

 <b>Eskom</b>	<b>SOW</b>	<b>Camden Power Station</b>
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Title: **Rubber Lining for Demin Vessels**

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**HBS / Functional Location (Technical Docs):** **00GCK**

Area of Applicability: **Auxiliary Plant Engineering**



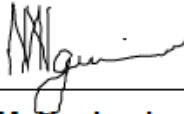

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## Content

	Page
1. Introduction.....	3
2. Supporting Clauses .....	3
2.1 Scope.....	3
2.1.1 Purpose.....	3
2.1.2 Applicability .....	3
2.1.3 Effective date.....	3
2.1.4 Normative References.....	3
2.1.5 Informative References .....	4
2.2 Definitions .....	4
2.3 Abbreviations .....	4
2.4 Process for Monitoring.....	4
2.5 Related/Supporting Documents.....	4
3. Scope of Work.....	5
3.1 Pre-Preparation: .....	5
3.2 Contractor Responsibilities:.....	6
3.3 Employer Supply .....	7
3.4 Detailed Design specifications .....	8
3.4.1 Anion and Cation Vessel Specifications.....	8
3.4.2 Mixed Bed Vessel Specifications .....	9
3.5 Health, Safety & Environmental Requirements .....	9
4. Acceptance.....	9
5. Revisions.....	9
6. Development Team .....	10
7. Acknowledgements .....	10
ANNEXURE A – REQUIREMENT CRITERIA FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS .....	11
ANNEXURE B: CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS.....	13
ANNEXURE C: 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.....	16
ANNEXURE D: RTD/MAT/20/235: PROTECTIVE COATING SPECIFICATION (BY RUBBER LINING) FOR CAMDEN POWER STATION – DEMINERALISATION TRAIN VESSELS.....	28
Figure 1: Layout of laterals.....	6
Figure 2: Cation and Anion Vessel.....	8

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## 1. Introduction

Demin water is produced when all dissolved solids are removed from the water. These solids, in the form of cations and anions, are removed in the cation, anion and mixed bed vessels (i.e. a demin train) by the use of ion exchange resin through a process called demineralisation.

There are three (3) demineralised water trains at Camden Power Station, each consisting of a cation, an anion and a mixed bed vessel and associated flanges, manholes and pipes that are rubber lined.

## 2. Supporting Clauses

### 2.1 Scope

#### 2.1.1 Purpose

The condition of the rubber lining in the demineralised vessels and fittings 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] 240-48929482: Tender Engineering Evaluation Procedure
- [6] BS 6374: Part 5 – Lining of equipment with polymeric materials for the process industries
- [7] SANS 1198: The manufacture of rubber sheeting for rubber lining
- [8] ISO 8501-1: Preparation of steel substrates before application of paints and related products
- [9] ISO 9001: Quality Management Systems – Requirements
- [10] 240-106628253: Standard for Welding Requirements on Eskom Plant

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### 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
BS	British Standard
Demin	Demineralised Water
ISO	International Organization for Standardization
m	meter
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

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### 3. Scope of Work

The following scope of work shall involve the full spectrum of work required to install a new lining system for the demin vessels and the associated pipework, flanges and manholes and shall include removal of the existing liner, sandblasting of the steel, application of the liner, testing of the liner including guarantees and the disposal of the old liner to an Eskom approved dumping site. NB. Seven of the vessels to be completely re-lined and the condition of the remaining two vessels will be assessed by Eskom and the Contractor first to determine if patch repairs will be conducted or if the vessels will be completely re-lined. The scope will also include removal and loading of resin and inspection and repair (if necessary) of the laterals and nozzles inside the vessels and will apply to the following:

- Train 1 (Cation, Anion and Mixed Bed) – full scope
- Train 2 (Cation and Anion - lining condition to be assessed after inspection. Based on inspection, decision will be made if required, but costs for this must be included. Mixed Bed – full scope)
- Train 3 (Cation, Anion and Mixed Bed) – full scope

The Contractor shall take note and make provision that there will be a time delay between the availability of the vessels in order to ensure continued Demin water production. One train of vessels will be available at a time to conduct lining replacement. The next or following train of vessels will only be available once a relined train has been refurbished and commissioned. The same applies for the third train of vessels. Eskom will advise on the order of repair based on plant availability and conditions.

#### 3.1 Pre-Preparation:

- All documentation as per section 4 of RTD/MAT/20/235: Protective Coating Specification (by rubber lining) for Camden Power Station – Demineralisation Train Vessels must be given to Eskom for acceptance. This document can be found in Annexure D
- The contractor must comply with the information in Annexure A, which is the requirement criteria for corrosion protection paint and rubber lining applicators.
- As part of the tender returnables, Annexure B must be completed by the contractors
- All material required for the replacement 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 vessels are 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 built for each train prior to any work commencing.

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### 3.2 Contractor Responsibilities:

- To ensure a fully functional internal lining system for three Cation, three Anion and three Mixed Bed Demin (Demineralised) vessels at Camden Power Station.
- The supply of all equipment for the application and testing of the 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
- Removal of resin from inside the vessels. Please note the resin from Anion (1, 2 and 3) and Cation (2 and 3) will be re-used once the re-lining is complete. Hence the resin needs to be removed and stored in such a manner that will preserve the condition of the resin. The remaining vessels i.e. Cation 1 and Mixed Bed (1, 2 and 3) will be filled with new resin.
- The supply of all equipment for the removal, storage and re-loading of the resin
- Training of Eskom personnel on how to load and de-load resin from the vessels
- Removal of the stainless steel laterals from all 9 vessels. The laterals are to be inspected and tested (using Ultrasonic, Dye Penetrant and pressure testing) for any defects such as pinholes or cracks. Any defects found are to be repaired by the Contractor prior to re-installation. **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. The laterals are installed as depicted in the schematic below:

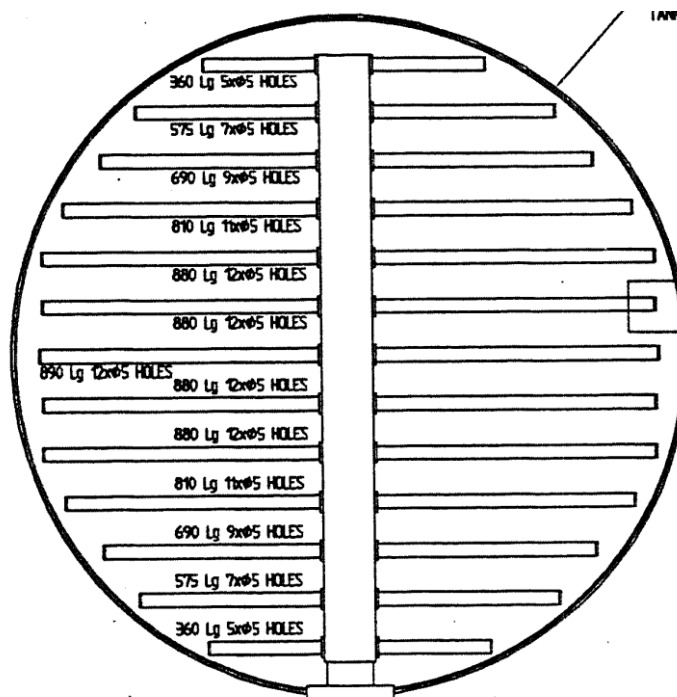


Figure 1: Layout of laterals

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- All nozzles fitted on the laterals are to be inspected for damage and replaced if necessary. NB. Eskom will supply new nozzles if necessary
- All pipework inside and connected to the vessels to be removed and repaired where necessary including the lining. 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 vessel metal surface for re-lining (See Annexure C for details).

NB. The vessels are to be inspected by the Contractor and repaired if necessary

- Complete re-lining of 7 vessels and repairs to 2 vessels (vessels to be inspected first as mentioned above) (See Annexure C for details)
- Once the new lining has been checked and accepted by Eskom, re-installation of all pipework and laterals (including nozzles)
- Loading of resin into all 9 vessels
- Boxing-up and commissioning of the vessels in conjunction with Eskom Operating and Maintenance personnel
- The disposal of the old liner and resin from Cation 1 and Mixed Bed (1,2 and 3) 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 both tanks
- All scaffolding required for access to the vessels
- New resin for Cation 1 and Mixed Bed (1,2 and 3)
- New nozzles if required
- 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

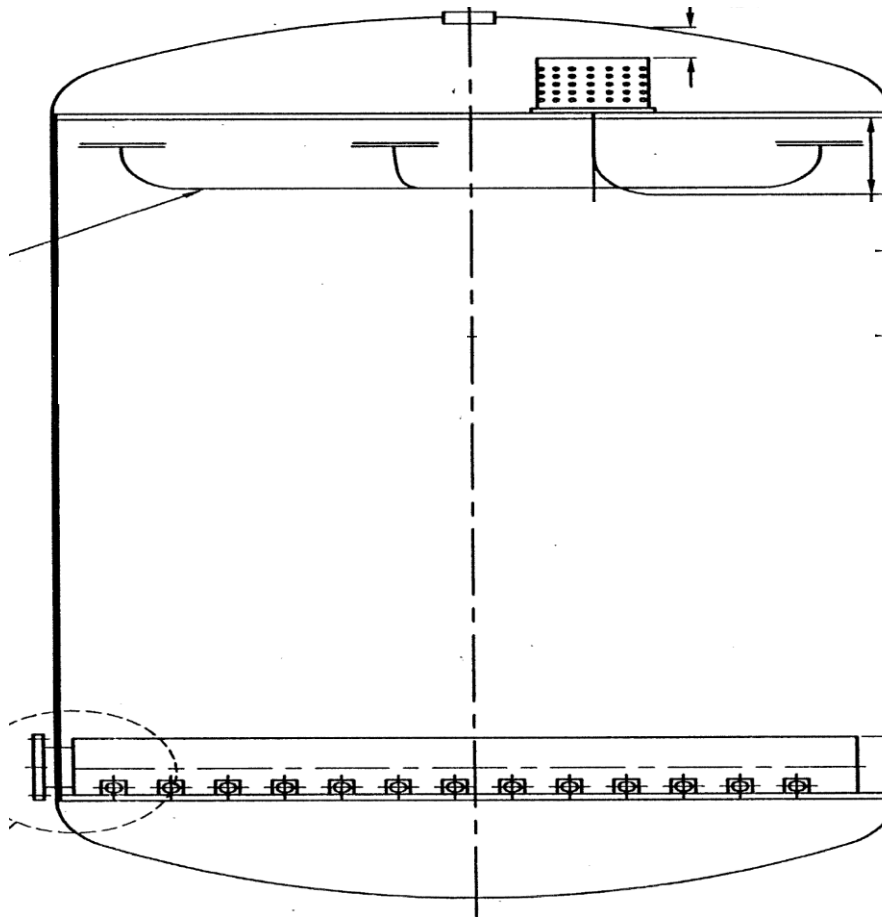
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### 3.4 Detailed Design specifications

#### 3.4.1 Anion and Cation Vessel Specifications



**Figure 2: Cation and Anion Vessel**

- Material of Construction: Mild Steel
- Diameter:  $\pm 2.3\text{m}$
- Vertical Height:  $\pm 3.6\text{ m}$
- Contents of Anion Vessel: Anion Resin regenerated with 3.5% Caustic Soda
- Contents of Cation Vessel: Cation Resin regenerated with 4% Sulphuric Acid

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

Please refer to Annexure C for more details on the vessels.

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### 3.4.2 Mixed Bed Vessel Specifications

- Material of Construction: Mild Steel
- Diameter:  $\pm 1.9$  m
- Vertical Height:  $\pm 3.1$  m
- Contents of Mixed Bed Vessel: Anion Resin regenerated with 3.5% Caustic Soda  
Cation Resin regenerated with 4% Sulphuric Acid

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

Please refer to Annexure C for more details on the vessels.

