	<b>Standard</b>	<b>Technology</b>
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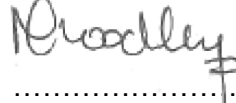
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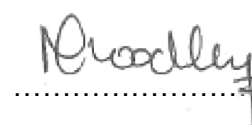
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## **1. INTRODUCTION**

This standard covers general plant and equipment on all power stations including coal fired, nuclear (Conventional Island), pumped storage and gas turbine installations.

The selection of lining materials for immersed service is directly dependent upon the properties of the liquid in contact with the lining. Each specific liquid will require a specific lining material. This standard describes the procedure for the selection and application of linings for the internal corrosion protection of water and chemical tanks, vessels and associated piping systems. The type of input information required for the compilation of these proposed standards is given in Annexure C.

A number of different organic lining materials are available for the internal protection of water and chemical tanks and associated piping systems. Depending upon the liquid being contained or carried, these include, but are not limited to, the following:

1. Solvent borne or solvent free epoxies.
2. Elastomeric or rigid polyurethanes.
3. Glass filled polyesters or vinyl esters.
4. Rubber linings

## **2. SUPPORTING CLAUSES**

### **2.1 SCOPE**

#### **2.1.1 Purpose**

This standard focuses on the use of organic linings as a means of corrosion protection for mild steel substrates exposed to aqueous or chemical immersion conditions.

Selection criteria of generic organic lining systems for the typical environments and substrate materials should be based on past experience, proven case histories and current international practice.

With the exception of circumstances as described in Section 2.5 (d) in all other cases the Contractor shall be responsible for proposing suitable protective lining systems based on the information provided by the Eskom Engineer in Annex C. The proposed suitable lining system/s shall be submitted to Eskom at the time of tender for review and acceptance.

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

The standard requirements detailed herein shall not be modified in any way without the written approval of the Eskom Engineer.

#### **2.1.2 Applicability**

This standard applies to plant and equipment exposed to aqueous and chemical immersion conditions. Protection of chemical plant bund areas is excluded from this standard.

This standard is applicable to situations where the selection and application is performed by external contractors as well as Eskom Maintenance departments.

When considering protective linings for aqueous or chemical immersion there are several parameters and aspects that require closer scrutiny especially in cases of significantly sized project packages and or in severely corrosive environments. Examples of these are tank internals and piping systems exposed to specific oils, chemicals (bases and acids) and industrial waters. In these instances the Corrosion Department of Eskom, RT&D, must be consulted with detailed proposals submitted by the Contractor.

RT&D will be able to provide recommendations on a case by case basis. These recommendations will be based on project size, severity and uniqueness of the environment as well as life cycle costing issues.

Any such approval or consent, or any review shall not relieve the Contractor from any obligation or responsibility.

## **2.2 NORMATIVE/INFORMATIVE REFERENCES**

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

### **2.2.1 Normative**

- [1] ASTM D4414: Standard practice for measurement of wet film thickness by notch gauges.
- [2] ASTM E376: Measuring coating thickness by magnetic field or eddy current electromagnetic test methods.
- [3] ASTM D4541: Standard Method for Pull-off Strength of Coatings using Portable Adhesion Testers.
- [4] BS 6374: Part 5 - Lining of equipment with polymeric materials for the process industries.
- [5] ISO 813: Rubber, vulcanized or thermoplastic. Determination of adhesion to a rigid substrate - One plate method.
- [6] ISO 12944: Paint and varnishes – Corrosion protection of steel structures by protective paint systems. Parts 1 to 8.
- [7] ISO 4628: Paints and varnishes – Part 1 to 6.
- [8] ISO 8501-1: Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
- [9] ISO 8501-4: Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 4: Initial surface conditions, preparation grades and flash rust grades in connection with high-pressure water jetting.
- [10] ISO 8502-3: Preparation of steel substrates before application of paint and related products – Tests for the assessment of surface cleanliness-Part 3: Assessment of dust on steel surfaces prepared for painting (pressure sensitive tape method).
- [11] 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.
- [12] ISO 8504: Preparation of steel substrates before application of paint and related products – Surface preparation methods.
- [13] ISO 4624: Paints and varnishes – Pull-off test for adhesion.
- [14] ISO 9001: Quality Management Systems – Requirements.
- [15] SANS 1217: Guidelines for internal and external organic coating protection for buried steel pipelines.
- [16] SANS 1198: The manufacture of rubber sheeting for rubber lining.

- [17] SANS 1091: National colour standard.
- [18] SANS 10140: Identification Colour Marking.
- [19] SANS 10064: The preparation of steel surfaces for coating.
- [20] SANS / ISO 2808: Paints and varnishes – Determination of film thickness.
- [21] SANS 5159: Adhesion of paint and varnish films (cross cut test).
- [22] SANS 5769: Cleanliness of blast cleaned surfaces for painting (assessed by freedom from dust and debris).
- [23] SANS 5772: Profile of blast cleaned surfaces for painting (determined by a micrometer profile gauge).
- [24] SANS 5870: Hardness of vulcanized rubbers of hardness 30 — 95 degrees
- [25] SIS 055900: Swedish Code of Practice – Pictorial surface preparation standard for painted steel surfaces.

## 2.3 DEFINITIONS

Definition	Description
adhesive	The liquid bonding system used to promote adhesion between the rubber and the substrate.
approved	Refers to written approval by the Eskom Engineer.
applicator	Refers to personnel applying the lining system.
bonding system	System used to bond the rubber lining to the substrate.
cover coat	Is the second coat of a bonding system. It provides the link between the rubber and the primer.
Coating/lining/film	A continuous film of paint resulting from a single application.
lining/coating/paint system	"Coating/paint system" is an all-embracing term including method and degree of surface preparation, generic type, thickness and number of coats and the method of application of the coats.
Contractor	The paint applicator/rubber liner or Contractor having the main Contractual responsibility to Eskom.
dry film thickness/nominal	The thickness of a lining remaining on the surface when it has hardened, the dry film thickness specified for each coat or for the entire paint system to achieve the required durability.
durability	The expected life of a lining system.
generic rubber type	Refers to the type of rubber being used.
generic organic lining	Refers to a type of product e.g. epoxy, polyurethane, etc.
inspector	Anyone responsible for ensuring conformity with this standard.
lining	A protective coating on the inner surface of a tank or pipe.
manufacturer	The manufacturer of the paint or rubber lining compounds and associated products such as primers, adhesives, solvents, cleaners etc.
maintenance	The sum of all measures which ensure that the function of the protection against corrosion is maintained.
primer	The base coat of a bonding system, which is applied directly to the metal substrate. This coat provides the link between the substrate and the cover – coat.
project	The whole of the work for which the standard is developed.
reference areas	Suitable areas on the structure used to establish a minimum acceptable standard for the work, to check that data is correct and to assess lining performance.
rubber lining	A process in which rubber is applied as an anticorrosion protection to protect the outside or inside of vessels, tanks, pipes and equipment for industries.
substrate	A surface which has been prepared by grit blasting, followed by the application of the lining system.
surface preparation	The preparation of a substrate prior to applying the lining, i.e. welding, grinding, blasting, cleaning, application of bonding agents and tie coats.
specified	Conditions agreed to at the time of Contract award. These may not be



Definition	Description
	altered unless agreed to by the Contractor and the Eskom Engineer
supervisor	Refers to a person having a minimum of two years' experience in the field of surface preparation and application of coatings/linings.

### 2.3.1 Disclosure Classification

**Public domain:** published in any public forum without constraints (either enforced by law, or discretionary).

## 2.4 ABBREVIATIONS

Abbreviation	Description
ASTM	American Society for Testing and Materials
CFU	Colony forming units
DFT/NDFT	Dry Film Thickness/ Nominal Dry Film Thickness
EID	Electrical Insulation Defect.
ISO	The International Organization for Standardization
FTU	Formazin turbidity units often designated JTU or NTU
OHS	Occupational Health and Safety
RT&D	Research Testing and Development
SANS	South African National Standards
SAQCC	South African Qualification and Certification Committee for Corrosion Protection
QC	Quality Control
QCP	Quality Control Plan

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## **2.5 ROLES AND RESPONSIBILITIES**

