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1. Introduction

This document provides the technical specification that would form part of the contract for Lethabo Power Station. It provides the necessary detail to outline the scope of work for the design, manufacture, and construction and commissioning of the refurbishment for the Demineralised Water Treatment Plant (WTP) project.

There are 5 main aspects that make up the entire scope and each of these sections will be detailed in the sections that follow:

1. Mechanical
2. Process
3. C&I
4. Civil
5. Electrical

2. Supporting Clauses

2.1 Scope

The scope of work includes the scope requirements and technical specifications for the vessels, valves, actuators, piping, pumps as well as associated control and instrumentation, civil and electrical requirements.

2.1.1 Purpose

The purpose is to ensure that the plant is returned to its original as designed state or better after the refurbishment and provide the contractor with all the relevant details required to perform work as defined in the scope.

2.1.2 Applicability

This document applies to Lethabo Engineering, Projects, Configuration, Operating and Maintenance Departments and all other stakeholders involved in planning and execution of the Lethabo PS Demineralised Water Treatment Plant (WTP) refurbishment project.

2.2 Normative/Informative References

2.2.1 Normative

[1] 32-184: ROC – User Requirement Specification: Lethabo Power Station – Demineralised Water Treatment Plant Refurbishment

[2] 375-PRJ-AABZ28-SP0008-1: Lethabo Power Station Demineralised Water Treatment Plant Refurbishment Stakeholder Requirements Definition

[3] 375-PRJ-FBBZ26-RP0000-1: Lethabo Power Station Demineralised Water Treatment Plant Stakeholder Requirements Definition End of Phase Report

[4] 375-PRJ-1-FDDD-D00185-2: Lethabo Power Station Demineralised Water Treatment Plant Concept Design Report

[5] 375-PRJ-1-BDDD-D00185-6: Lethabo Power Station Demineralised Water Treatment Plant Concept Design End of phase Report

[6] ISO 9001: Quality Management Systems

[7] ISO 14001: Safety Management Systems

2.2.2 Informative

Table 1: List of Specifications

Title	Reference Number
General Specifications:	
Occupational Health and Safety Act and Construction Regulations	Act No 85, 1993 and subsequent revisions
Quality Requirements for Engineering and Construction work	7.1/ST/02
The Preparation of Steel Surfaces for Coatings	SANS 10064
The structural use of concrete Part 1 & 2	SANS 10100-1&2
Classification of Hazardous Location (Electrical Plant)	SANS 10108 (2005)

The Code of Practice for the Wiring of Premises	SANS 10142
Basis of structural design and actions for buildings and industrial structures	SANS 10160 Series
Pipe flanges	SANS 1123
Standardized specification for civil engineering construction Section L: Medium pressure pipe lines	SANS 1200 L
Civil Work Standards	SANS 1200 Series
Fasteners	SANS 1700
Electric welded low carbon steel pipes for aqueous fluids (large bore)	SANS 719
Welded Low-Carbon Steel Pipes (Large Bore)	SANS 719 (2011)
Eskom Specifications:	
Eskom Generation Plant Safety Regulations (PSR)	36-681
Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings	240-106365693
Eskom Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings.	240-101712128
Lethabo Corrosion Protection Specification for Effluent and De-Gasser Sump (Walls and Floor)	GAM/MAT/22/245
Protective Coating Specification – Lethabo Power Station: Effluent Neutralisation Piping Systems (50NB – 1000NB)	GAM/MAT/21/013

Lethabo Power Station Corrosion Protection of New Fabricated IX and WTP Vessels and Associated Carbon Steel Piping by Rubber Lining	GAM/MAT/21/61
Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining)	GAM/MAT/21/62
Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings	GAM/MAT/21/63
Lethabo Corrosion Protection of Off-Loading Bay/Apron, Bulk Storage Bunds and Chemical Dosing areas	GAM/MAT/21/64
Lethabo Power Station Corrosion Protection of Dosing/Mixing Bunds and Floors, Hardstands, Plinths, Steel Base Plates, Structural Members and Encased Columns	GAM/MAT/21/66
Lethabo Power Station Corrosion Protection of Water Treatment Plant General Walkways	GAM/MAT/21/67
Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps	GAM/MAT/21/69
Lethabo Power Station Corrosion Protection of Drain Pits, Spillways, Channels and Trenches by Thermoplastic Sheeting	GAM/MAT/21/70
Standard for Welding Requirements on Eskom Plant	240-106628253
Specification for the Identification of the Contents of Pipelines and Vessels	ESKSCAAC6
Identification of Colour Markings	SANS 10140
Flanges and their joints - Circular flanges for pipes, valves, fitting and Accessories, PN designed	EN 1092

Specification for flanges and bolting for pipes, valves and fittings	BS10
Metallic products - types of inspection certificates	EN10204
Standard for Low Pressure Pipelines	240-123801640
Specification for Centrifugal Pumps.	240-56030557
The manufacture of rubber sheeting for rubber lining	SANS 1198
The application of rubber linings to pipes, pipe fittings and vessels	SANS 1201
Eskom Standard for low pressure valves	240-105020315
Industrial valves; pressure testing of valves	ISO 5208:1993
Hydraulic fluid power - Pressure-relief valves - Mounting surfaces	ISO 6264:1998
SHE Organization	240-28463367
Safety, Health and Environmental Specifications for *Contractor*s	240-30008949
Hazard and Operability Analysis (HAZOP) Guideline	240-49230111
Supplier Contract Quality Requirement's Specification	240-55944466
Earthing and lightning standard	240-56356396
Structural Design and Engineering Standards	240-56364545
Environmental, Occupational Health and Safety Incident Management Procedure	32-95

Eskom Safety, Health, Environmental and Quality Policy	32-727
Eskom Life Saving Rules, Directive	240- 62196227
Eskom vehicle and driver safety management 32-93	32-93
Eskom vehicle specification	32-345
Eskom *Contractor* Health and Safety requirements standards	32-136
Eskom Waste Management Standard 32-245	32-245
Emergency Preparedness and response	32-29
Generation Plant Safety Regulations	36-681
Design Review Procedure	250-53113685
Engineering Change Management Procedure	240-53114002
Chemistry for Coal Fired Units with Drum Boilers Operating at 17 MPa and Above Standard	240--55864811
Material Specification and Certification Guideline for Power Generating Plant.	240-84513751
Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water	240-53113712
Supplier Contract Quality Requirements	QM 58
Coal Fired Power Stations Lighting and Small Power Installations Standard as a minimum.	240-55714363

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.
coating/paint/lining system	"Coating/paint system" is an all-embracing term including method and degree of surface preparation, generic type, thickness and number of coats and the method of application of the coats.
Contractor	The paint applicator/rubber liner or *Contractor* having the main Contractual responsibility to Eskom.
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.
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.

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	Formazan 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
WTP	Water Treatment Plant

2.5 Roles and Responsibilities

a) The Eskom Engineer or other Eskom employed nominated specific specialist/responsible person will do a quality check on all the works which is done by the *Contractor*.

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

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

d) The *Contractor* shall be responsible for ensuring that all Sub-Contracting parties such as the paint/rubber lining applicator and the paint/rubber liner manufacturer are fully

conversant with the requirements of this scope of work and referenced standards in this document.

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

f) The Project/Contract Manager should ensure the *Contractor* performs the works as per the scope of work.

2.6 Process for Monitoring

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

2.7 Related/Supporting Documents

- N/A

3. Executive summary

The Lethabo Water Treatment Plant (WTP) Refurbishment Project was initiated to reinstate the plant to a good state of operation. All parts of plant which includes mechanical, electrical, civil and Control & Instrumentation (C&I) in this area is included in the scope of works. The scope for the refurbishment project includes the following areas:

- Chemical offloading areas,
- Bulk chemical storage and handling areas,
- Chemical (acid, caustic, brine, hot water and dilution water) preparation and injection plants,
- Demineralised water production plant
- Gland seal water system,
- Effluent handling system from demineralised vessel outlets up until the effluent neutralisation sump inlet valves.

For the above systems, refer to the highlighted P&ID's in Appendix F2 for further clarity of the Mechanical, Process, and C&I battery limits in combination with the WTP equipment list for additional technical specification of the equipment that forms part of the scope of work.

The *works* is inclusive of all activities necessary for the provision of a fully functional system that meets the *Employer* 's requirements. The *Contractor* designs, manufactures, procures, installs, commissions and decommissions all Mechanical, Civil, Electrical, C&I Plant required for the *works* as defined in this specification.

This includes interfacing with, and utilisation of, existing plant and equipment. The *Contractor* shall ensure that the complete design shall be performed by, or under the direction, control and supervision of an ECSA registered professional engineer/technologist for each discipline as required by the scope of the design. The professional engineer/technologist will be responsible for signing off the design as applicable to his field of registration.

Subject to a detailed plant inspection and subsequent agreement by both parties, all equipment on this system in need of replacement are supplied and installed by the *Contractor*. The *Employer* will, in conjunction with the *Contractor*, mark all items that are to be salvaged prior to decommissioning. These items are to be removed in a manner that does not damage the equipment. The *Contractor* also disposes of all unwanted plant components, waste and scrap In line with environmental policy / procedure / work instruction.

The *Contractor* must supply prices for the full replacement of all components mentioned in the price list section.

The *works* listed below are not necessarily in a pre-determined sequence or preference hence, the *Contractor* considers all requirements in preparing and submitting his own plan or method statement for review and acceptance by the *Project Manager*. It is also possible that planning may change during the course of the works should the *Project Manager* deem it necessary.

The *Contractor* studies the specification thoroughly and immediately reports any ambiguities or inconsistencies to the *Employer* for clarity during the tender period. The *Contractor* should not base his/her pricing on assumptions and should seek clarity during the tender phase on anything that is not clear. The *Contractor* performs the following tasks as part of the *works*.

4. General

4.1 Preliminary and General

a. The *Contractor* studies the *Employer*'s specification to prepare and submit a detailed work methodology (Method Statement) and Quality Control Plan (QCP) to the *Project Manager*, for each section of works, in order to obtain acceptance before each activity is started. The *Contractor* liaises with all the *Employer*'s project team members such as engineer, quality controller/s, plant specialist/s etc. and requests clarification from the *Project Manager* immediately, if any discrepancy or vagueness is discovered in the specification, which was not clarified during the tender period. The *Employer* will review and provide decisions on all such discrepancies and vague areas of scope within the first four (4) weeks of the contract and thereafter, the *Contractor* provides the *works* as per the Specification.

b. The *Contractor* submits the prerequisite documentation as per Section 23 during the tendering period, and before any fabrication or work on Site commences for approval by the *Employer*'s representatives and AIA (Approved Inspection Authority).

c. Except where otherwise stated, the *Contractor* provides all items of expense including management, supervision, safety and quality oversight, competent labour resources, materials, plant, equipment, personal protective equipment, consumables, replacement plant components, planning and organising, documentation, transport and fuel, meals, accommodation, etc, as necessary to provide the *works* according to the specification.

d. The *Contractor* shall erect scaffolding and barricading wherever necessary. Safety harnesses must be worn by all the *Contractor*'s personnel to access scaffolds via ladders and in all areas when working at heights. The scaffolding must be erected in such a way that it does not prevent/hinder normal operation of the surrounding plant.

4.2 Site Establishment and De-Establishment

a. The *Contractor* conducts site establishment once off for the entire works at the identified location on site. The *Contractor* provides the necessary facilities for his employees and for safe storage of equipment and materials. The *Contractor* maintains such establishment for the duration of the works and removes everything from site for de-establishment. The *Contractor* ensures that proper housekeeping is done before de-establishing site (once-off) in accordance with the Eskom housekeeping standard as a minimum. The area must also be rehabilitated before safety clearance is issued.

4.3 Permitry

The *Contractor* ensures that suitable supervisory personnel are sent to Site for training as Responsible Person's (RP). A minimum of 2 people is required to be trained as RP's so that at least one of these personnel are supervising at all times during the execution of the works. This is a compulsory requirement.

The Contractor takes notes that High Voltage 1 course is 1 week long. Plant Safety Regulations (PSR) course is 2 weeks and ARC and Risk course are 1 and half days each. In total, the whole course for RP training is 4 weeks. This is then followed by at least 2 weeks for practical training before the identified personnel is required go to the examining committee for their final assessment for authorisation as a RP. These timelines should be incorporated into the programme with allowance in case the course is not passed.

The *Contractor* verifies that the respective system being worked on is drained, isolated and is safe to work on by means of the issue and acceptance of a Permit to Work (PTW) by the Responsible Person (RP) and that all workers are signed on to the RP's Worker's Register.

The *Contractor* is responsible for the temporary removal of any plant equipment, walkways, ladders, supports etc. for purposes of access or inspection for the duration of the works.

All plant equipment removed for the purpose of access or inspection will also be included in the respective activity's QCP/ITP to ensure that all equipment is properly re-installed. The re-installation of the plant equipment will be the responsibility of the *Contractor*. The *Contractor* securely and safely protects the vessels, pipework and other equipment remaining in service to ensure that they are not damaged during the works. Any damages to the plant will result in serious safety and production related incidents and must be avoided.

4.4 Safety

The *Contractor* studies and understands the hazards of working with sulphuric acid and sodium hydroxide (remaining inside pipes and other equipment) as well as hazards of working in the vicinity of the other chemical plants so that all necessary precautions and mitigations may be put in place. Proper risk assessments must be conducted before starting work.

The *Contractor* sets up any additional safety barriers/screens and signage around the area and prepares the area for the execution of the *works*.

The *Contractor* ensures that all personnel wear the appropriate level of PPE necessary while working and are fully conversant with the emergency procedures to be followed in case of an incident.

The locations of safety showers and clean water supply must be known.

The *Contractor* replaces the existing safety screens (curtains) with new transparent chemical resistant splash guards. The *Contractor* ensures that the materials of construction of the new splash guards is selected such that it does not discolour or turn opaque over time or with exposure to the chemicals.

4.5 Cleaning

The *Contractor* must neutralise and clean all components that have been removed from plant before transporting them from the plant area to prevent chemical burns during handling and environmental contamination from occurring.

The *Contractor* submits a proposal outlining the method that will be used for the *Employer*'s approval and only after approval is given in writing, may the neutralisation and cleaning of sulphuric acid and sodium hydroxide commence.

All liquid and dissolvable waste generated during the neutralisation and cleaning process should be diluted with water and washed down into the high conductivity effluent collection system on Site. The *Contractor* ensures that all bund areas and equipment are clean and dry directly after neutralisation.

All solid and non-dissolvable waste generated during the neutralisation and cleaning process may not be washed down into the high conductivity effluent collecting system on Site and will be disposed of by the *Contractor* according to the *Employer's* waste management procedures. All waste containing sulphuric acid and/or sodium hydroxide is treated as hazardous waste and disposed of by the *Contractor* off Site at a registered hazardous waste site and the relevant disposal certificates supplied.

4.6 Drawings

4.6.1 Isometric Drawings

The existing isometrics must be reviewed and updated. If there are any changes made, new isometrics must be drafted. New isometric drawings are also required for the parts of plant which do not have isometric drawings. The *Contractor* must make allowance for this, and the drawings must be supplied in a format suitable to Eskom for review and acceptance. At handover, a full set of isometrics are required for the entire plant, whether new or existing.

4.6.2 Piping and Instrumentation Diagrams (P&ID's)

For all the plant, which is part of the works, the existing P&ID's must be reviewed and updated if there are any changes made (also if there are no changes) to reflect the as built plant after the project. Currently no AKZ reference are made on the P&ID's and will have to be added in

on the P&ID's and an excel spreadsheet with all the relevant AKZ to be submitted to the client for review. The *Contractor* must make allowance for this, and the drawings must be supplied in a format suitable to Eskom (refer to Eskom drawings standard) for review and acceptance.

4.6.3 Pipe Support Drawings

For all the plant, which is part of the works, the existing pipe support drawings must be reviewed and updated if there are any changes made (also if there are no changes) and new pipe support drawings must be drafted for the parts of plant which do not support the same type of pipe support as previous for whatever reason. The *Contractor* must make allowance for this, and the drawings must be supplied in a format suitable to Eskom (refer to Eskom drawings standard) for review and acceptance.

