GAM/MAT/22/173: Medupi Power Station Corrosion Protection Considerations for Chemical Resistant Pumps, Valves and Piping Supports

To be considered as Annexure D of 240-101712128 and 240-106365693: "Standard for the Internal and External Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings"	
Components	Effluent Neutralisation Sump (ENS) Pumps, Valves and Structural Steel, Piping Supports, Hangers & Brackets. For specific details with respect to types sizes and quantities, manufacturing standards etc. refer to the Scope of Work document 346-9995116 'Medupi PS Modification of Effluent Neutralisation Sump Pumping System Technical Specification'.
Environment (Internal)	• Immersed/internal materials for chemical resistant valves and pumps. • High/low Conductivity Effluent (Mixture of Sulphuric Acid, NaOH, Demin Water, Brine). • pH: 1-12 • Conductivity: Up to 1020 µs/cm • Na: >100 ppm • Chloride: up to 50 ppm • Design Temperature: 2 to 60 °C • Design Pressure: Atmospheric pressure
Environment (External)	For any component on the ENS system as per the "Components" section above. • Occasional spill and splash by internal medium – High/low conductivity effluent. • Ambient temperature

Surface Preparation (External)	• Abrasive blast clean to Grade Sa 2.5 (externally) as per ISO 8501-1. Ensure a suitable substrate profile as per the Manufacturer's requirements.
Generic System (External Surface)	• Primer = Recoatable Two Component Polyamide Cured Epoxy. • Intermediate coats = Two Component Solvent Free, amine Cured Epoxy Novalac. • Finishing coat = High Build Re-coatable Polyurethane Acrylic.
Primer Coat	Apply by spray, one coat re-coatable, Two Component Polyamide Cured Epoxy Primer **from 60 to 80 microns**. Primer shall be compatible with subsequent coats.
First Coat	After allowing sufficient time (as recommended by the coating Manufacturer) for the primer coat to cure, then immediately prior to spray application of the first intermediate coat, all accessible edges, weld seams, bolt holes and other crucial areas shall be stripe coated by brush using the first/intermediate coating. Apply by airless spray, one coat Two Component Solvent Free Amine Cured Epoxy coating **from 350 - 450 micron**. Thinning in excess of 5% shall not be permitted.
Second Coat	Allowing sufficient time for the first coat to cure, the Manufacturer's recommendations shall be adhered to in this regard, apply by spray, second coat Two Component Solvent free, Amine cured Epoxy from **350 to 450 microns.** Thinning in excess of 5% shall not be permitted.

Final Finishing Coat	Allowing sufficient time for the preceding intermediate coat to cure, the Manufacturer's recommendations shall be adhered to in this regard, apply by spray, one coat Twin Pack, High Build Re-coatable Polyurethane Acrylic Finish from **60 to 80 microns**. Total System Minimum DFT = **820 to 1060 microns**.

With respect to aspects not mentioned in the above coating specification table (e.g. mixing ratios, pot life, straining, thinning, induction times, over-coating and curing times), the manufacturer's recommendations shall be strictly adhered to.

1. General Requirements for Material Selection

1.1. As per Medupi technical specification document 346-9995116 the contractor is required to design pumps, valves and piping supports with material suitable to handle corrosive effluent. For these corrosive mediums refer to the Table above (environmental properties).

1.2. The contractor/supplier is required to consider and select the correct materials (grades, types hereof) with due consideration of all corrosion, degradation or deterioration related aspects for the anticipated environment and possible variations for these environments. Furthermore the material selection process shall also consider the following potential corrosion impacts:

- Design aspects and corrosion allowances.
- All manufacturing processes such as casting, forming, welding, heat treatment processes, cutting, machining, surface pickling and passivation, surface polishing, corrosion protection by coating systems (surface preparation and application) etc.
- All required and suitably adequate tests and Non-Destructive Testing (NDT) methods for the determination and quantification of applicable and relevant defects and flaws during and post installation, assembly and construction processes.
- All storage and preservation measures to be employed during periods of transportation and construction phases.
- Suitability and applicability of greases, inhibitor systems to prevent/mitigate corrosion mechanisms and to ensure that these methods do not induce any corrosion mechanisms.

