Eskom	SCOPE OF WORK	Engineering

Title: **Corrosion Protection of WTP vessels and lines and Fly Ash silos at Kriel Power station**

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1. Introduction

Kriel Power Station water treatment plant consists of nine vessels for demineralised (Demin) plant and nine vessels that for condensate polishing plant (CPP) regeneration system.

At the Demin Water Treatment Plant, there are three parallel trains (A, B and C), each consisting of three vessels (cation, anion and mixed bed) for the removal of impurities from the pre-treated filtered raw water. The pre-treated and filtered raw water is passed through resin beds where the impurities are removed through ion exchange process to produce mineral free water for use in the Boiler to produce steam for Turbines.

At the CPP, the resin from the units is transferred into these vessels where it is regenerated where chemicals (sulphuric acid and caustic) are injected. The CPP consists of three parallel trains (A, B and C), each consisting of three vessels namely; cation, anion and storage vessels respectively.

All vessels have associated distribution pipework as part of the process to dose or inject chemicals for the purpose of regen and complete water treatment.

Kriel Power Station Fly ash from below the Electrostatic Precipitator (ESP) is pneumatically conveyed to the transfer and main silos where it is temporarily stored before transportation to ash dams. Compressed air used for conveying of this fly ash and its vented into the atmosphere using reverse jet fabric filters situated on roof top of each main silo to trap ash and vent the air. The transfer and main silos top roofs have been affected by heat, erosion and corrosion (from internal and external factors) resulting in roof leaks. Water leaking into the silos causes ash clinkers and hang-ups resulting in no ash flow for transportation to ash dams. After steelwork repairs of each roof top rubber lining is required to be done.

The scope of work is for refurbishment of the rubber lining in the WTP vessels and piping as well as the rubberlining of the fly ash silos roof cones for a period of 3 years.

2. Supporting Clauses

2.1 Scope

This document covers technical requirements in the form of scope of work for rubber lining the Water treatment plant vessel as well as the top part of ash silos at Kriel Power Station.

The scope shall include plant pre-inspections, surface preparation, rubber lining, chemical resistant paint application on dry dust silos, Demin and CPP vessels associated pipelines.

- Operating, maintenance and engineering shall discuss and define the extent of scope of work as a team as soon as the defect has been identified.
- Operating raise a flag to maintenance and engineering to ensure awareness of a defective plant.
- Employer’s representative informs the Contractor of the required services through a task order.
- The contractor shall submit all the necessary quality control plans and task safety risk assessments before execution of each task scoped.

2.1.1 Purpose

The purpose is to ensure that the plant is returned to its ensure long term plant health of the plant.

2.1.2 Applicability

This document is applicable to the Water Treatment Plant at Kriel Power Station

2.2 Normative/Informative References

2.2.1 Normative

[1] ISO 9001 Quality Management Systems

[2] IS0 14001 Safety Management Systems

[3] GAM/MAT/22/072: Corrosion Protection Specification for Kriel Power Station WTP Vessels Either by Rubber Lining Patch Repair or Complete Relining

[4] GAM/MAT/22/073: Corrosion Protection Specification for Kriel Power Station Water Treatment Plant Piping

2.2.2 Informative

Table 1: List of Specifications

Title	Reference Number
General Specifications:	
Occupational Health and Safety Act and Construction Regulations	Act No 85, 1993 and subsequent revisions
Quality Requirements for Engineering and Construction work	7.1/ST/02
Eskom Generation Plant Safety Regulations (PSR)	36-681
Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings	240-106365693
Eskom Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings.	240-101712128
Specification for the Identification of the Contents of Pipelines and Vessels	ESKSCAAC6
Identification of Colour Markings	SANS 10140

The manufacture of rubber sheeting for rubber lining	SANS 1198
The application of rubber linings to pipes, pipe fittings and vessels	SANS 1201
SHE Organization	240-28463367
Safety, Health and Environmental Specifications for Contractors	240-30008949

2.3 Definitions

Definition	Description
approved	Refers to written approval by the Eskom Engineer.
applicator	Refers to personnel applying the lining system.
coating/paint/lining system	"Coating/paint system" is an all-embracing term including method and degree of surface preparation, generic type, thickness and number of coats and the method of application of the coats.
Contractor	The paint applicator/rubber liner or Contractor having the main Contractual responsibility to Eskom.
inspector	Anyone responsible for ensuring conformity with this standard.
manufacturer	The manufacturer of the paint or rubber lining compounds and associated products such as primers, adhesives, solvents, cleaners etc.
rubber lining	A process in which rubber is applied as an anticorrosion protection to protect the outside or inside of vessels, tanks, pipes and equipment for industries.
surface preparation	The preparation of a substrate prior to applying the lining, i.e. welding, grinding, blasting, cleaning, application of bonding agents and tie coats.

2.4 Abbreviations

Abbreviation	Description
CPP	Condensate Polishing plant
QC	Quality Control
QCP	Quality Control Plan
WTP	Water Treatment Plant

2.5 Roles and Responsibilities

a) The Eskom Engineer will do a quality check on all the works which is done by the Contractor

b) Contractor shall be fully responsible for the implementation of all of the works.

c) The Contractor shall be fully responsible for the control and execution and the successful completion of the works.

d) The Contractor shall be responsible for ensuring that all Sub-Contracting parties such as the paint/rubber lining applicator and the paint/rubber liner manufacturer are fully conversant with the requirements of this scope of work and referenced standards in this document.

e) Any specific queries or requirements not covered by this document shall be referred to the Eskom Engineer.

f) The Project Manager should ensure the contractor performs the works as per the scope of work.

2.6 Process for Monitoring

- Engineering to ensure that QC inspections are done for all of the works.

2.7 Related/Supporting Documents

- N/A

3. Description of the *works*

The works entails the application of rubber lining and chemical resistant paint on ash silos (transfer and main) top roof, CPP vessels, demin water vessels and associated pipelines. The works scope is for corrosion protection of surfaces to prolong the life of plant and minimize breakdowns. Quality control tool shall be used to manage execution to ensure that desired quality of work on newly applied linings for Kriel Power Station's vessels and pipes is in accordance with prescribed standards to improve plant performance.

3.1 Scope

The following scope applies to 6x main silos, 6x transfer silos, 9x Demin vessels, 9x CPP vessels and their associated pipework.

The scope shall include internal inspections, repairs or relining on the Demin and CPP vessels depending on nature of the defects per vessel. The scope includes offsite rubber lining of associated steel plates and pipework as per the Employer's representative's instructions on each task order.

Requirements on ash silos are external inspections and repair work as per the defects. The works includes cleaning to remove excess ash, stripping the rubber floor and removal of any loose equipment's at ash silo top to make the area safe for work.

Scope breakdown for vessels:

- WTP Operating manpower to take out resin with the side nozzle using chemical injection pumps to push it out

- Operating issues a permit for manhole opening to maintenance,
- Operating conducts a gas test for vessel entry i.e. minimum 21 ppm oxygen required,
- Operating issues a permit for vessel entry and maintenance work,
- Maintenance and engineering conducts inspections respectively within the vessel to determine a thorough scope of work
- Employer's representative informs and notifies the Contractor about scope of work required to be done thru a task order,
- Contractor submits QCP, MSDS, product data sheets, work method statements and any other information on material and process that he/she will be using for approval before coming onsite
- No work shall be performed until the Quality Control Plan is approved by Eskom
- After approval the *Contracto*r reports to site, performs risk assessment and obtain permit to work
- The *Contractor* conducts his/her own inspections within the vessel to confirm the scope of work after task order issuing
- The Contractor's safety officer shall prepare a Safety File for the area to be worked on. This Safety file shall address hazardous activities of abrasive blast cleaning and spray painting
- The site supervisor shall verify that the personnel carrying out these activities are suitably qualified and safely protected
- The *Contractor* performs the work as specified following the guideline conditions below
- The Contractor apply chemical resistant corrosion protection as requested by the Employer Representative on the vessel internal and external surface and piping.