4.6.4 Piping General Arrangement Drawings

For all the plant, which is part of the works, the existing general pipe arrangement drawings must be reviewed and updated if there are any changes made (also if there are no changes) and general piping arrangement drawings must be drafted for the parts of plant which piping layout has changed. The *Contractor* must make allowance for this, and the drawings must be supplied in a format suitable to Eskom (refer to Eskom drawings standard) for review and acceptance.

4.7 Rubber-lining Inspection and Reporting

All components inside the Atmospheric Degasser, Weak Base Anion (WBA), Strong Base Anion (SBA) and Mixed Bed (MB) vessels should be inspected by the *Contractor* while being witnessed by Eskom. The *Contractor* must hand over the inspection report with recommendations to Eskom no later than one week after initial inspection. The inspection report should include all components in the vessels. This will include components such as collectors, laterals, support beams, nuts and bolts, etc. The inspections must also include thickness testing on the walls of the vessels, support legs as well as the piping. Based on these findings and recommendations it will be decided if the components should be replaced or can be reused.

Similarly, the piping to and from the vessels must be inspected. Recommendations should be provided to Eskom in the form of a report. This piping inspection must also include the acid and caustic injection piping as well as the effluent piping.

The rubber lining inside the vessels and the piping protects the walls against all corrosive materials. This rubber lining has a certain lifespan, and this might have been exceeded. Before replacing any rubber lining, however, the following tests need to be performed to confirm that the rubber lining is failing:

- Visual inspection for defects,
- Spark testing (as described in 240-55864836),
- Hardness Testing (as described in 240-55864836).

The *Contractor* must provide a cost for the full rubber-lining of all the vessels (and internals) and piping included in this scope.

4.8 Pipework Inspection and Reporting

The pipework is constructed out of a variety of materials based on the service requirements on site. The details of the materials of construction are covered under each section, additionally the pipe specifications of the original pipework is covered in F1 – WTP Equipment list. However, the state of the pipework is unknown. The pipework will need to be dismantled as the plant becomes available. Inspection of the pipework will be done. Depending on the inspection, the *Contractor* and *Employer* will decide what pipework will be stored or scrapped. Full replacement is required as per technical specifications within the battery limits of this scope of work. The lining of the supplied pipework must be done out-situ. The *Contractor* must supply and install pipework which is the same as what is installed currently in the plant (unless otherwise mentioned). The dismantling, transport to and from the applicator as well as installation of the pipework must be done by the *Contractor*.

The pipework to be lined and supplied are approximated at the following segmented lengths for the different areas. Nominal bores from P&ID's can be used as reference for size of pipes in the plant. The *Contractor* must confirm all the dimensions of the pipes, elbows, bends, t-pieces, reducers etc. Therefore, it is important that suppliers make necessary arrangements to visit site to obtain the correct measurements and required fittings for the works. If there are any additional details, these will be clarified on the compulsory site visit. The supply of valves is part of the scope of work for the *Contractor*. If the face-to-face dimensions of the new valves are not as per the current installed valves, the *Contractor* must allow for these deviations in the manufacture of the new lines.

The *Contractor* must price for full removal of all existing pipes within the WTP plant area as per the requirements for each section and dispose of them according to the *Employer*'s waste management procedure. These are treated as hazardous waste and are safely transported and disposed of at a registered hazardous waste facility and the proof of disposal supplied to the *Project Manager*.

The *Contractor* must allow for the supply and installation of new pipes within this area of the same specifications, as specified.

The *Contractor* removes existing pipe supports and fittings and supplies and installs new pipe supports including new reducers, extensions, gaskets, spacers, brackets, bolts, nuts and washers.

All newly installed pipework will be flanged or welded according to the existing isometric drawings (where available). The *Contractor* complies with all listed Eskom welding procedures. Refer to Section 8 Welding specifications for any welding done on pipework.

All newly installed pipework must undergo hydrostatic pressure testing and non-destructive testing (100% visual inspection and 10% X-ray on welds). If the 10% X-ray on the welds do not pass, then the all the pipework welds must be X-rayed at the *Contractor's* cost. The *Contractor* submits the resulting pressure test certificates and non-destructive test certificates to the *Project Manager*.

The *Contractor* submits the material certificates, corrosion protection control sheets and corrosion protection inspection and test certificates, iso-datasheets and final installation inspection reports for all pipework to the *Project Manager*.

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

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All pipes to be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All pipes internal corrosion protection to be in accordance with E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings

All pipe supports will be constructed using mild steel and will be corrosion protected, as per Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings). The dimensions and thickness of the supports will be the same as the existing supports in the plant unless new valves and actuators requires a different type of support. In such a case the *Contractor* is to design a pipe support and make it part of the pipe support drawings schedule. Refer to list of drawings for the current pipe supports on Lethabo Power Station. Refer to E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification

E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings and RTD/MAT/19/122: Protective Coating Specification for specific details on the external corrosion of the supports.

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

In addition to the standards mentioned above, the following standards must be used:

- EN 1092-1 - Flanges and their joints - Circular flanges for pipes, valves, fitting and Accessories, PN designed,
- BS10 specification for flanges and bolting for pipes, valves and fittings,
- EN10204 Metallic products - types of inspection certificates,
- 240-123801640 Standard for Low Pressure Pipelines,

For specifications on the original pipework, Refer to Appendix F1 – WTP System Equipment List for specifications on the original piping that was installed. Contractor shall base the tender on an equivalent specification and shall supply the same list indicating the technical equivalent standards that will be used for review by the client.

Additional information on piping is as follows:

- Service Rating: 600 kPa / 5 to 160°C
- Service Limit: 1000 kPa / 40°C
- Hydro Test: 1500 kPa / 25°C
- NDE: 10% X-ray
- Corrosion Allowance: 1 mm

4.9 Pumps

Refer to Appendix F1 – WTP Systems Equipment List which contains a tab for the list of pumps that need to be replaced.

All pumps are to be replaced with the same type of pump currently installed in the plant. Where the same type of pump is not available, the Contractors should propose a technically equivalent pump based on all information provided in this specification and all referenced documentation. If there are any unclear parameters these needs to be addressed at the tendering phase.

The *Contractor*'s offer shall be such that replacement of all these pumps is catered for which includes any modification to pump base plate, plinths, and corrosion protection that goes with the installation of the pump.

All centrifugal pumps shall be in accordance with the requirements of the *Employer*'s 240-56030557: Specification for Centrifugal Pumps.

4.9.1 Special Requirements for Specific Areas

4.9.1.1 Anion Supply Pump

The Anion supply pumps are the only pumps to be upgraded to be VFD controlled. The main purpose of this to:

- Allow for softer start-ups and shut down of the demin trains,
- Control flow rate for the train that is in service,
- Energy efficiency,
- General optimisation of the demin trains performance,
- Ensure the pump runs within acceptable duty point range as per OEM's recommendations.

Refer to the electrical section for technical specification that VFD's need to adhere to.

Contractor to ensure the VFD adhere to Eskom specification as per electrical section. Contractor is responsible for the supply, installation, commissioning and fault finding. This works includes and support brackets, electrical cables, control and instrumentation cables needed for a fully functional VFD operated Anion supply pump.

4.9.1.2 Potable pH Correction

The current potable pH correction pump is pneumatically controlled, and existing control will be kept. *Contractor* is responsible for the full replacement of the pump and any needed modifications to the existing plant to ensure a fully functional potable pH correction pump. The current pump in the plant is obsolete and an equivalent pump needs to be tendered for. All data sheets, pump curves and needed specification of the pump to be supplied with the tender.

The *Contractor* needs to replace the pump (incl. pneumatic stroke adjustor) and all associated pipework, valves, motors, instrumentation as per Appendix F2 – Marked up P&ID's as per specification detailed in Appendix F1 – WTP equipment list.

4.9.1.2.1 Functional Requirements

Current pump is pneumatically controlled with a 4-20mA I2P that gives a 20 – 100 Pa signal to the pump which controls the stroke of the pump, so that pH is controlled to the Eskom standard for potable water. Refer to the Appendix F1 – WTP Systems Equipment List for more detail on the current pH Correction pump.

4.9.2 Tests and Inspections Before Delivery

- Vibration tests according to ISO 10816
- Pump hydraulic performance acceptance tests according to ISO 9906.

4.9.3 Tests and Inspections

The *Contractor* performs the following site acceptance tests:

- Vibration tests according to ISO 10816
- Confirm pump duty point
- System performance at minimum and maximum system flow rate
- Confirm that all control valves are operated within the valve's control range
- One (1) month system reliability run

4.9.4 ITP Requirements

The *Contractor* includes the following on his ITP:

- Acceptance of all relevant documents and drawings

- All inspections required by the relevant codes and standards
- Confirmation of the Permit to Work
- Inspection of components on delivered to Site
- Anchor bolt position checks
- Position and dimension checks on all items before being grouted
- Alignment checks for all piping connected to fixed components (vessels, pumps etc.)
- Inspections during flushing and pressure testing
- Plant inspection before safety clearance
- Plant labelling
- Issuing of all certificates
- All site acceptance tests

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

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All pumps to be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- The *Contractor* must follow specification E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps.

4.10 Valves and Actuators Inspection and Reporting

This section specifies the scope of work for the inspection of the valves and actuators in the WTP. The existing valves on the plant must be opened, inspected and tested to confirm the valves are not defective.

The *Contractor* together with the *Employer* must test the valves' mechanical/manual position indications to confirm if they are correct locally and correspond to the control room indication. This must be done prior to removing the valves as well as after removal of the valves.

The *Contractor* must allow for the full replacement of all the valves and actuators within the scope, and it must include the supply, delivery, installation and commissioning of the valves and actuators with new valves and actuators of the same specification as outlined in this document. Refer to Appendix F1 – WTP System Equipment List for more details on the current valves and actuators and must be read in conjunction with to the listed P&ID's. The type of actuator is indicated on the P&ID's to ensure that the replaced valves are suited for their required capability when actuated. Identified obsolete equipment must be replaced with a technical equivalent from a reliable and well know brand/OEM, ideally locally sourced with good spares availability.

The works includes the removal and disposal of the defective valves and actuators or storage (if deemed the valve/actuators are still in good working condition) of working valves and actuators. It also includes the supply, installation and commissioning of these valves with new valves of the same specification as outlined in this document.

4.10.1 Valves

The *Contractor* must allow for the full replacement of all the valves with the same technical specification as the current valves in the plant, and it must include the supply, delivery, installation and commissioning of the valves.

4.10.2 Actuators

The *Contractor* must allow for the full replacement of all the actuators included with the battery limits of this scope. The Contractor must supply the valve, actuator, and manual valve position indication for each valve as a fully functional integrated unit.

The position of the valve (open/closed) should be visible for the operator from the operating floor. Actuators that are not available in the market anymore (Deemed obsolete, with written proof from the OEM stating such) needs to be replaced with a technical equivalent actuator and must be of proven and reliable design and manufacturing. Valves and actuators need to be matched to ensure the correct torque is provided to ensure the valve operates with no sticky/malfunction operations in the future. The coupling/adapter and bracket assemblies should be in accordance with latest industry standard and should be available of the self items.

Contractor needs to standardise the actuator across as many other similar sized valves as technically possible where obsolescence of the actuator affects the scope to allow minimal different types of actuators installed in the plant.

4.10.2.1 Functional Requirements for Pneumatic Actuators

- Minimum air supply pressure for pneumatic actuators are in the region of 350-650 kPa.
- Maximum working fluid pressure can be assumed to be less than 650 kPa.
- Standardised mounting brackets and adapter connections to be used for connection the valves in the plant.

4.10.3 Actuated Valve Assemblies

The *Contractor* must allow for the full replacement of all the actuated valves, and it must include the supply, delivery, installation and commissioning of the valves.

Contractor shall replace actuators in the plant with the same actuators currently installed. If the actuator in the plant is not available, the *Contractor* shall supply a technically equivalent actuator to that what is installed in the plant.

Contractor must standardise the actuated valve assembly across as many other valves included in this scope as possible where obsolescence affects the scope.

4.10.4 List of Valve Specifications and Standards:

During the installation of the valves, as a minimum, the following specifications and standards must be adhered to:

- 240-105020315 Eskom Standard for low pressure valves
- ISO 4126-1:2004 Safety devices for protection against excessive pressure - Part 1: Safety valves.
- ISO 5208:1993 Industrial valves; pressure testing of valves.
- ISO 6264:1998 Hydraulic fluid power - Pressure-relief valves - Mounting surfaces

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

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All valves to be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).

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

4.11 General requirements

4.11.1 Method Statement

The contractor is to submit a method statement at tender phase that includes all disciplines (Civil, process, mechanical, electrical & Control and instrumentation) on how the works will be executed.

1) This Method Statement clearly illustrates how the *Contractor* accounts for the risks of this project and is tailored to address the specified project objectives and requirements.
2) The Method Statement includes, as a minimum and where applicable, the following:
    - Constraints identified and considered by the *Contractor*.
    - Interfacing with *Others*; the *Contractor* illustrates an understanding of the work that is to be completed by *Others* and accommodates for the completion of such work in his methodology.
    - Description and illustrations of a construction traffic plan, use of laydown areas and plot plan.

- Shifts and hand overs for the various sections of the works, this information is to enable the *Employer* to integrate the programmes of the various *Contractor*s.
- Design tools and systems that the *Contractor* plans to use.
- Construction methodology and sequence of construction taking into consideration access restrictions and safety requirements.
- Detailed risk assessment which lists risks specific to the works and is accompanied with associated proposed mitigations.
- List and description of plant and machinery required to carry out the civil, structural components of the works, mechanical plan installation, interfacing with electrical and C&I equipment etc.
- Inspection and quality control plan.
- A clear description of the responsibilities of the *Contractor's* personnel involved with the works, including (where applicable) his *Project Manager*, Site Quality Manager, Site Engineer, Health and Safety Manager, Technical Office Manager, Production Manager, Supervisor, Environmental Officer, Fabricator, Erection Engineer, Shop detailer, Transporter and other personnel required for the civil and structural works.
- Removal, construction, fabrication and installation sequencing considerations, which takes into account any constraints.
- Health, safety and quality control for the activity.
- All plant, equipment and machinery required to complete activities as specified in the specification.
- Manufacturer's literature/ Technical Data Sheets for all materials used including product description, composition, material and performance properties, installation and application procedures, use limitations and recommendations.
- Plan for confining, collecting and disposing of waste materials as a result of removal operations, where applicable.
- Works required to safeguard existing infrastructure and services.

4.11.2 Project Schedule

1) The *Contractor* submits a Level 3 programme for the project considering all the interfaces and time constraints.
2) This programme does not omit key activities. Timing of the activities is consistent with the Method Statement.
3) The programme is to show that the *Contractor* has a clear understanding of the full scope of works, including the accompanying risks. The programme is to be logical and realistic.
4) The *Contractor* submits a Programme for all the phases of the works to the *Project Manager* for review and acceptance.

5) This programme is accompanied with the following:
   - A comprehensive narrative which describes the basis of the programme;
   - A list of assumptions that the programme was based on;
6) The programme clearly indicates the following:
   - Activities of all the project work to be done by the *Contractor* and the other work covered by the contract that is being done by the sub-*Contractor*s;
   - Logical links/ sequence/ relationships that connect the various activities together (showing all hold points);
   - Master schedule is to show Links/logic, the CPM (Critical Path Method) technique is used for programme and planning. The critical path is clearly illustrated.
   - The works is completed within accepted durations that are in consistence with key dates provided in the Contract Data. Milestone dates in line with Key Date/Contract Data shown on the schedule.
   - Schedule Work Package Classifications (Deliverable, Engineering, Procurement, Manufacturing, Supply, Construction and Installation Work Packages)
   - The number of shifts planned per day for each section of the works.
   - The way in which the *Contractor* plans to interface with Others. Interface points with Others are identified in the programme;
   - A comprehensive description of each activity, including the name and designation of the responsible person;
   - Full details of all terminal point release requirements;
   - Any erection or commissioning activities that may affect other maintenance and construction activities on Site;
   - Identifies when services are required for commissioning purposes;
   - Sufficient information with regard to the activity duration and a description to enable measurement of the progress of the activity within the required update period;
   - Each description in the programme explains and represents the performance of the activity, including tangible deliverables or products;
   - Resources required to perform an activity for each activity that requires resource assignment;
   - Single source of responsibility or ownership per activity.

