Eskom	**SOW**	**Camden Power Station**

Title: **Re-lining of Brine Tank**

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Content

1. Introduction

During the demineralisation process organic material may be absorbed on the anion resins, this is organic fouling. This organic fouling may cause a capacity reduction resulting in early leakage of silica on the mixed bed vessel. Organic de-fouling (also called an alkaline brine wash) is a process that is used to remove these organics from the anion resin.

The alkaline brine solution is mixed in the rubber lined brine tank. The lining and the tank need to be inspected and repaired/replaced where necessary.

2. Supporting Clauses

2.1 Scope

2.1.1 Purpose

The condition of the lining in the brine tank has deteriorated over the years and needs to be replaced.

2.1.2 Applicability

- Auxiliary Plant Engineering
- Auxiliary Plant Maintenance
- Chemical Services

2.1.3 Effective date

See date of authorized signature

2.1.4 Normative References

[1] Eskom SHEQ policy 32-327

[2] OHS Act 85 of 1993

[3] QM-58 Supplier Contract Quality Requirements Specification

[4] 240-101712128: Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with linings

[5] 240-106628253: Standard for Welding Requirements on Eskom Plant

[6] 240- 83539994: Standard for Non-Destructive Testing (NDT) on Eskom Plant

[7] 240-168966153: Generation Tender Technical Evaluation Procedure

[8] BS 6374: Part 5 – Lining of equipment with polymeric materials for the process industries

[9] ISO 9001: Quality Management Systems – Requirements

[10] 240-106628253: Standard for Welding Requirements on Eskom Plant

[11] GE/MAT/24/001: Camden Power Station Water Treatment Plant Brine Tank Corrosion Protection Specification

2.1.5 Informative References

- N/A

2.2 Definitions

Approved / Approval	Refers to written approval by the Engineer.
Contractor	Means the person(s) named demineralised in the Contract Agreement.
Demineralised Water	Water which is void of any ions

2.3 Abbreviations

Abbreviation	Description
ACH	Aluminium Chlorohydrate
BS	British Standard
ISO	International Organization for Standardization
m	meter
NDT	Non Destructive Test
OHS	Occupational Health and Safety
PPE	Personnel Protective Equipment
QCP	Quality Control Plan
SANS	South African National Standards
SHEQ	Safety, Health, Environment and Quality

2.4 Process for Monitoring

N/A

2.5 Related/Supporting Documents

N/A

3. Scope of Work

The following scope of work shall involve the full spectrum of work required to inspect and repair the brine tank and internal lining.

3.1 Pre-Preparation:

- All documentation requested in GE/MAT/24/001: Camden Power Station Water Treatment Plant Brine Tank Corrosion Protection Specification must be given to Eskom for acceptance. This document can be found in Annexure B
- All material required for the repair should be procured and delivered to site prior to commencement of the task
- The Contractor shall provide a risk assessment per activity to Eskom as the tank is located within the operating area of the power station. Safety equipment, barriers and plant signage shall be provided by the Contractor
- The Contractor shall ensure a safe working environment and that all work practices comply with Eskom's SHEQ (Safety, Health, Environment and Quality) requirements
- Scaffolding to be installed prior to any work commencing (if required)

3.2 Contractor Responsibilities:

- To ensure a fully functional internal and external lining system for the brine tank at Camden Power Station.
- The supply of all equipment for the repair and testing of the tanks and lining system
- For his own traveling and accommodation to perform the entire scope
- For site establishment and storage of all tools and equipment required to execute the entire scope
- The brine tank is to be inspected and tested using non - destructive testing (NDT's) to check for any defects such as pinholes or cracks. Any defects found are to be repaired by the Contractor. **NB.** All welding work must comply with 240-106628253 - Standard for Welding Requirements on Eskom Plant. Welding procedures and welding QCP's must be supplied to Eskom for approval prior to welding work (if required) commencing. All weld repairs must be 100% NDT and inspected by an Eskom Welding Inspector
- All pipework connected to the tank to be removed and repaired where necessary. If the condition of the pipework is beyond repair then the components should be replaced with like for like material
- Removal of the old rubber lining and preparation of the tank metal surface for re-lining (See Annexure B for details)
- Complete re-lining of the brine tank (See Annexure B for details) including external corrosion protection