- a) The Eskom Engineer shall ensure that this standard is utilised for compiling an enquiry for the internal corrosion protection of water systems, chemical tanks and vessels and associated piping with linings.
- b) At the time of enquiry document issuing the Contractor will receive the completed information sheet **ANNEXURE C: QUESTIONNAIRE FOR THE SELECTION OF SUITABLE ORGANIC LINING/RUBBER LINING FOR THE INTERNAL CORROSION PROTECTION OF WATER SYSTEMS, CHEMICAL TANKS AND VESSELS AND ASSOCIATED PIPING** from the Eskom Engineer. The information sheet shall contain all of the information that the Contractor needs to be able to select the correct organic lining/rubber compound and application procedure.
- c) Annexure C is specific to a given environment and as such a separate Annexure C shall be completed for each environment to which the component is exposed i.e. the waterside is regarded as a different environment to the steam-side, oil or air side. The Eskom Engineer shall be responsible for correctly populating all required information requested on the Questionnaire/s.
- d) In certain instances this standard will be accompanied by an Annexure D. The Eskom Engineer is required to consult with the Corrosion Department of Eskom, RT&D in compilation of specific requirements. In these instances Annexure D will specify Eskom's selection for all or part of the project and shall apply accordingly.
- e) In the absence of Annexure D, in all other cases the Contractor shall be fully responsible for the selection of the lining system.
- f) The Contractor shall be fully responsible for the control and execution of the successful application of lining systems above. The Contractor should note that the Eskom will not be liable for any rectifications, additional costs, etc. as incurred by the Contractor, any of his / other Sub-Contractors or the paint/rubber liner manufacturer as a result of potential lining failures, re-work, additional work, etc. during the execution of the lining activities.
- g) The Eskom Engineer shall be responsible for consulting with the Corrosion Department of Eskom, RT&D in order to assess the requirement relating to the request for all documents as described in Section 3 below.
- h) In the event that no instruction to waive specific requirements in terms of the above are detailed in the enquiry or Annexure E then the Contractor shall comply with all the requirements as required in Section 3.
- i) This standard provides a high level indication of the Eskom Engineer's requirements with regards to lining systems for steel substrates in aqueous or chemical immersion applications. The Contractor is responsible for using the standard requirements in this document in the process of deciding which lining system he intends proposing to the Eskom Engineer for use in a specific application.
- j) The Contractor shall be responsible for ensuring that all Sub-Contracting parties such as the paint/rubber lining applicator and the paint/rubber liner manufacturer are fully conversant with the requirements of this standard and referenced standards in this document.
- k) Any specific queries or requirements not covered by this standard shall be referred to the Eskom Engineer.
- l) The Contractor shall be responsible for ensuring that he is fully conversant with the requirements of this standard. In the event of conflict between this document and the referenced standards, the requirements of this document shall prevail.
- m) The Contractor shall take full responsibility for all aspects related to the organic lining system/rubber lining proposal and the successful application and quality thereof, including but not limited to the following aspects:

- Organic lining system / rubber lining selection
  - Logistics
  - Product chemical formulation control
  - Application nuances & procedure
  - Surface preparation & over-coating period details
  - Any potential deviations / additional requirements to the product data sheet requirements
  - Additional costs not envisaged or that arise in successfully applying the proposed lining/rubber lining systems to be borne by the Contractor.
- n) Eskom's representative/s and/or third party/independent inspection authority shall have un-hindered access to witnessing all testing processes at both the paint/rubber manufacturing facility and paint/rubber applicators facility.
- o) The Contractor shall be responsible for quality assurance and control. Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by Eskom (including the absence of disapproval) shall not relieve the Contractor from any responsibility under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances.
- p) The Contractor shall take note of and respond to any comments made by Eskom on the Contractor's documents. However, Eskom is not bound to check the Contractor's documents for any errors, omissions, ambiguities or discrepancies or compliance with the requirements of the Contract. Eskom's receipt of, or review of, or comment on, the Contractor's documents will not relieve the Contractor from responsibility for the Contractor's errors or omissions or departure from the requirements of the standard.

## **2.6 PROCESS FOR MONITORING**

- a) The Corrosion Department of Eskom, RT&D, must be consulted with detailed proposals submitted by the Contractor. RT&D will be able to provide recommendations on a case by case basis. The level of involvement by RT&D will be based on project size, severity and uniqueness of the environment and will be decided between RT&D and the respective Eskom Engineer prior to the enquiry being issued.
- b) A clarification meeting to discuss and analyse the procedures and processes to be used on the project shall be held prior to commencement of the work. The purpose of the clarification meeting would be to ascertain specifics in relation to this standard. Attendance shall as a minimum include the Eskom Engineer, Contractor, manufacturer, applicator and inspector. The requirement for attendance/involvement by RT&D will be based on project size, severity and uniqueness of the environment and will be decided between RT&D and the respective Eskom Engineer prior to the enquiry being issued.
- c) Quality Control and assurance functions, processes and requirements are described in subsequent sections of this Standard.

## **2.7 RELATED/SUPPORTING DOCUMENTS**

Not Applicable

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### **3. DOCUMENT SUBMISSION BY CONTRACTOR**

The following section describes the exhaustive list of documents to be submitted by the Contractor for the proposed paint/rubber lining manufacturer and applicator. The Eskom Engineer, in the enquiry document, shall state which of these documents are mandatory tender returnable documents are. If mandatory documents are not provided at the tender stage, the tender (for the corrosion protection aspects contained in this standard) will be considered technically non-compliant and will not be evaluated. The Eskom Engineer, as part of the enquiry, shall provide the Contractor with a list of documents which will be required for tender evaluation purposes and will also indicate when the remaining documents from the list below will be required.

All tender returnable documents to be compiled in English.

#### **3.1 PAINT MANUFACTURER TENDER DOCUMENTS**

Documentation and information (specific to this project) to be provided from the paint manufacturer shall include:

- a) A Quality Management System that meets or exceeds the requirements of ISO 9001. Relevant and applicable quality certification and the quality management policy to be submitted.
- b) Name of manufacturing facility, web address, e-mail address, contact telephone number and physical address.
- c) Product and system selection, including details of number of coats, NDFT and Maximum DFT for each layer. In each case the manufacturer shall provide recommendations and criteria in the event of paint inadvertently applied in excess of the Maximum DFT.
- d) Provide the latest product and material safety data sheets as well as manufacturing batch certificates for each of the products being proposed. In the case of batch certificates where twin pack material applies then separate batch certificates for each pack shall apply.
- e) Product data sheets shall contain the following as a minimum.
  - A description of the generic type of paint
  - Methods and practices for transitioning onto other existing organic lining systems.
  - Recommended and non-recommended uses
  - Service temperatures and chemical resistance limits
  - Surface preparation
  - Application conditions and details including but not limited to: DFT, Over-coating, compatibility, application temperatures, dilutions, application techniques and curing times.
- f) The Product Data Sheet/s shall be signed by the manufacturer, Contractor and applicator. The signed Product Data Sheet/s shall be deemed to be part of this standard and 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 is permitted until acceptance by Eskom.
- g) Manufacturing batch certificates containing (as a minimum) the information described in Section 4.6 (h).

- h) For each of the proposed systems submit a lining procedure, indicating (as a minimum) requirements for surface preparation, Min/Max DFT and NDFT's, over-coating times, special requirements or precautions.
- i) For each of the proposed systems submit procedures and proposed supplementary compatible systems or products such as fillers, sealers in situations of flange surfaces, crevices, joints etc. with due consideration of over-coatability and compatibility between the various proposed systems.
- j) Maximum continuous and non-continuous operating temperature limitations of each of the proposed lining product/systems.
- k) Provide verifiable/auditable evidence that each of the proposed products and systems (for equivalent or greater surface areas as required by this project) has been successfully applied in comparable environments. In this regard two separate projects older than 10 years and three projects completed within the last five years shall be listed. Products that were used in these projects shall have been manufactured by the same facility as in (b) above. The listing shall include contact details for the listed reference projects.
- l) The manufacturer shall propose suitable acceptance criteria specifically in terms of all possible damage and lining deterioration mechanisms as defined in ISO 4628 Part 1 to 6 for each of the systems and then specific coats in the system in the event that these are damaged during the course of the system application i.e. mechanical damage, weathering or aging before application of the subsequent coat. The acceptance criteria will be reviewed by Eskom prior to tender award.
- m) To ensure minimum acceptable work standards, verifiable manufacturer or Contractor data and to assess lining performance, reference areas as prescribed in ISO 12944 - 7 and 8 are required. The manufacturer is required to provide written commitment to this requirement (details as per ISO 12944 - 7 Annex A).
- n) After tender award and prior to project execution the manufacturer shall submit samples of each lining product and the lining system as proposed in the tender submission. For each product and part of system (step by step) until complete system, two samples will 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 lining products shall also be applied in accordance with the datasheet. The size of the test sample panels shall be (100mm X 200mm X 2mm). 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. The manufacturer shall provide written commitment to this requirement.
- o) Eskom shall retain these samples and reserves the right to perform laboratory tests and destructive analysis to confirm/ascertain lining characteristics both prior to tender award and then during various future phases of the project. No deviation in formulation during the execution of the project will be permitted without Eskom approval.

- p) Provide an organogram, specific to this particular supply, detailing all the positions and individuals responsible for technical expertise and logistic support. Curriculum vitae of these key personnel shall be included with the submission. Suitably qualified technical backup/support, Quality Assurance and Quality Control personnel are considered key in the manufacturing process. In this regard, details of the personnel number, qualification type, level and experience to be provided as part of the organogram.
- q) If no exclusions or qualifications are submitted at the time of tender, the requirements as prescribed in this Standard and/or ISO 12944: Parts 1 to 8 shall apply.

### **3.2 PAINT APPLICATOR TENDER DOCUMENTS**

Documentation and information (specific to this project) to be provided by the Contractor for the proposed paint applicator shall include.

