ACTUATORS.	
5.0	**ACTUATOR + SY.GB SHALL MEET ALL THE CONDITIIONS MENTIONED IN ACTUATOR DATA SHEET (APPLICABLE FOR BHEL DAMPERS/ VALVES).**	
6.0	**EVERY ACTUATOR, ESPECIALLY SY.GB SHALL HAVE SELF LOCKING WORM GEARS.**	
7.0	**STARTING TORQUE FOR LOUVER SHALL BE MINIMUM 4 TIMES THE RUN TORQUE AND FOR GATE SHALL BE MINIMUM 5 TIMES THE RUN TORQUE (APPLICABLE FOR BHEL DAMPERS).**	
8.0	**GATE ACTUATORS SHALL BE CAPABLE OF RUNNING AT TWICE THE SPECIFIED RUN TORQUE VALUES FOR MINIMUM 6 MINUTES. (APPLICABLE FOR BHEL DAMPERS).**	
9.0	**NECESSARY NUMBER OF CD COATED FASTENERS (OR) MOUNTING BOLTS, NUTS WITH SPRING WASHERS PROPERLY FIXED OR SCREWED ON SECONDARY GEAR BOX SHALL BE FURNISHED WITH EVERY ACTUATOR(TO CALCULATE LENGTH OF FASTENERS, DAMPER FLANGE THICKNESS CAN BE CONSIDERED AS 20 mm). THE FASTENERS TO BE IDENTIFIED SEPARATELY IN SHIPPING LIST.**	
10.0	**ACTUATOR + SY. GB PAINTED WITH CORROSION RESISTANT EPOXY RESIN PAINT.**	
11.0	APART FROM KEYWAY, KEYS SHALL ALSO BE PROVIDED WITH EVERY ACTUATOR (DEPTH OF KEY SHALL BE AS PER STDS).	
12.0	ALL LOUVERS 90° MOVEMENT ACTUATORS SHALL	

1.4	MOTOR SHOULD BE RATED AS FOLLOWS: A. FOR INCHING APPLICATION MIN. 150 START/HR. B. FOR OPEN/CLOSE APPLICATION S2-15 DUTY i.e., 15 MIN.DUTY.	
1.5	MOTOR SUITABLE FOR DIRECT ON LINE START.	
1.6	STARTING CURRENT LIMITED TO 6 TIMES FULL LOAD CURRENT.	
1.7	TWO EARTH TERMINALS PROVIDED.	
1.8	ATLEAST ONE THERMOSTAT PROVIDED FOR MOTOR WINDING PROTECTION.	
1.9	MOTOR WINDING CONNECTION BROUGHT TO COMMON TERMINALS.	
2.0	ACTUATOR+ SECONDARY GEAR BOX ACTUATOR + SY.GB. CAN START AT 80% RATED VOLT AND RUN AT 75% VOLT AT SPECIFIED RUN TORQUE FOR 5 Min.	
2.1	ACTUATOR + SY.GB CAN OPERATE AT SPECIFIED RUN TORQUE FOR THE FOLLOWING CONDITIONS: A. AT ± 10% RATED VOLTAGE (400 V). B. AT ± 5% RATED FREQUENCY (50 Hz). C. AT 10% RATED VOLTAGE + FREQUENCY ABSOLUTE. ACTUATOR SHALL BE WITH INTEGRAL STARTER	
2.2	ACTUATOR + SY.GB CAPABLE OF MEETING TOTAL TURNS INDICATED IN "ACTUATOR DATA SHEET" AND LIMIT SWITCHES SET ACCORDINGLY.	
3.0	**ACTUATOR (BASIC ACTU + SY. GEAR BOX) AS A WHOLE SHOULD MEET IP 55 DEGREE OF PROTECTION.**	
3.1	NAME PLATE FOR TORQUE SWITCH CALIBRATION SHALL BE PROVIDED WITH TORQUE VALUE IN KGM.	
3.2	ACTUATOR HAND WHEEL DE-CLUTCH AUTOMATICALLY UPON POWER SUPPLY RESTORATION.	
3.3	COUNTER CLOCKWISE ROTATION LOOKING AT ACTUATOR DRIVING END SHALL RESULT IN CLOSE.	
3.4	ACTUATOR WILL MEET SPECIFIED RUN TORQUE FOR THE DUTY MENTIONED IN 1.4.	
3.5	FOUR LIMIT SWITCHES, TORQUE SWITCHES RATED FOR 5 AMPS AT 250V AC / 0.5 AMPS AT 220V DC AND EACH SWITCH SHALL HAVE 2NO + 2NC INDEPENDENT CONTACTS.	
3.6	ACTUATOR PROVIDED WITH MECHANICAL POSITION INDICATOR FOR 0 TO 100% ADJUSTABLE WITHIN 60°ROTATION.	