- Once the new lining has been checked and accepted by Eskom, re-installation of all pipework
- The disposal of the old liner from the brine tank to an Eskom approved dumping site

3.3 Employer Supply

- A connection point for potable water, service air and electrical power at normal voltage for the execution of the scope
- The necessary isolations and access to the brine tank
- All scaffolding required for access to the tank
- Lay Down Area for Site Establishment
- All NDT's will be carried out by an Eskom approved on-site company and the cost will be excluded from this SOW

3.4 Detailed Design specifications

3.4.1 Brine Tank Specifications

- Material of Construction: Mild Steel (Assumed)
- Dimensions: Height = ±1.42m, Diameter = ±1.5m
- Contents of Tanks : Alkaline Brine Solution

See Annexure A for more information

N.B. Please note all dimensions to be confirmed by the Contractor prior to commencement of any work on site.

3.5 Health, Safety & Environmental Requirements

Compliance with all current legislation and Eskom policies and directives is mandatory. The following requirements will be adhered to among others:

- OHS Act
- Environmental regulations

The Contractor will abide by the SHE requirements of Camden Power Station.

The Contractor will be responsible for personal protective equipment (PPE) requirements of Camden Power Station Water Treatment Plant for the Contractor's staff during the duration of execution.

The Contractor shall ensure cleaning of work areas and disposal of any waste materials generated in execution of the scope.

4. Revisions

Date	Rev.	Compiler	Remarks
September 2021	1	N. Naidu	Original Issue
January 2024	2	N. Naidu	Scope Revision

5. Development Team

- Hassen Cassim

6. Acknowledgements

N/A

ANNEXURE A: QUESTIONNAIRE FOR THE SELECTION OF SUITABLE ORGANIC LINING SYSTEM/RUBBER LINING FOR THE INTERNAL CORROSION PROTECTION OF WATER SYSTEMS, CHEMICAL TANKS AND VESSELS AND ASSOCIATED PIPING

The selection of the required organic lining system or rubber lining compound for immersed service is directly dependent upon the properties of the liquid being contained. Each specific liquid will require a specific organic lining or lining compound and it must never be assumed that similar liquids are in fact the same. In the case of rubber lining SANS 1198 'The manufacture of rubber sheeting for rubber lining' covers the requirements for the manufacture of rubber sheeting of soft and hard (ebonite) rubber for lining of pipes and pipe fittings of diameter at least 25 mm, and other metal or concrete equipment. It includes a classification of the linings that enables the requirements to be specified by a line call-out.

The following information is required by the paint applicator/rubber lining applicator to select the suitable lining or compile the required line call-out for the rubber compound to be used.

1.0 LOCATION OF COMPONENT	
1.1 Name of power station	Camden P/S
1.2 Component Identification i.e. Plant Code	Brine Mixing Tank
2.0 COMPONENT DETAILS	
2.1 Capacity of Component	1.42 m3
2.2 Dimensions	Diameter = approx. 1.5m Height = approx. 1.42m
2.3 No of access man-holes	N/A
2.4 Size of access man-holes	
2.5 Location of access man-holes	
2.6 Diameter and length of pipework	Drain in middle of base = 25mm, Outlet on bottom side = 50mm
2.7 Material of construction (mild steel etc.)	Mild Steel
2.8 Please provide A4 drawing of component with this questionnaire	
3.0 ACCESS COMPONENT	
3.1 Is access available to locate compressors and equipment next to the component?	Yes
3.2 If adjacent access is not available how long will air and spray hoses need to be?	
4.0 TYPE OF WORK	
4.1 New works – clean original steel	X
4.2 Maintenance work – previously lined	
4.3 Concrete i.e. Water retaining structures 4.3.1 Are surfaces new, dry, cured, post	