- a) A Quality Management System that meets or exceeds the requirements of ISO 9001. Relevant and applicable certification and the quality management policy to be submitted.
- b) Name of company, facility, web address, e-mail address, contact telephone number and physical address.
- c) Provide verifiable/auditable evidence that the proposed applicator has experience in the application of each of the same proposed products and systems, for similarly sized projects in comparable environments. Unless explicitly specified in the enquiry document then the minimum requirement is that two separate projects older than 10 years and three projects within the last five years shall be listed. The listing shall include contact details for the listed reference projects.
- d) If Eskom has not previously assessed and suitably approved the proposed applicator according to the requirements of this standard then the Contractor shall conduct an assessment using the criteria in Annex A and document/record the assessment using Annex B as a basis. The Contractor shall rate the applicator and sign the Annex B form and submit it with the tender.
- e) To ensure minimum acceptable work standards, verifiable manufacturer or Contractor data and to assess lining performance, reference areas as prescribed in ISO 12944 - 7 and 8 are required. The applicator is required to provide written commitment to this requirement (details as per ISO 12944 - 7 Annex A).
- f) Provide an organogram, specific to this particular supply, detailing all the positions and individuals responsible for technical expertise and logistic support. Curriculum vitae of these key personnel shall be included with the submission. Suitably qualified applicators, supervisors and inspectors are considered key in the application process. In this regard details of personnel number, qualification type, level and experience to be provided as part of the organogram and to be aligned with the requirements of Annex A and B.
- g) If no exclusions or qualifications are submitted at the time of tender, the requirements as prescribed in this Standard and/or ISO 12944: Parts 1 to 8 shall apply.
- h) Joint performance guarantees provided by the Contractor in collaboration with the paint manufacturer & paint applicator for the applied lining systems as described in detail in Section 4.14 of this standard.



### **3.3 RUBBER LINING APPLICATOR TENDER DOCUMENTS**

Documentation and information (specific to this project) to be provided by the Contractor shall include:

- a) A Quality Management System that meets or exceeds the requirements of ISO 9001. Relevant and applicable certification and the quality management policy to be submitted.
- b) The SANS 1198 line call-out for the rubber compound to be used.
- c) Name of applicator, facility, web address, e-mail address, contact telephone number and physical address.
- d) Name/s of rubber compound, adhesive, chemical curing agent manufacturer/s, facility, web address, e-mail address, contact telephone number and physical address.
- e) Provide the latest product and material safety data sheets as well as manufacturing batch certificates for each of the products being proposed.
- f) The Product Data Sheet/s shall be signed by the manufacturer, Contractor and applicator. The signed Product Data Sheet/s shall be deemed to be part of this standard and 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 is permitted until acceptance by Eskom.
- g) After tender award and prior to project execution the manufacturer shall submit samples of each primer, bonding solution, adhesive, rubber sheeting (in cured condition) as proposed in the tender submission. For each rubber sheet compound type or condition samples shall be submitted for each step of the process i.e. primer, bonding solution, and adhesive and cured rubber lining. Two sets of samples will 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 lining and associated products shall also be applied in accordance with the respective datasheets. The size of the test sample panels shall be (100mm X 200mm X 2mm). The lining shall be cured as would be in practical situations without any artificial assistance. The applicator/manufacturer shall supply the relevant batch certificate for each of the products used in the submitted test sample panels. The applicator/manufacturer shall provide written commitment to this requirement.
- h) Eskom shall retain these samples and reserves the right to perform laboratory tests and destructive analysis (as per Section 8 of SANS 1198) to confirm/ascertain rubber sheeting and other associated product characteristics both prior to tender award and then during various future phases of the project. No deviation in formulation during the execution of the project will be permitted without Eskom approval.
- i) The procedure and time required to cure the applied rubber to the required hardness as specified in the line call-out.

- j) Provide verifiable/auditable evidence that the proposed rubber lining applicator has experience in the application of each of the same proposed lining system, for similarly sized projects in comparable environments. Unless explicitly specified in the enquiry document then the minimum requirement is that two separate projects older than 10 years and three projects within the last five years shall be listed. The listing shall include contact details for the listed reference projects. The listing shall include contact details for the listed reference projects.
- k) If Eskom has not previously assessed and suitably approved the proposed applicator according to the requirements of this standard (from date of first issue i.e. Rev1) then the Contractor shall conduct an assessment using the criteria in Annex A and document/record the assessment using Annex B as a basis. The Contractor shall rate the applicator and sign the Annex B form and submit it with the tender.
- l) Provide an organogram, specific to this particular supply, detailing all the positions and individuals responsible for technical expertise and logistic support. Curriculum vitae of these key personnel shall be included with the submission. Suitably qualified applicators, supervisors and inspectors are considered key in the application process. In this regard details of personnel number, qualification type, level and experience to be provided as part of the organogram and to be aligned with the requirements of Annex A and B.
- m) If no exclusions or qualifications are submitted at the time of tender, the requirements as prescribed in this Standard and SANS 1198 and BS 6374: Part 5 shall apply.
- n) Joint guarantees provided by the Contractor/applicator, in collaboration with the rubber sheeting, adhesive and chemical curing agent manufacturer/s that the applied lining will perform in the given environment for a minimum period of 10 years.

## **4. REQUIREMENTS**

### **4.1 SPECIFIC REQUIREMENTS**

- a) In all cases linings for any immersion environment i.e. paints and associated materials such as primers, fillers, sealants shall be “solvent free”.
- b) In all cases the degree of cleanliness for lining systems in immersion service shall be Sa3 in accordance with ISO 8501/1.
- c) In all cases, lining by coating or rubber lining shall only be performed by applicators with a rating of 3 as defined in 4.4.2 (c).
- d) The following specific requirements apply to Rubber Lining
- The thickness of rubber shall be a minimum of 6mm. The applicator shall confirm this thickness as satisfactory for the application. The thickness of the lining may vary throughout a vessel, extra thickness may be required in areas of high wear.
  - The use of carbon disulphide curing solutions is forbidden at Eskom facilities
  - All joints to be ‘strapped joints’ as per BS 6374 Part 5 figure 7.



## **4.2 APPROACH OF THIS STANDARD TO LOW RISK, LOW IMPACT, GENERAL, SPECIAL OR CRITICAL “WORKS PACKAGES” OR APPLICATIONS**

- a) Eskom reserves the right to request all or part of the Mandatory Tender Documents as described in Section 3 depending on the criticality and project magnitude. If certain returnable documents are deemed unnecessary or not applicable by Eskom these will be explicitly listed in the enquiry document and in Annexure E.. In all other cases all requirements of Section 3 shall apply.

## **4.3 APPLICABILITY OF STANDARD CLAUSES TO RUBBER LINING**

- a) Although several clauses in Section 4 are applicable to rubber lining particularly surface preparation and ambient conditions (4.5.3, 4.7, 4.7.5 and 4.11). Specific requirements for rubber lining are prescribed in Section 5.

## **4.4 GENERAL REQUIREMENTS**

### **4.4.1 Design Considerations**

- a) Steel components shall be designed to be accessible for the purposes of applying, inspecting and maintaining the protective lining system.
- b) The guidelines to ensure accessibility and suitability for painting shall be drawn from ISO 12944-3: 'Paint and varnishes – Corrosion protection of steel structures by protective paint systems' Part 3 – 'Design considerations'.
- c) For the internals of circuits or systems containing liquids or gases, the conditions of the coated surfaces shall not be detrimental to the full and correct functioning of the circuit or system as envisaged in the applicable design criteria of that circuit or system.
- d) Care shall be taken to ensure adequate protection of any surfaces and parts of components not requiring blast cleaning and lining. Examples include valve seats, shafts, bearings, motors, small bore drain/vent piping systems, threaded components, flange surfaces etc.
- e) Unless otherwise instructed by the Eskom Engineer for flange surfaces at least one coat of the lining system shall be brought around onto a third of the surface area of the flange face. In these cases abrasive blasting of the flange face (gramophone surface finish) is not permitted. The requirement is the surface shall comply with the requirements in section 4.7.5 (a). It is recommended that the specifics of such instances be addressed on a case by case basis in the clarification meeting.

### **4.4.2 Contractor Skills and Competency**

- a) The Contractor shall ensure that there are at all times sufficient suitably qualified, experienced and skilled staff to carry out and supervise all activities.
- b) Staff shall be qualified in terms of the South African Qualification and Certification Committee for Corrosion Protection {SAQCC (Corrosion Protection)} as follows:
- Applicators: General Heavy Duty Coatings Applicator (PA1)
  - Supervisors: General Paint Supervisors (PS1)
  - Inspectors: Coating Inspectors (Level 1 or Level 2) or NACE CIP Level 1, 2 or 3

- c) The Contractor shall meet the **REQUIREMENT CRITERIA FOR CORROSION PROTECTION ORGANIC LINING AND RUBBER LINING APPLICATORS** (See Annexure A) and shall have been rated in accordance with the **CAPABILITY CHECKLIST FOR CORROSION PROTECTION ORGANIC LINING AND RUBBER LINING APPLICATORS** (See Annexure B).

## **4.5 EQUIPMENT**

### **4.5.1 Measuring and Test Equipment**

- a) The Contractor shall have a blast profile gauge, wet film comb, and a dry film thickness gauge at the shop/site at all times. The Contractor shall also have at the shop/site instrumentation to measure the psychrometric conditions and the substrate temperature.
- b) The electronic dry film thickness gauge shall conform to the requirements of SABS ISO 2808 and shall be calibrated using the smooth calibration disc supplied by the instrument manufacturer.
- c) Where immersed surfaces are being coated or lined, the Contractor shall have the necessary pin-hole detection equipment at the shop or site. The equipment shall be of either the wet sponge low voltage or high voltage spark type as dictated by the type of lining being applied. This instrumentation shall be set up and operated in accordance with the requirements of SANS 1217.
- d) All test equipment and shims shall have current calibration certificates.

### **4.5.2 Spray Equipment**

- a) The spray equipment used shall be capable of properly atomising the material and shall be equipped with suitable pressure regulators and gauges. Air caps, needles and nozzles shall be of the type recommended by the paint manufacturer.
- b) All spray painting equipment shall be fitted with suitable oil and moisture traps.