### 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. Acceptance

This document has been seen and accepted by:

Name	Function
N. Ngobese	Camden Power Station Chemical Services Manager
S. Sulliman	Chief Engineer

## 5. Revisions

Date	Rev.	Compiler	Remarks
January 2018	1	N. Naidu	Original Issue
January 2021	2	N. Naidu	Scope Change

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## 6. Development Team

- Hassen Cassim

## 7. Acknowledgements

N/A

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## ANNEXURE A – REQUIREMENT CRITERIA FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS

REQUIREMENT CRITERIA FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS	
Compiled By: Main Contractor Name:	Date: Company Representative Name: Title: Signature:
<p><b>1. Quality Assurance</b> Fully operational Quality Management System that meets the intent of ISO900. Required documentation to include:</p> <ul style="list-style-type: none"> <li>○ Quality Control check sheets to record paint batch numbers, psychrometric conditions, surface preparation, paint application and special tests as required.</li> <li>○ Works Procedures</li> <li>○ Daily Activity Reports</li> <li>○ Quality Control Plans</li> <li>○ Inspection and Test Plans</li> <li>○ Contract/Works Programmes</li> <li>○ Non-Conformance Reports</li> <li>○ Release Certificates</li> <li>○ Certificates of Conformance</li> <li>○ Data Books</li> </ul> <p><b>2. Personnel and Skills</b></p> <ul style="list-style-type: none"> <li>○ Appointed Site Manager / representative with project management skills.</li> <li>○ Competent site supervisors qualified to SAQCC (Corrosion Protection) Module PS1 'General Painting Supervisors'.</li> <li>○ Coating applicators/painters qualified to SAQCC (Corrosion Protection) Module PA1 'General Heavy Duty Coatings Applicator'.</li> <li>○ Coating inspectors qualified to SAQCC (Corrosion Protection) 'Coating Inspectors' Level 1 (shop inspections) or Level 2 (site inspections) or NACE Coating Inspection Programme (CIP)</li> <li>○ Sufficient personnel must be available to carry out the work within the required time frame.</li> </ul> <p><b>3. Safety</b></p> <ul style="list-style-type: none"> <li>○ Appointed safety officer.</li> <li>○ Fully comprehensive Safety File satisfying both the OHS Act as well as Construction Regulations.</li> </ul>	

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REQUIREMENT CRITERIA FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)		
Compiled By: Main Contractor Name:		Date: Company Representative Name: Title: Signature:
<b>4. Facilities and Equipment</b>		
Rating	Activity Type	Equipment
1	On-site patch repairs and top coats. Maintenance painting where abrasive blast cleaning and spraying not required or possible.	Mechanical Cleaning: needle guns, power wire brushes etc. Hand cleaning: wire brushes, scrapers, sand paper etc. Paint Applications: brushes and rollers.
2	Rating 1 activities + Abrasive blast cleaning and priming at fabricator's works or on site. Spraying of any or all coats.	Rating 1 equipment + Surface preparation: compressors, blast pots. Paint Applications: conventional and/or airless spray equipment.
3	Rating 1 & 2 activities + Working in confined areas such as tank linings, Cooling Water duct linings, penstock linings etc.	Rating 1 & 2 equipment + Blast media removal equipment, vacuum cleaners, high pressure water washers, dehumidifiers. Lighting and ventilation equipment. Additional qualified staff required when time constraints require night shifts.
<b>5. Quality Control Testing Equipment</b>		
<ul style="list-style-type: none"> <li>○ Hygrometer</li> <li>○ Wet film thickness (WFT) gauge.</li> <li>○ Depth profile gauge.</li> <li>○ Surface temperature gauge.</li> <li>○ Electronic dry film thickness (DFT) gauge.</li> <li>○ Pin-hole detection equipment (low voltage wet sponge or high spark) as required.</li> </ul>		
<b>6. Case Histories</b>		
<ul style="list-style-type: none"> <li>○ Records of completed successful contracts.</li> <li>○ List of major clients.</li> </ul>		

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## ANNEXURE B: CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS

CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)		
Main Contractor:		
Company Representative Name and Title :	Date:	
	Signature:	
Applicator:	Report No:	
Date of Evaluation:	Vendor Number:	
Scope: Quality Management System compliance, facilities, equipment, skills & general rating.		
Requirements	Y/N	General Comments
<b>1. Quality Assurance</b>		
Is a Quality Management System in place		
QC check sheets		
Works Procedures		
Daily Activity Reports		
Quality Control Plans		
Inspection & Test Plans		
Contract/Works Programmes		
Non-Conformance Reports		
Release Certificates		
Certificates of Conformance		
Data Books		
Requirements	No:	
<b>2. Personnel Skills</b>		
Number of Site Managers on staff		
Number of Site Supervisors on staff		
Number of Site Supervisors qualified to SAQCC		
Number of Coating Applicators on staff		
Number of Coating Applicators qualified to SAQCC		
Number of Coating Inspectors on staff		
Number of Coating Inspectors qualified to SAQCC		
Sufficient personnel to carry out the contract		

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CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)		
Main Contractor:		
Company Representative Name and Title :		Date:
		Signature:
Applicator:		Report No:
Date of Evaluation:		Vendor Number:
Requirements	Y/N	General Comments
<b>3. Safety</b>		
Is there an appointed Safety Officer		
Is there a comprehensive Safety File		
Requirements		General Comments
<b>4. Facilities &amp; Equipment</b>		
<b>Surface Preparation Equipment:</b>		
Hand Cleaning:		
Wire brushes		
Scrapers		
Sand paper		
Chipping hammers		
Power Cleaning: (electrical or pneumatic)		
Needle guns		
Power wire brushes		
Power sanders		
Abrasive Blast Cleaning:		
Compressors		
Blast pots		
Hoses and nozzles		
Water Cleaning:		
High Pressure cleaning equipment 68 - 680 bar (1 000 – 10 000 psi)		
Ultra High Pressure cleaning equipment 2 000 – 2 500 bar range (30 000 – 36 000 psi)		