service? 4.3.2 Is there spalling, cracking, exposed rebar? 4.3.2 What is allowable duration for lining activity?	
4.4 Type and age of previous lining	
4.5 Condition of the previous lining	
4.6 Total surface area to be lined (m^2)	10.23 m2
5.0 SURFACE PREPARATION	
5.1 Can abrasive blast cleaning be carried out inside the component/vessel/tank with consideration of access/confined space, ventilation etc.	
6.0 PROPERTIES OF LIQUID CONTAINED IN OR IN CONTACT WITH THE COMPONENT	
6.1 Acids/alkalis	
6.1.1 Type of acid/alkali	
6.1.2 pH of acid/alkali	
6.1.3 Concentration of acid/alkali	
6.2 Organic liquids – organic acids, fats oils or solvents	
6.2.1 Type of organic liquid	
6.2.2 pH of organic liquid	
6.3.3 Concentration of organic liquid	
6.3 Petroleum products – petrol, diesel etc	
6.3.1 Type of petroleum product	
6.4 Water – type of water	
6.4.1 Potable water 6.4.2 Cooling Water 6.4.3 Raw water (with micro-organisms?)	In all cases a water analysis is required and shall contain the following parameters as a minimum; pH, Turbidity (FTUs), Conductivity ($\mu S.cm^{-1}$), Total aerobic bacteria (CFUs/ml), Total anaerobic bacteria (CFUs/ml), Chlorides ($mg.kg^{-1}$), Sulphate ($mg.kg^{-1}$). A range of analysis (min, max, average) is required for each of the parameters.
6.4.4 Water treatment process waters (provide specific composition/concentration) i.e. % hydrochloric acid, sulphuric acid, caustic soda, ammonia, etc.)	X - 2% NaOH, 10% NaCl pH > 10
6.4.5 Distilled/demineralised/de-ionised 6.4.6 Condensate	
6.5 Temperature & Pressure of liquid	

6.5.1 Normal operating temperature	Ambient = approx. 14 deg C
6.5.2 Maximum or peak temperatures	40 deg C
6.5.3 Minimum temperatures	-4 deg C
6.5.4 Pressure of Liquid	Atmospheric
6.5.5 Maximum pressure of liquid	Atmospheric
6.5.6 Flow rate of liquid	
6.5.7 Will vacuum conditions occur?	N/A
6.7 If applicable, abrasion characteristics of the liquid	
6.7.1 Provide information of content, particle size, and physical characteristics of abrasive suspended matter likely to be present	Sodium Chloride and Caustic Soda solution
7.0 OPERATION OF COMPONENT	
7.1 Is the component operated on a continuous or batch process basis	Batch
7.2 Ion exchange vessels	Specifics to be provided as per points 6.4 and 6.5 above for both the process condition as well as the regen condition in the same vessel.
7.3 Will the applied lining be subjected to any thermal shock, if so describe the operation.	No
8.0 GENERAL	
8.1 Provide any further information considered relevant to ensure the selection of the most appropriate organic lining/rubber lining material i.e. photographs of previous components/coating condition	
8.2 In the case of refurbishment work what is the shut-down period during which this lining work mast be carried out (number of days)	
8.3 Provide information and details of whether corrosion protection by lining will interface with areas such as flanges, crevices and transition areas to other protective lining systems which would neccessitate specific consideration. Schematics, photographs or appropriate drawings will be required to provide specific recommendations.	There is a drain in the middle of the base and an outlet line at the bottom of one of the sides

Note: In the case of refurbished components all mechanical and welding repairs must be carried out before any lining applications are started.