4.11.3 Removal of equipment

If not clearly defined in a specific section of Scope in this document the following will take preference:

- The *Contractor* is responsible for removal and transportation of decommissioned/old/taken out equipment to a dedicated demarcated area defined by the *Employer.*
- *The Contractor is responsible for installation, commissioning testing and making sure all newly supplied equipment is working properly, unless otherwise stated.*

5. Demineralised Trains

The ion exchange resins currently used for the demineralised water treatment plant system are indicated in Appendix A. This appendix also describes the type of Ion-exchange vessels currently installed at Lethabo Power Stations' Water Treatment Plant.

The demineralised WTP consists of three trains, each with an original design hydraulic capacity of 220m^3/h and each train comprises of the following vessel process units:

- 1 x Cation vessel;
- 1 x Atmospheric degasser;
- 1 x Weak base Anion vessel;
- 1 x Strong base Anion vessel; and
- 1 x Mixed bed vessel.

The work to be carried out in this works information should not affect the capacity to produce sufficient demin water for the station to function normally. The risk will be highlighted at tender phase, and it is the responsibility of the Contractor to make sure all necessary measures are taken to ensure consistent demin water production.

Of late demin water consumption has been higher than original design due to multiple reasons. It is for this reason that the contractor must allow for a mobile demin plant to cater for demin production needs during the course of the refurbishment of the trains in the Demin plant.

Refer to Section 12 for more detailed requirements of the plant required.

5.1 Operating Design

The operation of the demineralised water production system is performed from the WTP control room. The modes of operation for programs are automatic and semi-automatic. Modes of operation for valves are remote (manual or automatic) or local via the LCS. Modes of operation for pumps are remote (manual or automatic).

5.2 Operating Philosophy

The operation described in the section below is for normal operating conditions.

5.2.1 Demineralised Water Production

Filtered water from the sand filters used for demineralised water production is sent directly to the cation exchanger and is distributed inside the exchanger over the whole exchanger surface. The cation inlet water quality is as per Table 2 below:

Table 2: Cation Inlet Qualities for the Past 5 Years

Parameter	Units	Average	Min	Max	95th percentile based on conductivity
Calcium Hardness as $CaCO_3$	mg/L	35.06	21.4	336	35.6
Chlorides	mg/L	8.45	5.2	18.4	8.75
Potassium	mg/L	1.3	4.99	3.36	3.67
Conductivity at 25°C	mg/L	7.93	376	182.54	225
M-alkalinity	mg/L	35.7	74.4	55.9	58.2
Magnesium hardness as $CaCO_3$	mg/L	19.9	36	30.12	31.4
Sodium as Na	mg/L	5.22	15.9	9.5	30.6
Oxygen Absorbed	mg/L	0.1	30	1.89	11.7
p-alkalinity	mg/L	0	4.2	0.03	0.2
pH		3.14	10.26	7.82	8.16
Silica as SiO_2	mg/L	1.34	13.5	7.26	7.54
Sulphates as SO_4	mg/L	9.66	23.3	13.56	19.3
TOC as C	mg/L	0	4.87	2.88	2.1
Total hardness	mg/L	41.2	74.7	63.96	67
Turbidity	NTU	0.019	8.77	0.234	0.141

After passing through the stratified/dual resin bed (WAC/SAC), the water exits the bottom and normally enters the top of the CO_2-degasser. There is a facility to manual bypass the degasser directly to the degasser sump. The cation exchanger is equipped with a pressure differential switch with an indication to signal excessive differential pressure across the bed. The product quality is monitored by means of a conductivity meter which is installed in the filter outlet and a sodium meter which takes its sample from a sample point at the bottom of the resin bed. A resin trap with a pressure differential switch is also installed on the main line.

The decationised water is fed directly from the cation exchanger into the top of the CO_2-degasser via a control valve, actuated by a level controller in the degassed water sump. This level controller can also operate the control valve in the demineralised water storage tank supply line to the degassed water sump to recycle the demineralised water to the sump should the need to do so arise. The decationised water is distributed on the top of the CO_2-degasser over a packed section of polypropylene rings. For the removal of the free CO_2 out of the water, air is blown in an up-flow direction through the CO_2-degasser by use of blowers, which are equipped with an inlet air filter. The air leaves the CO_2-degasser, together with the free CO_2 at the top above the roof. After passing through the packed section of polypropylene rings the water is collected in the degassed water sump, which is located underneath the CO_2-degasser. The degassed water sump is equipped with a level transmitter. The anion supply pumps trip when the degassed water sump is at low level.

The anion supply pump is supplied with water from the degassed water sump and delivers this water to the weak base anion exchanger. The pump is equipped with pressure measurement on the discharge. The low-level in the degassed water sump is a mechanical protection for the anion supply pumps.

The water delivered by the anion supply pump flows to the top inlet of the weak base anion exchanger is distributed inside the exchanger over the whole exchanger surface. After passing through the resin bed, the treated water is collected in the bottom and flows to the strong base anion exchanger. The exchanger is equipped with a pressure differential switch with an indication to signal excessive pressure drop across the bed. To monitor the outlet quality, a conductivity meter is provided. A resin trap with a pressure differential switch is also installed on the main outlet line.

The treated water from the weak base anion exchanger flows to the strong base anion exchanger, where it is distributed over the whole exchanger surface. After passing through the resin bed, the treated water is collected in the bottom and flows to the mixed bed exchanger. The strong base anion exchanger is equipped with a pressure differential switch to indicate in case of too high pressure drop across the bed. To monitor the outlet quality, a conductivity meter and SiO_2 analyser which takes its sample from a sample point in the resin bed above the bottom collector are provided. At high treated water conductivity, the treated water will be recycled back to the cation exchanger (Maximum recycle time 30 minutes). A resin trap with a pressure differential switch is also installed on the main outlet line.

The demineralised water from the strong base anion exchangers flows to the mixed bed exchangers, where it is distributed over the whole exchanger surface. After passing through the resin bed, the polished demineralised water is collected in the bottom and runs via a "security" resin trap to the demineralised water storage tanks. This resin trap is provided with a pressure differential switch. In the outlet line a flow meter is installed, by means of which the amount of treated water between two regenerations for the cation/anion exchangers and mixed exchangers can be pre-set in the DCS, (two separate indications have been provided). The exchanger is provided with a pressure differential switch with an indication to signal excessive differential pressure across the bed and with a pressure gauge in the water outlet. To monitor the polished demineralised water outlet quality, a conductivity meter, a sample connection to the SiO_2 analyser and a sodium analyser are provided. The readings from the analysers are transmitted to the DCS. Directly after recycling (in specification conductivity for 5 minutes) the demineralised stream goes into production. At high treated water conductivity, the treated water will be automatically recycled again to the cation exchanger (recycle fixed time 30 minutes).

Once the resin in an ion exchanger is exhausted it must undergo regeneration. The regeneration process of the ion exchange resins, cation and anion resin, occurs when the desired throughput (currently 11 000 m^3 per train with new resin) through a train is achieved or the breakthrough quality (Na and Conductivity for cation and SiO_2 for anion) exceeds the limits as specified in the Demineralised Water Production using Ion Exchange Resins Standard. Normal operation is to operate to volume of 11 000 m3 (with a safety factor of 5%) or if online analyser flags a breakthrough regeneration is started on the cation through to the strong base. Capacity for mixed bed is set at 100 000 m3 with 5% safety factor with same response for breakthrough. The maximum duration for the cation and anion vessels must be no longer than 15 hours.

Upon successful tender award, more detailed operation manual can be shared with the contractor if deemed needed by the contractor.

5.3 Works Function and Performance Requirements

The system shall be designed to function as follows:

1. Quality of the demineralised water produced shall meet the requirements of 240-55864811: Chemistry Standard for Coal Fired Units with Drum Boilers Operating at 17 MPa and Above.
2. The amount of demineralised water produced by the process is 220m^3/hr per train. The hydraulic requirement through the pipework is 660m^3/hr through three (3) trains.
3. The throughput for every production run must be 11 000m^3 (which includes a safety factor of 5%) or more before regeneration is required (before break through, where break through refers to maximum allowable chemistry parameters as per Eskom Chemistry standard) on the Cation and Anion vessel regenerations.
4. The throughput of the mixed bed vessel must be 100 000m^3 (with a safety factor of 5%) or more before regeneration is required (before break through, where break through refers to maximum allowable chemistry parameters as per Eskom Chemistry standard).

5. The quantity of effluent that is generated with the proposed solution is to be less than or equivalent to the current plant. The total effluent volume produced shall be 7% or less than the total production volume.

5.4 Resin Removal, Loading and Storage

The *Contractor* will be responsible for the removal of the resin from all the vessel, providing safe storage and preservation of the resin and then reloading of the resin once the refurbishment work is complete.

The *Contractor* will provide megabags to store the resin as well as the pall rings from the atmospheric degasser. The resin must be stored in a covered area to ensure resin is not exposed to direct sunlight. The *Contractor* must also ensure that the resin stays moist at all times.

The Contractor shall provide all necessary flexible hoses (3-inch Heli Flexi Hoses) with stainless steel quick couplers (camlock fittings) for the removal and reloading of the resin.

5.5 Battery Limits

The *Contractor* submits a set of marked-up P&ID's to depict their understanding of the full scope of work with their tender. All plant that is deemed to be included in the scope should are to be clearly highlighted by the contractor. The P&ID's associated with the scope of work from the clients' perspective are included in Appendix F2. Additional to the marked-up P&ID's supplied, a separate list of components included in this scope is submitted in Appendix F1 – WTP Equipment list, which lists the components and the task required. Replace on the list refers to:

- Removal of the old component and discard to approved area by the client/project manager.
- Supply of new component approved by the client.
- Installation, commissioning (if needed), testing of newly supplied component.

A site-visit will be planned during the tendering phase to allow the *Contractor* an opportunity to visit the plant to have a full understanding of the scope of work and the *Contractor* may request an additional plant visit, if required.

5.5.1 Electrical Battery Limits

Provide power using the existing 380V Water Plant Board 1A, 1B, 2A and 2B to all loads required by the process battery limits, mechanical battery limits and C&I battery limits in line with installed plant electrical philosophy to allow for a fully functional WTP.
Provide power from the existing batteries and the battery charger in the WTP Battery Room to all loads required by the process battery limits, mechanical battery limits and C&I battery limits in line with installed plant electrical philosophy to allow for a fully functional Water Treatment Plant.

The electrical scope includes modification of existing 380V Water Plant Board 1A, 1B, 2A, 2B, the modification if required of circuits in existing distribution boards (10JD01 and 10JD02), protection, cabling, racking, fire barriers, earthing and lightning protection.

5.6 Cation Vessel Requirements

Three cation units are provided. The cation units form the first stage of the demineralization process. Each cation unit consists of a steel pressure vessel in which the cation resin is contained. The unit is cylindrical in section and stands vertically. The resin occupies approximately two thirds of the vertical height of the vessel. The vessel has dished ends with a tekapor floor at the bottom. A side and a top access manhole are provided.

All three existing cation vessels are not fit for service and must be replaced with vessels matching the dimensions of the existing vessels. The design specifications for the existing Cation vessels are as per Table 4 below.

Water enters from the top of the vessel through a distribution and header system, then passes downwards through a stratified bed of weak and strong cation resin and out of the vessel.

Currently, a collector system is fitted at the bottom of the vessel, in the tekapor floor. The tekapor floor retains the resin in the vessel whilst allowing the water to be collected. The tekapor floor is problematic and fails frequently allowing resin to pass to the outlet.

Regeneration is done counter-currently as well as co-currently. Acid is injected from the bottom as well as from the top of the vessel and exits through the mid-collector header which is at the interface point between the weak base and the strong base resin.

As part of the *works*, the *Contractor* must remove and dispose of the three (3) existing cation exchange vessels and design, manufacture, install and commission three (3) new cation exchange vessels in the Water Treatment Plant (WTP).

The design of the new cation exchange vessels includes detailed process flow dynamics assessments to be performed to identify unacceptable levels of mechanical strain and stresses being experienced by the vessels, piping, supports and lateral systems.

The existing vessels experienced recurring failures on the mid-collector supports. The *Contractor* must take this into consideration in the design and prove that the new vessels will not experience the unacceptable levels of mechanical strain and stress.

As the main offer, the *Contractor* needs to redesign the new vessels to have a concrete filled base which is rubber lined. The bottom acid injection as well as the outlet collection system must be a header and lateral system. The new laterals must still connect to the pipework which is on the outlet of the vessel.

As part of the design, the *Contractor* must check that the load of the new vessel is within limits of the acceptable loading of the floor and civil support structures in the WTP. Refer to Section 11.3.3 for detail requirements regarding the structural verification of supporting infrastructures. Additionally refer to Drawing 02861.02 - WTP (WATER TREATMENT PLANT) (WEST) - RAFT SLAB - CONCRETE LAYOUT & 02862.02 - WTP (WATER TREATMENT PLANT) (WEST) - GROUND SLAB- CONCRETE LAYOUT SECTIONS for more information of the civil construction of the Water treatment plant.

The mid-collector, top inlet and top acid injection system is to be replaced with what is currently installed.

The collector consists of a stainless-steel header with arms to which the nozzle strainers are fitted. The nozzle strainers allow water to pass through but retain the resin inside the vessel.

The *Contractor* is responsible for the temporary removal of surrounding plant including pipework, walkways, ladders, supports etcetera, for purposes of access for the necessary duration of the *works*, provided that, continuous supply of demineralised water to the generating units is not interrupted or put at risk. The removal and installation of each cation exchange vessel is therefore, conducted expediently and in a phased approach i.e., one train at a time, to ensure continuous production of demineralised water by the remaining two trains.

5.6.1 Re-design of the Cation Exchange Vessels

- Each of the three demineralised production trains has a design production capacity of 220 m^3/hr. The *Contractor* ensures that the production capacity and throughput of each train is retained as per the original design intent via the *Contractor*'s new vessel design and installation.
- The cation vessel is designed by the *Contractor* for a minimum of twenty-five (25) years' service life. It is the contractor responsibility to design the vessel and allow for any corrosion that might be present to still be in safe service conditions with this minimum 25 year period.
- The *Contractor* needs to provide a maintenance regime for the vessels to ensure that they operate with their design limitations for the period of service.
- The detailed construction drawing of the originally designed and installed vessels is as per drawing number 063/1849 Revision 2.
- The *Contractor* ensures that all design calculations are submitted to the *Project Manager* for review and acceptance prior to procurement of material and manufacture of the vessels.
- The modelling and designs are performed by a Registered Professional Engineer appointed by the *Contractor* for each of the respective disciplines with proof of relevant, valid qualifications supplied.
- All rights and intellectual property to designs and documentation are transferred to the *Employer* upon acceptance and payment thereof, and the *Contractor* ensures that confidentiality of such information is maintained at all times.

5.6.2 Vessel Flow Dynamics Assessment

- The *Contractor* performs a process flow dynamics assessment of the existing demineralised water production system at Lethabo Power Station, to confirm the hydraulics and flow dynamics across the system, under all operating conditions that does not result in undue mechanical stresses on the plant components, which would ultimately result in the vessel failure.