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CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)		
Main Contractor:		
Company Representative Name and Title :		Date:
		Signature:
Applicator:		Report No:
Date of Evaluation:		Vendor Number:
Requirements	Y/N	General Comments
Lining Application		
Brushes		
Rollers		
Conventional spray equipment		
Airless spray equipment		
Specialised Equipment		
Media removal equipment (conveyors etc)		
Vacuum cleaners		
Dehumidifying equipment		
Lighting equipment		
Ventilation equipment		
Requirements	Y/N	General Comments
5. Quality Control Testing Equipment		
Hygrometer		
Wet film thickness (WFT) gauges		
Depth profile gauge (or Testex tape)		
Surface temperature gauge		
Electronic dry film thickness (DFT) gauge		
Pin-hole detection equipment (wet sponge/high spark)		
Requirements	No:	General Comments
6. Relevant i.e. comparable Case Histories		
Requirements		
Rating		
Does the applicator qualify for rating 1, 2 or 3. Specifically with respect to item "4. Facilities and Equipment" in Annexure A "REQUIREMENT CRITERIA FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS" sheet.		

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## ANNEXURE C: 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.

CationVessel

1.0 LOCATION OF COMPONENT	
1.1 Name of power station	Camden P/S
1.2 Component Identification i.e. Plant Code	Ion Exchange Vessels - Cation Vessels
2.0 COMPONENT DETAILS	
2.1 Capacity of Component	approx. 14.96m <sup>3</sup>
2.2 Dimensions	Diameter = approx. 2.3m      Height = approx. 3.6m
2.3 No of access man-holes	1
2.4 Size of access man-holes	Oval - approx. 440mm x 340mm
2.5 Location of access man-holes	On top
2.6 Diameter and length of pipework	Approximately 100 NB - 1 x 605 mm pipe and 3 x 571 mm pipes. See attached drawing
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	
4.2 Maintenance work – previously lined	X
4.3 Concrete i.e. Water retaining structures	N/A
4.3.1 Are surfaces new, dry, cured, post	

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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	Ebonite (assumed), >40 years (assumed)
4.5 Condition of the previous lining	Very poor condition -peeling and cracking
4.6 Total surface area to be lined (m <sup>2</sup> )	approx. 14.98m <sup>2</sup>
<b>5.0 SURFACE PREPARATION</b>	
5.1 Can abrasive blast cleaning be carried out inside the component/vessel/tank with consideration of access/confined space, ventilation etc.	Yes
<b>6.0 PROPERTIES OF LIQUID CONTAINED IN OR IN CONTACT WITH THE COMPONENT</b>	
<b>6.1 Acids/alkalis</b>	
6.1.1 Type of acid/alkali	Sulphuric Acid
6.1.2 pH of acid/alkali	
6.1.3 Concentration of acid/alkali	4%
<b>6.2 Organic liquids – organic acids, fats oils or solvents</b>	
6.2.1 Type of organic liquid	N/A
6.2.2 pH of organic liquid	
6.2.3 Concentration of organic liquid	
<b>6.3 Petroleum products – petrol, diesel etc</b>	
6.3.1 Type of petroleum product	N/A
<b>6.4 Water – type of water</b>	
6.4.1 Potable water	In all cases a water analysis is required and shall contain the following parameters as a minimum; pH, Turbidity (FTUs), Conductivity (µS.cm <sup>-1</sup> ), Total aerobic bacteria (CFUs/ml), Total anaerobic bacteria (CFUs/ml), Chlorides (mg.kg <sup>-1</sup> ), Sulphate (mg.kg <sup>-1</sup> ). A range of analysis (min, max, average) is required for each of the parameters.
6.4.2 Cooling Water	
6.4.3 Raw water (with micro-organisms?)	
6.4.4 Water treatment process waters (provide specific composition/concentration) i.e. % hydrochloric acid, sulphuric acid, caustic soda, ammonia, etc.)	
6.4.5 Distilled/demineralised/de-ionised	X
6.4.6 Condensate	
<b>6.5 Temperature &amp; Pressure of liquid</b>	

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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	510 kPa
6.5.5 Maximum pressure of liquid	510 kPa
6.5.6 Flow rate of liquid	80 m3/hr
6.5.7 Will vacuum conditions occur?	No
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	Filled with Amberjet 1300H resin
<b>7.0 OPERATION OF COMPONENT</b>	
7.1 Is the component operated on a continuous or batch process basis	Continuous
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
<b>8.0 GENERAL</b>	
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	N/A
8.2 In the case of refurbishment work what is the shut-down period during which this lining work must be carried out (number of days)	7 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 necessitate specific consideration. Schematics, photographs or appropriate drawings will be required to provide specific recommendations.	There are flanges and a manhole on the vessels

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

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Anion:

1.0 LOCATION OF COMPONENT	
1.1 Name of power station	Camden P/S
1.2 Component Identification i.e. Plant Code	Ion Exchange Vessels - Anion Vessels
2.0 COMPONENT DETAILS	
2.1 Capacity of Component	approx. 14.96m <sup>3</sup>
2.2 Dimensions	Diameter = approx. 2.3m      Height = approx. 3.6m
2.3 No of access man-holes	1
2.4 Size of access man-holes	Oval - approx. 440mm x 340mm
2.5 Location of access man-holes	On top
2.6 Diameter and length of pipework	Approximately 100 NB - 1 x 605 mm pipe and 3 x 571 mm pipes. See attached drawing
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	
4.2 Maintenance work – previously lined	X
4.3 Concrete i.e. Water retaining structures	N/A
4.3.1 Are surfaces new, dry, cured, post	