Scope breakdown for ash silos:

The Contractor caters and makes provision for fly ash contamination during rubber lining process in his pricing and work method. All the ash silos are not at ground level and the Contractor familiarise themselves with the plant areas and make provision for any other additional requirements for the purpose of performing work. The following scenarios are examples of what should be done to perform rubber lining replacement at ash silos plants:

1. Perform risk assessment and obtain permit to work

2. Perform pre-inspection of the plant and plan accordingly

3. Clean the fly ash

4. Stripping and removal of old rubber

5. Abrasive blast cleaning is the only acceptable method for surface preparation

6. Abrasive blast cleaning shall be carried out in accordance with Clause 5.3 of SANS 10064 (ISO 8504) and the degree of cleanliness achieved shall be Sa 3 in accordance with ISO 8501/1.

7. Surface preparation inspection

8. The primer coat shall be applied as soon as possible after the surface preparation operation not exceeding 4hours or as deemed acceptable by the rubber applicator taking into consideration the dry dust environment which could compromise or contaminate the primers.

9. Application of metal primer, the Contractor shall ensure that all paints/primer are mixed in accordance with the manufacturer's instructions

10. Application of primers first coat allowing to dry

11. Application of primers second coat allowing to dry

12. Rubber lining as per the MSDS using natural rubber SANS 1201 and SANS 1198

13. Contractor provides curing time prior of rubber lining according to MSDS specifications

14. Perform spark and Shore A hardness tests measurement, (45-55)

15. Final inspections and permit to work clearance if all stakeholders have signed-off QCP's

Note: The spark test and shore hardness measuring instruments valid calibration certificates to be provided as part of QCP, otherwise the results cannot be deemed valid.

4. Demineralised trains and CPP regeneration vessels

The demineralised WTP consists of three trains, and each train comprises of the following process units:

- 1 x Cation vessel;
- 1 x Anion vessel; and
- 1 x Mixed bed vessel.

The CPP regeneration vessels consists of three trains, and each train comprises of the following process units:

- 1 x Cation vessel;
- 1 x Anion vessel; and
- 1 x storage vessel.

Each vessel is a steel pressure vessel in which resin is contained. The unit is cylindrical in section and stands vertically. The vessel has dished ends. An access manholes to the vessels is provided.

The vessels are rubberlined internally. The contractor needs to make allowance for rubberlining of the entire shell, manholes, supports structures, inlet and outlet pipelines, etc.

The cation and anion vessels have a concrete base which has been cast into the bottom of the vessels. The contractor must make allowance for the rubberlining of this concrete floor as well.

The mixed bed vessels have a nozzle plate. The contractor must make allowance to rubberline the dome below the nozzle plate, as well as the top and bottom of the nozzle plate itself.

Once the vessels are inspected, the employer's representative will determine if patch repairs are required or full rubbelining of the entire vessel. The vessels must be rubber lined using 6mm Grade B Butyl rubber. Sandblast the whole vessel with silica free sand blasting grit. The Contractor must ensure that there is a system installed which will remove the dust created during sandblasting and must be exhausted outside the building in a designated area. Please take note that this is a demineralisation plant and hence the cleanliness during blasting operations is of outmost importance to prevent contamination during production.

Refer to section 66 for more details on the rubberlining requirement. The design specifications for the vessels are as per Table 2 below, and the dimensions can be used as a guide to determine the

rubber lining requirements for the vessel. Surface preparation and rubberlining will be done as per the following specification

- GAM/MAT/22/072: Corrosion Protection Specification for Kriel Power Station WTP Vessels Either by Rubber Lining Patch Repair or Complete Relining

The supports must be straightened before rubber lining is done.

Table 2: WTP Ion vessel design specification

Parameter	Unit	Cation	Anion	Mixed bed
Height	m	4.7	4.7	3.05
Inside Diameter	m	2.44	2.44	1.98
Design P/T	kPa/˚C	690 @ 50	690 @ 50	690 @ 50
Operating P/T	kPa/˚C	690 @ 20	690 @ 20	690 @ 20
Material of Construction	-	Rubber lined mild steel		
Estimated area for rubberlining	m^2	240	240	240

Table 3: CPP regeneration vessel design specification

Parameter	Unit	Cation	Anion	Storage
Height	m	3.5	4.5	4.5
Inside Diameter	m	2.13	1.37	2.13
Design P/T	kPa/˚C	500 @ 50	500 @ 50	500 @ 50
Operating P/T	kPa/˚C	516 @ 40	516 @ 40	516 @ 40
Material of Construction	-	Rubber lined mild steel		
Estimated area for rubberlining	m^2	240	240	240

Applicable drawings to this section of the scope is:

- 0.45-25496: Details of Cation vessel
- 0.45-25497: Details of Anion vessel
- 0.45/25538: Kriel Power Station Anion and Cation vessels for Demin Plant

5. Demin plant and CPR piping refurbishment

The water treatment plant pipework consists out of multiple areas that require lining replacement. The pipework is constructed out of mild steel. Inspection of the pipework will be done by the Employers representative to decide what is required and the work will be issued as a task order. The lining of the supplied pipework must be done out-situ. The Contractor must allow for full replacement and re-rubberlining of all the pipes.

The Contractor applies the necessary corrosion protection layers on all pipes, as per

- GAM/MAT/22/073: Corrosion Protection Specification for Kriel Power Station Water Treatment Plant Piping

All pipe supports will be corrosion protected, as per Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).

Proper planning of the replacement of pipework must be done to ensure work is done when the plant is not required.

Table 4: Demin, CPP and diluted acid pipework

Description	Value	Unit
300NB	30	m
200NB	30	m
150NB	30	m
100NB	30	m
80NB	30	m

6. Corrosion protection Specifications

All corrosion protection done in this project must be done in accordance to the following standards and specifications:

- 240-101712128 - Eskom Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings.
- 240-106365693 – Eskom Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings
- ESKSCAAC6 - Specification for the Identification of the Contents of Pipelines and Vessels
- SANS 10140 (Identification of Colour Markings).
- GAM/MAT/22/072: Corrosion Protection Specification for Kriel Power Station WTP Vessels Either by Rubber Lining Patch Repair or Complete Relining
- GAM/MAT/22/073: Corrosion Protection Specification for Kriel Power Station Water Treatment Plant Piping
- ISO 9001: Quality Management Systems – Requirements.
- SANS 1198: The manufacture of rubber sheeting for rubber lining.
- SANS 1201: The application of rubber linings to pipes, pipe fittings and vessels

7. Acceptance

This document has been seen and accepted by:

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8. Revisions

Date	Rev.	Compiler	Remarks
May 2022	01	S. Sulliman	Scope of Work

9. Development Team

The following people were involved in the development of this document:

S. Sulliman

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10. APPENDIX A: GAM/MAT/22/072: Corrosion Protection Specification for Kriel Power Station WTP Vessels Either by Rubber Lining Patch Repair or Complete Relining

To be considered as Annexure D of 240-101712128: "Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings"	
Vessel/Components	Demineralised (Demin) Train and Condensate Polishing Plant (CPP) Regeneration (Regin) Vessels including Vessel Piping attachments and Flange Faces. Demin Trains – Cation, Anion and Mixed Bed Vessels CPP Regen – Cation, Anion and Storage Vessels For detailed data with respect to type, quantities, access, manholes sizes and quantity, chemical environments, etc. refer to the scope of work document – Corrosion Protection of Fly Ash Silos and WTP Vessels and Lines at Kriel Power Station.
Material/Substrate	Existing steel - Internally rubber lined(aged rubber) - Externally epoxy coated Cation and Anion Vessels – Concrete Floor
Environment (Internal Immersed)	Aqueous Solution/mixtures - Sulphuric: 5 % - 8 % - Caustic: 5 % - NaCl: 10 % pH: 2 to 13 De-cationised water Filtered water De-ionised Water Design Temperature: 15 °C – 50 °C Design Pressure: <700 kPa NB - More details in the Scope of Work document.
Generic System (Internal Surface): **Pre-cured Butyl Rubber Lining (Grade B): 40 - 70 IRHD** as per SANS 1198. The adhesion of the rubber lining to substrate shall be ≥ 3.5 N.	
Rubber Lining Thickness	Lining thickness shall be 5 mm.