- Installation, assembly and construction processes which could have an impact on corrosion.

1.3. For the above the contractor/supplier shall propose and list all relevant and applicable internationally recognised standards, test methods and procedures. The Contractor/supplier shall consider the relevant points above for all plant areas for specific material and specific applications.

2. Specific Requirements for Valves

2.1. All valves shall be made of chemically resistant materials and shall be compatible and suitable for the purpose (as above) in “Environment Internal” and also aligned with the advisory material selection information in Tables 1, 2, 3, 4, & 5 further below.

2.2. The fundamental requirement of isolation valves is that they can achieve and maintain tight shut-off. Plug valves are extensively used for this purpose and are considered to be the most reliable, particularly for concentrated sulphuric acids and caustic. Quarter turn plug valves have been found to give good service.

2.3. The recommended type shall have a flanged end ductile iron body with an alloy 20 plug or Teflon encapsulated plug and a Teflon lining.

2.4. The specification for ball valves shall be anti-static, fire-safe, zero leak stem seal which is compatible with sulphuric acid and caustic soda.

2.5. Diaphragm valves shall not be used as primary outlet or drain valves because of the possibility of a large spillage if the diaphragm fails. It is essential that isolating valves can be closed quickly and safely in an emergency. Remotely operated shut off valves may be necessary. If a slam shut valve is fitted, the closing time shall be designed to prevent pressure surges which could cause flanges or pump seals to leak.

2.6. Non-Return Valves (NRV) all NRV's to be piston or ball check valves. The seals and seats must be PTFE which will be resistant to sulphuric acid of all concentrations. Pressure relief valves shall be installed on the discharge of the pumps to prevent over-pressurisation on the line.

2.7. A block and bleed valve provides an isolation between the sulphuric acid and water and prevents water from flowing back into the sulphuric acid pipework.

2.8. For caustic at high-temperature, nickel-cast iron plug valves or nickel gate valves with deep packing glands shall be used. Stainless steel can also be used in some cases. Other types of valves commonly used include non-lubricated ball valves and gate valves made entirely of iron or steel. For caustic, brass valves shall be avoided, especially at high temperatures or concentrations of 50% or above, because they are corroded by caustic soda.

3. Specific Requirements for Pumps

3.1. All pumps shall be made of chemically resistant materials and shall be compatible and suitable for the purpose (as above) in "Environment Internal" and also aligned with the advisory material selection information in Tables 1, 2, 3, 4, & 5 further below.

3.2. Centrifugal pumps of PTFE-lined cast iron or plastic or magnetic driven seal-less pumps are commonly used. The wetted parts shall be 316SS, Alloy 20 or PTFE. Where sealed pumps are used they shall be fitted with a mechanical seal. For sulphuric acid, fluorocarbon packing can be used since most other forms of gland packing are readily attacked by sulphuric acid.

3.3. For caustic, packing material shall be PTFE impregnated, caustic resistant fibres, or equivalent. All pumps shall be visually examined for leaks on a daily basis and inspected more thoroughly on a routine maintenance basis.

3.4. For applications in which small amounts of sulphuric acid is required (<1 m3/hr), a positive displacement pump can be used. The wetted parts must be constructed out of Alloy 20, SS316L or PTFE.