### **4.5.3 Blast cleaning Equipment**

- a) Industrial type surface preparation apparatus shall be used to ensure effective and time-efficient cleaning of surfaces. Effective oil and water separators shall be utilised on all airlines used for abrasive blast cleaning. The separators shall be of the 'cartridge' type.

### **4.5.4 Power Mixers**

- a) All paint shall be mixed with power mixers. Low speed mixers which do not induce air into the paint shall be utilised.

## **4.6 PAINT MATERIALS**

- a) All materials, i.e. paint, solvents and cleaning agents for a specific paint system shall be supplied by the same manufacturer.
- b) The solvents used shall be those recommended and manufactured by the paint manufacturer. Where the recommended 'solvent' and 'clean-up thinners' for a material differ, the 'clean-up' solvent must not be added to the paint for dilution purposes.

- c) Excessive dilution of paints is not permitted. Solvent additions for application purposes shall be in strict accordance with the paint manufacturer's Product Data Sheet.
- d) The maximum capacity of containers shall be 25 litres. Where required, the paint containers shall be of a size large enough to allow mixing in the containers themselves.
- e) The paint manufacturer's recommended shelf life and other storage requirements shall be met.
- f) The colours of the paints to be used shall be as specified by the Eskom Engineer.
- g) All paints and associated products shall be brought to site in new unopened containers. All containers shall be clearly marked with the manufacturer's material batch numbers and other relevant information.
- h) All materials shall be regularly tested at the manufacturers' factories and bench marked against international versions. The Contractor must make sure that regular quality control tests are carried out to ensure that good quality of the materials is maintained. The results of these tests are to be submitted to the Eskom Engineer.

The following properties shall be closely monitored:

- Quality of raw materials
- Analytical formulation of finished products
- Percentage solids by volume
- Specific gravity
- Colour and gloss
- Drying time for each coat in the lining system,
- Viscosity

During the testing/monitoring of Drying time and Viscosity properties above, measurements of humidity and temperature shall be recorded and retained.

- i) The Contractor shall ensure that the colour selection of the coat immediately prior to the finishing coat shall be suitable for complete obliteration by the finishing coat.

## **4.7 SURFACE PREPARATION**

### **4.7.1 General**

- a) Sharp edges shall be dressed to a radius of not less than 2 mm, but no more than half of the section thickness. All burrs, rags and weld spatter shall be removed as per the requirements of ISO 12944-3.
- b) Welds shall be free from imperfections (e.g. asperities, undercutting, blowholes, craters, and spatter) which are difficult to cover effectively with a protective paint system. The onus is on the Contractor to ensure that the surfaces are ready for lining.
- c) It is extremely important that the Contractor endeavours to achieve the best surface preparation possible by using the latest technology when it comes to surface preparation apparatus and materials. The minimum degree of surface preparation shall be as stipulated in the detailed coating standards.

#### **4.7.2 Pre-cleaning**

- a) Oil and grease shall be removed by high pressure water washing with detergent solution and rinsing with clean water prior to abrasive blast cleaning and application of linings.
- b) Chemical and cleaning contamination shall be removed by means of neutralising or flushing or both. It is important that clean potable water is used for cleaning, or the surfaces will be left contaminated after washing. The surfaces shall thereafter be allowed to dry completely prior to lining or before continuing with the rest of the surface preparation process.

#### **4.7.3 Mechanical and Hand Cleaning**

- a) Note that Mechanical and Hand Cleaning is strictly limited to exceptional circumstances such as where crevices require preparation for sealant systems after completion of lining.
- b) Mechanical and hand cleaning shall be in accordance with the procedure specified in Clause 5.4 of SANS 10064 (ISO 8540).
- c) The standard of surface preparation shall be in accordance with ISO 8501/1 and as specified in the relevant lining system.
- d) Cleaning by means of hand or power-tools, i.e. wire brushes, chipping hammers, scrapers, grinders, sanders, needle descenders etc. may only be used where specified in the generic organic lining standard and the condition of the substrate metal is such that efficient cleaning can be achieved and where the protective system is designed for application to brushed or ground surfaces, e.g. in the case of surface tolerant linings.

#### **4.7.4 Abrasive Blast Cleaning**

- a) Abrasive blast cleaning is the only method for surface preparation.
- b) Abrasive blast cleaning shall be carried out in accordance with Clause 5.3 of SANS 10064 (ISO 8504) and the degree of cleanliness achieved shall be Sa 3 in accordance with ISO 8501/1.
- c) The profile, peak to valley, when measured by SANS 5772 (ISO 8503-4), shall be as specified in the relevant manufacturer's Product Data Sheet for the primer being used.
- d) In general an anchor profile height of 25 to 75µm is recommended for most industrial paint systems up to a dry film thickness of about 250 micron. However, in the case of heavy-duty thicker film systems, the anchor profile needs to be increased in order to cope with the mounting stresses exerted by the lining.
- e) The required blast profile height shall be carefully considered and be within the range of the specified lining system, and as recommended in the Product Data Sheets. It is important that the blast profile does not exceed the specified thickness of the primer or first coat, especially where delays in over-coating are expected / encountered. Any primed or coated surfaces showing signs of "measle" corrosion shall be considered defective and shall be re-blasted.
- f) Good quality abrasives shall be used in order to minimise the amount of waste grit being generated and contamination of the surfaces.

- g) The abrasive may be any abrasive material (except silica sand) which meets the following requirements. It shall be suitable for the substrate. It shall be composed of clean, sound, hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter and water soluble salts. It shall be capable of producing the surface profile as specified for the relevant lining system. The use of re-cycled blasting media is not allowed for the final blast.
- h) The Contractor shall ensure that abrasive materials used conform to all national health and safety standards such as the OHS Act.
- i) All abrasive media shall be stored in an area that is completely dry and covered to allow for good preservation of the materials.
- j) In all cases, after blast cleaning, all traces of blasting media and dust shall be removed from the surface by vacuum cleaning. Cleaned surfaces shall not be contaminated with blast media, oil, grease, rust or other deposits before lining.

#### **4.7.5 Surface Cleanliness**

- a) No lining shall be applied to any surface containing traces of grit, grease, oil, loose rust, mill scale, surface contaminants (i.e. dust), chemical fall-out, salt deposits or corrosion products of any kind.
- b) Chalked, cracked, blistered, rusting, flaking primer/s or intermediate coat/s that have been allowed to age or weather shall not be coated. The requirements of ISO 4628 shall apply in these cases. It is therefore a requirement that the paint manufacturer shall propose suitable acceptance criteria specifically in terms of all possible damage and lining deterioration mechanisms as defined in ISO 4628 Part 1 to 6 for each of the systems and then specific coats in the system. The acceptance criteria will be reviewed by Eskom prior to tender award.
- c) The following requirements shall apply prior to lining application:
  - Freedom from dust and debris shall be less than 'dust quantity rating' 1 when tested in accordance with ISO 8502-3.
  - If the blast cleaned surface changes colour, or rust bloom begins to form, the surface shall be re-blasted.

#### **4.7.6 Soluble Salts**

- a) Soluble iron salts such as ferrous chloride and ferrous sulphate are found on surfaces in marine and industrial environments. As these salts are soluble in water they can cause osmotic blistering of linings which are applied to the steel and must be removed prior to painting.
- b) Soluble salts shall be removed by cleaning and flushing with fresh potable water. Persistent salt deposits may be removed by proprietary solutions with the prior approval of the paint manufacturer and the Eskom Engineer.
- c) All forms of soluble salts levels shall be measured using approved methods such as Weber Reilly Soluble Salts Test Kits or equivalent. The acceptable level of salts shall be as specified by the paint manufacturer.

## **4.8 PAINT APPLICATION**

### **4.8.1 Approval**

- a) No work shall be performed until the Quality Control Plan is approved by the Eskom Engineer.

### **4.8.2 Mixing**

- a) The Contractor shall ensure that all paints are mixed in accordance with the manufacturer's instructions.
- b) In the case of two pack materials, the splitting of kits as supplied from the factory is not permitted. The Contractor either has to make use of smaller kits or needs to plan the work in such a way that any unnecessary wastage of paint is avoided.
- c) During application, containers shall be agitated often enough to keep pigments in suspension.

### **4.8.3 Lining**

- a) All surfaces shall be coated as specified. Surfaces which do not require lining shall be suitably protected.
- b) To ensure minimum acceptable work standards, verifiable manufacturer or Contractor data and to assess lining performance, reference areas as prescribed in ISO 12944 - 7 and 8 are required.
- c) The primer coat shall be applied as soon as possible after the surface preparation operation during the same shift as the blast cleaning operation, but under no circumstances may the primer be applied over rust bloom or over surfaces that have changed colour due to humidity or other contamination.
- d) Lining application and cleaning shall not take place when site conditions are likely to negatively affect these operations. The Contractor shall ensure that the necessary protective equipment is used to prevent contamination of the lining and to minimise delays due to such site conditions.
- e) Successive coats shall be of distinctly different colour to the previous coat to ensure correct intercoat coverage. However, two finishing coats of the same colour may be applied to achieve complete colour uniformity. Special attention shall be given to cracks, crevices and edges to ensure complete coverage and paint thickness. All finishing colours shall be to the Eskom Engineer's approval.
- f) On pre-coated surfaces all traces of soluble salts and other corrosive airborne contaminants shall be removed with potable water and surfaces shall be allowed to dry prior to further paint application.
- g) Concealed surfaces shall be completely coated. Suitable sponges may be used for application of paint to concealed surfaces or back to back angles. In the case where it is impractical to coat the concealed surface, the opening shall be sealed utilising an approved mastic material.
- h) All edges, corners, bolt holes, mouse holes, cut ends and weld beads shall be stripe coated by brush application, prior to the application of the intermediate coat. The stripe coating shall be an additional coat of the specified intermediate coat. In order to assist in its identification, the stripe coat shall be a different colour to both the specified intermediate coat and finishing coat. Under no circumstances shall stripe coating be carried out by roller or spray-application.