ANNEXURE B: GE/MAT/24/001: CAMDEN POWER STATION WATER TREATMENT PLANT BRINE TANK CORROSION PROTECTION SPECIFICATION

Vessel/Components	**Existing Rubber Lined Water Treatment Plant (WTP) Brine Tank including Tank Piping, Attachments and Flange Faces.** For detailed component information with respect to type, sizes, quantities, access, manholes sizes and quantity, manufacturing standards etc. refer to Scope of Work section of the enquiry document.
Material/Substrate (Internal immersed /external)	• Existing Carbon Steel. • Internally - rubber lined. • Externally – coated (unknown). For existing steel there is a high probability of soluble salt contamination, both internally and externally. For further details/requirements refer to the relevant sections below.
Table 1: Internal Corrosion Protection System	
Internal Environment (1) (Internal Immersed Conditions)	**Aqueous Solution/Mixture** • 2% Sodium Hydroxide (NaOH), 10% Sodium Chloride (NaCl). • pH >10 Weak Alkali. • Design Pressure – atmospheric. • Design Temperature - Ambient – 40°C. **NB** – refer to more specific details in the Scope of Work document.
Surface Preparation (1) (Internal Surface)	**Internal Surface – Steel Material:** • Abrasive blast clean to Grade Sa 3 (ISO 8501-1). • For localised areas: mechanical clean to Grade St 3 (ISO 8501-1). In both cases the final surface profile shall be as specified by the rubber lining and adhesive Manufacturer's requirements.

Generic System (1) (Internal Surfaces Only)	• 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 kN/m. • Lining thickness shall be **5mm**, refer to section 1.6 for specific rubber thickness criteria.
Table 2: External Corrosion Protection System	
External Environment (2)	• Aggressive Outdoors. • Ambient temperature.
Vessel dimensions	• Surface Area 10.23m^2. • Diameter 1.5m. • Height 1.42m.
Surface Preparation (2) (External Surface: Steel Material)	• Abrasive blast clean to Grade Sa 2.5 (ISO 8501-1). • For localised areas: mechanical clean to Grade St 2 (ISO 8501-1). • Surface profile minimum 75µm or as specified by the coating manufacturer. In both cases the final surface profile shall be as specified by the rubber lining and adhesive Manufacturer's requirements.
Generic System (2) (External Surfaces Only).	• **Primer and Intermediate coats** = Two Component Solvent Free Epoxy. • **Finishing coat = High Build Re-coatable Polyurethane Acrylic.**
Primer Coat	Apply by spray/brush/roller, one layer of a two Component Solvent Free Amine Cured Epoxy coating between 125 - 200 micron. Thinning more than 5% shall not be permitted.
Stripe Coat - Primer	All accessible edges, weld seams, bolt holes and other crucial areas shall be given a stripe coat by brush. Stripe coating to be carried out in accordance with 240-106365693, Clause 4.7.3 (h) using the primer.

	All 'black' nuts and bolts to be patched with the primer and intermediate coats prior to the application of the finishing coat. All galvanized nuts and bolts to be patched with intermediate coat prior to the application of the finishing coat.
Intermediate Coat.	After allowing sufficient time for the primer and stripe coating to cure, the manufacturer's recommendations shall be adhered to in this regard, apply by spray/brush/roller, a single layer of a two component Solvent Free Amine Cured Epoxy coating between 125 - 200 micron.
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 = 300 to 260 microns.** **The colour of the final/finishing coat shall be as per the requirements of document 240-145581571: Standard for the Identification of the Contents of Pipelines and Vessels.**
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 Camden Power Station water treatment plant rubber lined Brine Tank and Associated Pipe Fittings.**	
1. Specific Requirements 1.1. The detailed scope of work is specified in the Scope of Work document for this project. 1.2. External coating shall only commence once the internal corrosion protection activities are concluded i.e., after rubber lining. 1.3. 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/ 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 (I), (III), (V) and (VI)) shall apply.	

1.4. 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.

1.5. 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.

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

1.7. All parts comprising systems i.e., Rubber Lining and 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 product with his system.

1.8. 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.

1.9. 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.

1.10. Surface preparation by abrasive blasting shall be performed by means of blasting equipment capable of removing remaining/residual rubber, 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.