Table 1: Listing of specialised alloys for sulphuric acid service

Alloy Type	**Sulfuric Acid Concentration versus Temperature**			**General Comments**
	Dilute	Mid-Range	Concentrated	
Duplex Stainless Steels				
SAF2205/SAF2507	< 20% (at ambient)	Not Recommended		
Chromium Based Alloys				
Iron-Nickel-Chromium, Molybdenum, Copper (Alloy 31)	< 60% (< 85°C)	60 – 80% (< 70°C)	80 – 98% (< 50°C)	
Chromium- Iron-Nickel (Alloy 33)	Suitable for all concentrations below 90% at ambient temperatures		95 – 98% (< 135°C)	Excellent resistance in hot concentrated oxidizing acid.
Nickel Based Alloys				
Nickel-Iron-Chromium, Molybdenum-Copper (Alloy 825)	< 40% (at ambient)	Not Recommended	95 – 98% (at ambient)	
Nickel-Chromium-Iron-Molybdenum-Copper (Alloy G, G-3,and G-30)	Suitable for all concentrations at ambient temperatures			Resistance in halide-contaminated H_2SO_4
Nickel-Copper (Alloy 400)	< 60% (< 95°C)	< 85% (< 30°C)	Not Recommended	Developed for reducing conditions.
Nickel-Molybdenum-Chromium (Alloy C-276)	Suitable for all concentrations at ambient temperature			
Nickel-Molybdenum (Alloy B-2 and B-3)	< 40% (at ambient)	40 – 80% (< 50°C)	80 – 98% (< 70°C)	Oxidizing contaminants, such as Fe^{3+} ions, drastically increase corrosion
Alloy Type	**Sulfuric Acid Concentration versus Temperature**			**General Comments**
	Dilute	Mid-Range	Concentrated	
Nickel-Chromium-Iron-Cobalt-Silicon (Alloy 55 and Alloy 66)	< 60% (< 50°C)	Not Recommended	80 – 98% (< 100°C)	
Nickel- Chromium-Molybdenum-Copper (Illium B and 98)	< 60% (< 50°C)	60 – 80% (< 60°C)	80 – 98% (< 100°C)	
Nickel-Chromium-Silicon	Suitable for all concentrations below 90% at ambient temperatures		93 – 98% (90-130°C)	Capability of fabrication in thin sections and complex shapes

Table 2: Chemical and temperature resistance of fluorinated plastics suitable for linings in pipe for handling H_2SO_4

Chemical resistance temperature limits for fluoroplastic linings in sulfuric acid		
Material	Maximum temperature °C (a)	Concentration
PTFE	230	All
PFA	230	All
FEP	205	All
ECTFE	150	< 98
ETFE	150	< 98 (b)
PVDF	120	< 16
	95	30 – 60
	65	85 – 93
	50	94 – 98 (b)

PTFE (polytetrafluoroethylene); PFA (perfluoroalkoxy); ECTFE (ethylene chlorotrifluoroethylene); FEP (fluorinated ethylene propylene) copolymer resin with TFE; ETFE (modified ethylene-tetrafluoroethylene); PVDF (polyvinylidene fluoride).

(a) Above 130 °C, service as a lining may be limited by permeation, mechanical properties, thermal expansion, and adhesives.

(b) PVDF and ETFE may be attacked by free SO_3 present at concentrations slightly higher than 98%

Table 3: Chemical and temperature resistance of stainless steel in NaOH solutions

Type	Concentration NaOH %	Temperature °C	Corrosion Rate (mm/yr)
302	20	50-60	<0.0025
304	22	50-60	<0.0025
309	20	50-60	<0.0025
310	20	50-60	<0.0025
410	20	50-60	0.0025
430	20	50-60	0.0025
304	72 (a)	120 – 125	0.09
316	72 (a)	120 – 125	0.08
329	72 (a)	120 – 125	0.0025
21Cr-4Ni-05Cu	72 (a)	120 – 125	0.15
410	72 (a)	120 – 125	0.8
302	72 (b)	120 – 125	0.97
304	72 (b)	120 – 125	1.1

(a) Solution moderately agitated
(b) No aeration

Table 4: Thermoplastics maximum temperature in various strength solutions of NaOH

Thermoplastic	Maximum Temperature			
	10% NaOH	30% NaOH	50% NaOH	70% NaOH
	°C	°C	°C	°C
Polyethylene (PE)	60	60	60	60
Polypropylene (PP)	100	100	100	100
Polyvinyl chloride (PVC)	60	40	40	40
Chlorinated polyvinyl chloride (CPVC)	80	80	80	80
Polyvinylidene fluoride (PVDF)	60	60	60	60
Fluorinated ethylene-propylene (FEP)	200	200	200	200
Polytetrafluorethylene (PTFE)	150	150	150	150

Table 5: Temperature limits for Fluorinated plastics in caustic soda

NaOH %	Temperature Limit			
	PVDC	PP	PVDF	PTFE
	°C	°C	°C	°C
<10%	65	93	79	150
10 – 15%	24	93	52	150
50%	24	93	NR	150
>50%	NR	65	NR	150

NR: Not resistant
PVDC (polyvinylidene chloride); PP (polypropylene); PVDF (polyvinylidene fluoride); PTFE (polytetrafluorethylene).