	designed for safety, corrosion resistance and ease of access to maintainable components. Special motor operating conditions (if any) will be individually considered and specified in requirements for those motors. Such conditions include frequent starting, ambient temperature extremes and variable or multi-speed operation. **Degree of Protection** Motors shall have a minimum Ingress Protection rating of IP55. For motors used in dust hazard area Zone 21, the IP class shall be IP65. Zone 22 area motors shall be min IP55. Motors are to be fitted with a breathing vent at the bottom of each end. Motors shall be provided with drain holes, which shall be tapped and fitted with a porous drain plug. When drain plugs are not provided, motors shall be supplied with space heaters. An approved sealing compound of non-setting material shall be used to weatherproof mating machined surfaces. **Surface Preparation and Finish** The Supplier's Standard epoxy painting system shall be offered on the provision that it provides protection against all site conditions and complies with applicable standards; otherwise the painting shall be in accordance with the Protective Coatings document: 319000-00000 -SP-2300-0001. Parts of the motor normally shielded by the fan cover and the inside of the fan cover shall, with respect to corrosion protection, be treated in a similar manner as normally exposed parts. The paint colour for motors shall be as follows: Non-Hazardous Area Motors Supplier Standard (Internal) / RAL 7001, Grey (External) Hazardous Area Motors (Zone 1, Zone 21) Supplier Standard (Internal) / RAL 5002, Blue (External) Hazardous Area Motors (Zone 2, Zone 22) Supplier Standard (Internal)/ RAL 1033, Golden Yellow (External) The Supplier shall advise if there are any significant implications for using the nominated colours as opposed to the Supplier standard colours. 05 All preliminary documents for approval or review shall be in English. All final documentation shall be in French and English. Documentation issued during execution of the contract shall be issued in French or English as required by the Owner. All documentation shall be functionally grouped, bound, labelled and indexed for ease of reference.	

	HAVE SPLINED REMOVABLE BUSH PROPERLY MACHINED AND DRILLED TO THE DIMENSIONS MENTIONED IN ACTUATOR DATA SHEET (APPLICABLE FOR BHEL DAMPERS).	
13.0	ACTUATORS OFFERED SHALL HAVE RPM OF AROUND 0.5 FOR LOUVER AND 1.9 FOR GATE. (APPLICABLE FOR BHEL DAMPERS).	
14.0	EVERY ACTUATOR SHALL BE SUPPLIED WITH ONE NO. ¾", TWO NOS. 1" & ONE NO. 1¼" ET THREAD CABLE ENTRY WITH DOUBLE COMPRESSION CABLE GLANDS WITH METAL THREADED PLUGS FOR ALL ENTRIES.	
15.0	ACTUATOR NAME PLATE SHALL HAVE THE MINIMUM OF FOLLOWING: A. STANDARD MOTOR DETAILS. B. RATED CURRENT (PROPORTIONAL TO RUN TORQUE). C. TAG.NO. AS SPECIFIED BY BHEL. D. DIRECTION OF ROTATION FOR CLOSING OF LOAD (DAMPER). E. SECONDARY GEAR BOX TYPE. F. 90° OR 360°. G. TORQUE CAPACITIES.	
16.0	SECONDARY GEAR BOX SHALL BE PROVIDED WITH SEPARATE NAME PLATE	
17.0	ACTUATOR (BASIC) AND SY. GEAR BOX SHALL PROPERLY COUPLE AND SHALL BE DESPATCHED AS SINGLE UNIT.	
18.0	ACTUATOR + SY. GEAR BOX SHALL HAVE PROPER SEALS TO PREVENT LEAKAGE OF OIL TO OTHER COMPARTMENTS UNDER ANY POSITION OF MOUNTING.	
19.0	SECONDARY GEAR BOX CONTINUOUS TORQUE CAPACITY SHALL BE GREATER THAN OR EQUAL TO STARTING TORQUE OF ACTUATOR.	
20.0	COLOUR OF THE ACTUATOR SHALL BE as per Clause no: 5.13.	
	Special Requirements: **CE Marking** All equipment shall carry the CE Marking (European Conformity), as per the 'Council of the European Communities' Directive. The Supplier is responsible for CE Marking conformity. The equipment shall be designed and installed to operate continuously at full load for 24 hours per day, 7 days per week at the extremes of temperature, humidity and environmental conditions indicated. The equipment shall have a design life of 20 years without the need for an excessive maintenance regime. Motors shall be	