- i) The stripe coat is not intended to increase the overall specified dry film thickness of the system but to ensure that the minimum thicknesses required are actually achieved at edges.

#### **4.8.4 Application**

- a) Unless otherwise specified, all paint applied in the shops or on site shall be applied by airless spray techniques.
- b) In instances where spray application is considered not to be possible, practical or feasible, this must be brought to the attention of the Eskom Engineer at the time of tendering.
- c) The Contractor should note that many of the high build organic linings specified in the relevant systems are only capable of achieving their recommended film thicknesses by spray application. Other application methods such as brush and roller can result in lower film builds being achieved per coat.
- d) Unless otherwise specified, all application work shall be carried out in strict accordance with the recommendations and instructions given in the signed Product Data Sheet supplied by the paint manufacturer. This includes required climatic conditions, methods of surface preparation, substrate temperatures, blast profiles, over coating times, application equipment and methods to be utilised and pertinent requirements not listed in this standard.
- e) All coats in the lining system shall be evenly applied to form a smooth, continuous, unbroken coating free from tears, runs, sags, wrinkles, blisters, mud-cracking, change in colour or gloss, orange peel, visible pin-holes, dirt, dust or fluff occlusions or any other visible defects. Each coat shall provide complete coverage.
- f) The Contractor shall take adequate precautions to protect areas being painted against contamination and fall-out from adjoining sections of the structure during painting operations, should this become necessary.
- g) Where surfaces are to be welded, no paint shall be applied within 50 mm of the weld and the subsequent intermediate and finishing coats (where applicable) shall be stepped at 25 mm intervals to produce a feathered edge for patch repairs after welding. The steps may be achieved by using masking tape at the time of surface preparation and paint application. The masking tape on the blast cleaned surface adjacent to the weld area shall be left in place to provide temporary protection until the welding is carried out.

#### **4.8.5 Ambient Conditions**

- a) Paint shall not be applied under the following conditions:
- When the surface may become damaged by rain, air borne dust, chemical fall-out, fog or condensation. When it is anticipated that these conditions will prevail during the drying period, suitable enclosures shall be provided to protect the surfaces.
  - When the ambient air temperature or the steel temperature is outside the paint manufacturer's recommended range.
  - When the ambient relative humidity exceeds 85%.
  - Using the above data, the dew point shall be determined by means of a suitable dew point calculator. During paint application, the substrate temperature shall be at least 3°C above the dew point.

#### **4.8.6 Patch Repairs**

- a) The Contractor shall be wholly responsible for surface preparation and lining application. The coated surfaces shall meet the minimum dry film thickness required by required by ISO 12944 'durability requirements'.
- b) Provisions must be made for the repair of handling damage to the lining after erection.
- c) All areas of lining damage shall be patch repaired by brush application. The extent of the damage shall be carefully inspected to assess which coats in the system have been damaged. When the damage extends to the steel substrate, 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 abrasive blast cleaned to grade Sa 3 of ISO 8501/1. All edges of existing paint shall be feathered back to a hard edge. The patch primer used shall be in accordance with the requirements of the relevant lining system. In certain instance the principle of over-coating onto an existing lining by subsequent intermediate and finishing coats (where applicable) shall be stepped at 25 mm intervals to produce a feathered edge similarly as is described in 4.8.4 (i). Specifics of such instances shall be addressed on a case by case basis in the clarification meeting.

#### **4.8.7 Site Painting**

- a) In situations where primer or first coats have been applied in the shop then the finishing coats being applied on site shall be sourced from the same manufacturer as the shop applied primer and intermediate coats.
- b) All shop coated surfaces shall be inspected and examined for mechanical damage on arrival on site. If the damage is excessive it may be preferable to repair this transport damage before erection whilst access is easier. Alternatively all repairs may be carried out after erection. Repairs shall be carried out in accordance with clause 4.8.6.
- c) If site respraying is necessary all other areas not to be painted shall be carefully masked. Any overspray which occurs despite this masking shall be removed by the Contractor.
- d) In the case where lining systems are to be applied in the shop and then later finished on site the Contractor/manufacturer shall define the acceptance criteria specifically in terms of all damage and lining deterioration mechanisms as defined in ISO 4628 Part 1 to 6. The acceptance criteria will be reviewed by Eskom prior to tender award.
- e) The shop applied coats must be thoroughly washed to remove all traces of dust, dirt, grease, salts or any other forms of surface contamination. Where deemed necessary, detergent cleaners, as recommended by the respective paint manufacturers, may be used.
- f) After cleaning, all areas of damaged lining shall be patch repaired as detailed in 4.8.6.
- g) Where more than one coat is being applied on site, surface preparation and washing as per (e) above shall be carried out between coats in accordance with the paint manufacturer's data sheet.
- h) Where paint is allowed to age before finishing, the paint manufacturer may require that the surface be prepared by light sanding, scrubbing with potable water using a bristle brush and drying before over-coating.



- i) The applicator must continually involve and liaise with the paint manufacturer regarding the specific site conditions to confirm that the requirements as per the product data sheet are achieved. If unsure about over-coating on aged primer or subsequent coats then destructive tests shall be conducted to confirm the soundness of the application over the aged primer.
- j) All linings shall be given adequate time for curing prior to service. On average, for most organic lining systems, full cure is achieved after 7 days at 25°C providing good ventilation is maintained.

## **4.9 SAFETY PRECAUTIONS**

### **4.9.1 General**

- a) Special care needs to be taken when working with all paint. Prior to the use of any coating material, the Material Safety Data Sheets shall be obtained from the relevant paint manufacturer. The Contractor/applicator shall be familiar with the contents of these safety data sheets and ensure that the necessary safety precautions are taken in order to comply with local and national safety and health requirements such as the OHS Act.
- b) During the application of all paint, care shall be taken to ensure adequate ventilation to allow for good visibility and proper curing of the lining and to avoid/minimise health and safety risks.
- c) Any solid waste materials or liquids stripped or generated during lining operations shall be discarded in accordance with the requirements of the appropriate national and/or local authorities or the requirements of Eskom.
- d) The Contractor/applicator shall ensure that he complies with all statutory regulations, municipal by-laws, etc. concerning pollution and the health and safety of his personnel and members of the public who may be affected by his work.
- e) The Contractor/applicator shall provide for all necessary safety precautions and risk assessments.
- f) The Contractor/applicator shall advise Eskom of all hazardous materials to be brought on site.
- g) All painting 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.

### **4.9.2 Contractor's Safety File**

- a) The Contractor's safety officer shall prepare a Safety File for the area to be worked in.
- b) This Safety File shall address the hazardous activities of abrasive blast cleaning and spray painting. The Contractor/applicator shall verify that the personnel carrying out these activities are suitably qualified.

### **4.9.3 Fire Hazards**

- a) The Contractor/applicator shall ensure that adequate precautions are taken to avoid fire hazards.

#### **4.9.4 Storage of Hazardous Materials**

- a) Oily or solvent rags shall be kept segregated in closed containers and in minimum quantity. Any spillage of volatile material shall be wiped up immediately.
- b) Solvents and volatile materials shall be stored in designated areas.

#### **4.9.5 Environment**

- a) The Contractor/applicator shall ensure that any solid waste materials or liquids stripped or generated during the surface preparation and lining processes are discarded in accordance with all statutory and regulatory requirements, or as governed by the Eskom's Environmental Management Procedures.

#### **4.9.6 Scaffolding and Rigging**

- a) The Contractor/applicator shall provide and erect such scaffolds and rigging as may be required. All scaffolding and rigging shall comply with the requirements of the OHS Act.
- b) Temporary welded support elements are not permitted except where written approval has been granted by Eskom.

### **4.10 INSPECTION AND TESTING**

#### **4.10.1 Surface Preparation**

- a) The blast profile shall be measured in accordance with SANS 5772 (ISO 8503-4).

#### **4.10.2 Visual Inspection**

- a) Visual inspection for paint film defects shall be performed after each coat is applied. All defects including pinholes, runs, sags, dry spray etc. shall be corrected based on the requirements of ISO 12944 Part 4, before the next full coat is applied. Inspection and rectification shall be based on the requirements of ISO 12944 Part 4.

#### **4.10.3 Dry Film Thickness (DFT)**

- a) DFT shall be measured in accordance SABS ISO 2808 and instruments shall be calibrated using the smooth calibration disc supplied by the instrument manufacturer.
- b) The frequency of dry film thickness readings shall be a minimum of three reading per square metre of coated surface or more such as to be defined in the works package and documented in the applicable QCP, as agreed between the Contractor/applicator and the Eskom Engineer at the start of the lining process.
- c) The product data sheet shall indicate the required minimum and maximum DFT. The DFT is given in a range for each coat in the relevant lining system. These are the required minimum and acceptable maximum thicknesses. No individual thickness shall be less than 80% of the specified minimum thickness and not more than 20% of thickness measurements taken shall be less than the specified thickness.