4. Coating Specific Requirements

4.1. The more stringent requirement shall apply in cases where there may be contradictory or conflicting requirements between this specification sheet, and the following:

- 240-101712128: Standard for the internal corrosion protection of water systems, Chemical Tanks and Vessels and Associated Piping with Coatings.
- 240-106365693: Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings.
- 240-145581571: Standard for the Identification of the Contents of Pipelines.

4.2. At all times care shall be taken to ensure adequate protection of any surfaces and parts of components or systems not requiring blast cleaning and coating (as an example valve seats/trim, pump inlets) and every effort shall be taken to prevent grit, water and other dirt entering drain systems, tank/vessel inlet/outlet piping or settling on isolating valves seats, shafts etc.

4.3. Equipment name plates and identification plates shall be protected from coatings. No coatings shall be applied over any surfaces where these will adversely affect the performance of the item or component.

4.4. Corrosion Protection shall only proceed once all mechanical, fabrication, manufacturing activities i.e. cutting and welding have been completed and released in terms of the manufacturing/fabrication Quality Control Plan (QCP).

4.5. External coating shall only commence once the internal corrosion protection activities are concluded i.e. after curing.

4.6. All parts comprising systems i.e. Organic Coating, in this specification sheet, shall be supplied by the same Manufacturer. Should this not be possible the Coating Supplier shall confirm suitability or compatibility of the particular product with his system.

4.7. The solvents used shall be those recommended and manufactured by the paint Manufacturer. Where the recommended 'solvent' and 'clean-up thinners' for a material differs, the 'clean-up' solvent shall not be added to the paint for dilution purposes.

4.8. Surface preparation by abrasive blasting shall be performed by means of blasting equipment capable of removing mill scale, rust and suitably preparing the substrate to the required cleanliness of Grade Sa 2.5 or Sa 3 for internal or external surfaces.

5. Coating General Requirements

5.1. The Contractor shall be wholly responsible for the surface preparation and lining/coating application.

5.2. Rounded edges are required in order to be able to apply the protective coating uniformly and to attain adequate coating DFTs on sharp edges, refer to ISO 12944-3 should more detail be required.

5.3. Sharp edges shall be dressed to a radius of not less than 3 mm. All burrs and weld spatter shall be removed. Welds shall be free from imperfections (e.g. asperities, undercutting, blowholes, craters, and spatter).

5.4. Weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius less than 3 mm shall be ground.

5.5. All welds shall be free of slag, slag inclusions and pinholes. Adjacent areas shall be free of weld spatter, which shall be removed by grinding or scraping.

5.6. All surfaces shall be completely dry and free from contaminants such as traces of oil, grease, etc., before surface preparation is carried out.

5.7. Prior to any surface preparation all surfaces that are, or are likely to be contaminated with oil or grease as a result fabrication/manufacturing process shall be solvent cleaned with a suitable water-soluble biodegradable alkaline cleaner/detergent or with appropriate organic solvents.

5.8. Cleaning may be performed by using rags for small areas, or a spray gun for large areas. The detergent/solvent-cleaned surfaces shall then be thoroughly washed down with fresh/clean water ensuring that the oil-water emulsion formed is completely removed from the metal. Special attention shall be paid to drillings, bolt holes, etc.

5.9. Degreased and water washed surfaces shall be checked for residual oil and grease using the atomized water spray test as per ASTM F21 and further degreasing shall be carried out if residual oil or grease is found to be present. In instances where there is no or poor natural lighting then the interpretation of the ASTM F21 shall be assessed by means of ultraviolet light i.e. back light.