Rubber Lining Options	Rubber lining options shall be determined by inspection findings: - Rubber Lining Patch Repairs. - Complete Rubber Lining Replacement.
Environment (External)	- Aggressive Indoors - Ambient Temperature
Generic System (External Surface) Primer and intermediate coats = Twin Pack Polyamide Cured Epoxy. Finishing coat = High Build Recoatable Polyurethane Acrylic	
Primer Coat	Apply by spray, one coat Twin Pack Polyamide Cured Epoxy Primer from **60 to 80 microns or as per coating Manufacturer's recommendation.**
Stripe Coat	After allowing sufficient time (as recommended by coating Manufacturer) for the first coat to cure, all edges, weld seams, bolt holes and other crucial areas shall be given an additional stripe coat with the same material as the following coat.
Intermediate Coat	Allowing sufficient time for the primer coat and stripe coat to cure, the Manufacturer's recommendations shall be adhered to in this regard, apply by spray, one coat Twin Pack, High Build Polyamide Cured Epoxy Intermediate Coat from **120 to 150 microns or as per coating Manufacturer's recommendation.**
Final Coat	Allowing sufficient time for the intermediate coat to cure, the Manufacturer's recommendations shall be adhered to in this regard, apply by spray, one coat Twin Pack, High Build Recoatable Polyurethane Acrylic Finish from **50 to 60 microns or as per coating Manufacturer's recommendation.** **Total System Minimum DFT = 230 to 290 microns.** The colour of the final/finishing coat shall be as per the requirements of 240-145581571: Standard for the Identification of the Contents of Pipelines and Vessels.

Surface Preparation	**Internal Surface – Steel Material:** - Abrasive blast clean to Grade Sa 3 (ISO 8501-1). Surface profile as specified by the rubber lining and adhesive Manufacturer. **Internal Surface – Concrete Substrate:** - Concrete repair and abrasive blast clean. **External Surface – Steel Material** - Abrasive blast clean to Grade Sa 2.5 (ISO 8501-1). The surface profile as specified by the coating Manufacturer.
The corrosion protection of the vessels and associated piping will be performed in situ at Kriel Power Station	

1. Rubber Lining Patch Repairs

The scope of work shall include the following:

1.1. Conduct a detailed visual inspection and pin-hole detection testing (no more than 3 kilovolts per mm) on the existing rubber to check the condition of the rubber lining and identify the defects. Identify and mark-up the defects or the areas requiring the repairs. Eskom will witness all aspects of the inspection and be responsible for the selection of repair areas or complete relining.

1.2. The piping supports and nozzles inside the vessels may require removal in order to allow access inside the vessel.

1.3. The Contractor shall compile a rubber patch repair procedure and submit to Eskom for approval. As a minimum the repair procedure shall include the following:

- Pin-hole detection testing on the existing rubber lining.
- Cutting out, stripping and removal of the existing rubber in the marked-up areas as per the above inspections.
- Surface preparation of the substrate after removal of existing rubber in the marked-up areas. For smaller areas to be patch repaired where abrasive cleaning is impractical the Rubber Liner or Contractor shall propose suitable cleaning method/s. The cleaning method/s shall be submitted to Eskom for review and approval before commencement of the work.
- Provision shall be made for mechanical and civil repairs i.e. concrete casting, welding and grinding where necessary, before new rubber patch repairs. The Contractor shall propose substrate repair procedures and submit to Eskom for approval.

1.4. Power and hand tool cleaning is only applicable to localised patch repairs. Hand-tool cleaning for isolated/localised areas may be utilised provided the required standard of finish is achieved. For all internal applications final mechanical cleaning shall be by bristle blaster in order to create a surface profile.

1.5. Cleaning by means of hand or power-tools, i.e. wire brushes, chipping hammers, scrapers, grinders, sanders, needle descalers, bristle blasters etc. may only be used where accepted by the Eskom engineer.

1.6. Burnishing of the surface shall not be permitted.

1.7. In all cases, after wire brushing or grinding, all traces of loose material shall be removed from the surface by vacuum cleaning. Cleaned surfaces shall not be contaminated with oil, grease, rust or other deposits before primer application. Unnecessary traffic prior to painting/lining shall be avoided.

1.8. Care shall be taken during welding and surface preparation to protect the remaining rubber lining from any damage such as mechanical damage, welding/grinding sparks, and welding spatter.

1.9. Once the above activities have been completed conduct rubber lining patch repairs of the affected areas. In the event that the pre-cleaned substrate has been exposed for more than 8 hours or the cleanliness grade of the substrate has deteriorated then the substrate will require rework to reinstate the required grade of cleanliness in accordance with ISO 8501-1.

2. Complete Rubber Lining Replacement

The scope of work for option 2 will include the following:

2.1. Internal parts such as piping supports/laterals and nozzles that are removable shall be removed from the vessel, the old rubber stripped out and replaced with butyl rubber grade B with 40-70 IRHD.

2.2. All components in the vessel shall be rubber lined except components constructed from stainless steel or plastic. The components include distribution pipes and nozzle plates. As part of the method statement the Contractor shall consider and propose steps and measures to ensure a leak tight seal between the nozzles and nozzle plate. The measures shall describe how the rubber lining will be applied to the nozzle plate to ensure the rubber is completely flat to facilitate nozzle assembly. The rubber lining on the nozzle plate shall serve a dual purpose of corrosion protection and as a gasket.

2.3. In conjunction with the requirements above, the Contractor shall manufacture a mock-up test plate to simulate the actual vessel nozzle plate.

The test plate shall match the configuration and dimensions of the nozzle plate, nozzles and rubber lining in all respects as would be encountered in actual practice i.e. plate thickness, rubber lining thickness, hole and nozzle configuration, shape, dimensions, thread pitch and depth.

2.4. Using the mock-up test plate the Contractor shall develop method/s, as example the use of suitable Teflon thread tape, developing and standardising optimum torque setting of the nozzles for leak tightness for assessment and either approval/rejection by Eskom.

2.5. The Rubber Liner or Contractor shall remove most of the existing rubber lining by initial removal techniques such as cutting out, stripping and flapper disc grinding.

2.6. Inspect and assess the extent of possible pitting and corrosion of the underlying steel and concrete substrates, it may be necessary to determine the need for possible mechanical and civil repairs i.e. welding, concrete casting. Should these repairs be required the Contractor shall propose substrate repair procedures and submit these to Eskom for approval.

2.7. Proceed with rubber lining operation once the above inspections and welding/concrete repairs have been completed.

2.8. Subsequent surface preparation shall be by means of abrasive blast cleaning method. Abrasive blast cleaning to grade Sa 3 in accordance with ISO 8501-1.