- d) Where excessive film thickness can be detrimental to the integrity of the lining, the manufacturer's recommended maximum thickness shall apply.
- e) The increase in thickness created by the application of the stripe coat shall not be used to justify recorded thicknesses that are in excess of the maximum specified thickness of the system.
- f) All deficient film thicknesses shall be rectified to the approval of the Eskom Engineer at the Contractor's expense.
- g) Actual readings and not averages shall be recorded.

#### **4.10.4 Adhesion Tests**

- a) Adhesion testing shall be based on the requirements of ISO 12944 Part 4.
- b) Random pull-off adhesion tests shall be carried out on the applied lining using the ASTM D4541 test method. Adhesion (pull-off) values of the coating to the substrate (A/B) shall be a minimum of 5 MPa with no intercoat adhesion or cohesion failures as determined by a mechanically spring loaded pull-off tester and not by an hydraulic pull-off tester.
- c) The number and location of tests shall be agreed with the applicator at the start of the works. If testing results indicates deficiencies then the number of test will be increased accordingly. Inspection and rectification shall be based on the requirements of ISO 12944 Part 4.
- d) Repairs to the lining damaged by the tests shall be carried out in accordance with clause 4.8.6.

#### **4.10.5 Pin-Hole Detection (EID) Tests**

- a) All lining systems intended for immersion service shall be tested for continuity in accordance with SANS 1217, either low voltage 'wet sponge' or high spark techniques, depending upon the system being used.

### **4.11 QUALITY ASSURANCE**

#### **4.11.1 Contractor Qualification**

- a) The Eskom Engineer may, at his discretion, require a Quality Audit of the Contractor (paint/rubber lining applicator and paint/rubber sheeting manufacturer) to ensure adequate management, facilities and skilled staff to carry out the work in accordance with the standard.
- b) The Contractor shall retain full responsibility for the quality of his work and of materials used, irrespective of any quality surveillance that may be carried out by the Eskom Engineer.

#### **4.11.2 Quality Control**

- a) The Contractor shall have the necessary equipment and qualified staff to carry out the quality control required to ensure compliance with the standard.
- b) Quality control shall be carried out by a qualified inspector who is independent of the application activities. Quality control cannot be carried out by the site supervisor or any member of staff involved in production and programming.

- c) The Contractor shall retain at least the following records:
- Material batch records
  - Signed Product Data Sheets.
  - Psychrometric records (including steel temperatures).
  - Records of surface preparation.
  - Records of dates and times of the application of each coat including repair coats.
  - Dry film thickness measurements per coat including repair coats.
  - Records of specific tests as required by the Eskom Engineer.
- d) These records shall be kept in a format that meets the approval of the Eskom Engineer which will be agreed at the clarification meeting.
- e) The cost of quality control shall be included in the Contractor's tender price.
- f) Before the commencement of the contract, the Contractor shall prepare the following:
- A Quality Plan detailing each activity to be carried out during the execution of the works. Each activity shall be supported by a detailed Works Procedure for that activity. The Quality Plan shall also detail the inspection requirements of each specific activity, listing whether it is a review, witness or hold point, and defining the responsibilities of the various parties at each stage of the works.
  - The Safety File as required in 4.9.2.
  - The joint guarantee with the paint/rubber sheeting manufacturer as required in 4.14.
- g) The Contractor shall provide the necessary documentation to be used during all quality control inspections. Such documentation shall be reviewed and accepted by the Eskom Engineer before lining commences.
- h) The Contractor shall produce evidence that he has copies of, and understands, all reference documents listed under Section 2.2 'References'.

#### **4.11.3 Quality Surveillance**

- a) The Eskom Engineer may either carry out Quality Surveillance of the work or employ an independent technically qualified organisation to carry out Quality Surveillance of the work on his behalf. In the event of dispute, the decision of the Eskom Engineer shall be final.
- b) For the purpose of carrying out quality surveillance, the Eskom Engineer or his authorised representative shall be granted access to any part of the Contractor's premises relevant to the work being carried out, at any reasonable time. The Contractor shall provide, at his own cost, any equipment or labour necessary to gain safe access to surfaces which are coated, to be coated or are in the process of being coated.
- c) The Eskom Engineer or his authorised representative may remove any reasonable samples of materials to be used in the lining application. Rejection of the samples shall place a hold on the use of material of the same batch number and may lead to rejection of all that batch of material and the reworking of any components that have already been coated with rejected material.
- d) The Eskom Engineer or his authorised representative may carry out reasonable destructive tests to ascertain compliance with the standard. Areas thus damaged shall be repaired by the Contractor to the satisfaction of the Eskom Engineer at no additional cost.

- e) The cost of quality surveillance will be borne by the Eskom, except where surveillance results in rejection of the work or when notice by the Contractor results in a fruitless trip, in which cases the cost of surveillance shall be carried by the Contractor.
- f) A report shall be compiled by the surveyor for each visit. A copy of the report will be given to the Contractor on completion of each surveillance visit.

#### **4.11.4 Release Certificate**

- a) The lining applied in the shops will be inspected by the Eskom Engineer or his authorised representative at the Contractor's premises before releasing the coated items for delivery. A clearance certificate will be issued by the contractor authorising the release.
- b) The Contractor shall notify the Eskom Engineer or his authorised representative in advance and timeously of the date on which the lining activities will be complete and ready for inspection.
- c) The lining applied on site will be inspected by the Eskom Engineer or his authorised representative. A final acceptance certificate will be issued after the completion and final inspection and acceptance of each area of the structure.
- d) On completion of the total structure, plant, equipment or contract a final inspection shall be carried out by the Eskom Engineer or his authorised representative and a Contract Completion Certificate issued. Final payments will not be made until this Contract Completion Certificate has been issued. This final 'completion' inspection shall be carried out just prior to the commissioning of the plant.

#### **4.11.5 Records**

- a) On completion of the works, the Contractor shall provide the Eskom Engineer with a Data Book containing all the relevant Quality Control documents and records pertaining to the works.
- b) This data book shall contain, as a minimum, the following:
  - The Quality Plan.
  - Copies of all Batch Release Certificates from the manufacturer acquired during the course of the project.
  - Copies of the signed paint manufacturer's data sheets acquired during the course of the project.
  - All relevant QC Records listed in 4.11.2 clause (c).
- c) The Contractor shall submit to the Eskom Engineer the number of copies of the Data Book as required by the contract. In addition, the paint/rubber sheet manufacturer shall retain a copy of the Data Book for his own records.

#### **4.12 ALTERNATIVE ORGANIC LINING SYSTEM OR RUBBER LINING**

- a) Should the Contractor wish to propose alternative products and/or methods to either organic lining systems or rubber lining materials he shall submit a detailed motivation via the Eskom Engineer to the Corrosion Department at RT&D. The motivation shall include, but not be limited to, the following:
  - Benefit to Eskom
  - Product licensor and technical back-up available
  - Location, experience and ISO quality rating of the production facility
  - Detailed case histories

- Performance guarantee offered
  - Manufacturer's data sheets for each product
- b) Should the proffered case histories be deemed insufficient or inconclusive, additional testing may be required to confirm the adequacy of the alternative lining systems. The costs of such testing will be borne by the Contractor.
- c) Eskom reserves the right to reject the proposed alternative above and will not be in any way obliged to accept testing as described in (b).

#### **4.13 MAINTENANCE PAINTING**

- a) Maintenance painting covers the repainting of plant and equipment that has been previously painted.
- b) Maintenance painting is carried out when either the original lining system has been damaged or has reached the end of its effective service life, i.e. it has reached a degree of degradation equivalent to rating Ri 2 of ISO 4628-3.
- c) It is imperative that the paint systems used for maintenance painting are either the same materials as originally applied or are compatible with those originally applied. If the new and existing systems are not generically compatible, coating failures will occur.
- d) The degree of maintenance painting required is dependent upon the degree of degradation that has taken place.
- e) The area requiring maintenance painting needs to be carefully assessed to determine the generic type of the existing lining and the extent of maintenance required. This assessment should be carried out by suitably qualified personnel from the Corrosion Department of RT&D.
- f) Maintenance painting standards must be compiled on a case-by-case basis.

#### **4.14 GUARANTEES**

- a) The Eskom Engineer requires performance guarantees for the applied lining systems. Such guarantees shall be provided jointly by the Contractor in collaboration with the paint/rubber lining applicator/s and manufacturer's at the time of tender. The typical minimum guarantee period will be 10 years for lining systems and rubber lining. In the case of organic lining systems the criteria for failure will not exceed rating Ri 2 of ISO 4628-3.
- b) Although visible lining defects such as blistering, cracking, flaking and peeling are not always associated with visible rusting, they indicate defects that could either lead to substrate corrosion or are shielding substrate corrosion that has already taken place beneath the lining. Any such defects noted during the guarantee period shall be the Contractor's responsibility and shall be repaired.

#### **4.15 HANDLING AND STORAGE**

##### **4.15.1 Handling**

- a) All lined components shall be handled using soft slings. Large components shall have sufficient lifting/support points to avoid flexing or bending that could damage the applied lining systems.

#### **4.15.2 Loading**

- a) All coated components to be transported shall be loaded with support blocks, packing between pieces and tight lashing to avoid chafing.

#### **4.15.3 Off-loading**

- a) Off-loading at site shall be conducted using the same care and precautions for on-loading. Components shall not be tipped off the transportation.