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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	Ebonite (assumed), >40 years (assumed)
4.5 Condition of the previous lining	Very poor condition -peeling and cracking
4.6 Total surface area to be lined (m <sup>2</sup> )	approx. 14.96m <sup>2</sup>
<b>5.0 SURFACE PREPARATION</b>	
5.1 Can abrasive blast cleaning be carried out inside the component/vessel/tank with consideration of access/confined space, ventilation etc.	Yes
<b>6.0 PROPERTIES OF LIQUID CONTAINED IN OR IN CONTACT WITH THE COMPONENT</b>	
<b>6.1 Acids/alkalis</b>	
6.1.1 Type of acid/alkali	Caustic Soda
6.1.2 pH of acid/alkali	
6.1.3 Concentration of acid/alkali	3.5%
<b>6.2 Organic liquids – organic acids, fats oils or solvents</b>	
6.2.1 Type of organic liquid	N/A
6.2.2 pH of organic liquid	
6.2.3 Concentration of organic liquid	
<b>6.3 Petroleum products – petrol, diesel etc</b>	
6.3.1 Type of petroleum product	N/A
<b>6.4 Water – type of water</b>	
6.4.1 Potable water	In all cases a water analysis is required and shall contain the following parameters as a minimum; pH, Turbidity (FTUs), Conductivity (µS.cm <sup>-1</sup> ), Total aerobic bacteria (CFUs/ml), Total anaerobic bacteria (CFUs/ml), Chlorides (mg.kg <sup>-1</sup> ), Sulphate (mg.kg <sup>-1</sup> ). A range of analysis (min, max, average) is required for each of the parameters.
6.4.2 Cooling Water	
6.4.3 Raw water (with micro-organisms?)	
6.4.4 Water treatment process waters (provide specific composition/concentration) i.e. % hydrochloric acid, sulphuric acid, caustic soda, ammonia, etc.)	
6.4.5 Distilled/demineralised/de-ionised	X
6.4.6 Condensate	
<b>6.5 Temperature &amp; Pressure of liquid</b>	

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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	310 kPa
6.5.5 Maximum pressure of liquid	310 kPa
6.5.6 Flow rate of liquid	80 m3/hr
6.5.7 Will vacuum conditions occur?	No
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	Filled with Amberite IRA 405 Cl
<b>7.0 OPERATION OF COMPONENT</b>	
7.1 Is the component operated on a continuous or batch process basis	Continuous
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
<b>8.0 GENERAL</b>	
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	N/A
8.2 In the case of refurbishment work what is the shut-down period during which this lining work must be carried out (number of days)	7 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 necessitate specific consideration. Schematics, photographs or appropriate drawings will be required to provide specific recommendations.	There are flanges and a manhole on the vessels

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

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## Mixed Bed – Anion Section

1.0 LOCATION OF COMPONENT	
1.1 Name of power station	Camden P/S
1.2 Component Identification i.e. Plant Code	Ion Exchange Vessels - Mixed Bed Vessels - Anion Section
2.0 COMPONENT DETAILS	
2.1 Capacity of Component	approx. 8.65 m3
2.2 Dimensions	Diameter = approx. 1.9 m      Height = approx. 3.1 m
2.3 No of access man-holes	1
2.4 Size of access man-holes	Oval - approx. 440mm x 340mm
2.5 Location of access man-holes	On top
2.6 Diameter and length of pipework	No information available
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	
4.2 Maintenance work – previously lined	X
4.3 Concrete i.e. Water retaining structures	N/A
4.3.1 Are surfaces new, dry, cured, post	

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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	Ebonite (assumed), >40 years (assumed)
4.5 Condition of the previous lining	Very poor condition -peeling and cracking
4.6 Total surface area to be lined (m <sup>2</sup> )	approx. 8.65 m <sup>2</sup>
<b>5.0 SURFACE PREPARATION</b>	
5.1 Can abrasive blast cleaning be carried out inside the component/vessel/tank with consideration of access/confined space, ventilation etc.	Yes
<b>6.0 PROPERTIES OF LIQUID CONTAINED IN OR IN CONTACT WITH THE COMPONENT</b>	
<b>6.1 Acids/alkalis</b>	
6.1.1 Type of acid/alkali	Caustic Soda
6.1.2 pH of acid/alkali	
6.1.3 Concentration of acid/alkali	3.5%
<b>6.2 Organic liquids – organic acids, fats oils or solvents</b>	
6.2.1 Type of organic liquid	N/A
6.2.2 pH of organic liquid	
6.2.3 Concentration of organic liquid	
<b>6.3 Petroleum products – petrol, diesel etc</b>	
6.3.1 Type of petroleum product	N/A
<b>6.4 Water – type of water</b>	
6.4.1 Potable water	In all cases a water analysis is required and shall contain the following parameters as a minimum; pH, Turbidity (FTUs), Conductivity (μS.cm <sup>-1</sup> ), Total aerobic bacteria (CFUs/ml), Total anaerobic bacteria (CFUs/ml), Chlorides (mg.kg <sup>-1</sup> ), Sulphate (mg.kg <sup>-1</sup> ). A range of analysis (min, max, average) is required for each of the parameters.
6.4.2 Cooling Water	
6.4.3 Raw water (with micro-organisms?)	
6.4.4 Water treatment process waters (provide specific composition/concentration) i.e. % hydrochloric acid, sulphuric acid, caustic soda, ammonia, etc.)	
6.4.5 Distilled/demineralised/de-ionised	X
6.4.6 Condensate	
<b>6.5 Temperature &amp; Pressure of liquid</b>	

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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	510 kPa
6.5.5 Maximum pressure of liquid	510 kPa
6.5.6 Flow rate of liquid	80 m3/hr
6.5.7 Will vacuum conditions occur?	No
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	Filled with Amberite IRA 405 CI
<b>7.0 OPERATION OF COMPONENT</b>	
7.1 Is the component operated on a continuous or batch process basis	Continuous
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
<b>8.0 GENERAL</b>	
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	N/A
8.2 In the case of refurbishment work what is the shut-down period during which this lining work must be carried out (number of days)	7 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 necessitate specific consideration. Schematics, photographs or appropriate drawings will be required to provide specific recommendations.	There are flanges and a manhole on the vessels