- The *Contractor*'s assessment includes:
    - Computation Fluid Dynamics (CFD) modelling of the vessel including fatigue analysis.
    - Hydraulic Analysis including all transient events and water hammer scenarios (Preference Flownex) of the entire system (Flow and Pressure results required as a minimum).
    - Code Compliant Analysis of the vessel (Preference PV Elite).
    - Stress Strain Analysis of the Vessels.
    - Pipe Stress Analysis of the Entire System (Preference Caesar II).
- The *Contractor* submits proposals for review and acceptance for the use of any alternate software or system used for the CFD, to those preferred (as stated above) to the *Project Manager* to give acceptance in writing, thereby confirming suitability to the *Employer's* own software and systems.
- The vessels in the trains undergo regeneration of the resin periodically. The *Contractor* models the regeneration steps as well.
- The assessment is done on all piping and connections within the battery limits, as well as the internal laterals and shells of the vessels.
- The objective of the flow dynamics assessment is to assess if there is any mechanical strain being experienced by the existing cation vessels, or any other plant from the current operating philosophy of the process, whether in the form of water hammer during start up or shut-down conditions, during operation of control valves, switching from production to regeneration mode, etcetera.
- Should any stresses be determined, the *Contractor* proposes the changes required to the existing system or modifications to the design requirements of the new cation vessels, either through changes to the control logic or the plant or both, that is necessary to eliminate these stresses.
- Should there be any unacceptable and undesirable stresses identified, the *Contractor* optimises the system in order to remove these stresses and demonstrate through the modelling that the stresses are fully addressed through the recommended changes.
- The positioning of the internals of the cation vessel remains the same and the modelling is performed on that assumption. A sensitivity analysis to changes in the positioning of key injection or drain points is indicated.
- The *Contractor* submits a detailed report, including findings and recommendations to improve or correct the current design, for review and acceptance by the *Project Manager*. Necessary clarifications and/or amendments may be requested before acceptance is granted. The *Contractor* amends the report as necessary and re-submits for final acceptance in writing.
- The *Contractor* performs the following as a minimum:
    - Uses the DCS logics as an input into the modelling process.

- Extracts the existing plant data from VA View (Plant information system) as further inputs into the modelling.
- Utilises the demineralised water plant mechanical component designs with the proposed upgraded cation vessel's design that is implemented.
- Models the impact of both operating modes (production cycle and the regeneration cycle) on the vessels as well as the cycling effect between the modes.

5.6.3 Vessel Shell Fabrication

- All associated dimensions on the detailed construction drawings are re-determined by the *Contractor* to accommodate the new vessel design. It must be noted that the *Contractor* is responsible to ensure all tie-ins/battery limits are not impacted by any adjustment to the vessel dimensions. The *Contractor* submits detailed construction drawings of the vessel design as well as the detailed design calculations that must indicate compliance to the design code requirements, for review and acceptance by the *Project Manager* prior to proceeding with procurement and manufacturing.
- The cation vessels are vertical, cylindrical construct with dished ends.
- Shells are of an all-welded construction.
- The cation exchange vessels are constructed and designed by the *Contractor* in accordance with latest PD5500, Specification for Unfired Fusion Welded Pressure Vessels.
- The *Contractor* verifies that the *Employer's* design regarding the vessel shell thickness, etcetera is supported for the stress loads of the vessel.
- The shell is supplied with a 3.1 certification as per BS EN 10204:2004. In addition, Contractor to comply to the requirements of 240-84513751 Material Specification and Certification Guideline for Power Generating Plant.
- The *Contractor* performs non-destructive testing (NDT) on the vessel shells and internal laterals, pipework and supports in accordance with 240-83539994, Standard for Non-Destructive Testing on Eskom Plants. All PD5500 requirements to be met.
- The *Employer* conducts quality control inspections at various stages of the manufacturing in accordance with the *Contractor*'s accepted QCP.

5.6.4 Vessel Flanges and Nozzles

- The *Contractor* is responsible for specifying a suitable material for all flanges and nozzles.
- The nozzle material to be supplied with a 3.1 certification as per BS EN10204:2004.
- All nozzles are designed and manufactured in accordance with latest version of EN1092-1.

- The nozzles must be in the same positions and have the same orientation and same pipe connection geometry, as the existing installed pipes in the existing vessels.
- The *Contractor* is responsible for ensuring that flanges installed on the new vessel are compatible and in alignment with the flanges on the existing system piping.
- The *Contractor* is responsible for verifying the dimensions and lengths of all existing connecting flanges to ensure compatibility of the nozzles for construction on the vessels. These are independently verified, for each vessel on each train and not assumed as consistent throughout.
- Piping interface, connection, welding and NDE between new vessel nozzles and existing pipework are done according by the *Contractor* to BS EN13480.
- If the nozzles are not located in the same position, as stated above, the *Contractor* is responsible for proposing modifications of the existing pipework to suite new nozzle positions.

5.6.5 Vessel Internal and External Corrosion Protection

- The *Contractor* complies with the Eskom standard: 240-101712128 - Internal Corrosion Protection of Water Systems Chemical Tanks and Vessels with Linings Standard, Revision 1 as well as RTD/MAT/21/61 in Appendix E: Corrosion Protection Specifications, for the requirements of the rubber lining application required to the inside of the cation vessels.
- The applicator confirms that this thickness as satisfactory for the application or proposes an alternate thickness of rubber lining for review and acceptance by the *Employer*.
- The thickness of the lining may vary throughout a vessel; extra thickness may be required in areas of high wear.
- The *Contractor* complies with 240-106365693, Eskom Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings and RTD/MAT/21/61 in Appendix E: Corrosion Protection Specifications for the external corrosion protection of the vessel.
- The *Contractor* notes that the colour coding applied to the external of the cation vessel at Lethabo Power Station is Strong Blue.
- The colour code is selected and applied as per SANS 1091:

Colour No.	**Colour name**	**Natural** Colour **System (NCS)**	**Nearest NCS**
F11	Strong Blue	3648-R97B	4050-B

- A graphic depiction of the SANS 1091 colours in relation to the full NCS system is given in Annexure C of SANS 1091. These NCS colours are available in an A4 colour chart from SANS.

- The external of the vessel corrosion protection must be in accordance with E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings.

5.6.6 Vessel Internal Pipework, Headers and Laterals

The *Contractor* designs and installs new internal pipework, i.e., the headers, laterals and collecting pipework. The *Contractor* provides a manufacturing drawing of all the new laterals to be replaced. The drawings of the originally installed laterals and headers are provided to the *Contractor*. The *Contractor* is responsible to provide flow modelling of the distribution system to prove the even flow distribution through the system with no channelling occurring through the resin bed, refer to section Vessel Flow Dynamics Assessment.

The new cation exchange vessels are constructed with grade 316L stainless steel internals. Contractor can propose other material but the main offer should have SS316L as a minimum.

All the internal distribution pipelines are supplied with a 3.1 certification as per BS EN 10204:2004. In addition, Contractor to comply to the requirements of 240-84513751 Material Specification and Certification Guideline for Power Generating Plant.

Internal top/inlet distribution systems are designed to ensure an even distribution over the resin bed and do not cause disturbance or uneven settling of the resin.

Bottom collection systems are designed to ensure minimal “dead” resin space.

Gravel under beds, as support for ion exchange material are not permitted.

The ion exchange resin is contained in the cylindrical section of the vessel and not the domes. The typical volume of resin can be found in Appendix A.

5.6.7 Vessel Sight Glasses

- Four (4) sight glasses per vessel are located currently as per the Cation Vessel drawing 0.63/1849. It is imperative that sight glasses remain the same as the other vessel in the WTP to remain with standardised sight glass through the vessels in the plant.
- Sight glasses are flush with the inside wall of the vessel and do not provide for entrapment of resin.
- Sight glasses are oval with dimensions as per drawing 0.63/1874 - WTP (WATER TREATMENT PLANT) (WEST) TYPICAL SIGHT GLASS ASSEMBLY AND DETAILS.
- The sight glass installed does not turn opaque with either time or exposure to the chemicals used in the plant. Should double panels be utilised, there is no condensation or biological growth formation allowable between the panels.

- Those glasses used for viewing the top of the resin bed have clearly visible permanent graduation marks at one-centimetre intervals.
- Glasses are aligned to a resin surface in such a manner that the normal design level of the resin surface is positioned approximately halfway across the sight glass.
- The *Contractor* constructs the vessel to accommodate the sight glasses held in position by bolted flanges with frames.

5.6.8 Vessel Manholes

Access manholes are fitted on top of the vessel and along the bottom sidewall, as per the original cation vessel design. The new manholes are to be the same size as the existing manholes.

All current access platforms and ladders are removed by the *Contractor* for the purpose of access only and are permanently re-installed as per the existing positions and current method of attachment around the new vessels.

Valves, pipework, instrumentation, or any other installation does not restrict or interfere with access to manholes and sight glasses.

5.6.9 Vessel Vents and Drains

Vents and drains are provided for all parts of the vessel, which are not completely vented and drained via the main nozzle connections. All vents and drains are butt-welded connections.

If any vents, drains, instrumentation tapping points or ancillary plant are present on the section that needs to be modified, these are included in the modification and are restored to existing system and purpose.

5.6.10 Vessel External Pipework, Valves, and Other Plant

The *Contractor* disconnects all existing connections to the vessel, ensures the correct preservation and care of these disconnected portions during the process of manufacture and installation of the new vessels, and reconnects all connections (process, electrical and Control and Instrumentation) to the original design requirements, which are re-tested during the commissioning phase of the project.

The *Contractor* is aware of the surrounding plant, which is in operation during the execution of the works and performs adequate risk mitigation.

The *Contractor* takes note of the sample lines currently installed around the cation vessels. The integrity of these lines must be maintained during the execution of the works to ensure that samples are obtainable during the operation of the adjacent trains/vessels.

Should the installation of the new vessels necessitate re-orientation of the existing valves, the *Contractor* takes note that all valves, especially manually operated, wherever possible, are mounted in front of the vessel at a height accessible to a person of average height without undue stretching. Any valve that cannot be so located is listed and a design change is

submitted to the *Project Manager* for review and acceptance. If accepted, the *Contractor* also designs, supplies and installs appropriate access platforms.

The existing vessels are complete with all necessary external pipework, valves and instruments as per the original design drawing. The relevant drawings capturing these details as per the original design. Where necessary, the *Contractor* makes the relevant adjustments to external pipework based on the design code and prepares revised drawings for acceptance by the *Project Manager* prior to manufacturing. The *Contractor* provides updated, revised construction drawings.

The *Contractor* properly assesses and ensures that the piping that connects to the vessel nozzles remain adequately supported while they are disassembled or disconnected, as necessary. Should additional supports be required to maintain the integrity of the piping after disassembly or disconnecting or should they need to be removed in its entirety until the new vessel has been installed, this is correctly performed by the *Contractor*. The *Contractor* is responsible for the correct storage and preservation of the connecting pipes for the period of them being removed and properly re-installed, when required. The *Contractor* is responsible to ensure that all the electrical apparatus e.g., electrical distribution boards and motors are properly protected to prevent water and dust ingress during the execution of the works. Electrical apparatus that could hinder access to working areas are clearly marked by the *Contractor* and permission requested from the *Project Manager* for removal. Upon the granting of permission, they are removed and stored in a safe place by the *Contractor*. All labour, materials, equipment, consumables and plant required for removal and re-installation of piping and safe storage spaces are provided by the *Contractor*.

The *Contractor* ensures that all instrumentation is safely disconnected, tagged and stored safely in the interim, and then reconnected afterwards. All labour, materials, equipment, consumables and plant required for removal and re-installation of piping and clean, safe storage spaces are provided by the *Contractor*.

5.6.11 Vessel Lifting Lugs

All new vessels are supplied with permanent lifting lugs and adequate provisions are made by the *Contractor* for safely lifting and handling the total weight of the vessel.

5.6.12 Vessel Nameplates and External Markings

Each vessel is provided with a conspicuous, permanent, corrosion-resistant nameplate.

The information recorded on the nameplate is in SI units.

The nameplate, as a minimum, displays the information required by the applicable Code and the requirements of OHS Act of 1993 with reference to the Pressure Equipment Regulations (PER).

The new cation exchange vessels are labelled/marked appropriately as per the Eskom Plant Labelling Standard, 240-71432150.

5.6.13 Vessel Supporting Columns

The new vessel supports or feet must be in the same positions as the existing vessel supports.

The new vessels are supported on the existing support columns. The *Contractor* conducts the necessary calculations and design checks to ensure the existing supports can safely carry the new vessels. All calculations and evaluation reports are submitted to the *Project Manager* for review and acceptance prior to construction.

The *Contractor* conducts a structural assessment and provides a comprehensive structural assessment report of the support columns. Should the columns require remedial works, the *Contractor* submits a report with the proposed action(s) to the *Project Manager* for acceptance.

Should any modification be required on the supports, the *Contractor* submits the proposed solution/s to the *Project Manager* for review and acceptance as part of the design package.

5.6.14 Removal and Reinstallation of Building Roof

The existing vessels are removed in a phased approach as detailed in section 5.6.15. - New Cation Vessel Installation. The *Contractor* opens a portion of the roof above the existing vessels to be removed. Existing vessels and new vessels are moved out of or into the building by rigging them through the appropriate roof opening. Drawings of the current roof will be made available to the contractor upon request.

The *Contractor* conducts a detailed constructability analysis of the plant and provides a detailed method statement to replace the vessels. This is submitted to the *Project Manager* for review and acceptance in advance of any work beginning.

A preliminary constructability analysis has been conducted by the *Employer*. This report is supplied to the *Contractor* upon request and may be used as a basis for the *Contractor*'s detailed constructability analysis.

The *Contractor*'s analysis considers, as a minimum the following; construction access, facilities, services, and utilities, noting the demineralised water production plant shall remain in operation while the works are executed.

The *Contractor*'s analysis thoroughly considers the effect on the roof supporting structures such as purlins, bracing and sag bars.

The *Contractor* conducts design calculations and verifies that the removal of roof members does not have an impact on the integrity of the roof, ensuring safety at all times.

All calculations and structural analyses performed are submitted to the *Project Manager* for review and acceptance.

The *Contractor* replaces the roof and support structure to the original state using new fasteners, sheeting and sealant, where necessary and replaces anything damaged by removal or improper handling or storage. The roof cannot be kept open for more than two days at a time and the *Contractor* is responsible for protecting any plant that may be damaged by rain and/or adverse weather while the roof is opened. If this time period is not sufficient it should be done so in writing by the contractor.

If the vessel can be replaced by any other method still in-line with the engineering code, a proposal for installation should cater for as an alternative method and stipulated and costed as part of the contractors' alternative proposal.

5.6.15 New Cation Vessel Installation

The *Contractor* studies, understands and documents all the hazards of working in the vicinity of the surrounding chemical plants so that all necessary precautions and mitigations are put in place.

All plant removed for the purpose of access or inspection is also included in the respective activities in the QCP/ITP to ensure that all plant/apparatus is properly re-installed. The removal and re-installation of the plant affected is the responsibility of the *Contractor*. The *Contractor* securely and safely protects the vessels and pipework remaining in service to ensure that they are not damaged during installation. Any damages to the plant may result in serious safety and production related incidents and must be avoided.

The *Contractor* neutralises and cleans any sulphuric acid or caustic soda from the conveying pipework removed for installing a vessel to prevent chemical burns during handling and environmental contamination from occurring.

The *Contractor* submits a proposal outlining the planned method for use to remove the existing vessels and installation of the new vessels for the *Project Manager*'s review and acceptance. Only after acceptance is given in writing, may the removal and installation begin.

The *Contractor* removes the scrapped vessels and fixtures from their positions and treats them as general waste. The *Contractor* disposes of them according to the *Employer*'s waste management procedure.

The *Contractor* supplies and fits new fixtures, fittings and hold-down bolts and secures the new vessels into position.

Provision is made by the *Contractor* for various internal inspections of each vessel including final internal inspection before boxing-up and commissioning.

5.6.16 Process Design Requirements

- The cation vessel gets it feed from the Filter supply pumps which takes suction from the filtered water sump and feeds the pre-treated water through the sandfilters and then into the cation vessel. The specifications of the filter supply pumps are as indicated below:

Table 3: Sandfilter Feed Pump Parameters

Parameter	Value	Units
Flow	225	m3/hr
Pressure	395	kPa

- The basis of the current design of the feed water to be treated by the Cation exchanger is indicated in Table 2: Cation Inlet Qualities for the Past 5 Years above.
- The current vessels have the following design specifications in Table 4 that should be consistent in the new vessel design for ease of operation and maintenance.