1.11. After the old rubber lining is removed and initial surface preparation is completed, a detailed visual inspection shall be carried out to check for defects of the substrate surface. Where necessary mechanical repairs i.e. welding and grinding shall be carried out before new rubber is installed. The Contractor shall propose substrate repair procedures and submit these to Eskom for approval. The procedure shall be agreed by both parties before commencement of work.

1.12. Corrosion Protection shall only proceed once all mechanical or welding activities on the vessels have been completed and released in terms of the applicable mechanical repair Quality Control Plan (QCP).

1.13. To enable proper inspection the vessels need to be emptied and all components that are removable shall be removed from the vessel. These components include but are not limited to the laterals, nozzles and distribution pipes.

1.14. Based on the inspection findings it might be necessary to conduct repairs on the vessel before corrosion protection application therefore provision shall be made for mechanical repairs i.e. welding and grinding.

1.15. For these mechanical repairs, it is strongly recommended that the appropriate engineering subject matter experts (welding engineers and NDT subject matter experts) are consulted. The engineering experts in consultation with the Rubber Liner or Contractor and Lining Manufacturer shall compile substrate repair procedures for the works and submit to Eskom for review and approval.

1.16. All components in the vessel shall be rubber lined except components constructed from stainless steel or plastic. These 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.

1.17. 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.

1.18. After tender award and prior to rubber lining installation the Contractor shall supply 2 test sample panels of 200 mm X 300 mm X 3 mm, with a rubber lining thickness of 5 mm. On one edge along the 200 mm side, the rubber material should be applied to the test panel with a 40 to 50mm loose overhang followed by a 20 to 30mm section unbonded to the test panel. 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. 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.

1.19. 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.

1.20. Specifically for the tensile testing, specimens shall be prepared as per SANS 10037 “Type 1 Dumbbell”. The Rubber Liner or Manufacturer shall provide written commitment to this requirement at the tender stage.

1.21. During rubber lining 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. On one edge along the 200mm side, the rubber material should be applied to the test panel with a 40 to 50mm loose overhang followed by a 20 to 30mm section unbonded to the test panel. The prepared test panels shall be sent to Eskom for adhesion/peel testing as per the requirements of SANS 1201 section 9.4.

1.22. The Rubber Liner/Coating Contractor/Corrosion Protection Applicator shall supply the relevant batch certificates for each of the lining products used.

2. General Requirements.

2.1. The Contractor shall be entirely responsible for the surface preparation and lining/coating application.

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. During all corrosion protection processes 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.

2.7. 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. 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 lint free 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 ASTM F21 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 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. 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.

2.18. 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. Surface preparation by abrasive blasting shall be performed to the required cleanliness of Grade Sa 2.5 as specified for external surfaces.

2.19. 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.

2.20. 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.

2.21. 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.

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

2.23. 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.

2.24. 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.

2.25. 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 the primer layer, or the adhesion of the corrosion protection system will be impaired.

2.26. Immediately before application of the rubber-lining, primer and adhesive the blast cleaned steel shall not exhibit more than “dust quantity rating” 1 when tested in accordance with ISO 8502-3.

2.27. Immediately before application of the external coating, the blast cleaned steel shall not exhibit more than “dust quantity rating” 2 when tested in accordance with ISO 8502-3.

2.28. The Contractor shall ensure that during surface preparation and coating or 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.

2.29. 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.

2.30. During periods of inclement or cold weather conditions the environmental parameters shall be measured and recorded hourly. If 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 application steps 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.

2.31. To avoid recontamination and flash rusting of the surfaces, the primer shall be applied within 4 hours after final surface preparation of the steel surfaces. Under no circumstances shall the blast be permitted to stand overnight.

2.32. Individual rubber sheets shall be tailored to fit the surface to be lined.

2.33. 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.

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

2.35. All surfaces shall be pinhole tested to ensure the rubber lining is pinhole free with the testing starting from the top of the vessel downwards as the scaffolding is being dismantled. If practically achievable, 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.

2.36. 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.

2.37. 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 at the tender stage as a deviation for acceptance or rejection.