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

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## Mixed Bed - Cation Section

1.0 LOCATION OF COMPONENT	
1.1 Name of power station	Camden P/S
1.2 Component Identification i.e. Plant Code	Ion Exchange Vessels - Mixed Bed Vessels - Cation Section
2.0 COMPONENT DETAILS	
2.1 Capacity of Component	approx. 8.65 m3
2.2 Dimensions	Diameter = approx. 1.9 m      Height = approx. 3.1 m
2.3 No of access man-holes	1
2.4 Size of access man-holes	Oval - approx. 440mm x 340mm
2.5 Location of access man-holes	On top
2.6 Diameter and length of pipework	
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	
4.2 Maintenance work – previously lined	X
4.3 Concrete i.e. Water retaining structures	N/A
4.3.1 Are surfaces new, dry, cured, post	

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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	Ebonite (assumed), >40 years (assumed)
4.5 Condition of the previous lining	Very poor condition -peeling and cracking
4.6 Total surface area to be lined (m <sup>2</sup> )	approx. 8.65 m3
<b>5.0 SURFACE PREPARATION</b>	
5.1 Can abrasive blast cleaning be carried out inside the component/vessel/tank with consideration of access/confined space, ventilation etc.	Yes
<b>6.0 PROPERTIES OF LIQUID CONTAINED IN OR IN CONTACT WITH THE COMPONENT</b>	
<b>6.1 Acids/alkalis</b>	
6.1.1 Type of acid/alkali	Sulphuric Acid
6.1.2 pH of acid/alkali	
6.1.3 Concentration of acid/alkali	4%
<b>6.2 Organic liquids – organic acids, fats oils or solvents</b>	
6.2.1 Type of organic liquid	N/A
6.2.2 pH of organic liquid	
6.2.3 Concentration of organic liquid	
<b>6.3 Petroleum products – petrol, diesel etc</b>	
6.3.1 Type of petroleum product	N/A
<b>6.4 Water – type of water</b>	
6.4.1 Potable water	In all cases a water analysis is required and shall contain the following parameters as a minimum; pH, Turbidity (FTUs), Conductivity (µS.cm <sup>-1</sup> ), Total aerobic bacteria (CFUs/ml), Total anaerobic bacteria (CFUs/ml), Chlorides (mg.kg <sup>-1</sup> ), Sulphate (mg.kg <sup>-1</sup> ). A range of analysis (min, max, average) is required for each of the parameters.
6.4.2 Cooling Water	
6.4.3 Raw water (with micro-organisms?)	
6.4.4 Water treatment process waters (provide specific composition/concentration) i.e. % hydrochloric acid, sulphuric acid, caustic soda, ammonia, etc.)	
6.4.5 Distilled/demineralised/de-ionised	X
6.4.6 Condensate	
<b>6.5 Temperature &amp; Pressure of liquid</b>	

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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	510 kPa
6.5.5 Maximum pressure of liquid	510 kPa
6.5.6 Flow rate of liquid	80 m3/hr
6.5.7 Will vacuum conditions occur?	No
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	Filled with Amberjet 1300H resin
<b>7.0 OPERATION OF COMPONENT</b>	
7.1 Is the component operated on a continuous or batch process basis	Continuous
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
<b>8.0 GENERAL</b>	
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	N/A
8.2 In the case of refurbishment work what is the shut-down period during which this lining work must be carried out (number of days)	7 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 necessitate specific consideration. Schematics, photographs or appropriate drawings will be required to provide specific recommendations.	There are flanges and a manhole on the vessels

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

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**ANNEXURE D: RTD/MAT/20/235: Protective Coating Specification (by rubber lining) for Camden Power Station – Demineralisation Train Vessels**

<p><b>This specification is to be considered as Annexure D of 240-101712128: Specifications for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Coatings.</b></p>	
<b>Components</b>	<p>3 x Mix Bed Vessels.</p> <p>3 x Cation Ion Exchange Vessels.</p> <p>3 x Anion Ion Exchange Vessels.</p> <p>Surface area approximately 8.65m<sup>2</sup>/vessel.</p> <p>Capacity 8.65m<sup>3</sup>/vessel.</p>
<b><u>Internal Immersed</u></b> (Material/Substrate)	<p>Carbon Steel.</p> <p>Existing rubber lined (assumed to be ebonite).</p>
<b><u>Internal Immersed</u></b> (Environment)	<ul style="list-style-type: none"> <li>• Temperature = ambient. Maximum 40°C. Minimum -4°C.</li> <li>• Pressure = 510kPa.</li> <li>• Flow Rate = 80m<sup>3</sup>/hr.</li> <li>• pH = &lt; 4.</li> <li>• Medium = 3.5% caustic soda, 4% Sulphuric acid.</li> </ul>
<b><u>Vessel Dimensions</u></b>	<p>As per Scope of Work document.</p> <p>ID = 1.9m. Shell Height = 3.1m</p>
Generic System	
Pre-cured Butyl Rubber Material, Grade B, 40 to 70 IRHD.	
<b><u>Surface Preparation</u></b>	<p>Abrasive blast clean to Grade Sa 3 (ISO 8501-1).</p> <p>For localised areas mechanical clean to Grade St 3 (ISO 8501-1).</p> <p>The final surface profile shall be as specified by the primer Manufacturer.</p>
<b><u>Lining Thickness</u></b>	Lining thickness 6mm.
<b><u>Rubber Lining</u></b>	Rubber lining options shall be determined by inspection findings.