Table 4: Cation Vessel Design Specification

Parameter	Value	Unit
Nominal Flow	220	m3/h
Linear Velocity	32.5	m/h
Specific load	12.4	m3/m3/hr
Maximum pressure drop	150	kPa
Height (tan-tan line)	4.8	m
Inside Diameter	3	m
Design P/T	600 @ 40	kPa/˚C
Operating P/T	320 @ 25	kPa/˚C
Material of Construction	Rubber lined mild steel	-
Volume of Resin in Vessel	Refer to Appendix A	litres

More information is contained in Appendix F1 – WTP Equipment list and drawing indicated in the spreadsheet. If more information is needed by the contractor it should be done at tender phase so that contractor is comfortable to quote accordingly.

- The resin type is a consumable and may change between suppliers as the need arises.
- The cation outlet water quality must be in accordance with Table 12 in the Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water.
- Upon completion of the 11 000m^3 run or should the sodium (or silica) in the cation (or anion) outlet water quality exceed the specification, the train is taken out of service for regeneration to take place. Both the anion and cation vessels are regenerated at that point, with the mixed bed exchanger undergoing regeneration after about every ten anion regenerations. The regeneration sequence is manually initiated by the operator in the control room but runs through the sequence automatically.
- The cation vessels therefore, experience two sets of cycles, the production cycle and the regeneration cycle.

5.6.17 Parts of the Works which the *Contractor* is to Design

- The *Contractor* is required to design, supply, install, and commission three new cation exchange vessels as per the specifications listed under Section 5.6, and which conforms to the design process design requirements listed under Section 5.6.16 Process Design Requirements.

- The proposed design is a cost-effective option and is in the best interest of the *Employer*.
- The *Contractor* performs a process flow dynamics assessment of the existing system as part of the design process; refer to section Vessel Flow Dynamics Assessment, as part of the design.
- The *Contractor* verifies and satisfies himself that the *Employer*'s design requirements regarding the vessel shell thickness, is supported for the stress loads and mechanical strain of the vessel identified by the flow dynamics assessment.
- Where strains/stresses are observed during the flow dynamics assessment, the *Contractor* proposes, as part of the design, the necessary modifications to be made to the existing system either through the control logic or plant and equipment that is necessary to eliminate these strains/stresses. A detailed design of these modifications is required to allow for implementation.

5.6.18 Procedure for Submission and Acceptance of *Contractor*'s Design

- The *Contractor* submits a preliminary detailed design package for construction, for accepted by the *Project Manager* before any fabrication commences.
- The *Project Manager* provides the new AKZ codes (plant codification) where necessary and provides the coded drawings back to the *Contractor* to have all relevant plant AKZ labels manufactured and installed.
- The *Contractor* notes that the *Employer* requires a minimum of thirty (30) working days for review of all engineering information for acceptance before continuing with construction. A Detailed Design review is conducted once the detailed designs are compiled by the *Contractor*. The *Contractor* provides an allowance for this review in the project programme. The detailed design report is compiled by the *Contractor* using the Eskom Document Template number 240-49910707.
- The 240 - 53113685 Design Review Procedure is followed for the review of the *Contractor*'s design at the end of the Detailed Design phase. The *Contractor* ensures that at least thirty (30) working days' notice is provided before any acceptance is required. All documentation required for the detailed design phase is submitted prior to the start of the thirty working day notice period.
- The *Contractor* notes that incomplete design submissions are rejected for re-submission by the *Contractor*.
- The End-of-Phase Review is a milestone and hold point in the project and is approved before moving onto the next phase.
- The *Contractor* allows for time in the schedule to address comments from the review and for rework, if required.
- Interim reviews are recommended during the design phase to ensure that major issues are rectified and to prevent delays that could result from an End-of-Phase review being rejected. The overall design however, will only be accepted once whole design package is reviewed.
- Supply and installation of the components are subject to the *Project Manager* approval of the final design package and written approval to implement the solution. The approved design package must be available prior to the start of installation activities.

- The final detailed design package, including all 'as-built' general arrangement drawings and datasheets for the new cation exchanger vessels, is signed off by the *Project Manager* and *Contractor* representative prior to contract completion.
- The *Contractor* ensures that the detailed design is reviewed, approved and signed off by an ECSA professionally registered mechanical or process engineer, as well as an ECSA professionally, registered electrical or control & instrumentation engineer.
- As per the definitions in the Design Review Procedure, the *Contractor* is the Design Authority for this Scope of Work.

5.6.19 Other Requirements of the *Contractor*'s Design

5.6.19.1 HAZOP Study

- The *Contractor* carries out formal Hazard and Operability (HAZOP) study involving the *Employer's* design team, which includes Engineering, Operation and Maintenance team members.
- The *Contractor* is responsible for appointing a trained facilitator, independent of the project team, to conduct the HAZOP study.
- This study is done in accordance with the requirements as laid down in Eskom HAZOP Guideline: 240-49230111. The HAZOP report is sent to the *Project Manager* for review before the final report is issued to the *Project Manager* for acceptance.
- The *Contractor* makes provision for the submission and review of the HAZOP in the programme after the process and C&I designs are complete but before the detailed design is finalised.
- The *Contractor* is responsible for updating the design as per the actions noted during the HAZOP study to address the deficiencies noted.

5.6.20 Use of *Contractor*'s Design

- There are no restrictions imposed on the *Employer's* use of the *Contractor*'s design.
- The *Employer* may use, copy and distribute the *Contractor*'s design for any purpose including use for procurement, construction, modification, alteration and demolition of the works.
- The *Contractor* grants the *Employer* full rights and ownership of the *Contractor*'s design, drawings, datasheets, specifications and other documentation obtained as part of the works.
- Construction and As-built drawings, operating manuals and maintenance schedules
- The *Contractor* provides both construction and As-built drawings in MicroStation (DGN) format as well as Tiff and/or PDF formats. Three (3) A1 size, hard copies and an electronic copy of each drawing is submitted to the *Project Manager*.
- The approved design package with designs, drawings, installation and operating manuals and maintenance schedules, material and equipment datasheets etc. must be available prior to installation and are necessary to conduct commissioning activities.
- The *Contractor* re-draughts all drawings listed in Table 4 and submits them in hard copies and electronically (requirements as stated above) to the *Project Manager* for

review and acceptance. The existing isometric drawings that pertain to the same plant sections may be combined, where proposed and agreed.

5.6.21 Resin Strainers

The *Contractor* must also inspect all the strainers on the vessel and replace if required. There are four strainers on each cation vessel

1. Back wash outlet (08-10UB1[1-3]G002)
    - Size: 100mm (NB)
    - Material of Construction: U-PVC
    - Process Fluid: Demin Plant Regeneration Effluent Water (2% H_2SO_4) Effluent Solution)
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Flow Rate: 60m^3/hr

2. Bottom Outlet inline witch hat strainer
    - Size: 200mm (NB)
    - Material of Construction: SS 316L
    - Process Fluid: Decationised water and 2% H_2SO_4
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Flow Rate: 280m^3/hr

3. Vent strainers – (08-10UB1[1-3]G003)
    - Size: 50mm (NB)
    - Material of Construction: TBC
    - Process Fluid: Demin Plant Regeneration Effluent Water (2% H_2SO_4)
    - Pressure Rating: PN16
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Cover Closure: Threaded Nut
    - Flow Rate: 60m^3/hr

4. Sample probe strainer
    - Refer to 0.63/4698 Sample probe strainer details

Figure 1: Typical bottom outlet SS316L witch hat strainer

Figure 2: Typical Backwash Outlet U-PVC strainer

All welding done must comply with the detailed requirements for welding as per section 8.

In addition to the above, all bolts, nuts, washers and gaskets must also be replaced.

5.6.22 Drawings

Drawings which show construction details of these vessel can be found in the drawing list in Section 0.

Applicable drawings to this section of the scope are:

0.63	1849	CATION UNIT NO. 1, 2 and 3
0.63	04683 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET CATION ARRANGEMENT
0.63	04683 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET CATION LATERAL DETAILS
0.63	04683 Sheet 3	WTP (WATER TREATMENT PLANT) TOP INLET CATION CLIPS ON VESSEL DETAILS
0.63	04683 Sheet 4	WTP (WATER TREATMENT PLANT) TOP INLET CATION SUPPORT ANGLE DETAILS
0.63	04684 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET CATION PARTS LIST
0.63	04684 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET CATION PARTS LIST
0.63	04685 Sheet 1	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) LATERAL DETAILS
0.63	04685 Sheet 2	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) LATERAL DETAILS
0.63	04685 Sheet 3	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) CLIPS ON VESSEL DETAILS
0.63	04685 Sheet 4	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) SUPPORT ANGLE DETAILS
0.63	04686 Sheet 1	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) PARTS LIST
0.63	04686 Sheet 2	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) PARTS LIST
0.63	04687 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR (CATION) ARRANGEMENT
0.63	04687 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR (CATION) LATERAL DETAILS
0.63	04688 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR (CATION) PARTS LIST

0.63	04688 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR (CATION) PARTS LIST
0.63	04689 Sheet 1	WTP (WATER TREATMENT PLANT) BOTTOM REGENERANT DISTRIBUTOR (CATION) ARRANGEMENT
0.63	04690 Sheet 2	WTP (WATER TREATMENT PLANT) BOTTOM REGENERANT DISTRIBUTOR (CATION) PARTS LIST
0.63	04691 Sheet 1	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR DISTRIBUTOR (CATION) ARRANGEMENT
0.63	04691 Sheet 2	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR DISTRIBUTOR (CATION) PARTS LIST

5.7 Atmospheric Degasser Requirements

Three atmospheric degassers are installed. The atmospheric degasser consists of a cylindrical vessel, vertically mounted, closed at the bottom, but open to atmosphere at the top by way of a stack which passes through the roof of the water treatment plant building. The unit is fabricated from carbon steel and is rubber lined internally.

The water enters at the top of the unit through a header and lateral system which ensures good distribution of the flow over the cross-sectional area of the unit.

Just below the distribution system, plastic pall rings are packed into the vessel and occupy most of the top half of the unit. They are supported on a grid which rests on rubber lined steel supports.

The water from the degasser flows into a degasser sump. The refurbishment of the degasser sump and blowers are covered in another section of the works in this document.

A fan mounted alongside each atmospheric degasser blows filtered air into the unit.

The fan entry is below the pall ring supports. The air passes up through the pall ring packing and passes out through the stack mounted on the top of the vessel.

The inspection report will determine if complete rubber lining is required or patch repairs. The *Contractor* will tender for either patch repairs per square meter (for a maximum of 30% of full surface area of the vessel) or for a complete vessel rubber lining. The *Contractor* must remove the internal laterals and beams in the vessels, as well as the packing inside the degasser and the bottom fibreglass grid. Once this has been removed, inspection and testing of the vessel will be done as stated in 5.2. If rubber lining is required, the vessel, supports and all beams needs to be rubber lined using 6mm Grade B Butyl rubber. Sandblast the whole vessel with silica free sand blasting grit. The *Contractor* must ensure that there is a system installed which will remove the dust created during sandblasting and must be exhausted outside the building in a designated area. Please take note that this is a demineralisation plant and hence the cleanliness during blasting operations is of outmost importance to prevent contamination during production.

Refer to section 5.14 for more details on the rubber lining requirement. The specifications for the atmospheric degasser vessel are as per Table 5 below, and the dimensions can be used to determine the rubber lining requirements for the vessel.

Surface preparation, Grit blasting and rubber lining will be done as per specific specification GAM/MAT/62 in E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining).

The supports must be straightened before rubber lining is done. If complete replacement of the supports is required, the *Contractor* must price for the replacement and rubber lining of the supports as well. Depending on the inspection report, the *Contractor* together with Eskom will decide if the top laterals must be replaced. The *Contractor* must tender for the replacement of the lateral system and the labour for removal and installation as separate line items in the price list. The condition of the pall rings must be assessed once it is removed to decide if it can be reused or it must be replaced. The *Contractor* must provide a costing for installing new pall rings. A photo of the pall rings can be found in Figure 3. The *Contractor* must also tender for the replacement of the fibreglass grid on which the pall rings are supported and the labour for removal and installation as separate line items in the price list. Depending on the inspection report, the *Contractor* together with Eskom will decide if the grid must be replaced.

Figure 3: Photo of the pall ring in the degasser

Table 5: Atmospheric Degasser vessel design specification

Parameter	Value	Unit

Height	6.618	m
Diameter	2.5	m
Design P/T	Atm. @ 40	kPa/˚C
Operating P/T	Atm. @ 25	kPa/˚C
Material of Construction	Mild steel (Rubber lined)	-

The *Contractor* must also do thickness testing on the entire vessel and provide a report of the thickness of the shell. The thickness test must be done without removing the paint from the vessel.

Drawings which show construction details of these vessel can be found in the drawing list in Section 0.

Applicable drawings to this section of the scope are:

0.63	04692 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET DEGASSER ARRANGEMENT
0.63	04692 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET DEGASSER CLIPS ON VESSEL DETAILS
0.63	04693 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET DEGASSER PARTS LIST
0.63	04693 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET DEGASSER PARTS LIST
0.63	04717	WTP (WATER TREATMENT PLANT) DEGASSER DETAILS
0.63	1850	DEGASSER UNIT NO. 1, 2 and 3
0.63	1634	Degasser General arrangement

The *Contractor* applies the necessary corrosion protection layers on the whole vessel as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining).
- E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification

- E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings. In addition to the above, all bolts, nuts, washers and gaskets must also be replaced.

5.8 Weak Base Anion (WBA) Vessels Requirements

Three weak base anion units are installed. Each unit consists of a steel pressure vessel which is rubber lined internally. The weak anion resin is contained in these units. The unit is cylindrical in section and stands vertically. The resin occupies approximately two thirds of the vertical height of the vessel.

The vessel has dished ends, with a bottom tekapor false floor is fitted. An access manhole is also provided on the side as well as the top of the vessel. Water enters at the top of the vessel through a distributor consisting of a header and lateral system and downward through the resin bed and out of the vessel.

A collector fitted in the tekapor floor collects the water. The tekapor floor retains the resin whilst allowing the water to be collected. The tekapor floor is problematic and has failed frequently.

As the main offer, the *Contractor* needs to redesign the existing vessels to have a concrete filled base which is rubber lined. The outlet collection system must be a header and lateral system. The new laterals must still connect to the pipework which is on the outlet of the vessel.

The *Contractor* can provide an alternative offer for the redesign of the existing vessels with a false flat bottom.

The design of the bottom the outlet collection system is the responsibility of the *Contractor*. As part of the design, the *Contractor* must check that the load of the vessel (vessel, lateral system and resin) is within limits of the acceptable loading of the floor and civil support structures in the WTP. Refer to Section 11.3.3 for detail requirements regarding the structural verification of supporting infrastructures. Additionally refer to Drawing 02861.02 - WTP (WATER TREATMENT PLANT) (WEST) - RAFT SLAB - CONCRETE LAYOUT & 02862.02 - WTP (WATER TREATMENT PLANT) (WEST) - GROUND SLAB- CONCRETE LAYOUT SECTIONS for more information of the civil construction of the Water treatment plant.

Refer to Appendix A for details on the resin.

The top inlet and caustic injection must be replaced with what is currently installed.

5.8.1 Process Design Requirements

- The weak base anion vessel gets it feed from the anion supply pumps which takes suction from the degasser sump and feeds the decationised water into the weak base anion vessel. The specifications of the anion supply pumps are as indicated below:

Table 6: Anion Supply Pump Parameters

Parameter	Value	Units

Flow	222	m3/hr
Pressure	5.66	bar

- The current vessels have the following design specifications in Table 7 that should be consistent in the new vessel design for ease of operation and maintenance.

Table 7: Weak base anion vessel design specification

Parameter	Value	Unit
Nominal Flow	220	m3/h
Linear Velocity	32.5	m/h
Specific load	26.4	m3/m3/hr
Maximum pressure drop	90	kPa
Height (tan-tan line)	2.4	m
Inside Diameter	3	m
Design P/T	730 @ 60	kPa/˚C
Operating P/T	480 @ 50	kPa/˚C
Material of Construction	Rubber lined mild steel	-
Volume of Resin in Vessel	Refer to Appendix A	litres

- The resin type is a consumable and may change between suppliers as the need arises.
- The weak base anion outlet water quality must be in accordance with Table 13 in the Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water.
- Upon completion of the 11 000 m^3 run or should the sodium (or silica) in the cation (or anion) outlet water quality exceed the specification, the train is taken out of service for regeneration to take place. Both the anion and cation vessels are regenerated at that point, with the mixed bed exchanger undergoing regeneration after about every ten anion regenerations. The regeneration sequence is manually initiated by the operator in the control room but runs through the sequence automatically.
- The weak base anion vessels therefore, experience two sets of cycles, the production cycle and the regeneration cycle.