21.0	REQUIRED DOCUMENTS (ALONG WITH OFFER): A. DRAWINGS FILLED UP TECHNICAL INFORMATION DATA SHEET & CATALOGUES IN 4 SETS EACH. B. OFFER IN QUADRUPLICATE. OFFER FOR C. COMMISSIONING SPARES D. SPARES FOR 2 YEARS TORQUE FREE OPERATION. E. SPECIAL TOOLS.	
22.0	REQUIRED DOCUMENTS (ON PLACEMENT OF ORDER): A. 4 COPIES OF O&M MANUALS B. CATALOGUES C. 2 NO. CD CONTAING THE ABOVE. D. INSTALLATION DRAWING / MANUAL. E. 6 SETS OF TEST CERTIFICATES.	
23.0	TEST REQUIREMENTS FOR ACTUATOR ALONG WITH SECONDARY GEAR BOX SHALL BE COMPLIED WITH.	

"TECHNICAL INFORMATION"

(FILL UP FOR EACH ACTUATOR- TAKE PLAIN PAPER COPIES - FURNISH ALONG WITH OFFER) SUPPLIER SHALL FURNISH THE FOLLOWING IN THIS SAME FORMAT ONLY. ABSENCE OF ANY DETAIL WILL RESULT AS INCOMPLETE OFFER AND WILL NOT BE CONSIDERED.

SPECIFY TOLERANCE WHEREVER APPLICABLE - (REQUIRED TO BE CHECKED DURING TESTING/INSPECTION).

1.0	ACTUATOR TYPE CHOSEN.	
2.0	**MOTOR:** TYPE & FRAME SIZE	
2.1	K.W (400V, 50Hz, 3ϕ,AC)	
2.2	STARTING CURRENT (A)	
2.3	CURRENT AT RUN TORQUE (A)	
2.4	FULL LOAD CURRENT (AT 100% TORQUE SETTING) (A)	
2.5	CURRENT AT DYNAMIC STALL (LOCKED ROTOR) (A)	
2.6	TIME ALLOWED AT LOCKED ROTOR (IN SECONDS)	
2.7	A. STARTING TORQUE (KGM) B. RUN TORQUE (KGM) C. CLASS OF INSULATION D. STATOR WINDING - STAR OR DELTA.	
2.8	FULL LOAD TORQUE (100% TORQUE SETTING) (KGM)	
2.9	A. NO. OF STARTS PER HR.WITH NO LOAD. B. NO OF STARTS PER HR WITH LOAD AT SPECIFIED RUN TORQUE. C. FULL LOAD RPM. D. AMBIENT TEMPERATURE IN °C (-20°C TO +50°C). E. DUTY TIME.	