2.38. The supply and cost of all testing, inspection and specialized testing equipment shall be the Contractor's responsibility. Quality Control shall be performed by the Rubber Liner 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.

2.39. 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.

2.40. The Eskom standard 240-106365693 shall apply for the selection and application of the external coating.

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

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

2.43. 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.

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

2.45. 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.

2.46. 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.

2.47. 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.

2.48. 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.

2.49. 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.

2.50. 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.

2.51. 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.

2.52. 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 and where the position and condition of the substrate metal is such that efficient cleaning and surface profile can be achieved.

2.53. Burnishing of the surface shall not be permitted.

2.54. 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.

2.55. 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.

2.56. 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.

2.57. 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.

2.58. 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

2.59. Coating application shall be by airless or dual component/plural spray equipment/ as per the Manufacturer's recommended method.

3. Tender Returnables.

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

3.1. Mandatory Tender Returnables.

At the time of tender, verifiable evidence shall be submitted that:

3.1.1. At the time of tender, verifiable evidence shall be submitted that the Contractor for the corrosion protection works, both for the internal and external of the vessel and piping, has experience in the application of corrosion protection systems, as defined in the table at the top of this specification, in comparable environments i.e., tanks/confined spaces, piping and pipe fittings. 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, the total surface area of the vessels lined and contact details, for at least 3 similar projects.

3.2. Tender Returnables for Evaluation.

3.2.1. Rubber Lining.

The Contractor for the corrosion protection works shall supply individual product technical datasheets and material safety datasheets (MSDS) for all products comprising the corrosion protection 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 for the rubber lining as per table 4 in SANS 1198.
- 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.
- Recommended and non-recommended uses.

- 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 Rubber Liner and/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. Coating.

As a minimum the following shall be submitted for the external coating. The Contractor for the corrosion protection works and coating Manufacturer shall supply individual product data sheet for all products, comprising the system which shall contain the following as a minimum:

- A description of the generic type of product.

- Confirmation that the corrosion protection system is suitable for the intended method of application.

- Recommended and non-recommended uses.

- Maximum recommended service temperature which shall be a minimum of 30% greater than the maximum temperatures as is indicated in the table at the top of this specification. The system rating shall consider the above temperatures as continuous service i.e., not intermittently.

- Chemical resistance limits.

- Surface preparation.

- Application conditions and details including but not limited to: application temperatures, dilutions, pot-life, application techniques and DFT for the particular application method, over-coating intervals, and curing times required before immersion.

- Product Data Sheet/s shall be signed by the system Manufacturer and the Contractor for the corrosion protection works. 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.

3.2.3. 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:

- 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, adhesives, lining and coating layers shall be described.
- The Method Statement shall detail the precise sequence and breakdown of work areas/activities 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 corrosion protection 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.
- 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.

3.2.4. 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 and coating

applications. Inspections during lining/coating 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.

3.2.5. 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 in committing to the requirement for the submission of samples as prescribed above.

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

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. 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.

4.3. 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.

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

4.5. 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.

4.6. 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.

4.7. 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.

4.8. The Contractor shall advise Eskom of all hazardous materials to be brought on site.

4.9. 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.

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

4.11. All materials shall be stored in designated areas in storage facilities that meet the storage requirements of the coating/rubber 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.

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

5. 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.

5.1. 240-101712128: Standard for the internal corrosion protection of water systems, Chemical Tanks and Vessels and Associated Piping with Coatings.

5.2. 240-106365693: Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings.

5.3. 240-145581571: Standard for the Identification of the Contents of Pipelines.

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

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

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

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

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

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

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

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

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

5.13. 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.

5.14. 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.

5.15. 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.

5.16. 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).

5.17. 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.

5.18. 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).

5.19. 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."

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

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

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

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

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

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

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

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

Submitted by:	**Accepted by:**
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Name: H. Cassim Title: Senior Advisor Date: 09/01/2024	Name: K. Northcott Title: Senior Consultant Date: 24/01/2024