5.8.2 Vessel Internal Pipework, Headers and Laterals

The *Contractor* designs and installs new internal pipework, i.e., the headers, laterals and collecting pipework. The *Contractor* provides a manufacturing drawing of all laterals to be replaced. The drawings of the originally installed laterals and headers are provided to the *Contractor*. The *Contractor* is responsible to provide flow modelling of the distribution system to prove the even flow distribution through the system with no channelling occurring through the resin bed.

The new headers and laterals in the weak base anion exchange vessels are constructed with grade 316 L stainless steel.

All the internal distribution pipelines are supplied with a 3.1 certification as per BS EN 10204:2004.

Bottom collection systems are designed to ensure minimal “dead” resin space.

Gravel under beds, as support for ion exchange material are not permitted.

The ion exchange resin is contained in the cylindrical section of the vessel and not the domes. The typical volume of resin is as per

Appendix A: Current Ion Exchange Resins.

5.8.3 Rubber lining

The inspection report will determine if complete rubber lining is required or patch repairs. The *Contractor* will tender for either patch repairs per square meter (for a maximum of 30% of full surface area of the vessel) or for a complete vessel rubber lining. The *Contractor* must remove the internal laterals, headers and beams in the vessels inside the vessel. Once this has been removed, inspection and testing of the vessel will be done as stated in 5.2. If rubber lining is required, the vessel, supports and all beams needs to be rubber lined using 6mm Grade B Butyl rubber. Sandblast the whole vessel with silica free sand blasting grit. The *Contractor* must ensure that there is a system installed which will remove the dust created during sandblasting and must be exhausted outside the building in a designated area. Please take note that this is a demineralisation plant and hence the cleanliness during blasting operations is of outmost importance to prevent contamination during production.

Refer to section 5.14 for more details on the rubber lining requirement. The design specifications for the Weak base anion vessel are as per Table 7: Weak base anion vessel design specification above, and the dimensions can be used to determine the rubber lining requirements for the vessel. Surface preparation, Grit blasting and rubber lining will be done as per specific specification E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining).

The supports must be straightened before rubber lining is done. If complete replacement of the supports is required, the *Contractor* must price for the replacement and rubber lining of the supports as well. Depending on the inspection report, the *Contractor* together with Eskom will decide if the laterals must be replaced. The *Contractor* must tender for the replacement of the lateral systems and the labour for removal and installation as separate line items in the price list.

The *Contractor* must also do thickness testing on the entire vessel and provide a report of the thickness of the shell. The thickness test must be done without removing the paint from the vessel.

In addition to this, there may be various repairs which needs to be done one the vessel shell walls because of leaks. The *Contractor* must make allowance for welding in each vessel, based on a rate per linear meter and a total welding length of 30m per vessel. Once inspections are done after the rubber has been stripped by the *Contractor*, then the scope for welding can be finalised. The material used on the vessel for welding must be the same as the original material. The detailed requirements for welding are as per Section 8.

The *Contractor* applies the necessary corrosion protection layers on the whole vessel as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining).

- E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings.

5.8.4 Resin strainers

The *Contractor* must also inspect all the strainers on the vessel and replace if required. There are four strainers on the weakbase anion vessel

1. Back wash outlet
    - Size: 100mm (NB)
    - Material of Construction: U-PVC
    - Process Fluid: Demin Plant Regeneration Effluent Water (4% NaOH) Effluent Solution)
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Flow Rate: 25m^3/hr

2. Bottom Outlet
    - Size: 200mm (NB)
    - Material of Construction: SS 316L
    - Process Fluid: Decationised water and 4% NaOH
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Flow Rate: 280m^3/hr

3. Vent strainer
    - Size: 50mm (NB)
    - Material of Construction: TBC
    - Process Fluid: Demin Plant Regeneration Effluent Water (4% NaOH)
    - Pressure Rating: PN16
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Cover Closure: Threaded Nut
    - Flow Rate: 25m^3/hr

4. Sample probe strainer
    - Refer to 0.63/4698 Sample probe strainer details

5.8.5 Sight glasses

The *Contractor* must also replace the sight glasses on the vessels. There are 3 sight glasses on the anion vessel (Refer to Drawing 0.63/1874).

- Sight glasses are flush with the inside wall of the vessel and do not provide for entrapment of resin.
- Sight glasses are oval with dimensions as per drawings below
- Those glasses used for viewing the top of the resin bed have clearly visible permanent graduation marks at one-centimeter intervals.
- Glasses are aligned to a resin surface in such a manner that the normal design level of the resin surface is positioned approximately halfway across the sight glass.
- The sight glass installed does not turn opaque with either time or exposure. Should double panels be utilised, there is no condensation or biological growth formation allowable between the panels.

Drawings which show construction details of these vessel can be found in the drawing list in Section 0.

Applicable drawings to this section of the scope are:

0.63	04696 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) ARRANGEMENT
0.63	04696 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) CLIPS ON VESSEL DETAILS
0.63	04696 Sheet 3	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) LATERAL DETAILS
0.63	04696 Sheet 4	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) SUPPORT ANGLE DETAILS
0.63	04697 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) PARTS LIST
0.63	04697 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) PARTS LIST
0.63	04699 Sheet 1	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR WEAK BASE ANION EXCHANGER MATERIAL LIST
0.63	04699 Sheet 2	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR WEAK BASE ANION EXCHANGER PARTS LIST
0.63	04702	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM (STRONG BASE ANION) ARRANGEMENT
0.63	04703	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM (STRONG BASE ANION) PARTS LISTS
0.63	04704 Sheet 1	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR (WITH REGENERANT DISTRIBUTOR) MATERIAL LIST
0.63	04704 Sheet 2	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR (WITH REGENERANT DISTRIBUTOR) PARTS LIST
0.63	04724 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) ARRANGEMENT

0.63	04724 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) LATERAL DETAILS
0.63	04724 Sheet 3	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) CLIPS ON VESSEL DETAILS
0.63	04724 Sheet 4	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) SUPPORT ANGLE
0.63	04725 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) PARTS LIST
0.63	04725 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) PARTS LIST
0.63	1851	WEAK BASE ANION UNITS NO. 1, 2 AND 3

In addition to the above, all bolts, nuts, washers and gaskets must also be replaced.

5.9 Strong base anion vessels Requirements

Three strong base anion units are installed. Each unit consists of a steel pressure vessel which is rubber lined internally. The strong anion resin is contained in this vessel.

The vessel is cylindrical and stands vertically. The resin occupies approximately two thirds of the vertical height of the vessel.

The vessel has dished ends, with a bottom tekapor false floor is fitted. An access manhole is also provided on the side as well as the top of the vessel. Water enters at the top of the vessel through a distributor consisting of a header and lateral system and downward through the resin bed and out of the vessel.

A collector fitted in the tekapor floor collects the water. The tekapor floor retains the resin whilst allowing the water to be collected. The tekapor floor is problematic and has failed frequently.

As the main offer, the *Contractor* needs to redesign the existing vessels to have a concrete filled base which is rubber lined. The bottom caustic injection and outlet collection system must be a header and lateral system. The new laterals must still connect to the pipework which is on the outlet of the vessel.

The *Contractor* can provide an alternative offer for the redesign of the existing vessels with a false flat bottom.

The design of the bottom caustic injection as well as the outlet collection system is the responsibility of the *Contractor*. As part of the design, the *Contractor* must check that the load of the new vessel is within limits of the acceptable loading of the floor and civil support structures in the WTP. Refer to Section 11.3.3 for detail requirements regarding the structural verification of supporting infrastructures. Additionally refer to Drawing 02861.02 - WTP (WATER TREATMENT PLANT) (WEST) - RAFT SLAB - CONCRETE LAYOUT & 02862.02 - WTP (WATER TREATMENT PLANT) (WEST) - GROUND SLAB- CONCRETE LAYOUT SECTIONS for more information of the civil construction of the Water treatment plant.

The top inlet must be replaced with what is currently installed.

5.9.1 Process Design Requirements

- The strong base anion vessel gets it feed from the anion supply pumps which takes suction from the degasser sump and feeds the decationised water into the weak base anion vessel and then into the strong base anion vessel.
- The current vessels have the following design specifications in Table 8 that should be consistent in the new vessel design for ease of operation and maintenance.

Table 8: Strong base anion vessel design specification

Parameter	Value	Unit
Nominal Flow	220	m3/h
Linear Velocity	37.3	m/h
Specific load	28.4	m3/m3/hr
Maximum pressure drop	120	kPa
Height (tan-tan line)	3	m
Inside Diameter	2.8	m
Design P/T	730 @ 60	kPa/˚C
Operating P/T	320 @ 50	kPa/˚C
Material of Construction	Rubber lined mild steel	-
Volume of Resin in Vessel	Refer to appendix A	litres

- The resin type is a consumable and may change between suppliers as the need arises.
- The strong base anion outlet water quality must be in accordance with Table 14 in the Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water.
- Upon completion of the 11 000 m^3 run or should the sodium (or silica) in the cation (or anion) outlet water quality exceed the specification, the train is taken out of service for regeneration to take place. Both the anion and cation vessels are regenerated at that point, with the mixed bed exchanger undergoing regeneration after about every ten anion regenerations. The regeneration sequence is manually initiated by the operator in the control room but runs through the sequence automatically.
- The strong base anion vessels therefore, experience two sets of cycles, the production cycle and the regeneration cycle.

5.9.2 Vessel Internal Pipework, Headers and Laterals

The *Contractor* designs and installs new internal pipework, i.e., the headers, laterals and collecting pipework. The *Contractor* provides a manufacturing drawing of all laterals to be replaced. The drawings of the originally installed laterals and headers are provided to the *Contractor*. The *Contractor* is responsible to provide flow modelling of the distribution system to prove the even flow distribution through the system with no channelling occurring through the resin bed.

The new headers and laterals in the weak base anion exchange vessels are constructed with grade 316 L stainless steel.

All the internal distribution pipelines are supplied with a 3.1 certification as per BS EN 10204:2004.

Bottom collection systems are designed to ensure minimal “dead” resin space.

Gravel under beds, as support for ion exchange material are not permitted.

The ion exchange resin is contained in the cylindrical section of the vessel and not the domes. The typical volume of resin is as per

Appendix A: Current Ion Exchange Resins.

5.9.3 Rubber lining

The inspection report will determine if complete rubber lining is required or patch repairs. The *Contractor* will tender for either patch repairs per square meter (for a maximum of 30% of full surface area of the vessel) or for a complete vessel rubber lining. The *Contractor* must remove the internal laterals, headers and beams in the vessels inside the vessel. Once this has been removed, inspection and testing of the vessel will be done as stated in 5.2. If rubber lining is required, the vessel, supports and all beams needs to be rubber lined using 6mm Grade B Butyl rubber. Sandblast the whole vessel with silica free sand blasting grit. The *Contractor* must ensure that there is a system installed which will remove the dust created during sandblasting and must be exhausted outside the building in a designated area. Please take note that this is a demineralisation plant and hence the cleanliness during blasting operations is of outmost importance to prevent contamination during production.

Refer to section 5.14 for more details on the rubber lining requirement. The design specifications for the Strong base anion vessel are as per Table 8: Strong base anion vessel design specification Table 8 above, and the dimensions can be used to determine the rubber lining requirements for the vessel. Surface preparation, Grit blasting and rubber lining will be done as per specific specification E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining).

The supports must be straightened before rubber lining is done. If complete replacement of the supports is required, the *Contractor* must price for the replacement and rubber lining of the supports as well. Depending on the inspection report, the *Contractor* together with Eskom will decide if the laterals must be replaced. The *Contractor* must tender for the replacement of the lateral systems and the labour for removal and installation as separate line items in the price list.

The *Contractor* must also do thickness testing on the entire vessel and provide a report of the thickness of the shell. The thickness test must be done without removing the paint from the vessel.

In addition to this, there may be various repairs which needs to be done one the vessel shell walls because of leaks. The *Contractor* must make allowance for welding in each vessel, based on a rate per linear meter and a total welding length of 30m per vessel. Once inspections are done after the rubber has been stripped by the *Contractor*, then the scope for welding can be finalised. The material used on the vessel for welding must be the same as the original material. The detailed requirements for welding are as per Section 8.

The *Contractor* applies the necessary corrosion protection layers on the whole vessel, as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining).

- E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings.

5.9.4 Resin Strainer

The *Contractor* must also inspect all the strainers on the vessel and replace if required. There are four strainers on the strong base anion vessel.

1. Back wash outlet
    - Size: 100mm (NB)
    - Material of Construction: U-PVC
    - Process Fluid: Demin Plant Regeneration Effluent Water (4% NaOH) Effluent Solution)
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Flow Rate: 25m^3/hr

2. Bottom inline witch hat outlet strainer
    - Size: 200mm (NB)
    - Material of Construction: SS 316L
    - Process Fluid: Decationised water and 4% NaOH
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Flow Rate: 280m^3/hr

3. Vent strainer
    - Size: 50mm (NB)
    - Material of Construction: TBC
    - Process Fluid: Demin Plant Regeneration Effluent Water (4% NaOH)
    - Pressure Rating: PN16
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Cover Closure: Threaded Nut
    - Flow Rate: 25m^3/hr

4. Sample probe strainer
    - Refer to 0.63/4698 Sample probe strainer details

5.9.5 Sight glasses

The *Contractor* must also replace the sight glasses on the vessels. There are 3 sight glasses on the anion vessel. Refer to drawing 0.63/1874.

- Sight glasses are flush with the inside wall of the vessel and do not provide for entrapment of resin.
- Sight glasses are oval with dimensions as per drawings below
- Those glasses used for viewing the top of the resin bed have clearly visible permanent graduation marks at one-centimeter intervals.
- Glasses are aligned to a resin surface in such a manner that the normal design level of the resin surface is positioned approximately halfway across the sight glass.
- The sight glass installed does not turn opaque with either time or exposure. Should double panels be utilised, there is no condensation or biological growth formation allowable between the panels.

Drawings which show construction details of these vessel can be found in the drawing list in Section 0.

Applicable drawings to this section of the scope are:

0.63	04694 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) ARRANGEMENT
0.63	04694 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) LATERAL DETAILS
0.63	04694 Sheet 3	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) CLIPS ON VELLEL DETAILS
0.63	04694 Sheet 4	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) SUPPORT ANGLE
0.63	04695 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) PARTS LISTS
0.63	04695 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) PARTS LIST
0.63	04700 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR STRONG ANION ARRANGEMENT
0.63	04700 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR STRONG ANION LATERAL DETAILS
0.63	04701 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR STRONG ANION PARTS LISTS
0.63	04701 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR STRONG ANION PARTS LISTS
0.63	04702	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM (STRONG BASE ANION) ARRANGEMENT
0.63	04703 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM (STRONG BASE ANION) PARTS LISTS

0.63	1852	STRONG BASE ANION VESSEL No. 1, 2 and 3

In addition to the above, all bolts, nuts, washers and gaskets must also be replaced.

5.10 Mixed bed vessels Requirements

Three mixed bed units are installed. They form the last part of the demineralisation process. Both cation and anion resin are contained in the mixed bed vessels.

Each unit consists of a steel pressure vessel which is rubber lined internally. The vessel is cylindrical and is mounted vertically. Access manholes are provided at the top and on the side.

Water enters at the top of the vessel where an inlet distributor is fitted. The inlet distributor consists of a header.

A bottom floor is a nozzle plate which is fitted plastic nozzles.