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<u>Options</u>	<p>Option 1 – Rubber Lining Patch Repairs.</p> <p>Option 2 – Complete Rubber Lining Replacement.</p>
<p>This specification is applicable to the vessels indicated in the scope of work for the refurbishment of Camden Power Station Water Treatment Plant Demineralisation Trains. The rubber lining works will be performed in situ at Camden Power Station.</p>	
<p><b>1. Option 1. Rubber Lining Patch Repairs.</b></p> <p>The scope of work for option 1 will include the following:</p> <ol style="list-style-type: none"> <li>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.</li> <li>1.2. The laterals, nozzles and pipes inside the vessels also require removal in order to allow access inside the vessel.</li> <li>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: <ul style="list-style-type: none"> <li>➤ Pin-hole detection testing on the existing rubber lining.</li> <li>➤ Cutting out, stripping and removal of the existing rubber in the marked up areas as per the above inspections.</li> </ul> </li> <li>1.4. Proceed with surface preparation of the substrate. 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. <ul style="list-style-type: none"> <li>➤ 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.</li> </ul> </li> <li>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</li> </ol>	

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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.

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.

1.8. To assess the extent of possible pitting and corrosion of the underlying steel substrate it may be necessary to determine the need for possible mechanical repairs i.e. welding. Unfortunately, this inspection can only be carried out once the surfaces have been blast cleaned in preparation for lining. Based on the damage on the vessel it may be required to conduct mechanical repairs before rubber lining.

1.9. 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.

1.10. Rubber lining shall only proceed once all mechanical repairs or activities on the vessels have been completed and released in terms of the applicable manufacturing/fabrication Quality Control Plan (QCP).

1.11. Once the above inspection and welding repairs are 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. Option 2. Complete Rubber Lining Replacement.

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

2.1. The laterals, nozzles and pipes inside the vessels also require removal in order to allow access inside the vessel.

2.2. The Rubber Liner or Contractor shall remove most of the existing rubber lining by initial

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removal techniques such as cutting out, stripping and flapper disc grinding.

- 2.3. Assess the extent of possible pitting and corrosion of the underlying steel substrate it may be necessary to determine the need for possible mechanical repairs i.e. welding.
- 2.4. Proceed with rubber lining operation once the above inspections and welding repairs have been completed. Rubber lining shall only proceed once all mechanical repairs or activities on the vessels have been completed and released in terms of the applicable manufacturing/fabrication Quality Control Plan (QCP).
- 2.5. 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.
- 2.6. Different grades and types of blasting media exist. It is important that the correct abrasive be used to achieve the specified surface profile. The required blast profile height should be carefully considered. The Applicator shall select an appropriate abrasive type and mesh size to attain the specified surface profile.
- 2.7. Only inert mineral grit or steel grit abrasives shall be used. Steel grit shall be used in sensitive plant areas such as Water Treatment Plants in order to ensure no contamination of plant processes due to excessive dust. Sand or silica based abrasives shall not be used. Abrasive material for blast cleaning shall be used in line with local environmental regulations.
- 2.8. The abrasive shall be used in accordance to 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.
- 2.9. 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.
- 2.10. The use of re-cycled blasting media for the final blast is strictly prohibited.
- 2.11. All abrasive media shall be stored in an area that is completely dry, covered and protected from weather.
- 2.12. The profile height of the blasted surfaces should be within the range of the specified

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primer system. Refer to the Manufacturers Product Data Sheets.

- 2.13. 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. 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.
- 2.14. 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.
- 2.15. 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 or Contractor to take note of the selected type of rubber required in the table above.
- 2.16. All the laterals, nozzles and pipes shall be removed from the vessel, the old rubber stripped out and replaced with butyl rubber grade B with 40-70 IRHD.
- 2.17. Pre-cured Butyl rubber grade B with 40-70 IRHD is the specified material for this application. 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 support geometry and rubber lining.
- 2.18. The rubber lining thickness of 6mm is specified. The Rubber Liner or Contractor shall confirm the specified thickness as satisfactory for the application.
- 2.19. The rubber lining Manufacturer, adhesive Manufacturer and Rubber Liner 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.

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### 3. General Requirements

- 3.1. The Contractor to take note of the different material of construction on the shell of and the floor of the vessels to be rubber lined. The shell and floor of the vessels are constructed from mild steel and concrete material respectively.
- 3.2. The refurbishments as mentioned in section 1 and 2 should be carried out on the vessels (metal and concrete surfaces) before rubber lining commence.
- 3.3. Sharp edges shall be dressed to a radius of not less than 3 mm. All burrs and weld spatter shall be removed. Welds shall be free from imperfections (e.g. asperities, undercutting, blowholes, craters, and spatter).
- 3.4. All surfaces shall be completely dry and free from contaminants such as traces of oil, grease, etc. before surface preparation is carried out.
- 3.5. 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 application.
- 3.6. The Applicator shall ensure that during surface preparation and primer/adhesive application the relative humidity (RH) in open, undercover shop environments is less than 80% RH and for the vessel internal space is less than 60% RH. Ambient temperatures shall be between 5°C and 30°C or as per the Manufacturer recommendations or as per clauses 4.1.1.2 to 4.1.1.5 of BS 6374-5, whichever is the more stringent.
- 3.7. The maximum/minimum substrate temperature at the time of primer 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. 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 primer/adhesive application shall be permitted. All measurements shall be recorded at the steel surface. Dew point requirements as

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per the Product Datasheet or 240-101712128.

- 3.8. For all inspections of all surfaces before primer application the surfaces shall be clean allowing unhindered visual access to the surface. The Applicator shall provide sufficient and adequate lighting (Cool White) to enable inspections. Cell phone lighting is not acceptable.
- 3.9. Cleaned surfaces shall not be contaminated with oil, grease, rust or other deposits before priming. Unnecessary traffic prior to primer application shall be avoided.
- 3.10. On completion of grit blasting the surface shall be thoroughly vacuumed until no loose dust is evident. The level of cleanliness required shall be less than "dust quality rating" 2 when tested in accordance with ISO 8502-3. It is imperative that all surface dirt and contaminants are completely removed before lining or the adhesion of the lining shall be impaired.
- 3.11. 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.
- 3.12. Prior to rubber lining installation the Contractor shall ensure that the metal surface is suitable for receiving the lining system. The onus is on the Rubber Liner or Contractor to ensure that the surfaces are ready for lining.
- 3.13. 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 (200mm X 300mm X 3mm). 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. Properties such as hardness shall be evaluated by Eskom to ensure compliance to the Manufacturer's product data sheet, The Manufacturer shall provide written commitment to this requirement at the tender stage. In addition to the panel samples above, representative

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(considering different batches), loose rubber sheeting 500mm X 500mm shall be submitted for tensile testing in order to ensure conformity to SANS 1198.