3. Concrete Surface Preparation

3.1. Concrete, by its nature is alkaline and if any breakdown in the corrosion protection occurs, for whatever reason, the acid would rapidly dissolve the concrete. Future repairs are made extremely difficult once the existing concrete has been contaminated, owing to its porous nature.

3.2. When conducting rehabilitation of exposed concrete, it is imperative that the acid saturated and contaminated concrete be chopped out and repaired, prior to the application of any new acid proving lining.

3.3. Conduct pH testing on concrete substrate to establish pH levels. pH levels should be between 9 and 10.

3.4. Ensure that the concrete is firm, free of foreign matter, inclusions, blowholes, and porosity and non-friable. Loose, defective and friable concrete should be repaired.

3.5. Suitable and sufficient tests must be conducted to measure any residual concrete moisture and confirm that the residual moisture levels detected conform to the coating or lining material's minimum requirements and the Manufacturer's minimum prescriptions.

3.6. All new concrete MUST be a minimum of 28 days old prior to the commencement of ANY surface preparation or lining procedures. This is essential to allow the Hydration reaction to complete in the concrete.

3.7. If concrete has already cracked, then the cracks need to be sealed using the application procedure proposed by the Contractor and approve by Eskom.

3.8. Typically surface preparation is the same for the concrete as for the steel, namely Abrasive Blast Cleaning. However, owing to the porosity of the concrete the requirements for the vacuuming of the substrate prior to the commencement of the lining procedure are more stringent and therefore more time consuming. The practical/achievable surface cleanliness and remaining dust and debris acceptance criteria, shall be agreed by the Contractor and Eskom. A surface prepared test patch on the concrete, shall be performed at the kick-off stage to determine acceptance criteria.

3.9. When coating the concrete, the primer used must be a low viscosity penetrative primer and it must totally soak in the concrete substrate, if this is not successfully attained, the lining system will fail. The primer must be applied by brush in a stippling motion to ensure total absorption.

4. General Requirements

4.1. The Eskom standard 240-101712128 (Section 5 in particular), SANS 1201, SANS 1198 and BS 6374-5 shall apply for the Manufacturer, selection and installation of rubber lining. The Rubber Liner or Contractor to take note of the selected type of rubber required in the table above. NOTE: Special Requirements as per SANS 1198, Table 4, Property Column (Special points (III), (V) and (VI)) shall apply.

4.2. The Contractor to take note of the different material of construction on the shell and the floor of the vessels to be rubber lined. Cation and anion shell and floor of the vessels are constructed from mild steel and concrete material respectively.

4.3. Surface preparation by abrasive blasting shall be performed by means of conventional handheld blasting equipment capable of removing remaining/residual rubber, corrosion product, rust and suitably preparing the substrate to the required cleanliness - Grade Sa 3 and Sa 2.5 in accordance with ISO 8501-1 for internal and external surfaces respectively.

4.4. After the old rubber lining is removed and surface preparation complete , a detailed visual inspection shall be carried out to check for defects on both steel and concrete substrates. Unfortunately, this inspection can only be carried out once the surfaces have been prepared for lining. Based on the damage on the vessel it may be required to conduct mechanical and or civil repairs before rubber lining.

4.5. The Contractor shall submit the above repair procedures as required above to Eskom for review and approval. Repair procedures for the works shall include the sealing of joints and cracks on concrete surface and welding as well as non-destructive testing requirements on the steel surfaces.

4.6. Rubber lining processes, whether patch or complete relining, shall only proceed once all mechanical and civil repairs or activities on the vessels have been completed and released in terms of the applicable manufacturing/fabrication Quality Control Plan (QCP).

4.7. Pre-cured Butyl rubber grade B with 40-70 IRHD is the specified material for the internal surfaces. Pre-cured rubber lining sheet is typically inflexible (not pliable) relative to other rubbers. The Rubber Liner or Contractor shall propose the application method to ensure the correct bond and adhesion strength between the vessel support geometries and rubber lining.

4.8. The rubber lining thickness of 5mm is specified. The Rubber Liner or Contractor shall confirm the specified thickness as satisfactory for the application.

4.9. The Manufacturer/s of the rubber lining material and adhesive or Contractor shall select the relevant primer and or adhesive systems for the type of rubber lining (butyl rubber) material, substrate and service conditions to ensure compatibility. All the products to be used on the system shall be supplied by the same Manufacturer.

4.10. All parts comprising corrosion protection systems required in the table above shall be supplied by the same Manufacturer. Should this not be possible the coating/rubber lining Supplier shall confirm suitability or compatibility of the particular product with his system.

4.11. All materials, i.e. paint, solvents and cleaning agents for a specific paint system shall also be supplied by the same Manufacturer. 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

4.12. The responsibility for selecting the type of rubber/ coating system required by Eskom for the application above rests solely with the Applicator and his material (primer, coating, compound and adhesive) Suppliers.

4.13. Prior to rubber lining installation the Contractor shall supply test sample panels of about 200 mm X 300 mm X 3 mm with a rubber lining thickness of 5 mm. Properties such as hardness and adhesion will be tested by Eskom to ensure compliance to both the product data sheet and the above-mentioned standard (SANS 1201), including all the Normative references contained therein.

4.14. In addition to the panel samples above, representative (considering different batches), loose rubber sheeting 500 mm X 500 mm X 5 mm shall be submitted for confirmation of correct rubber type (by Fourier Transform Infrared Spectroscopy) and tensile testing before the commencement of any lining in order to ensure compliance to both the product data sheet and the standard (SANS 10037), including all the Normative references contained therein.

4.15. Specifically for the tensile testing, specimens shall be prepared as per SANS 10037 "Type 1 Dumb-bell". The Rubber Liner or Manufacturer shall provide written commitment to this requirement at the tender stage.

4.16. During corrosion protection of the vessel:

- The Rubber Liner shall prepare (200 mm X 300 mm X 3 mm) test panels with a rubber lining thickness of 5 mm at the same time and under the same conditions as the vessel. The prepared test panels shall be sent to Eskom for adhesion/peel testing as per the requirements of SANS 1201 section 9.4.
- The Coating Applicator shall be prepared (100mm X 200mm X 2mm) test panels as per the requirements of the Manufacturer's datasheet and in compliance with the requirements of this Standard. The coating shall be applied under the same condition as the vessel. The coating shall be cured as would be in practical situations without any artificial assistance. The prepared test panels shall be sent to Eskom for adhesion tests.

4.17. The Corrosion Protection Applicator or Contractor shall supply the relevant batch certificates for each of the coating/lining products used.

4.18. It is strongly recommended that engineering subject matter experts (civil, welding engineers and NDT subject matter experts) are consulted for mechanical and civil repair activities.

4.19. The engineering experts in consultation with the Rubber Liner or Contractor and Lining Manufacturer shall compile detailed application procedures for the works. The procedure shall be submitted to Eskom for review and approval. The Contractor shall be wholly responsible for the surface preparation and lining application.

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

4.21. 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.

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

4.23. After initial blasting of representative patches soluble salt testing shall be performed by the Bresle soluble salt test method. If not within acceptable limits (as per the Manufacturer requirement but not exceeding 100 mg/m2), the surfaces shall then be washed/decontaminated by High Pressure (HP) water washing using fresh/clean water (with a conductivity reading of maximum 100 µS/cm) at a minimum pressure of 300 bar. A salt decontamination chemical additive with demonstrated capability of removing salts may be used in conjunction with HP cleaning.

4.24. Soluble salt testing shall be repeated on representative test patches and if acceptable then proceed with blasting and application steps – if not then repeat HP washing until the salt contamination has been removed to within acceptable limits.