The following components inside the mixed bed vessels must be replaced:

- All the nozzles in the bed plate inside of each vessel
- Top inlet header with all its laterals
- Caustic injection header with all its laterals
- Mid collector (effluent outlet) header with all its laterals
- Acid injection headers with all its laterals.
- All the bolts, nuts, washers and gaskets

Table 9: Mixed base anion vessel design specification

Parameter	Value	Unit
Nominal Flow	220	m3/h
Linear Velocity	51	m/h
Specific load	45.9	m3/m3/hr
Maximum pressure drop	100	kPa
Height (tan-tan line)	2.25	m
Inside Diameter	2.4	m
Design P/T	730 @ 60	kPa/˚C
Operating P/T	320 @ 50	kPa/˚C
Material of Construction	Rubber lined mild steel	-
Volume of Resin in Vessel	Refer to Appendix A	litres

All the nozzles in the bed plate must be replaced. There are 340 nozzles in each vessel. The nozzles should be acid and caustic soda resistant and should not contain silica. A nozzle must be procured which matches the existing nozzle in every aspect. The datasheet for the new nozzles will be reviewed by the *Employer*, and only upon acceptance of the nozzle, will procurement be allowed. The flowrate through the nozzles in production and in regeneration mode, as well as pressure drop across the nozzles must be taking into consideration when nozzles are selected. A pressure drop versus flow curve must be supplied together with the data sheet. The thickness of the nozzle plate is approximately 25mm thick and the diameter of the holes in the nozzle plate is approximately 42mm without rubber. If 6mm rubber is used the diameter on the nozzle hole will be 30mm. These are approximate dimensions and should be confirmed by the *Contractor.* Refer to Figure 26. The open slit width must be no more than 0.2mm.

Figure 4: Side view of mixed bed nozzle

Figure 5: Side view of mixed bed nozzle showing slit

Figure 6: Bottom view of mixed bed nozzle

Figure 7: The mixed bed flush ring

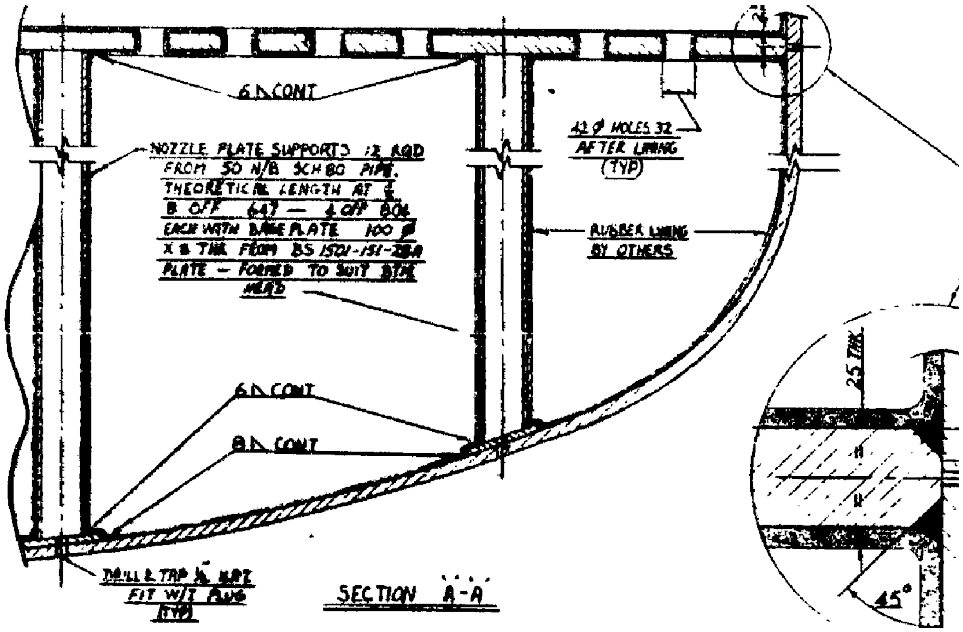


Figure 8: Schematic of the bottom nozzle plate in mixed bed nozzle

Figure 9: Picture of current mixed bed floor arrangement

5.10.1 Rubber lining

The inspection report will determine if complete rubber lining is required or patch repairs. The *Contractor* will tender for either patch repairs per square meter (for a maximum of 30% of full surface area of the vessel) or for a complete vessel rubber lining. The *Contractor* must remove the internal laterals, headers and beams in the vessels inside the vessel. Once this has been removed, inspection and testing of the vessel will be done. If rubber lining is required, the vessel, supports and all beams needs to be rubber lined using 6mm Grade B Butyl rubber. Sandblast the whole vessel with silica free sand blasting grit. The *Contractor* must ensure that there is a system installed which will remove the dust created during sandblasting and must be exhausted outside the building in a designated area. Please take note that this is a demineralisation plant and hence the cleanliness during blasting operations is of outmost importance to prevent contamination during production.

Refer to section 5.14 for more details on the rubber lining requirement. The design specifications for the Mixed bed vessel are as per Table 9: Mixed base anion vessel design specification and the dimensions can be used to determine the rubber lining requirements for the vessel. Surface preparation, Grit blasting and rubber lining will be done as per specific specification E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining).

The supports must be straightened before rubber lining is done. If complete replacement of the supports is required, the *Contractor* must price for the replacement and rubber lining of the supports as well. The supports for the mid-collector laterals are SS316L and these supports must also be inspected to determine if it can be re-used. Depending on the inspection report, the *Contractor* together with Eskom will decide if the laterals must be replaced. The *Contractor* must tender for the replacement of the lateral systems and the labour for removal and installation as separate line items in the price list.

The *Contractor* must also do thickness testing on the entire vessel and provide a report of the thickness of the shell. The thickness test must be done without removing the paint from the vessel.

In addition to this, there are various repairs which needs to be done one the vessel shell walls because of leaks. The *Contractor* must make allowance for welding in each vessel, based on a rate per linear meter and a total welding length of 30m per vessel. Once inspections are done after the rubber has been stripped by the *Contractor*, then the scope for welding can be finalised. The material used on the vessel for welding must be the same as the original material. The detailed requirement for welding is as per Section 8.

The *Contractor* applies the necessary corrosion protection layers on the whole vessel, as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining).

- E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings.

5.10.2 Resin strainers

The *Contractor* must also inspect all the strainers on the vessel and replace if required. There are four strainers on the mixed bed vessel

1. Back wash outlet
    - Size: 100mm (NB)
    - Material of Construction: U-PVC
    - Process Fluid: Demin Plant Regeneration Effluent Water (6% H_2SO_4 and 4% NaOH Effluent Solution)
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Flow Rate: 25m^3/hr

2. Bottom Outlet (08-10UB5[1-3]G002)
    - Size: 300x100mm (NB)
    - Material of Construction: SS 316L
    - Process Fluid: Decationised water and 6% H_2SO_4 and 4% NaOH
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Flow Rate: 280m^3/hr

3. Vent strainer
    - Size: 40mm (NB)
    - Material of Construction: TBC
    - Process Fluid: Demin Plant Regeneration Effluent Water (6% H_2SO_4 and 4% NaOH)
    - Pressure Rating: PN16
    - Connection: Flanged (Drilled to BS 4504 16/3)
    - Internal Screen Size: 300 micron
    - Cover Closure: Threaded Nut
    - Flow Rate: 60m^3/hr

4. Sample probe strainer
    - Refer to 0.63/4698 Sample probe strainer details

5.10.3 Sight glasses

The *Contractor* must also replace the sight glasses on the vessels. There are four sight glasses on the mixed bed vessel. Refer to drawing 0.63/1874.

- Sight glasses are flush with the inside wall of the vessel and do not provide for entrapment of resin.
- Sight glasses are oval with dimensions as per drawings below
- Those glasses used for viewing the top of the resin bed have clearly visible permanent graduation marks at one-centimeter intervals.
- Glasses are aligned to a resin surface in such a manner that the normal design level of the resin surface is positioned approximately halfway across the sight glass.
- The sight glass installed does not turn opaque with either time or exposure. Should double panels be utilised, there is no condensation or biological growth formation allowable between the panels.

Drawings which show construction details of these vessel can be found in the drawing list in Section 0. Applicable drawings to this section of the scope are:

0.63	04705 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED ARRANGEMENT?
0.63	04705 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED LATERAL DETAILS
0.63	04705 Sheet 3	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED CLIPS ON VESSEL DETAILS
0.63	04705 Sheet 4	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED SUPPORT ANGLE DETAILS
0.63	04706 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED PARTS LIST
0.63	04706 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED PARTS LIST
0.63	04707 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED ARRANGEMENT
0.63	04707 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED LATERAL DETAILS
0.63	04707 Sheet 3	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED HEADER SUPPORT DETAILS
0.63	04708 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED PARTS LIST
0.63	04708 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED PARTS LIST
0.63	04709 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM MIXED BED ARRANGEMENT
0.63	04709 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM MIXED BED LATERAL DETAILS

0.63	04710 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM MIXED BED PARTS LIST
0.63	04710 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM MIXED BED PARTS
0.63	04711 Sheet 1	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED ARRANGEMENT
0.63	04711 Sheet 2	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED LATERAL DETAILS
0.63	04711 Sheet 3	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED CLIPS ON VESSEL DETAILS
0.63	04711 Sheet 4	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED SUPPORT ANGLE DETAILS
0.63	04712 Sheet 1	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED PARTS LIST
0.63	04712 Sheet 2	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED PARTS LIST
0.63	1853	MIXED BED VESSEL NO. 1,2 AND 3

In addition to the above, all bolts, nuts, washers and gaskets must also be replaced.

5.11 Demin Plant Piping Replacement requirements

The water treatment plant pipework consists out of multiple areas that require lining replacement. Refer to Appendix F1 – WTP equipment list and Appendix and F2 – Marked up P&ID's. The piping into and out of the demin vessels includes:

- All the demin water production inlets and outlets
- All the demin production lines from one vessel to the next vessel
- All the regeneration chemical injection lines from the first mixing tee up until the inlet the vessels
- All the effluent outlet lines from the vessels all the way to the inlet to the neutralisation sump
- All the back wash lines on the vessels
- All vents on the vessels
- All the drains on the vessels
- All the air lines from the blower discharge up until the inlets to the vessels
- All the recycling and dumping lines
- All the lines from the suction isolation valve of the dilution water pumps up until the mixing tees of the chemical regeneration lines

The pipework is constructed out of mild steel which is rubber lined. The *Contractor* must allow for:

- OPTION A: full replacement of all lines with Carbon steel rubber lined pipes

- OPTION B: full replacement of all lines with Stainless steel 316L

Only the most expensive option must be added to the total of the final price.

The *Contractor* applies the necessary corrosion protection layers on the entire piping, as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating of Acid dilution pipework to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification. Normally 6 meter after initial mixing point.
- All internal coating of Acid and Caustic carbon steel dilution pipework to be done in accordance with GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining)
- GAM/MAT/22/126: Lethabo P/S Corrosion Protection of Water Treatment Plant (WTP) Carbon Steel Piping Systems (Internal: Rubber Lining & External: Organic Coating/Pipe Wrapping) Demin Valves Inspection and Replacement Requirements

Specialised equipment that is relevant for the works must be certified and operated by qualified individuals Refer to section 4 on Valves. All valves to be replaced on the demin trains as per Appendix F1 – WTP Equipment List.

The *Contractor* applies the necessary corrosion protection layers on the entire valve, as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal corrosion protection must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings

5.12WTP Pump Requirements

Refer to Appendix F1 - WTP Equipment List for details on the following pumps that are to be replaced:

- 3 x Anion Supply Pumps

- 2 x Recarbonator Acid Dosing Pumps
- 7 x Concentrated Acid Metering Pumps
- 7 x Caustic Metering Pumps
- 1 x Caustic Offloading Pump
- 2 x Demin Regen Dilution Pump
- 2 x Gland Seal Demin Water Pumps
- 1 x Brine Pump
- 1 x pH correction Pump

The *Contractor* applies the necessary corrosion protection layers on all pumps must be as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal corrosion protection must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings

5.13 Degasser Fans Requirement

Three degasser fans are installed in the plant. Each fan is driven by an electrical motor which together with the fan is housed on a common baseplate. The fan blows air into the degasser tower. Refer to Appendix F1 – WTP Equipment List.

The *Contractor* applies the necessary corrosion protection layers on the fans must be as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal corrosion protection must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings

5.14 Demin Blowers Requirement

Two demin blowers are installed in the plant. Each blower is driven by an electrical motor which together with the blower is housed on a common baseplate. The blower blows air into the mixed bed vessel and anion vessels. Refer to Appendix F1 – WTP Equipment list for more technical specification of the installed equipment.

The contractor needs to to replace the blowers and all associated pipework, valves, motors, instrumentation as per Appendix F2 – Marked up P&ID's.

5.15 Gland seal system Requirement

Two gland seal pumps are installed in the plant. Each pump is driven by an electrical motor which together with the pump is housed on a common baseplate. The pump supplies gland seal water to critical pump in the WTP. Refer to Appendix F1 – WTP Equipment list for more technical specification of the installed equipment.

The *Contractor* needs to replace the pumps and all associated pipework, valves, motors, instrumentation as per Appendix F2 – Marked up P&ID's.

6. Chemical offloading, handling, storage and dosing system

6.1 Operating philosophy

6.1.1 Chemical offloading, handling and storage

The chemical offloading bay is situated on the outside of the WTP building and allows either acid or caustic to be delivered at a time. The chemicals are offloaded from the transported tankers and stored in the storage tanks on the inside of the WTP building.

6.1.1.1 Sulphuric Acid (96-98%) Bulk Storage

The 96-98% Sulphuric Acid (H_2SO_4) for regeneration is supplied from two H_2SO_4 storage vessels (10UE51G001/2) on the west side inside the WTP building with a capacity of each is 47.5 m^3. These storage vessels are filled from transport tankers by means of compressed instrument air.

The vessels are equipped with air dryers (10UE51G003/4) to ensure that the breathing air of the H_2SO_4 vessel is dry to prevent corrosion (diluted sulphuric acid is more corrosive) as concentrated H_2SO_4 is inclined to take up water from the air.

The vessels are interlinked as balancing tanks with isolating valves. The vessels have level transmitters. Re-used acid is stored in a separate vessel which has a capacity of 14,5m3. This vessel is used for Condensate Polisher Regeneration (CPR).

6.1.1.2 Sodium Hydroxide (Caustic soda) (45%) Bulk Storage

The 45% NaOH for regeneration is supplied from two NaOH storage vessels (10UE62G001/2); capacity of each is 58.9 m^3. The storage vessels are filled from transport tankers by caustic offloading pump 10UE60D001 or by means of compressed instrument air and are provided with CO_2 absorbers (10UE62G003/4) and electric heating devices. The offloading pump is designed to deliver a flow of 30m^3/hr to the vessels.

The vessels are equipped with air dryers (10UE62G003/4) to ensure that the breathing air of the NaOH vessel is dry to prevent corrosion.

The vessels are interlinked as balancing tanks with isolating valves. The vessels have level indicators, level transmitters and level switches.

6.1.1.3 Salt for Brine treatment

The salt for brine is offloaded in pallets. An overhead crane is used to lift the pallet onto the first floor of the WTP building.

The 40% brine solution is prepared in the brine storage tank that has an inlet chute into the tank through which the powdered salt is added before it is diluted with demineralised water. See below illustration for the layout of the level and chute used for brine preparation. This is a snip from the drawing "02499.07 - WTP (WATER TREATMENT PLANT) WEST WATER TREATMENT BUILDING PLOT PLAN".