3.14. During rubber lining of the vessels the Contractor shall prepare (200mm X 300mm X 3mm) test panels in the same conditions as the vessels, meaning that the samples must be prepared inside the vessels. The prepared test panels shall be sent to Eskom RT&D for destructive analysis.

3.15. During rubber lining 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.

3.16. 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).

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

3.18. 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.

3.19. 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.

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

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3.21. Prior to commencement of rubber lining the Rubber Liner 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.

3.22. 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 (>10mm on either side), entrapped air or any other defects which will impair its use. Defective areas shall be cause for rejection of the lining.

#### 4. Tender Returnables

4.1. 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. The verifiable evidence of case studies shall list projects where vessels have been successfully lined by the Rubber Liner with the proposed rubber within the last five years. The verifiable evidence shall include contact details, signed QCPs or Release Certificates for the listed reference projects.

4.2. The system Supplier/Rubber Liner or Contractor shall supply (with the tender) individual product data sheets and material safety datasheets (MSDS) for all products comprising the system i.e. rubber lining, adhesives, tack coats and solvents. For the rubber lining as a minimum the following shall be submitted:

- A description of the generic type of rubber lining.
- Physical and chemical properties as per table 3 in SANS 1198.
- Recommended and non-recommended uses.
- Service temperatures and chemical resistance limits. For the chemical resistance, special property (III), (refer to 240-101712128 for this special requirement).
- 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

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- 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.

4.3. A detailed procedure/method statement shall be submitted to Eskom at the time of tender detailing all steps, procedures and activities of the 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 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.
- 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 volatile/combustible/explosive or toxic 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

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flow shall be described and detailed.

- 4.4. 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 application. Inspections during lining application shall at least cover 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.
- 4.5. At the time of tender the Contractor shall indicate any Deviations or Exclusions from this specification and all referenced documents within this specification. If there are none then a definitive statement in this regard needs to be provided.
- 4.6. 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.
- 4.7. At the time of tender the Rubber Liner shall submit a detailed programme showing how the works shall be carried out and completed within the time constraints of the project as detailed in the enquiry document.

## 5. Safety Requirements and Considerations

- 5.1. During the rubber lining activities, care shall be taken to ensure adequate ventilation and lighting, to allow for good visibility and to avoid/minimise health and safety risks.
- 5.2. A confined space/s (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.
- 5.3. Flammable Atmospheres: Gases, vapours and dusts can become trapped in CSs and

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create flammable or explosive atmospheres, and include combustibles e.g. Hydrogen, Acetylene, Adhesive, Primer and thinning/cleaning solvents, etc.

- 5.4. Walking / Working Surfaces and Visibility: Poor lighting may add to hazards caused by an irregular, sloped, or constricted working surface.
- 5.5. The Rubber Liner or 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.
- 5.6. 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.
- 5.7. The Rubber Liner or 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 Rubber Liner or Contractor shall provide the personnel with the appropriate required PPE.
- 5.8. The Rubber Liner or Contractor shall provide for all necessary safety precautions and risk assessments.
- 5.9. The Rubber Liner or Contractor shall advise Eskom of all hazardous materials to be brought on site.
- 5.10. All rubber lining materials on site shall be stored in designated areas in storage facilities that meet the storage requirements of the paint Manufacturer and the safety requirements of the specific site. 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 shall be located (indoors/outdoors), typical ambient temperature for the particular season of the year and the maximum storage temperature limits as per the Manufacturers recommendations.
- 5.11. The Rubber Liner or Contractor's Safety File for the area to be worked it shall address

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all the hazardous activities of abrasive blast cleaning and spray painting. The Rubber Liner or Contractor shall verify that the personnel carrying out these activities are suitably qualified.

5.12. The Rubber Liner or 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/Applicator'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/Applicator 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 Risk and Safety office/department.

#### 6. Reference Documents:

The Eskom Standards 240-106365693: Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings and 240-101712128: Standard for the internal corrosion protection of water systems, Chemical Tanks and Vessels and Associated Piping with Coatings were compiled in 2016 and are due for revision in 2020. Since 2016 there have been changes in terms of the referenced documents i.e. some documents have been withdrawn, replaced or superseded. The following list of references shall apply in addition to the requirements of 240-101712128. The latest revision of the referenced standards shall apply. Where conflict exists between any of these documents the more stringent requirement shall apply.

1. 240-101712128: Standard for the internal corrosion protection of water systems, Chemical Tanks and Vessels and Associated Piping with Coatings.
2. 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

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customer and regulatory requirements.”

3. ASTM D5162: Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates.
4. ASTM E376: Measuring coating DFT by magnetic field or eddy current electro-magnetic test Methods.
5. ASTM F21: Standard Test Method for Hydrophobic Surface Films by the Atomizer Test.
6. 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. 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).
8. ISO 8502-6: Preparation of steel substrates before application of paint and related products – Test for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis – The Bresle method.
9. 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).
10. ISO 12944-3: Paint and varnishes – Corrosion protection of steel structures by protective paint systems. Part 3: Design considerations.
11. SANS 10064: The preparation of steel surfaces for coating.
12. SANS / ISO 2808: Paints and Varnishes: Determination of film DFTs (Can be used as alternative to ASTM E376).
13. SANS 5770: Preparation of steel substrates before the application of paints and related

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products – Test for the assessment of cleanliness of blast-cleaned steel surface – Freedom from certain soluble salts.

14.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 micrometer profile gauge (Can be used as alternative to ISO 8503-4).

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

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

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

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

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

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

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