4.25. No abrasive blasting 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.

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

4.27. 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.

4.28. 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.

4.29. 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.

4.30. The Contractor shall ensure that during surface preparation and rubber lining 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. The maximum/minimum substrate temperature at the time of 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.

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

4.32. During corrosion protection process on site care shall be taken to ensure adequate protection of the surrounding areas and any parts of the ancillary equipment i.e. pumps, filters, valves seats, drains, inlet and outlet piping from abrasive blasting and spent grit particles, paint.

4.33. Different grades and types of blasting media exist. It is important that the correct abrasive be used in combination with a specific rubber lining 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.

4.34. Only inert mineral grit or steel grit abrasives shall be used. Steel grit is preferred in sensitive plant areas such as Water Treatment Plants in order to ensure no contamination of plant. Sand or silica based abrasives shall not be used. Abrasive material for blast cleaning shall be used in line with local environmental regulations.

4.35. 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.

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

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

4.38. The requirement for surface preparation of all metallic surfaces for immersion is strictly Grade Sa 3 (ISO 8501-1), in which case the surfaces shall be blast cleaned to white metal where all traces of rust, mill scale and other foreign matter are removed.

4.39. All compressed air for blasting 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.

4.40. After surface preparation, all dust, grit blasting media or any other deleterious matter shall be removed from the surfaces by vacuuming. The process shall be repeated until the required level of dust and debris removal is achieved. It is imperative that all surface dirt and contaminants are completely removed before primer or the adhesion of the rubber shall be impaired.

4.41. On completion of grit blasting the surface shall be thoroughly vacuumed until no loose dust is evident. The level of cleanliness required on the steel substrate shall be less than "dust quality rating" 1 when tested in accordance with ISO 8502-3.

4.42. 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.

4.43. The profile height of the blasted surfaces should be within the range of the specified 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.

4.44. 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.

4.45. 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.

4.46. Individual rubber sheets shall be tailored to fit the surface to be lined. The lining shall be bonded to the manhole flange faces. The mating surface of the flange face to gasket shall be suitably dressed such that the face is acceptably flat to ensure sealing between the liner and the gasket. The application and flange arrangement shall be as per SANS 1201 Figure 7 a) or c) and the Eskom Engineer requirements.

4.47. All joints of lined rubber shall be strapped as per BS 6374-5.

4.48. All surfaces shall be pinhole tested (only after completion of all handling, moving and equipment and scaffolding removal) to ensure the lining is pinhole free and if required additional repairs shall be performed and once cured then the repair areas shall be retested. The process to be repeated until a pinhole free lining is achieved.

4.49. For all inspections of all surface preparation and lining 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.

4.50. The installed lining shall present a smooth appearance and be free of voids, blisters, pinholes, cracks, open seams, excessive squeeze out of adhesive at the joints (>10 mm on either side), entrapped air or any other defects which will impair its use. Defective areas shall be cause for rejection of the lining.

5. Tender Returnables

5.1. Mandatory Tender Returnables

5.1.1 At the time of tender verifiable evidence shall be submitted that the Rubber Liner has experience in the application of rubber lining systems in comparable environments i.e. tanks/confined spaces. In this regard the experience shall, as a minimum, be equal to the surface area (m^2) as defined in the enquiry and Scope of Work (SOW) documents.

This verifiable evidence shall be for projects where vessels have been successfully lined by the Contractor, within the last five years. The verifiable evidence shall include formal signed off QCP's or release certificates and contact details for the listed reference projects.

5.2. Tender Returnables for Evaluation

5.2.1 The System Supplier or Rubber Liner or Coating Applicator or Contractor shall supply individual product datasheets and material safety datasheets (MSDS) for all products comprising the system i.e. rubber lining, adhesives, tack coats and solvents. As a minimum the following shall be submitted:

- A description of the generic type of rubber lining.
- Physical and chemical properties as per Table 4 of SANS 1198.
- Recommended and non-recommended uses.
- Service temperatures and chemical resistance limits. For the chemical resistance, special property (I), (III), (V) and (VI) as per SANS 1198 Clauses 4.2.2 (d), 4.2.3 (b) in conjunction with the environment and operating conditions in the table above in this specification sheet shall apply. Confirmation that the lining shall not contaminate the system/process fluid to be handled. Special property (V & VI) as per 240-101712128 and SANS 1198. The approved test results or certificates from the independent laboratory shall be written in English.
- 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 sheet.
- Surface preparation requirements.

5.2.2 A detailed procedures/method statements shall be submitted to Eskom at the time of tender detailing all steps, procedures and activities of the coating/lining application process. The steps to be considered includes:

- Define and describe the requirements as defined in section 2.2 to 2.4.
- The methods, steps, sequence and equipment required for ventilation and dust mitigation.
- Grease decontamination and washing.
- Soluble salt decontamination.
- Methods for dust and debris removal, maintaining and ensuring cleanliness between adhesives and lining shall be described.
- The Method Statement shall detail the precise sequence and breakdown of work areas/activities in order to apply the system with due consideration of dust contamination.
- The Method Statement shall also consider the most efficient methods and sequencing to avoid unnecessary delays that may have an impact i.e. time required for removal of spent abrasive grit and dust/debris.
- All inspection interventions during and after completion of rubber installation 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.
- The required ventilation for the prevention and/or management of fumes and dust build-up. The number of extraction fans; mounting diameters, sizes and mounting methods of fans to manholes; power rating of fans; positioning of fans and direction of intended air flow shall be described and detailed.

5.2.3 A detailed Quality Control Plan (QCP) shall be submitted at the tender stage and shall detail all inspections and tests with acceptance criteria during lining application. Inspections during lining application shall at least cover compressed air blotter test for blasting, surface preparation, environmental parameters, rubber thickness, hardness, adhesion, continuity and visual tests. Tests for continuity shall be carried out using the high frequency spark test method.

5.2.4 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. In addition to this statement the Contractor, Rubber Liner or Manufacturer shall also provide a definitive statement for the submission of samples as prescribed above.

5.2.5 The applied lining system shall be guaranteed jointly by the rubber lining Manufacturer and Rubber Liner or Contractor. This guarantee with proposed terms and conditions shall be submitted at the time of tender. The applied rubber lining system shall perform in the given environment for a minimum period of 10 years.

6. Safety Requirements and Considerations

6.1. During the application of rubber lining, care shall be taken to ensure adequate ventilation and lighting, to avoid/minimise health and safety risks.

6.2. A confined spaces (CSs) may be defined as an enclosed, restricted, or limited space in which, because of its construction, location or contents, or any work activity carried on therein, a hazardous substance may accumulate and/or an oxygen-deficient atmosphere may occur, and/or in which a dangerous liquid or dangerous concentration of gas, vapour, dust or fumes may be present. It includes any chamber, tunnel, pipe, pit, sewer, container, valve, pump, sump, chute, bunker, silo, gearbox, tank, receiver, drum or any similar construction, equipment, machinery or object.

6.3. Flammable Atmospheres: Gases, vapours and dusts can become trapped in CSs and create flammable or explosive atmospheres, and include combustibles e.g. Hydrogen, Acetylene, Rubber and thinning/cleaning solvents, etc.

6.4. Walking / Working Surfaces and Visibility: Poor lighting may add to hazards caused by an irregular, sloped, or constricted working surface.

6.5. Special care needs to be taken when working with all organic coatings/linings. Prior to the use of any coating/lining material, the Material Safety Data Sheets shall be obtained from the relevant Manufacturer. The Contractor shall be familiar with the contents of these 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.