5.10. A black light test shall be used to check for oil contamination. Zero oil and grease contamination are the acceptable limit. Washing with fresh/clean water containing a suitable degreasing agent of partially painted components shall take place between coats, if surfaces are found to be contaminated.

5.11. Different grades and types of blasting media exist. It is important that the correct abrasive be used in combination with a specific corrosion protection system to achieve the specified surface profile. The required blast profile height should be carefully considered. The Contractor shall select an appropriate abrasive type and mesh size to attain the specified surface profile.

5.12. Sand or silica-based abrasives shall not be used. Abrasive material for blast cleaning shall be used in line with local environmental regulations.

5.13. The abrasive shall be used in accordance with the Manufacturer’s specifications and shall be clean, sound, hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter and water soluble salts. It is important that good quality abrasives are used in order to minimize the amount of waste grit and dust generated and contamination of the surfaces.

5.14. The use of re-cycled blasting media for the final blast is strictly prohibited.

5.15. All abrasive media shall be stored in an area that is completely dry, covered and protected from weather.

5.16. The profile height of the blasted surfaces should be within the range of the specified coating system. Refer to the Manufacturers Product Data Sheets. Unless otherwise specified by the Coating Manufacturer, a profile height of 25 microns to 70 microns is recommended for most coatings systems.

5.17. It is important that the blast profile does not exceed the specified DFT of the primer. Blast cleaning of severely corroded surfaces may result in high profiles i.e. > than 100 microns.

5.18. In these cases, the primer shall be applied by brush/roller to ensure complete wet-out of the pitted/jagged surface. However, agreement should be reached between the Applicator and Primer Manufacturer as to the most suitable profile range, with due consideration of the application method, for the specific primer.

5.19. Compressed air for blasting and coating/lining activities shall be free from entrained moisture and oil. All traps shall be in a functional condition. The compressed air shall be tested at regular intervals using clean white clothes to assess cleanliness and dryness. This requirement shall be included in the QCP.

5.20. No abrasive blasting, coating or lining applications shall take place when conditions are likely to affect these operations. Clauses 4.1.1.2 to 4.1.1.5 of BS 6374-5 shall apply.

5.21. Removal of dust and debris from the surfaces shall be performed by using dry, clean and oil free compressed air.

5.22. Immediately before coating application, blast cleaned steel shall not exhibit more than “dust quantity rating” 1 when tested in accordance with ISO 8502-3.

5.23. The Contractor shall ensure that during surface preparation and coating activities the relative humidity (RH) in open, undercover shop environments is less than 60 % RH. Ambient temperatures shall be between 5 °C and 30 °C or as per the Manufacturer recommendations, whichever is the more stringent.

5.24. The maximum/minimum substrate temperature at the time of coating application shall be strictly in accordance with the product data sheet. During stable weather conditions environmental parameters shall be measured and recorded at least 4 times per shift.

5.25. During periods of inclement or cold weather conditions the environmental parameters shall be measured and recorded hourly. In the event that the latest two readings of any of the parameters indicate a deteriorating trend which would likely exceed parameter/s limit then no final surface preparation or spray application shall be permitted.

5.26. All measurements shall be recorded at the steel surface. Dew point requirements shall be as per the Product Datasheet or 240-101712128.

5.27. In order to avoid recontamination and flash rusting of the surfaces, the primer shall be applied within 8 hours after final surface preparation of the steel surfaces. Under no circumstances shall the blast be permitted to stand overnight.

5.28. The supply and cost of all testing, inspection and specialized testing equipment shall be the Contractor's responsibility. QC shall be performed by the Coating Applicator and the Quality Assurance inspection shall be conducted by Eskom. A series of witness and hold points shall be agreed such that Eskom may witness any of the above tests. Eskom may elect to carry out its own tests at these times.

5.29. For all inspections of all surface preparation and coating activities the surfaces shall be clean allowing unhindered visual access to the surface. The Contractor shall provide sufficient and adequate lighting (Cool White) to enable inspections. Cell phone lighting is not acceptable.

5.30. For the external surfaces the spray operator shall ensure application in a smooth and controlled motion. The spray operator shall be equipped with a "wet comb" and frequently monitor the wet film thickness to prevent/reduce a wide spread of DFT's.