#### **4.15.4 Cover**

- a) Coated items shall be stored under cover where possible.
- b) Shop applied linings that require site finishing and are sensitive to weathering must be shielded and protected to prevent degradation.
- c) Items not stored under cover shall be stored in such a manner as to avoid retention of water and allow good air circulation.
- d) Items shall be stored on baulks of timber to raise the lowest level above the rain splash zone.
- e) Pipe “end caps” shall fit over the pipe i.e. not a plug type design with the sealing surface on the pipe internal diameter. The “end caps” shall be UV resistant and not prone to cracking. The effectiveness and condition of the “end caps” shall be inspected at intervals not exceeding 6 months. During the inspection a suitable sample of “end caps” shall be removed to assess internal pipe condition and presence of humidity/moisture. Based on the findings of the inspection the Contractor may be required to move or restack certain piping components to the satisfaction of the Eskom Engineer.
- f) Depending on project specific requirements i.e. considering magnitude, expected duration of storage, etc. the Contractor may be required to propose a suitable desiccant regimen and method statement of ensuring a “first in first out” philosophy is applied.

#### **4.15.5 Stacking**

- a) Items shall be stacked using timber packings or other approved means to avoid surface to surface contact. Sufficient bearing area of packing shall be used to avoid damage to the lining. The steelwork shall be placed in such a manner as to ensure adequate drainage of rainwater and condensation.

### **5. SPECIFIC REQUIREMENTS OF RUBBER LINING MATERIALS BY “LINE CALL-OUT” IN ACCORDANCE WITH SANS 1198**

#### **5.1 INTRODUCTION**

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. This line call-out system has been adopted by Eskom for all rubber lining applications on power station plant and equipment.



## **5.2 SELECTION**

The selection of the type of material to be used for a specific application shall be done in consultation with the lining Contractor and manufacturer, because the physical and chemical properties of rubber linings vary widely. It is essential that the relevance of the following details be taken into consideration:

- a) the nature and composition (including substances present in trace quantities) of the material(s) to be handled;
- b) the content, particle size, and physical characteristics of abrasive suspended matter likely to be present in the material(s) to be handled, and the rates of flow; and
- c) the maximum operating temperature, the maximum operating pressure or the degree of vacuum, and the cycle of operations.

## **5.3 DESIGNATION**

### **5.3.1 General**

The sheeting for lining covered by SANS 1198 is classified in accordance with the type of basic polymer, the grade (based on a minimum value of the tensile strength), and the class (based on the hardness). Provision is also made for specification of certain additional special properties.

### **5.3.2 Line call-out**

The properties of a lining required by a purchaser shall be specified by a line call-out that comprises the following:

- a) the appropriate type; followed by
- b) the appropriate grade; followed by
- c) the appropriate class; followed,
- d) when relevant, by the Roman numerals in the series I to VII, appropriate to the special properties, as required.

### **5.3.3 Amplification of a line call-out**

The line call-out shall (when and as relevant) be amplified in respect of the special properties as follows:

- a) When resistance to heat, special property (I) is required, the purchaser shall specify whether the lining is to be rated as resistant up to, but not limited to, 70°C, 80°C, 90°C, 100°C, 110°C or 120°C.
- b) When resistance to chemicals, special property (III) is required, the purchaser shall specify the chemical and the maximum operating temperature.
- c) When resistance to abrasion, special property (IV) is required, the values of the test shall be agreed upon between the purchaser and the Contractor.
- d) When resistance to release of contaminants, special property (V) is required, the purchaser shall specify the chemical.



e) Any other specified property.

## **5.4 REQUIREMENTS FOR LININGS**

### **5.4.1 Type**

The type of rubber for lining shall be one of those given in SANS 1198 as specified by the applicator to meet Eskom's requirements. The types of rubber include:

<b>Type</b>	<b>Basic Polymer</b>
1	Natural (NR)
	Styrene-butadiene (SBR)
	Butadiene (BR)
	Synthetic isoprene (IR)
2	Butyl rubber (IIR)
	Bromobutyl (BIIR)
	Chlorobutyl (CIIR)
3	Nitrile (NBR)
4	Chloroprene (CR)
5	Chlorosulphonated polyethylene (CSM)

### **5.4.2 Grade**

When tested in accordance with the relevant methods, the rubber shall comply with the requirements given in SANS 1198 for the Grades A, B, C or D (Ebonite) which relate to the tensile strength of the rubber.

### **5.4.3 Class**

A lining shall be one of the following classes, as specified by the applicator to meet Eskom's requirements; 40 IRHD, 50 IRHD, 60 IRHD or 70 IRHD which relate to the hardness of the rubber.

### **5.4.4 Special properties**

When so required by Eskom, a lining shall have one or more of the applicable of the following special properties, indicated by the symbols I to VII:

- I : Resistance to heat rated for use up to 70 °C, 80 °C, 90 °C, 100 °C, 110 °C or 120 °C.
- II : Resistance to ozone.

- III : Resistance to chemicals (i.e. to a specific chemical up to a specific maximum operating temperature).
- IV : Abrasion resistance
- V : Resistance to release of contaminants (by a specific chemical)
- VI : Resistance to water
- VII : Resistance to oil

### **Example:**

The line call-out **4 B 60 (II) (IV)** represents a lining based on chloroprene polymer, that has a minimum tensile strength of 14 MPa and a nominal hardness of 60 IRHD, and that shall be resistant to ozone and to abrasion.

## **5.5 RUBBER LINING INPUTS**

### **5.5.1 Suppliers of Sheet (Manufacturer)**

Suppliers of sheet, i.e. rubber compounders, will compound the rubber based on the SANS 1198 line call-out provided to them by the rubber lining applicator.

### **5.5.2 Rubber Lining Applicators**

The applicator must have the in-house expertise to identify the line call-out requirements of the rubber material to meet the operating and environmental requirements identified by Eskom.

Based on the complexity of the application and the access and time constraints, the applicator will select the appropriate method of vulcanization:

- Steam or hot water vulcanization
- Chemical curing in-situ
- Pre-vulcanized rubber

The applicator shall have the plant and skilled operators required to carry out the lining application.

The applicator shall guarantee the applied rubber for a minimum period of 10 years.

### **5.5.3 Solution and Adhesive Suppliers**

The solution and adhesive suppliers shall provide the following to the applicator, based on the line call-out requirements:

- Non-toxic solutions for chemical curing
- Adhesives for pre-vulcanized rubber

The solution and adhesive suppliers shall provide guarantees on their materials to the applicator.

### **5.5.4 Guarantees**

The Contractor/applicator carries the overall guarantee responsibility with his compound, solution and adhesive suppliers. The requirements of these Guarantees are described in Section 4.14.

## **5.6 RUBBER LINING APPLICATORS**

- a) The responsibility for selecting the type of rubber required by Eskom for a particular application rests solely with the applicator and his material (compound, solution and adhesive) suppliers.
- b) The applicator must have the technical expertise required to compile a line call-out in accordance with SANS 1198.
- c) The applicator must have the equipment and qualified staff required to carry out the application in strict accordance with SANS 1201 and BS 6374.
- d) Based on the type of work and access and time constraints, the applicator must decide on the method of vulcanization that will be applicable. There are essentially three possibilities:

### **5.6.1 Steam or hot water vulcanization**

- a) Steam or hot water vulcanization can be used on small components that can be steam cured in an autoclave at the applicator's works or large components that can be sealed to allow steam or hot water vulcanization in-situ.
  - Advantage: produces the best quality in terms of rubber curing and substrate and joint adhesion
  - Disadvantage: not always possible under on-site maintenance conditions

### **5.6.2 Chemical curing in-situ**

- a) Uncured rubber sheeting is applied and post cured using curing chemicals.
  - Advantage: bonding agents and tie coats will be vulcanized at the same time as the rubber compound to produce a composite system
  - Disadvantages:
    - achieved quality seldom equals steam cured
    - very dependent on applicator skills
    - risk of uncured and unbonded areas that cannot be non-destructively identified
    - limited to natural rubber compounds
    - curing can take from 10 to 21 days (this may preclude this method on certain shut-down programmes)
- b) Chemical curing agents: The use of carbon disulphide (CS<sub>2</sub>) is prohibited on Eskom facilities due to toxicity. Only xanthogen based curing compounds may be used.

### **5.6.3 Pre-vulcanized rubber**

- a) Pre-vulcanized rubber sheeting is glued to the substrate using selected adhesives. This method requires special application skills as the cured rubber compound is not as pliable and formable as uncured compound.

- Advantage: as rubber compound is pre-vulcanized its state of cure should be uniform
- Disadvantages: success of application is directly dependent upon the quality of the adhesive used.  
  
substrate and joint adhesion depends upon the quality of the adhesive and the thoroughness of its application  
  
risk of unbonded areas that cannot be non-destructively identified

b) When pre-vulcanized rubber is used all joints shall be strapped.

#### **5.6.4 Auto-vulcanizing rubber**

The auto-vulcanizing process takes up to 21 days for full cure to be achieved. This method has been precluded from this procedure as this curing period is deemed too long to be accommodated during typical shut-downs. This method may however be used for lining processes carried out in the applicators works prior to being transported to site.