6.6. Any solid waste materials or liquids stripped or generated during the lining operations shall be discarded in accordance with the requirements of the appropriate national and/or local authorities or the requirements of Eskom.

6.7. 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.

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

6.9. All materials shall be stored in designated areas in storage facilities that meet the storage requirements of the Lubber Liner 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.

6.10. The Contractor's Safety File for the area to be worked it 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.

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

Specifically with respect to CSs and based on the descriptions and definitions of safety risks as per the above points it is imperative that the Contractor's Method Statement shall describe in detail, the measures and mitigation steps for the risks and hazards as identified in this specification sheet.

It is compulsory that these safety risks/mitigation measures and any others as identified by the Contractor be included in the Method Statement. Prior to the commencement of any work the Method Statement shall be submitted for review, acceptance/rejection by the respective Power Station Risk and Safety office/department.

7. 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.

7.1. 240-101712128: Standard for the internal corrosion protection of water systems, Chemical Tanks and Vessels and Associated Piping with Coatings.

7.2. 240-106365693: Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings

7.3. 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".

7.4. SANS 1198: The manufacture of rubber sheeting for rubber lining.

7.5. BS 6374-5: Lining of equipment with polymeric materials for the process industries.

7.6. SANS 1201: The application of rubber linings to pipes, pipe fittings and vessels.

7.7. SANS 10037: Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties.

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

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

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

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

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

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

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

7.15. 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.

7.16. 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.

7.17. 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.

7.18. 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).

7.19. 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).

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

7.21. 2ISO 9223: Corrosion of metal and alloys – Corrosivity of atmospheres – Classification.

7.22. SANS 10064: The preparation of steel surfaces for coating.

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

7.24. 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).

7.25. SIS 055900: Swedish Code of Practice - Pictorial surface preparation standard for painted steel surfaces. (Can be used as alternative to ISO 8501 – 1).

Submitted by:	**Accepted by:**
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Name: N. Pheta	Name: K. Northcott
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Date: 5 May 2022	Date: 5 May 2022

11. APPENDIX B: GAM/MAT/22/073: Corrosion Protection Specification for Kriel Power Station Water Treatment Plant Piping

To be considered as Annexure D of 240-101712128: "Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings"	
Vessel/Components	Piping Components (bends, elbows, tees, pools flange faces) in the range 80 mm – 350 mm. For detailed data with respect to piping quantities, manufacturing standards etc. refer to the scope of work document – Corrosion Protection of Fly Ash Silos and WTP Vessels and Lines at Kriel Power Station.
Material/Substrate (Internal/external)	**Existing steel** - Internally rubber lined (aged rubber) - Externally epoxy coated **New steel** - mill scale For existing steel there is a high probability of soluble salt contamination, both internally and externally. For new steel there is a high probability of oil contamination due to the manufacturing process. For further details/requirements refer to the relevant sections below.
Environment (Internal Immersed)	Aqueous Solution/mixtures • Sulphuric: 5 % - 8 % • Caustic: 5 % • NaCl: 10 % pH: 2 to 13 De-cationised water Filtered water De-ionised Water. Design Temperature: 15 °C – 50 °C Design Pressure: <750 kPa NB - More details in the Scope of Work document

Environment (External)	- Exposed to aggressive corrosive conditions. - Ambient Temperature
Generic System (Internal Surface) Steam cured Butyl Rubber Lining (Grade B, 40 to 70 IRHD) as per SANS 1198. The adhesion of the rubber lining to substrate shall be > 3.5 N/mm. **NOTE:** Curing shall be by autoclave. It should be noted that no part of the rubber lining may be subjected to the vulcanisation process more than twice.	
Surface Preparation	Abrasive blast clean to Grade Sa 3 (internally) and Sa 2.5 (externally) as per ISO 8501-1. Suitable substrate profile as per the rubber lining material and adhesive Manufacturer's requirements.
Rubber Lining Thickness	Lining thickness shall be 5 mm, refer to section 1.3 for specific rubber thickness criteria.
Generic System (External Surface) Primer and intermediate coats = Twin Pack Polyamide Cured Epoxy. Finishing coat = High Build Re-coatable Polyurethane Acrylic.	
Primer Coat	Apply by spray, one coat Twin Pack Polyamide Cured Epoxy Primer from **60 to 80 microns**.
Stripe Coat	After allowing sufficient time (as recommended by Coating Manufacturer) for the first coat to cure, all edges, weld seams, bolt holes and other crucial areas shall be given an additional stripe coat with the same material as the following coat.
Intermediate Coat	Allowing sufficient time for the primer coat and stripe coat to cure, the Manufacturer's recommendations shall be adhered to in this regard, apply by spray, one coat Twin Pack, High Build Polyamide Cured Epoxy Intermediate Coat from **120 to 150 microns**.

Final Coat	Allowing sufficient time for the 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 **50 to 60 microns**. **Total System Minimum DFT = 230 to 290 microns.** The colour of the final/finishing coat shall be as per the requirements of 240-145581571: Standard for the Identification of the Contents of Pipelines and Vessels.

The rubber lining/external coating shall be performed off-site at the Rubber Liner/Coating Applicator's premises.

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.

This specification is applicable to Kriel Power Station Water Treatment Plant Piping Corrosion Protection Specification

According to Kriel Power Station the WTP piping was previously lined with 5mm rubber many years ago. The corrosion protection scope of work will be define based on the condition of the existing rubber lining. The Eskom Engineer or Eskom representative will conduct relevant inspections and decide on the piping to be sent to the Contractor for corrosion protection. This specification only caters for internal and external corrosion protection of piping. When quoting; the Contractor shall consider the following:

- Transportation of components/piping from and to the Employer site before and after corrosion protection.
- All piping ranging from 80 mm – 350 mm nominal bore that are found to still be acceptable for continued service shall be prepared and relined with new rubber.
- The preparation include stripping of old rubber inside the piping and surface preparation (internally and externally) by means of stripping and/or burning followed by abrasive blast cleaning as per the requirements of this specification.
- There is a possibility of receiving new pipes from Employer's site for corrosion protection. Where piping deemed to be excessively damaged by Eskom Engineer or Employer's representative shall be replaced with new piping by the Employer. In this regards the Contractor will receive new piping to be corrosion protected using specification.

- The accepted size and length requirements for piping to be rubber lined shall be considered; refer to section 5 of SANS 1201.
- 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).

The detailed scope of work; piping sizes and quantities are covered in the Scope of Work document – Corrosion Protection of Fly Ash Silos and WTP Vessels and Lines at Kriel Power Station.

1. Specific Requirements

1.1. The Eskom standard 240-101712128 (Section 5 in particular), SANS 1201, SANS 1198 and BS 6374-5 shall apply for the manufacture, selection and installation of rubber lining. The Rubber Liner/Coating Applicator or Contractor to take note of the selected type of rubber required in the table above. NOTE: Special Requirements as per SANS 1198, Table 4, Property Column (Special points (III), (V) and (VI)) shall apply.

1.2. The type of rubber for lining shall be one of those given in SANS 1198, as specified by the Rubber Liner, to meet Eskom's requirements namely Butyl rubber grade B with 40-70 IRHD.

1.3. The rubber lining thickness of 5 mm is specified on condition that this thickness is suitable for the flange arrangement and eventual fitment/re-assembly in terms of existing piping/flange length and alignment.

1.4. The Rubber Liner/Coating Applicator or Contractor shall confirm the specified thickness as satisfactory for the application. The Rubber Liner/Coating Applicator and Manufacturer/s of the external coating and rubber material, primer, adhesive shall select relevant primer and or adhesive system for the type of rubber lining (butyl) material, substrate and service conditions to ensure compatibility.