5.31. After allowing sufficient time for the first coat to cure, all edges, weld seams and other crucial areas shall be given an additional stripe coat, by brush application, with the same material as the following coat. Should the use of a primer be omitted, stripe coating shall be carried out between applications of the first coat and the subsequent coat.

5.32. Multiple coats shall be applied as per the table at the top of this specification sheet. Single coat systems are not permissible.

5.33. The applicator shall perform pinhole detection using appropriate “spark” testing equipment at a voltage setting as per the coating manufacturer’s requirements. Wet sponge testing shall not be acceptable.

5.34. Defects and pinholes shall be recorded and an additional coat shall be applied in this area. Wherever possible and achievable the pinhole detection and general patch repairs shall be performed before final cure of the coating system. Repair of pinholes and coating damage after full cure will require surface preparation i.e. sanding/abrasion to provide a mechanical key for the repair.

5.35. It is standard practice that ISO Certified industrial coating Manufacturers of finishing coats such as Acrylic Polyurethane Finish will provide the complete range of colours as may be required by industrial colour coding standards.

5.36. Where more than one coat is being applied in an open exposed yard environment, surface preparation and washing shall be carried out between coats. Where the coating has completely cured or allowed to age before finishing, before application of a subsequent coat the surface shall be prepared by light sanding, scrubbing with potable water using a bristle brush and drying before over-coating.

5.37. Application of subsequent coats shall be in accordance with the specified system. The required over-coating intervals as mentioned in the latest Product Data Sheet shall be observed and adhered to.

5.38. The number of coats and DFT per coat required to achieve the total film DFT shall be agreed between the Contractor and Coating Manufacturer and will be dependent upon the method of application chosen.

5.39. The total DFT of the applied coating system shall comply with the recommended minimum and maximum DFT limits as recommended in the latest Product System Data Sheet and this specification.

5.40. The range of DFTs of each coat shall be as follows; 90 % of random readings shall be equal to or greater than the minimum specified DFT. No individual reading shall be less than 80 % of the specified DFT. In the case of solvent borne coatings no individual reading shall be greater than 150 % of the Manufacturer's maximum specified DFT. All deficient film DFTs shall be rectified prior to release of components.

5.41. The coating shall be evenly applied to form a smooth, continuous, unbroken layer free from misses, sags, runs, tears and other defects that could affect the integrity of the coating.

5.42. All areas of coating damage (external) shall be patch repaired. The extent of the damage shall be carefully inspected to assess which coats in the system have been damaged and which surface preparation methods are most suitable and appropriate. The Eskom Engineer shall accept/reject the Contractor's recommended method of surface preparation i.e. mechanical power and hand tool cleaning. When more widespread repairs are required and when the damage extends to the steel substrate abrasive blast cleaning to Grade Sa 2.5 (ISO 8501-1) is required.

5.43. All coats in the system shall be re-instated. Areas to be primed shall be cleaned of dust, dirt, grease, salts or other deleterious matter and all edges of existing paint shall be feathered back to a hard edge.

5.44. The patch primer used shall be in accordance with the requirements of the relevant coating system. The over-coating onto an existing coating by subsequent intermediate and finishing coats (where applicable) shall be stepped at 25 mm intervals to produce a feathered edge. Specifics of such instances shall be assessed on a case-by-case basis.

5.45. All shop coated surfaces shall be inspected and examined for coating damage on arrival at site. If the damage is excessive, it may be preferable to repair the transport damage before installation/assembly/erection whilst access is easier.

5.46. Provision shall also be made for the repair of handling damage to the coating after installation/assembly/erection/scaffolding removal. Spot repairs shall reinstate each of the previous coats and shall commence directly after the localised surface preparation.

5.47. All coated surfaces shall be adequately ventilated until full cure has been achieved. At the end of the curing period and before immersion the full cure of the applied coating shall be verified by the Contractor and/or Coating Manufacturer.

6. Tender Technical Returnables

Note that the returnables as detailed below shall be returned as part of the Contractor's Tender document/submission.