	F. FULL LOAD POWER FACTOR. G. FULL LOAD EFFICIENCY. H. RECOMMENDED BACK UP FUSE & OLR VALUES FOR DESIGNING THE MCC.	
3.0	<u>GEAR BOX:</u> A. PRIMARY GEAR BOX RATIO. B. PRIMARY GEAR BOX EFFICIENCY.	
3.1	PRIMARY GEAR BOX MAX OPERATING TORQUE KGM.	
4.0	A. SECONDARY GEAR BOX TYPE & MAKE. B. SECONDARY GB RATIO C. SECONDARY GB EFFICIENCY	
4.1	SY.GB.MAX. OPERATING TORQUE KGM.	
4.2	SY.GB.MOMENTARY TORQUE CAPACITY.	
5.0	ACTUATOR + SY.GEAR BOX OUTPUT RPM.	
5.1	ACTUATOR + SY. GB RUN TORQUE RANGE, KGM	
5.2	SECONDARY GB LEAD ANGLE LESS THAN OR EQUAL TO 6°	
5.3	WORM & WORM WHEEL MATERIAL.	
5.4	ACTUATOR + SY.GB STARTING TORQUE, KGM	
5.5	ACTUATOR + SY. GEAR BOX DYNAMIC STALL TORQUE KGM.	
5.6	BORE DIA X LENGTH OF SY. GB IN MM.	
5.7	APPROXIMATE WEIGHT OF ACTUATOR + SY. GEAR BOX. (KG)	
5.8	<u>LUBRICANT:</u> A. RECOMMENDED INTERVAL OF CHECKING/FILLING. B. TYPE OF LUBRICANT. C. INDIAN EQUIVALENT MAKE. D. QTY. IN LITRES/KG. E. INITIAL FILL BY VENDOR	
5.9	TYPE AND MAKE OF LIMIT SWITCHES AND TORQUE SWITCHES.	
5.10	ACTUATOR + SY. GB PAINT A. COLOUR B. PAINT THICKNESS. (MICRONS)	
5.11	OPERATING TIME IN SECONDS FOR EACH ACTUATOR TO BE FURNISHED	
5.12	INDICATE VERY CLEARLY THE RELATIONSHIP BETWEEN NOMINAL TORQUE & RATED TORQUE AND NOMINAL CURRENT & RATED CURRENT	

<u>ROUTINE TEST:</u>

1	DIMENSIONS	OVERALL & MOUNTING
2	DETAILS OF PAINTING AS PER SPECIFICATION & VENDOR	1. ANTI CORROSIVE EPOXY PAINT 2. SHADE 3. FINISH 4. PAINT THICKNESS (MIN 80 MICRONS) 5. PEEL OFF TEST
3	MANUAL OPERATION THROUGH HAND WHEEL	
4	CHECKING OF BHEL STD. TB WIRING DIAGRAM	
5	TESTING OF POSITION & TORQUE LIMIT SWITCHES FOR ACCURACY AND REPEATABILITY. BY TURN SETTING (NO OF TURNS) FOR POSITION LIMIT SWITCHES & TORQUE FOR TORQUE SWITCHES.	
6	MANUAL - AUTO SWITCHING FUNCTION	
7	FOR MOTORS, ALL ROUTINE TESTS AS CALLED FOR IN IS 325 / BS 4999/ VDE 0530 / IEC 432.	
8	FINAL OUTPUT SHAFT SPEED & TORQUE OF ACTUATOR + SY. GB AND CORRESPONDING CURRENT AS PER CATALOGUES	

9	POSITION INDICATOR & TRANSMITTER CALIBRATION CHECK FOR ACCURACY, LINEARITY & REPEATABILITY.	
10	LEAKAGE TEST FOR GEAR CASE (VISUAL)	
11	HV TEST AT 1.6 KV (80% OF 2 KV) FOR THE ASSEMBLED ACTUATOR	
12	OPERATION OF ACTUATOR + SY. GB UNDER VARIATION IN SUPPLY VOLTAGE (± 10%)AND VARIATION IN FREQUENCY (± 5%) FOR VERIFYING SPECIFIED RUN TORQUE & SPEED.	
13	CHECKING OF ACTUATOR BORE DIA X LENGTH AND KEYWAY WIDTH X DEPTH DIMENSIONS	

TYPE TESTS:

1	TYPE TEST FOR MOTOR AS PER IS 325 / BS 4999 PART 60 / VED 0530 / IEC 432	
2	NOISE AND VIBRATION TEST FOR TOTAL ASSEMBLY IS 4729 / BS 4999	
3	TEMPERATURE RISE TEST DURING: • OPERATION OF ACTUATOR AT 75% VOLTAGE FOR 5 MINUTES • OPERATION OF ACTUATOR AT 50° C AMBIENT	
4	ENCLOSURE PROTECTION FOR THE TOTAL ASSEMBLY FOR IP 55 AS PER IS 2147 OR NEMA - IV OUTDOOR	

5	ENDURANCE TEST FOR ACTUATOR	
6	MECHANICAL & ELECTRICAL ENDURANCE TEST FOR LIMIT SWITCHES	
7	ALL TEST LISTED UNDER ROUTINE TEST	
8	DAMP HEAT CYCLE TEST AS PER IS 9000 / IEC 68-30	
9	**PERFORMANCE TEST OF ACTUATORS** A) SIZING TORQUE TEST Place the beam connected to the actuator in the horizontal position and add weights to it until the actuator stalls (With torque switch active) Ref.Fig.1 B) DYNAMIC STALL TORQUE TEST 1. Remove all the weights from the Damper simulator I beam. 2. Run the actuator without load until it hits a U-bolt arrangement which has weights attached to the bottom of it (Ref.Fig.2) 3. Add weights until the actuator cannot lift the U-bolt arrangement from the horizontal position. C) GEAR BOX STURDINESS TEST Repeat the sizing torque test and ensure that there is no damage of gear box of actuator.	
	DOCUMENTS TO BE PROVIDED	
1.	Certificate for routine test detailing out the results	
2.	Routine and type test for motors	
3.	Type test report for tests listed under 'B'	
4.	Material Test Certificate for casting, gear, shaft etc.	
5.	Endurance Test for limit switches	
	9. Packaging for Transport Heavy duty plastic wrapping and sealing of entries with threaded plugs as a minimum. Exposed shafts shall be wrapped with a protective tape to prevent surface deterioration. A shaft locking clamp to prevent drive end bearing damage by "Brinelling" during transport shall be fitted prior to shipment. A shaft key shall be supplied with the motor. Shaft locks shall prevent the longitudinal movement and the rotational movement of the rotor and shall be easily removable when the motor is installed. All motors fitted with a shaft lock shall have adequate warning notices displayed in a prominent position on the motor frame. Motors shall be fitted with lifting lugs or eye bolts to the weight of the motor. Removal of the lifting facilities shall not compromise the degree of protection of the motor. All lifting points are to be clearly identified. Sea worthy packing shall be employed when advised. **Wooden packing shall be as per ISPM15**	

	Packing, marking and shipping instruction refer: D319000-00000-W-GPCO-0001 Rev 04 (Attached)	

NOTES:

1. The tests should also be in conformity to the QP submitted by the supplier and approved by BHEL/Customer.
2. All test facilities shall be arranged by the vendor at his works before calling BHEL Representative for inspection.
3. Approved drawings, P.O., specifications and relevant standards shall be made available during testing/inspection.
4. All measuring and testing instruments shall be periodically calibrated from national test house and certificates made available during inspection.

ACTUATOR DATA SHEET

Vendor to furnish the following along with the Offer:

1.0 Actuator Starting Torque (KGM)

2.0 Final output shaft angular movement/RPM.

3.0 Actuator bore dia and length of the gate shaft inside the actuator.

4.0 End connection details of actuator considering end connection of gate.

5.0 GA drg. of actuator.

6.0 Lubrication details and

7.0 List of commissioning spares/O & M spares/Mandatory spares.

ANNEXURE TO SPECIFICATION FOR ELECTRICAL ACTUATORS WITH INTEGRAL STARTER

Motor Actuator:

The actuator motor design shall be of industrial type self-contained with integral control unit and electric
motor geared size to stroke the valve in a specified time.
The electronic components shall be suitable for vibration area and applicable to hazardous area classification "d" Flameproof as a minimum.
Each design of the actuator assembly shall have, but not limited the following requirements:

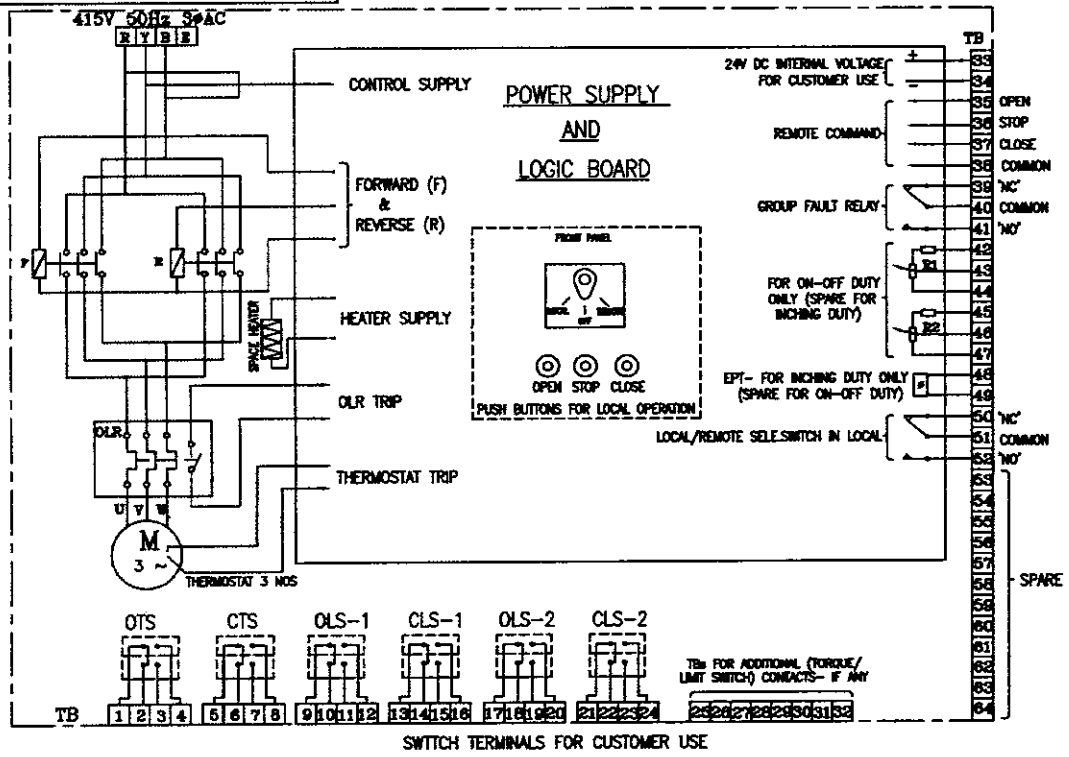
- Squirrel Cage type induction motor **(Power supply: 3 phase, 400VAC, 50 Hz).**
- Gearbox
- Output drive unit
- Local Position indicator
- Lockable selector switch (Local, Remote, etc)
- Local pushbuttons (Open, Stop, Close)
- Terminal Box for Power and Signal
- Anti condensate heater
- Handwheel
- Labeling (identification, torque rating, motor power, etc.)

The sizing of the motor shall be 150% of torque to the worst applicable condition.
The remote signal configuration for each motor shall be having; e.g., Start, Stop, Open, Close and Fault.

PREPARED: CHECKED: APPROVED:

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

DRAWING NO. 3-V-MISC-24227



CONTACT DEVELOPMENT DIAGRAM

OTS	1–2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3–4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5–6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7–8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9–10	
	11–12	
CLS-1	13–14	
	15–16	
OLS-2	17–18	
	19–20	
CLS-2	21–22	
	23–24	

SWITCH — TERMINAL NO. — FULL OPEN — a — INTERMEDIATE — b — FULL CLOSE

VALVE POSITION

——— INDICATES CONTACT CLOSED

- - - - - - INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

– CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* – BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