### **5.7 RUBBER LINING APPLICATION**

- a) All steps of the rubber lining application including all field/site activities including surface preparation, application, vulcanization, on-site inspection and testing shall be performed according to the requirements of BS 6374: Part 5 “ Lining of equipment with polymeric materials for the process industries.” All aspects and requirements of the following specific clauses shall apply:

*Section 2. Design, fabrication and surface finish of equipment to be lined*

*2.1 General*

*2.2 Design of metal equipment to be lined*

*2.3 Fabrication of metal equipment to be lined*

*Section 3. Selection and quality of linings*

*3.1 Selection of lining*

*3.2 Quality of lining*

*Section 4. Method of lining*

*4.1 Surface preparation*

*4.2 Adhesion system and application*

*4.3 Production of lining material*

*4.4 Application of the sheet to the substrate*

*4.5 Vulcanization*

*Section 5. Inspection and testing*

*5.1 Responsibility for inspection and testing*

*5.2 Inspection*

*Section 6. Methods of test*

*6.1 Continuity testing*

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*Section 7. Rectification of faults in fully cured linings*

*7.1 General*

*Section 8. Storage, handling, transportation and installation*

- b) No work shall be performed until the Quality Control Plan is approved by the Eskom Engineer.
- c) Before applying the lining the applicator shall verify that the correct rubber is used for the vessel being lined. The identity must be prominently displayed on the rubber as per Section 6 of SANS 1198. The date and time of the start of the lining operation shall be recorded. The applicator shall ensure that the substrate preparation has been correctly carried out and that the primer/bonding system has not passed its expiry date.
- d) The applicator shall ensure that their operation in no way damages the lining. All equipment, e.g. ladders and scaffolding, used inside the working area must be positioned and padded in such a way as to avoid damage to the lined vessel.

**5.8 PROVISION OF TEST SAMPLES RUBBER LINING APPLICATION**

- a) Test samples as prescribed in Section 8 of SANS 1198 and 3.3 (g) in this standard shall be provided by the rubber liner.
- b) Any laboratory testing shall be conducted as per Section 8 “Inspection and Methods of Test” of SANS 1198 shall apply.

**5.9 RECORDS**

- a) A record of the details (batch number, date of manufacture, etc.) of each rubber liner, primer, bonding agent, curing agent used shall be retained by the applicator and provided to the Eskom Engineer.
- b) In all cases the applicator shall be responsible for the quality control requirements and shall keep records of all inspections and tests.
- c) The Eskom Engineer may witness the final inspection and may also elect to have witness and hold points other than the final inspection. Prior to the commencement of work, the applicator shall confirm with the Eskom Engineer in writing, the date of the commencement of work and the Eskom Engineer's inspection requirements.

**5.10 SAFETY PRECAUTIONS**

**5.10.1 General Safety Precautions**

- a) Hazardous substances to be used must be declared, assessed and the relevant precautions enforced. Material Safety Data Sheets must form part of the Health and Safety Plan submitted by the Contractor.
- b) All conditions prescribed in Eskom Plant Safety Regulations must be enforced. Safety Risk Management staff (including Occupational Hygiene Practitioners) must perform the quality assurance of safety aspects on projects.

- c) The area must be certified safe by a competent person (AIA certified) prior to entering. The area must be tested during the working procedure.
- d) Ventilation shall be adequate to allow good visibility and proper curing of the lining and to avoid/minimise health and safety risks.
- e) Any solid waste materials or liquids shall be discarded/discharged in accordance with the requirements of the appropriate national and local authorities.
- f) Most bonding systems contain flammable solvents and shall be stored in a "flammable materials" store.
- g) Adhesives shall be disposed of in accordance with State and local regulations.
- h) Rags, spray booth filters, paint suits, empty cans, etc. contaminated with product may be considered as hazardous waste.
- i) Determine whether contaminated items are hazardous and dispose of appropriately.
- j) No naked flame or spark shall be allowed within the work area, smoking shall not be allowed.
- k) When working in an enclosed tank, the tank shall be adequately ventilated and flameproof apparatus shall be used. A face mask or breathing apparatus shall be worn if necessary.
- l) Contact between bonding solutions and skin and eyes must be avoided/mitigated by appropriate Personal Protective Equipment.

## **6. RECORDS**

The management process of records generated by this document is discussed in Section (2.5, 2.6, 3 and 4.2) and Annex A - D.

## 7. AUTHORISATION

This document has been seen and accepted by:

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Renisha Lutchminarain	Chemical CoE Senior Engineer
Andile Mukhubo	Senior Engineer, Kendal Power Station
Jenny Reeves	Chief Scientist, RT&D



## 8. REVISIONS

Date	Rev.	Compiler	Remarks
November 2015	0	K. Northcott	New document drafted for committee review
February 2016	0.1	K. Northcott	First Updated Draft for Comments Review Process
February 2016	0.2	K. Northcott	Final Draft for Comments Review Process
August 2016	0.3	K. Northcott	Updated Final Draft after Comments Review Process, document Type changed from Specification to Standard
August 2016	1	K. Northcott	Final Document for Authorisation and Publication

## 9. DEVELOPMENT TEAM

Keith Northcott

## 10. ACKNOWLEDGEMENTS

None

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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>	

**REQUIREMENT CRITERIA FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)**

**Compiled By: Main Contractor Name:**

**Date:**  
**Company Representative Name:**

**Title:**

**Signature:**

**4. Facilities and Equipment**

<b>Rating</b>	<b>Activity Type</b>	<b>Equipment</b>
<b>1</b>	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.
<b>2</b>	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.
<b>3</b>	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.

**5. Quality Control Testing Equipment**

- Hygrometer
- Wet film thickness (WFT) gauge.
- Depth profile gauge.
- Surface temperature gauge.
- Electronic dry film thickness (DFT) gauge.
- Pin-hole detection equipment (low voltage wet sponge or high spark) as required.

**6. Case Histories**

- Records of completed successful contracts.
- List of major clients.

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

<b>CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)</b>		
Main Contractor:		
Company Representative Name and Title :	Date:	
	Signature:	
Applicator:	Report No:	
Date of Evaluation:	Vendor Number:	
<b>Scope:</b> Quality Management System compliance, facilities, equipment, skills & general rating.		
<b>Requirements</b>	<b>Y/N</b>	<b>General Comments</b>
<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		
<b>Requirements</b>	<b>No:</b>	
<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		

<b>CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)</b>		
Main Contractor:		
Company Representative Name and Title :		Date:
		Signature:
Applicator:		Report No:
Date of Evaluation:		Vendor Number:
<b>Requirements</b>	<b>Y/N</b>	<b>General Comments</b>
<b>3. Safety</b>		
Is there an appointed Safety Officer		
Is there a comprehensive Safety File		
<b>Requirements</b>		<b>General Comments</b>
<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)		

<b>CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)</b>		
Main Contractor:		
Company Representative Name and Title :		Date:
		Signature:
Applicator:		Report No:
Date of Evaluation:		Vendor Number:
<b>Requirements</b>	<b>Y/N</b>	<b>General Comments</b>
<b>Lining Application</b>		
Brushes		
Rollers		
Conventional spray equipment		
Airless spray equipment		
<b>Specialised Equipment</b>		
Media removal equipment (conveyors etc)		
Vacuum cleaners		
Dehumidifying equipment		
Lighting equipment		
<b>Requirements</b>	<b>Y/N</b>	<b>General Comments</b>
<b>5. Quality Control Testing Equipment</b>		
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)		
<b>Requirements</b>	<b>No:</b>	<b>General Comments</b>
<b>6. Relevant i.e. comparable Case Histories</b>		
<b>Requirements</b>		
<b>Rating</b>		
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.		

## **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.

<b>1.0 LOCATION OF COMPONENT</b>	
1.1 Name of power station	
1.2 Component Identification i.e. Plant Code	
<b>2.0 COMPONENT DETAILS</b>	
2.1 Capacity of Component	
2.2 Dimensions	
2.3 No of access man-holes	
2.4 Size of access man-holes	
2.5 Location of access man-holes	
2.6 Diameter and length of pipework	
2.7 Material of construction (mild steel etc.)	
2.8 Please provide A4 drawing of component with this questionnaire	
<b>3.0 ACCESS COMPONENT</b>	
3.1 Is access available to locate compressors and equipment next to the component?	
3.2 If adjacent access is not available how long will air and spray hoses need to be?	
<b>4.0 TYPE OF WORK</b>	
4.1 New works – clean original steel	
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 <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.	
<b>6.0 PROPERTIES OF LIQUID CONTAINED IN OR IN CONTACT WITH THE COMPONENT</b>	
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	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	
6.4.6 Condensate	
6.5 Temperature & Pressure of liquid	

6.5.1 Normal operating temperature	
6.5.2 Maximum or peak temperatures	
6.5.3 Minimum temperatures	
6.5.4 Pressure of Liquid	
6.5.5 Maximum pressure of liquid	
6.5.6 Flow rate of liquid	
6.5.7 Will vacuum conditions occur?	
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	
<b>7.0 OPERATION OF COMPONENT</b>	
7.1 Is the component operated on a continuous or batch process basis	
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.	
<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	
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)	
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.	

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

**REQUEST SUBMITTED BY:**

Name:..... Tel:.....  
Designation:..... Cell:.....  
Department:..... e-mail:.....  
Power Station..... Signature:.....

ANNEXURE D: PROJECT SPECIFIC STANDARD

POWER STATION PROJECT SPECIFIC STANDARD		
Environment		
Material		
Temperature		
Typical Applications		
New Works		
Surface Preparation		
	Primer	Finishing
Generic System		
Notes:		
1.		