6.1. At the time of tender the Contractor shall provide verifiable evidence of relevant experience, in the material selection of metallic components compatible with respect to the environment/s in this specification and SOW/Enquiry documents as well as experience in the application of all corrosion protection systems/technologies, i.e. coatings and linings of the components specified above (pumps, valves & structural steel) for similar sized projects in comparable environments as described in this specification. In this regard the experience shall, as a minimum, be equal to the surface area (m^2) as defined in this enquiry and Scope of Work (SOW) documents.

6.2. The verifiable evidence shall include either formal signed off QCP's or release certificates accompanied by the contact details (Company, Project, Date, Engineer name, telephone and email) for at least 3 similar reference projects.

6.3. The System Manufacturer/Coating Applicator or Contractor shall supply individual product data sheets and material safety datasheets (MSDS) for all products comprising the system i.e. coatings, lining, adhesives, tack coats and solvents. As a minimum the following shall be submitted:

- A description of the generic type of coating/lining.
- Confirmation that the corrosion protection system is suitable for the intended method of application.
- Recommended and non-recommended uses for coating/lining.
- Service temperatures and chemical resistance limits.

- Chemical resistance limits.
- Surface preparation requirements.
- Maximum recommended service temperature which shall be a minimum of 30% greater than the maximum temperatures as is indicated in the table at the top of this specification. The particular system rating shall consider the above temperatures as continuous service i.e. not intermittently.
- Application conditions and details including but not limited to: application temperatures, dilutions, pot-life, application techniques and DFT for the particular application method, over-coating intervals, and curing times required before immersion.

6.4. A detailed procedure/method statement shall be submitted to Eskom at the time of tender detailing all steps, procedures and activities of both the internal corrosion protection and coating application process. The steps to be considered includes:

- Grease decontamination and washing.
- Methods for dust and debris removal, maintaining and ensuring cleanliness between primer and adhesive steps shall be described.
- The precise sequence and breakdown of work areas/activities in order to apply the system with due consideration of dust contamination.
- All inspection interventions during and after completion of corrosion protection application shall be considered and included.
- The Method Statement shall describe all measures and details for establishing and maintaining the environmental conditions as required by this specification.
- After Tender award and prior to any work the detailed Method Statement shall be reviewed by Eskom for acceptance/rejection. Eskom reserves the right to request further revision, clarification or additions in accordance with this specification sheet.

6.5. A detailed Quality Control Plan (QCP) for internals and externals shall be submitted and shall detail all inspections and tests with acceptance criteria during corrosion protection application. Inspections shall at least cover surface documentation review and approval, air blotter test for surface cleaning and blasting, environmental parameters, coating thickness, continuity and visual tests.

6.6. List of deviations or exclusions from this specification. If there are none then there shall be a definitive written statement to such effect. This mentioned list of deviations or definitive written statement shall be used as part of the contract.

6.7. The contractor shall make provision for reputable independent inspection authority/third party to witness and conduct testing during corrosion protection activities. The corrosion protection inspector shall be qualified to NACE CIP Level 1, 2 or 3 or equivalent.

7. Handling, Transportation, Storage and Erection of Piping

7.1. Every precaution must be taken to correctly support and protect the components during handling, transportation, storage and erection.

7.2. Prior to commencement of any work the Contractor shall submit a procedure for handling, transportation, storage and erection for Eskom’s approval.

8. Safety Requirements and Considerations

8.1. During the application of all coatings/lining systems, care shall be taken to ensure adequate ventilation and lighting, to avoid/minimise health and safety risks.

8.2. Special care needs to be taken when working with all organic coatings/linings. Prior to the use of any coating material, the Material Safety Data Sheets shall be obtained from the relevant Coating Manufacturer.

8.3. The Contractor shall be familiar with the contents of the safety data sheets and ensure that the necessary safety precautions are taken in order to comply with local and national safety and health requirements such as the OHS Act.

8.4. The Contractor shall ensure compliance with all statutory regulations, municipal by-laws, etc. concerning pollution and the health and safety of personnel and/or members of the public who may be affected by the work. The Contractor shall provide the personnel with the appropriate required PPE.