1.5. All parts comprising systems required in the table above i.e. both Rubber Lining & Organic Coating, in this specification sheet shall be supplied by the same Manufacturer. Should this not be possible the coating/rubber lining Supplier shall confirm suitability or compatibility of the particular product with his system.

1.6. 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.

1.7. The responsibility for selecting the type of rubber required by Eskom for the application above rests solely with the Applicator and his material (compound and adhesive) Suppliers.

1.8. 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 as specified for internal or external surfaces.

1.9. For piping the Maximum Lengths, Design, Fabrication shall comply with the requirements of:

- BS 6374-5: Lining of equipment with polymeric materials for the process industries – Section 2.
- SANS 1201: The application of rubber linings to pipes, pipe fittings and vessels – Section 5.

1.10. Prior to rubber lining installation the Contractor shall supply test sample panels of about 200 mm X 300 mm X 3 mm, with a rubber lining thickness of 5 mm. Properties such as hardness and adhesion will be tested by Eskom to ensure compliance to both the product data sheet and the above mentioned standard (SANS 1201), including all the Normative references contained therein.

1.11. In addition to the panel samples above, representative (considering different batches), loose rubber sheeting 500 mm X 500 mm with a thickness of 5 mm shall be submitted for confirmation of correct rubber type (by Fourier Transform Infrared Spectroscopy) and tensile testing before the commencement of any lining in order to ensure compliance to both the product data sheet and the standard (SANS 10037), including all the Normative references contained therein.

1.12. Specifically for the tensile testing, specimens shall be prepared as per SANS 10037 "Type 1 Dumb-bell". The Rubber Liner or Manufacturer shall provide written commitment to this requirement at the tender stage.

1.13. During rubber lining of the piping the Rubber Liner shall prepare (200 mm X 300 mm X 3 mm) test panels with a rubber lining thickness of 5 mm, at the same time and under the same conditions as the piping and spools. The prepared test panels shall be sent to Eskom for adhesion/peel testing as per the requirements of SANS 1201 section 9.4.

1.14. The Rubber Liner/coating Contractor shall supply the relevant batch certificates for each of the lining products used.

1.15. For the internal surfaces of piping the method of surface preparation and coating application shall be by either (1) centrifugal spinning or by (2) "Pipe blaster" and "Pipe coater" as detailed further below.

The centrifugal spinning technique is a technique whereby a spinning disc, brush or other device is used to firstly abrasive blast the substrate and secondly to atomise and coat the pipe internal surfaces with the required rubber-lining primer and adhesive coats. In both cases the blast and coating heads are attached to a retractable lance/boom that is fed all the way through the length of the pipe and then pulled back out of the pipe at a predetermined speed.

1.16. The selection of techniques/methods depends on the length and diameter range, new or old pipe, location of works i.e. on-site (possibly existing/in-situ) or at the Contractors works/shop/yard. Typically the first technique is used where there are multiple lengths of piping in excess of 6 metres.

1.17. The second technique is used for limited quantities and/or shorter lengths and smaller diameters of piping and/or piping fittings. Furthermore the selection may be a combination of either technique/method depending on geometries and diameters and whether either straight piping or fittings.

1.18. The technique/method shall be agreed between the Contractor and coating Manufacturer and presented in the Method Statement as required further below. The Method Statement shall be reviewed by Eskom for acceptance prior to commencement of any work.

1.19. The technique/method shall be agreed between the Contractor and Rubber Liner and presented in the Method Statement as required further below.

1.20. The Contractor shall consider the means of ensuring that the device/mechanism as above is capable of manoeuvring around at least half of the bend radius. The blasting process shall be performed from both ends of the component. The blasting direction internally, shall be “backwards” i.e. moving away from the prepared surface. Blasting in the other direction would very quickly result in piling up of grit ahead of the blaster.

2. General Requirements

2.1. All mechanical/manufacturing/welding activities shall be carried out and completed on the piping and spools before rubber lining/coating commences. The Contractor shall be wholly responsible for the surface preparation and lining/coating application. The external coated surfaces shall meet the DFT as required by this specification sheet and aspects thereof in referenced documents.

2.2. 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).

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

2.4. 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.

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

2.6. After initial blasting of representative patches soluble salt testing shall be performed by the Bresle soluble salt test method. If not within acceptable limits (as per the Manufacturer requirement but not exceeding 100 mg/m^2), the surfaces shall then be washed/decontaminated by High Pressure (HP) water washing using fresh/clean water (with a conductivity reading of maximum 100 µS/cm) at a minimum pressure of 300 bar. A salt decontamination chemical additive with demonstrated capability of removing salts may be used in conjunction with HP cleaning.

2.7. Soluble salt testing shall be repeated on representative test patches and if acceptable then proceed with blasting and application steps – if not then repeat HP washing until the salt contamination has been removed to within acceptable limits.

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

2.9. 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.

2.10. 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 ASTMF21 shall be assessed by means of ultraviolet light i.e. back light.

2.11. 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.

2.12. 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.

2.13. Only inert mineral grit or steel grit abrasives shall be used. Sand or silica-based abrasives shall not be used. Abrasive material for blast cleaning shall be used in line with local environmental regulations.

2.14. 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.

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

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

2.17. 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.

2.18. 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.

2.19. 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.

2.20. All compressed air for blasting 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.

2.21. No abrasive blasting 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.

2.22. Cleaned surfaces shall not be contaminated with oil, grease, rust or other deposits before coating application. Unnecessary traffic prior to painting/lining shall be avoided.

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

2.24. The dust and debris removal process shall be performed from both ends of the component. The process shall be repeated until the required level of dust and debris removal is achieved.

2.25. Assessment of the blast cleanliness shall be by visual means as far as is accessible in the straight piping and/or straight pipe and welded pipe fitting i.e. inlet and outlet ends by suitable length borescope/fiberscope to assess the cleanliness of the substrate.

2.26. Freedom of dust and debris shall be checked from both component ends as far as is accessible to perform the test. Abrasive blasting shall be performed on the external piping surfaces by means of conventional handheld blasting equipment capable of removing mill scale and suitably preparing the substrate to the required cleanliness of Grade Sa 2.5. Immediately before application of the rubber-lining, primer and adhesive and external coating, blast cleaned steel shall not exhibit more than "dust quantity rating" 1 when tested in accordance with ISO 8502-3.

2.27. 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. 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.

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

2.29. 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.

2.30. Individual rubber sheets shall be tailored to fit the surface to be lined. The process of rubber lining after rubber sheet/tube has been inserted into the piping, shall include filling the rubber sheet/tube with the compressed air to form a balloon and then drawing or pulling conical mandrel through the piping to ensure tight interface between rubber material and steel substrate.

2.31. The size or outer diameter of the conical mandrel shall be close to the internal diameter of the pipe to ensure a tight fit in order to make sure that air is not trapped between the rubber tube and steel substrate.

2.32. The lining shall be bonded to the flange faces. The mating surface of the flange face to gasket shall be suitably dressed such that the face is acceptably flat to ensure sealing between the liner and the gasket. The application and flange arrangement shall be as per SANS 1201 Figure 7 a) or c) and the Eskom Engineer requirements.

2.33. All joints of lined rubber shall be strapped as per BS 6374-5.

2.34. All surfaces shall be pinhole tested (only after completion of all handling, moving and equipment and scaffolding removal) to ensure the lining is pinhole free and if required additional repairs shall be performed and once cured then the repair areas shall be retested. The process to be repeated until a pinhole free lining is achieved.

2.35. The installed lining shall present a smooth appearance and be free of voids, blisters, pinholes, cracks, open seams, entrapped air or any other defects which will impair its use. Defective areas shall be cause for rejection of the lining.