NOTE:–

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1–24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25–32
2. CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 – LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 – LIMITSWITCHES FOR POSITION CLOSE
6. EPT – ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
7. R1-R2–POTENTIOMETER 2 x 100 OHMS (FOR ON–OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M – MOTOR 3φ 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.
UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPALLI-620014.
365–121

	NAME	SIGN	DATE	NO. OF VAR.
DRN	N.P.ESWAR	N.P	07.10.04	
CHD	D.DINAKARAN	D.D	07.10.04	
APPD	K.ARUNACHALAM	K.A	07.10.04	

DEPT: VL | CODE | SCALE | WEIGHT (KG). | REFERENCE INFORMATIONS | NO. OF SHEETS

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

ANNEXURE-VI
(LT Motor specification)

1) Doc No. 319000-00000-JSS-1691-0001 / Rev 05 Low Voltage motors – 12 Pages
2) Doc No. FBC&HRSG:CI:5312:LVM2 - Annexure-2 ECI (Specification for LV motors) – 2 Pages

REVISION HISTORY

Rev No.	Revision Date	Revision Detail
05	10/Mar/2008	Issued for Purchase
		Section 6.2- Modified – Min size of motors for repair included.
		Section 6.3- Modified – Further details included.
		Section 6.4- Modified – Details modified as EFF1 is applicable only till 90kW ratings.
		Section 6.5.2- Modified– Starting Current requirements detailed further
		Section 6.5.3 - Modified – Locked rotor time requirements detailed further
		Section 6.5.4 - Modified – torque requirements detailed further
		Section 6.6- Modified – Details modified to accept G.S slide rails
		Section 6.8 - Modified – Material requirements detailed further to include Aluminium frame for smaller motors and GRP/ metal alloy fans
		Section 6.10- Modified – Requirements for Dust Hazard area motors added.
		Section 6.11- Modified – Requirements for bidirectional motors modified to reduce noise levels
		Section 6.12 - Modified – Noise level requirements detailed further
		Section 6.13.1 - Modified – Bearings requirements detailed further
		Section 6.13.2 - Modified – Drip Trays for grease collection deleted
		Section 6.14 - Modified– Requirements detailed further to alternately include reinforced winding insulation (Class F) as an alternative to Class H for VSDS driven motors.
		Section 6.16 - Modified– Fan requirements detailed further for larger frame size, two pole motors
		Section 6.19.1 - Modified – Requirements for Dust Hazard area motors added.
		Section 6.19.2 - Modified – Requirements detailed further
		Section 6.19.4 - Modified – Requirements detailed further
		Section 6.19.4.1 - Modified – Requirements detailed further
		Section 6.20 - Modified– Document numbers corrected.
		Section 6.21 - Modified– Requirements for Dust Hazard area

LOW VOLTAGE MOTORS

Document Category : C

Rev.	Date (dd/mmm/yyyy)	Author (Name)	Checked (Name)	Approved (Name)	Approved (Name)	Status
05	17/Mar/2008	Pankaj Hedaoo	Paul Hanoun	Jude Adhibhan	K. Brown	Issued for Purchase
04	18/Oct/2007	Rajat K. Roy	Younes B. Arjmand	Jude Adhiban	K. Brown	Re-Issued for Implementation
03	13/July/2006	P. Shield	G. Bahuchet	H. Tendijowski	W. Yau	Re-Issued for Implementation
02	13/Jan/2006	L. Weber	G. Bahuchet	H. Tendijowski	W. Yau	Re-Issued for Implementation
01	13/Jan/2006	L. Weber	G. Bahuchet	H. Tendijowski	W. Yau	Re-issued for Approval
00	14/Dec/2005	L. Weber	G. Bahuchet	H. Tendijowski	W. Yau	Issued for Implementation
HT					Owner	

		motors added. Section 6.22- Modified – Requirements for vibration monitoring systems modified with respect to bearings lubricated for life. Section 6.23- Modified – Requirements for Dust Hazard area motors added. Section 8 - Modified – Combined testing of VSDS and Motor included. Section 9 Modified – Sea worthy packing included.