8.5. The Contractor shall provide for all necessary safety precautions and risk assessments.

8.6. All materials shall be stored in designated areas in storage facilities that meet the storage requirements of the Manufacturer. The Contractor shall be responsible for the provision of appropriate storage/shipping containers as required. These containers shall include the appropriate refrigeration/conditioning systems for temperature control. This requirement shall be dependent on where the container will be located (indoors/outdoors), typical ambient temperature for the particular season of the year and the maximum storage temperature limits as per the Manufacturer's recommendations.

8.7. The Contractor's Safety File shall address all the hazardous activities of abrasive blast cleaning and spray painting. The Contractor shall verify that the personnel carrying out these activities are suitably qualified.

8.8. The Contractor shall ensure that the abrasive materials used conform to all National Health and Safety Standards.

9. Reference Documents

The latest revision of the referenced standards shall apply. Where conflict exists between any of these documents the more stringent requirement shall apply.

9.1. 240-101712128: Standard for the internal corrosion protection of water systems, Chemical Tanks and Vessels and Associated Piping with Coatings.

9.2. 240-106365693: Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings.

9.3. 240-145581571: Standard for the Identification of the Contents of Pipelines.

9.4. 240-139611439: Water Treatment Plant Sulphuric Acid and Caustic Soda Dosing Design Guideline.

9.5. 346-9995116 'Medupi PS Modification of Effluent Neutralisation Sump Pumping System Technical Specification'

9.6. ASM Handbook, Volume 13C, Corrosion: Environments and Industries, ASM International, 2006.

9.7. ASTM D4414: Standard practice for measurement of wet film DFT by notch gauges.

9.8. ASTM D4541: Standard Method for Pull-off Strength of Coatings using Portable Adhesion Testers.

9.9. ASTM D5162: Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates.

9.10. ASTM E376: Measuring coating DFT by magnetic field or eddy current electro-magnetic test Methods.

9.11. ASTM F21: Standard Test Method for Hydrophobic Surface Films by the Atomizer Test.

9.12. BS 6374-5: lining of equipment with polymeric materials for the process industries.

9.13. ISO 2409: Paints and varnishes – Cross cut test.

9.14. ISO 4624: Paints and varnishes – Pull-off test for adhesion.

9.15. ISO 4628 – 1: 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.

9.16. ISO 4628 – 3: Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting.

9.17. ISO 8501-1: Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.

9.18. ISO 8502-3: Preparation of steel substrates before application of paint and related products – Test for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting (pressure sensitive tape method).

9.19. ISO 8502-6: Preparation of steel substrates before application of paint and related products – Test for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis – The Bresle method.

9.20. ISO 8503-4: Preparation of steel substrates before application of paint and related products – Surface roughness characteristics of blast-cleaned steel substrates - Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile – Stylus instrument procedure. (May be used as an alternative to SANS 5772).

9.21. ISO 9001: Quality Management Systems - “is defined as the international standard that specifies requirements for a quality management system (QMS). Organizations use the standard to demonstrate the ability to consistently provide products and services that meet customer and regulatory requirements.”

9.22. ISO 12944-3: Paint and varnishes – Corrosion protection of steel structures by protective paint systems. Part 3: Design considerations.

9.23. ISO 9223: Corrosion of metal and alloys – Corrosivity of atmospheres – Classification.

9.24. SANS / ISO 2808: Paints and Varnishes: Determination of film DFTs (Can be used as alternative to ASTM E376).

9.25. SANS 5770: Preparation of steel substrates before the application of paints and related products – Test for the assessment of cleanliness of blast-cleaned steel surface – Freedom from certain soluble salts.

9.26. SANS 5772: Preparation of steel substrates before the application of paints and related products – Surface roughness characteristics of blast-cleaned steel surfaces – Profile of blast-cleaned surfaces determined by a micrometre profile gauge (Can be used as alternative to ISO 8503-4).

GAM/MAT/22/173: Medupi Power Station Corrosion Protection Considerations for Chemical Resistant Pumps, Valves and Piping Supports

Submitted by:	**Accepted by:**
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