2.36. For all inspections of all surface preparation and coating/lining 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.

2.37. For the external surfaces the spray operator shall ensure application in a smooth and controlled motion and not in a vertical/horizontal criss-cross manner. 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.

2.38. 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.

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

2.40. After testing, repairs shall be carried out using a different colour. In other cases, two finishing coats of the same colour may be applied to achieve complete colour uniformity. All finishing colours for external surfaces shall be in accordance with the Eskom requirements; 240-145581571: Standard for the Identification of the Contents of Pipelines.

2.41. 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.

2.42. 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.

2.43. 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.

2.44. 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.

2.45. 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.

2.46. 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.

2.47. 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.

2.48. 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. 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.

2.49. 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.

2.50. 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.

2.51. 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.

3. Tender Returnables

3.1. Mandatory Tender Returnables

3.1.1. At the time of tender provide verifiable evidence that the Contractor has experience in the application of coating/rubber lining of piping and piping components for similar sized projects in comparable environments. 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.

This verifiable evidence shall be for projects where piping has been successfully coated/lined by the Contractor, within the last five. The verifiable evidence shall include formal signed off QCP's or release certificates and contact details for the listed reference projects.

3.2. Tender Returnables for Evaluation

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

- A description of the generic type of coating/rubber lining.
- Physical and chemical properties for the rubber lining as per table 4 in SANS 1198.
- Recommended and non-recommended uses for coating/rubber lining.
- Service temperatures and chemical resistance limits for the coating and rubber lining. For the chemical resistance, special property (I), (III), (V) and (VI) as per SANS 1198 Clauses 4.2.2 (d), 4.2.3 (b) in conjunction with the environment and operating conditions in the table above in this specification sheet shall apply.
- 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 sheet.
- Surface preparation requirements.
- Product Data Sheet/s shall be signed by the Manufacturer and Coating/Rubber Liner or Contractor. The signed Product Data Sheet/s shall be deemed to be a binding reference document (as part of the QCP). It shall be specific to this project any further/other subsequent revisions of the Product Data Sheet/s shall be submitted to Eskom for reacceptance clearly stating the variations/deviations. No further use/application of the related product, for this project, is permitted until acceptance is granted by Eskom.

3.2.2. After tender award the Manufacturer shall supply batch certificate for each of the lining/coating products. Specifically for rubber lining all tests, parameters, and results shall be as per the requirements of SANS 1198 Table 4. These tests shall be conducted as per SANS 1198 by an ISO 9001 certified independent laboratory. These test results or certificates shall be submitted to Eskom after tender award and before commencement of work to verify mechanical and chemical properties in the product data sheets.

3.2.3. After tender award and prior to project execution the Manufacturer shall submit test samples of the lining system as proposed in the tender submission. Two samples shall be required for reference purposes. The samples (substrates) shall be prepared as per the requirements of the Manufacturer's datasheet and in compliance with the requirements of this standard. The size of the test sample panels shall be (200 mm X 300 mm X 3 mm), with a rubber lining thickness of 5 mm. The lining shall be cured as would be in practical situations without any artificial assistance. The Manufacturer shall supply the relevant batch certificate for each of the lining products used in the submitted test sample panels.

3.2.4. In addition to the panel samples above, representative (considering different batches), loose rubber sheeting 500 mm X 500 mm, with a rubber lining thickness of 5 mm shall be submitted for tensile testing in order to ensure conformity to SANS 1198.

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

- The methods, steps, sequence and equipment required for ventilation and dust mitigation.
- Grease decontamination and washing.
- Soluble salt decontamination.
- Methods for dust and debris removal, maintaining and ensuring cleanliness between primer and adhesive steps shall be described.
- The Method Statement shall detail the precise sequence and breakdown of work areas/activities in order to apply the system with due consideration of dust contamination.
- The Method Statement shall also consider the most efficient methods and sequencing to avoid unnecessary delays that may have an impact i.e. time required for removal of spent abrasive grit and dust/debris.

3.2.6. All inspection interventions during and after completion of rubber installation and external corrosion protection shall be considered and included.

3.2.7. The Method Statement shall describe all measures and details for establishing and maintaining the environmental conditions as required by this specification.

3.2.8. For both rubber lining and external coating all inspection interventions during and after application/completion shall be considered and included.

3.2.9. 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.

3.2.10. A detailed Quality Control Plan (QCP) for internals and externals shall be submitted and shall detail all inspections and tests with acceptance criteria during lining application. Inspections during lining application shall at least cover surface documentation review and approval, air blotter test for surface cleaning and blasting, environmental parameters, coating/rubber thickness, hardness, adhesion, continuity and visual tests, submission and testing of rubber tests samples and lined panels. Tests for continuity shall be carried out using the high frequency spark test method;

- Before vulcanisation.
- After vulcanisation.
- Immediately prior to assembly.

3.2.11. The rubber lining Manufacturer and Rubber Liner or Contractor shall specify the test voltage and the length of spark (no less than 2kV per mm). If the Rubber Manufacturer cannot comply then a detailed motivation describing the reasons why this requirement can't be met shall be submitted for review, acceptance or rejection.

3.2.12. Prior to commencement of rubber lining/coating the Applicator shall submit detailed repair procedures in accordance with BS 6374-5. Any defects such as mechanical damage, cuts, blisters, lack of adhesion and poor joints shall be marked up and repaired according to BS 6374-5 Clause 5.2.4.

3.2.13. The supply and cost of all testing, inspection and specialized testing equipment shall be the Contractor's responsibility. QC shall be performed by the 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.

3.2.14. 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. In addition to this statement the Contractor, Rubber Liner or Manufacturer shall also provide a definitive statement of the submission of samples as prescribed above.

3.2.15. The applied lining system shall be guaranteed jointly by the rubber lining manufacture and Rubber Liner or Contractor. This guarantee with proposed terms and conditions shall be submitted at the time of tender. The applied rubber lining system shall perform in the given environment for a minimum period of 10 years.

4. Safety Requirements and Considerations

4.1. 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.

4.2. 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. 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.

4.3. Any solid waste materials or liquids stripped or generated during the coating operations shall be discarded in accordance with the requirements of the appropriate national and/or local authorities or the requirements of Eskom.

4.4. 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.

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

4.6. All materials shall be stored in designated areas in storage facilities that meet the storage requirements of the Rubber Liner 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.

4.7. 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.

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

5. Handling, Transportation, Storage and Erection of Piping

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

5.2. Flanges shall be protected with wooden shields bolted in such a manner to apply uniform pressure to the lining.

5.3. Prior to commencement of any work the Rubber Liner shall submit a procedure for handling, transportation, storage and erection for all rubber-lined components for Eskom's approval.

6. 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.

6.1. 240-101712128: Standard for the internal corrosion protection of water systems, Chemical Tanks and Vessels and Associated Piping with Coatings.

6.2. 240-106365693: Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings.

6.3. 240-145581571: Standard for the Identification of the Contents of Pipelines.

6.4. BS EN ISO 16961: Petroleum, petrochemical and natural gas industries — Internal coating and coating of steel storage tanks.

6.5. 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."

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

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

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

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

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

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

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

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

6.14. 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.

6.15. 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.

6.16. 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.

6.17. 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).

6.18. 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.

6.19. 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).

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

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

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

6.23. 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.

6.24. 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).

6.25. SANS 1198: The manufacture of rubber sheeting for rubber lining.

6.26. SANS 1201: The application of rubber linings to pipes, pipe fittings and vessels.

6.27. SANS 10037: Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties.

Submitted by:	**Accepted by:**
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