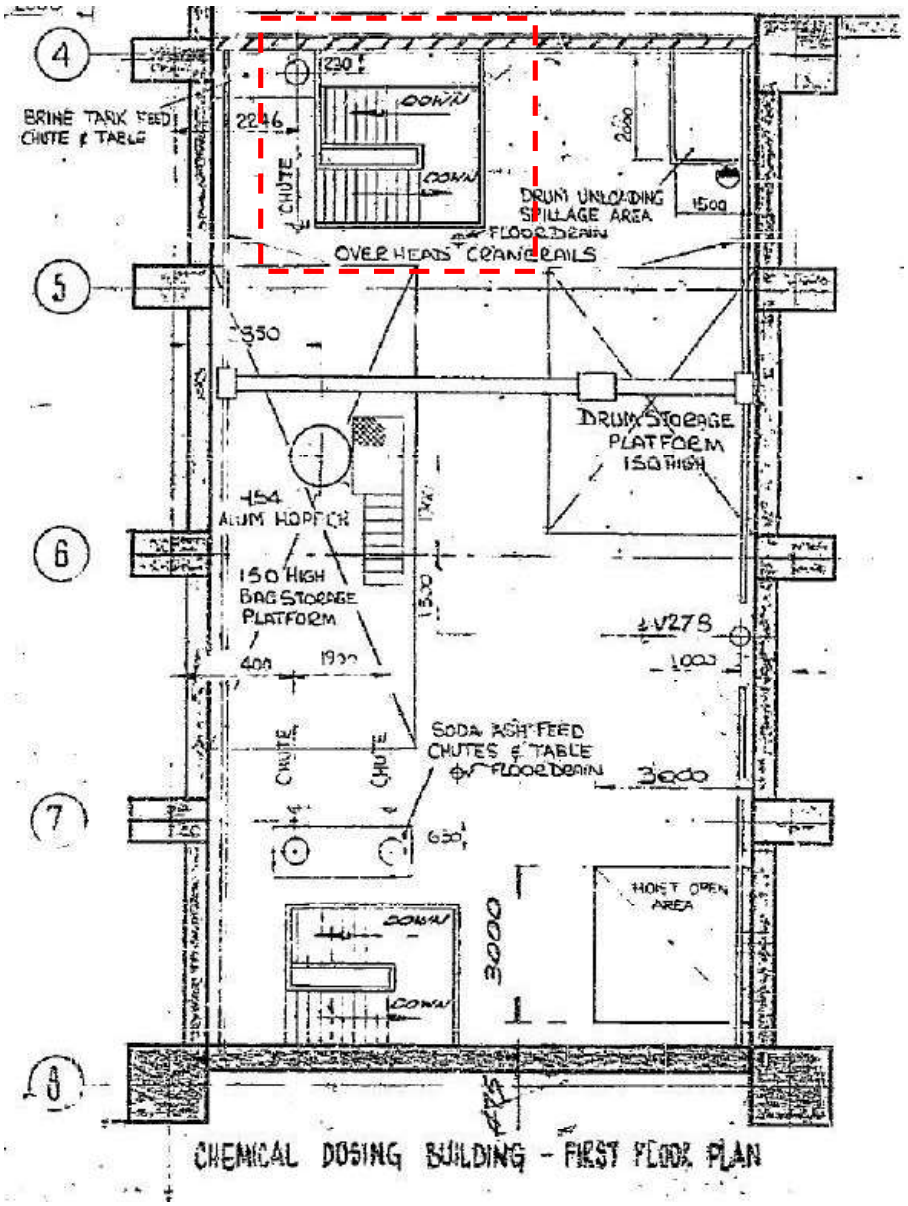


Figure 10: Brine off-loading floor layout

The picture below illustrates the area that needs to be modified:

Figure 11: Picture of the brine in-loading area

6.1.2 Chemical dosing system

Once the resin in an ion exchanger is exhausted it has to undergo regeneration. The regeneration process of the ion exchange resins, cation and anion resin, occurs when the desired throughput through a train is achieved or the breakthrough quality (Na and Conductivity for cation and SiO_2 for anion) exceeds the limits as specified in the Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water.

Chemical injection into the vessels is performed during the regeneration process of the resins. Cation resins use diluted sulphuric acid and anion resins use diluted caustic soda. The dilution is achieved by use of demineralised water from the demineralised water storage tanks. The process of regeneration is an automatic process which is initiated manually. The steps within the regeneration process are automated. The chemical preparation systems are located on the inside of the WTP building. All the metering pumps are positive displacement chemical dosing pumps.

6.1.2.1 Acid dosing

Acid dilution is required in several concentrations for the weak acid cation (WAC), strong acid cation (SAC) and the mixed bed SAC regeneration. For the WAC, concentrations of 0,8 – 1% H_2SO_4 is used in a co-current regeneration process. The SAC is regenerated in a counter current direction with concentrations of 3,2% H_2SO_4. Regeneration of cation resins is done simultaneously but independently with the regeneration of the strong base anion (SBA) resins. The mixed bed SAC is regenerated in counter current at 6% concentration of H_2SO_4. The mixed bed exchanger is regenerated separately from both the cation and anion exchangers.

The dilution of acid is achieved by use of the concentrated acid metering pumps and inline mixing tees. Dilution of the acid to the required concentration occurs at the mixing tees. The concentrated metering pumps are manually adjustable.

Refer to Appendix B: Regeneration for details on the regeneration parameters.

There are two (2) sulphuric acid chemical dosing pumps (10UE51D001/2) for mixed bed vessels resins regeneration, two (2) sulphuric acid chemical dosing pumps (10UE51D003/4) for cation exchange vessels resins regeneration and three (3) sulphuric acid chemical dosing pumps (10UE51D005/6/7) for the Condensate Polishing Plant (CPP) Regeneration process. The operating philosophy is to have a pump on duty and a on standby. The Condensate Polishing Regeneration has two pumps on duty and one shared standby pump.

There are two (2)dilution pumps for cation vessels resins regeneration, mixed bed vessels resins regeneration and three (3) acid dilution pumps for the CPP Regeneration process (Not included in this scope). For the demineralisation process there is one pump on duty and one on standby. The Condensate Polishing Regeneration has two pumps on duty and one on standby.

6.1.2.2 Caustic Soda Dosing

Caustic is diluted from 45% to 3,1% for the weak base anion (WBA) and SBA regeneration. The regeneration is conducted in co-current flow for WBA and in counter current flow for the SBA. The WBA can be regenerated separately or in series (thorough fare) with the SBA. The dilution concentration for the mixed bed SBA is at 4% concentration of NaOH and is regenerated in a co-current flow direction.

The dilution of caustic is achieved by use of hot demineralised water from the hot water tank. The temperature of the solution is limited to the operating temperature of the anion resins. WBA and SBA are regenerated at 32°C and the mixed bed SBA at 48° C.

There are two (2) caustic soda dilution pumps (10UE62D003/4) for mixed bed vessels resins regeneration, two (2) caustic soda dilution pumps (10UE62D001/2) for strong base anion vessels resins regeneration and three (3) caustic soda dilution pumps (10UE62D005/6/7) for the Condensate Polishing Plant (CPP) Regeneration process. The operating philosophy is to have a pump on duty and one on standby. The Condensate Polishing Regeneration has two pumps on duty and one shared standby pump. The concentrated caustic dosing pump (10UE62D008) is used for pH correction of potable water which is a back-up for the potable soda ash dosing pump.

There are two (2) caustic soda dilution pumps for mixed bed vessels resins regeneration, two (2) caustic soda dilution pumps for strong base anion vessels resins regeneration and three (3) caustic soda dilution pumps for the CPP Regeneration process. For the demineralisation process there is one pump on duty and one on standby. The Condensate Polishing Regeneration has two pumps on duty and one on standby (Not in the scope).

6.1.2.3 Brine treatment

Brine treatment of the anion and mixed bed anion resins take place in order to remove organic and other foulants that build up on the resins. The treatment consists of caustic regeneration, displacement and is followed by 10% brine treatment or an alkaline brine. Air mixing is used to assist with mechanical mixing. The caustic regeneration portion involves the caustic injection step into where concentrated caustic soda is diluted down to 2% and is injected into the vessel. Following this the caustic soda will then be displaced from the resin by rinsing the resin. Once the caustic has been rinsed the salt injection step follows where 25% brine is diluted to 10% before being injected into the vessel. The brine is then rinsed from the resin.

The solution is a mixture of 10% salt and 2% caustic soda.

Every make-up consist of about 5-10 tons of Brine, and is done every 15th regen for every train. This is approximately once a month, and increase as the resin age become a factor with shorter run times.

6.1.2.4 Hotwater tank system

A hot water tank which is used to supply hot water for dilution of the caustic soda and brine and is also included in this system. The dimensions of the hot water tank are 2150mm OD x 3250mm HL. The tank is made up of water from the dilution tank system. The water is heated in the tank to 95°C using elements inserted into the tank (refer to Drawing 23.63/55774 – Hot water vessel heater arrangement). When heated water is required, the hot water is mixed with the cold dilution water and the temperature is measured and regulated to obtain the desired temperature. There are 2 hot water tank in the system, one for the demin regenerations and one for the CPR regenerations. Both these systems are part of the *works*.

6.1.2.5 Chemical effluents

Demin plant effluents are produced during the regeneration of resin from the Demineralisation system or CPR system. Depending on the automatic control process and nature (cleanliness) of the effluents, it will be recovered into one of the following effluent sumps:

- High conductivity (K_{25}) effluents (>1000µS): to the effluent neutrilisation sump where it is neutralized.
- Medium conductivity (K_{25}) effluents (<1000µS): to the SSC sump.
- Clean water effluent lines are currently blanked off and should be officially decommissioned and removed.

6.1.2.6 Potable pH correction (08-10UE62D008)

The pH – adjustment of the filtered water can be achieved either by dosing caustic (by means of pump 10UE62D008) or Soda-ash (pump 10UE62D009 – NOT INCLUDED IN THIS SCOPE).

The chemical is dosed into the in-line mixer 10UA11G002 located in the potable water line.

However, the dosing system and pH-control will be adjusted based on the use of soda ash. In case, soda ash is not available caustic soda may be dosed.

6.2 Battery limits

6.2.1 Bulk chemical offloading and storage

As per P&IDs in Appendix F2 – Marked up P&ID's.

6.2.2 Chemical preparation and injection

This covers the entire acid, caustic and brine dosing systems as well as the hot water tank system and the dilution water pump systems with all its associated equipment. Refer to P&ID's in Appendix F2 – Marked up P&ID's.

6.3 Scope of the *works* for the offloading, handling and storage areas

6.3.1 Sulphuric offloading system requirements

The sulphuric acid tanks have been inspected and refurbished. There is no significant wall loss as per the AIA inspection and they therefore do not need to be replaced. Contractor shall inspect the tank when empty and produce a report.

However, the rest of the systems pipes, valves, compressed air lines, etc. must be inspected and replaced if necessary. The *Contractor* must allow for replacement of all the equipment in the system as a worst-case scenario. The outcomes of the inspection and testing must be conveyed to the *Project Manager* for decision making purposes. The tanks need to emptied and cleaned in order to work on the outlet piping and valves of each tank. When the tank common outlet piping needs to be inspected and replaced, temporary piping must be installed and routed from the bulk tank outlet to the pump inlets which must be supplied by the *Contractor* while work is being done on the dosing system.

The applicable drawing for this system is:

0.63	1735	Sulphuric (H_2SO_4) acid storage
0.63	1857	Sulphuric acid bulk storage vessels

6.3.1.1 Piping and Valve Replacement

Refer to Appendix F1: WTP Equipment list and to marked up P&ID's in appendix F2 for pipes that need to be replaced. Valves that require replacement is in Appendix F1: WTP Equipment list.

The applicable drawing for this system is:

0.63	11385	Eskom WTP Complex Lethabo Power Station (west)
0.63	11386	Eskom WTP Complex Lethabo Power Station (west)

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings

- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.3.2 Caustic offloading system requirements

It is assumed that the caustic tanks will not be replaced. The Contractor shall inspect the tank when empty and submit a report.

However, the rest of the systems pipes, valves, compressed air lines, etc. must be inspected and replaced if necessary. The *Contractor* must allow for replacement of all the equipment in the system as a worst-case scenario. The outcomes of the inspection and testing must be conveyed to the *Project Manager* for decision making purposes.

The tanks need to emptied and cleaned in order to work on the outlet piping and valves of each tank. When the tank common outlet piping needs to be inspected and replaced, temporary piping must be installed and routed to the temporary dosing skid which must be supplied by the *Contractor* while work is being done on the dosing system. The applicable drawing for this system is:

- 0.63/1737 rev.11: Caustic storage

Caustic Bulk Storage Vessels (10UE62G001/2)	
Dimensions	3 500 mm x 6 500 mm
Capacity	58.9 m^3
Operating temperature /pressure	20°C - 30°C/ Atmospheric
Design temperature /pressure	50°C 250 kPa

Breather Fitter	
Dimensions	183 mm x 356 mm
Design temperature	85°C
Design pressure	1 000 kPa

Capacity	4.3 m^3/min

6.3.2.1 Piping and Valve Replacement

The details of the associated piping and valves can be found in “Appendix F1: WTP Equipment List and Appendix F2 – Marked up P&ID’s for pipes that are included in the replacement scope.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).

- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.3.2.2 Caustic Offloading pump

The *Contractor* must replace the existing offloading pump with the same pump installed or with a suitable replacement, which must be first reviewed and accepted by the *Project Manager* before it is procured.

There is one offloading pump are installed in the plant. The pump is driven by an electrical motor which together with the pump is housed on a common baseplate. The pump draws caustic from the caustic road tanker. The delivery pipes discharge the caustic into the storage tanks.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.3.3 Salt for Brine System

Currently the 50kg salt bags are carried to the chute of the concentrated brine tank chute on the 1st level. There it is cut open and the salt is discharged into the brine tank.

The *Contractor* must design a new system which will transport the 50kg salt bags from the storage place to the chute. This is required since the current system is ergonomically not acceptable. The bags are heavy for the operators to manually carry to the chute bench where is is then pushed down the chute. 5 – 10 tons of salt requires the operator to lift 100-200 50kg bags for every brine that is made up, hence the new system must be designed and installed to ensure that no manual handling of the bags will be required.

The condition of the brine storage tank is not known. These tanks are to be inspected and refurbished by the *Contractor.*

The applicable drawing for this system is:

0.63	1741	Brine storage and metering station
0.63	1867	Brine storage tank
0.63	5998	Chute for brine tank
0.63	1868	Brine Measuring Tank

The design specifications of this tank are as follows:

Table 10: Design specification of the concentrated brine tank

Parameter	Dimensions	Units
Diameter	3	m
Height (tan-tan)	2.5	m
Design pressure	atmospheric	
Materials of construction	Fibre glass	

6.3.3.1 Piping and Valve Replacement

Detail of the piping and valves to be inspected and replaced can be found in “Appendix F1: WTP Equipment List”.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4 Scope of the *works* for the chemical dosing systems

The sulphuric acid and caustic dosing system consists of pumps, pipes, mixing tees, valves, flowmeters, conductivity analysers, etc. The condition of the system requires full replacement. And should be costed as such.

6.4.1 System Description

The existing sulphuric acid and caustic soda system is controlled manually by varying the stroke on the pump. Once the stroke is manually set and flow rate is adjusted by means of the Spring controlled valves., system is controlled via the program following the steps. The dosing pumps have an interlock with the dilution water flow and can only start once the dilution water flow is established (programmed in time period) and is correct as per the operating philosophy of the regeneration. The system has automated valves on the acid supply, water supply as well as the block and bleed system.

The *Contractor* must supply pumps which meet the electrical specification to ensure that Eskom can supply power to the various plant components without modifications on the switchgear and cabling.

6.4.2 Sulphuric Acid Dosing

6.4.2.1 Sulphuric Acid Dosing Pumps

There are 2 cation acid injection pumps, 2 mixed bed acid injection pumps and 3 CPR acid injection pumps installed in the plant. The pumps are driven by an electrical motor which together with the pump is housed on a common baseplate. The pump draws acid from the acid storage tank. The delivery pipes discharges to the cation, mixed bed and CPR vessels respectively.

The *Contractor* must supply 7 sulphuric acid dosing pumps with its pressure accumulators. Details of the pumps can be found in Appendix F1 – WTP Equipment List.

Details of the Pressure Accumulators is as follows:

- Pulsation dampener Model = U030A03V1-A1
- Dimensions = 114mm diameter
- Capacity = 2.5L
- Design temperature = 50°C
- Design temperature = 515 kPa

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and

- SANS 10140 (Identification of Colour Markings).
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4.2.2 Re-carbonator Acid Dosing Pump

There is two re-carbonator acid dosing pump installed in the plant. The pumps are driven by an electrical motor which together with the pump is housed on a seperate baseplates/plinths. The pump draws acid from the acid storage tank.

The *Contractor* must supply 2 Recarbonator Acid Dosing pumps. Information can be found in Appendix F1.

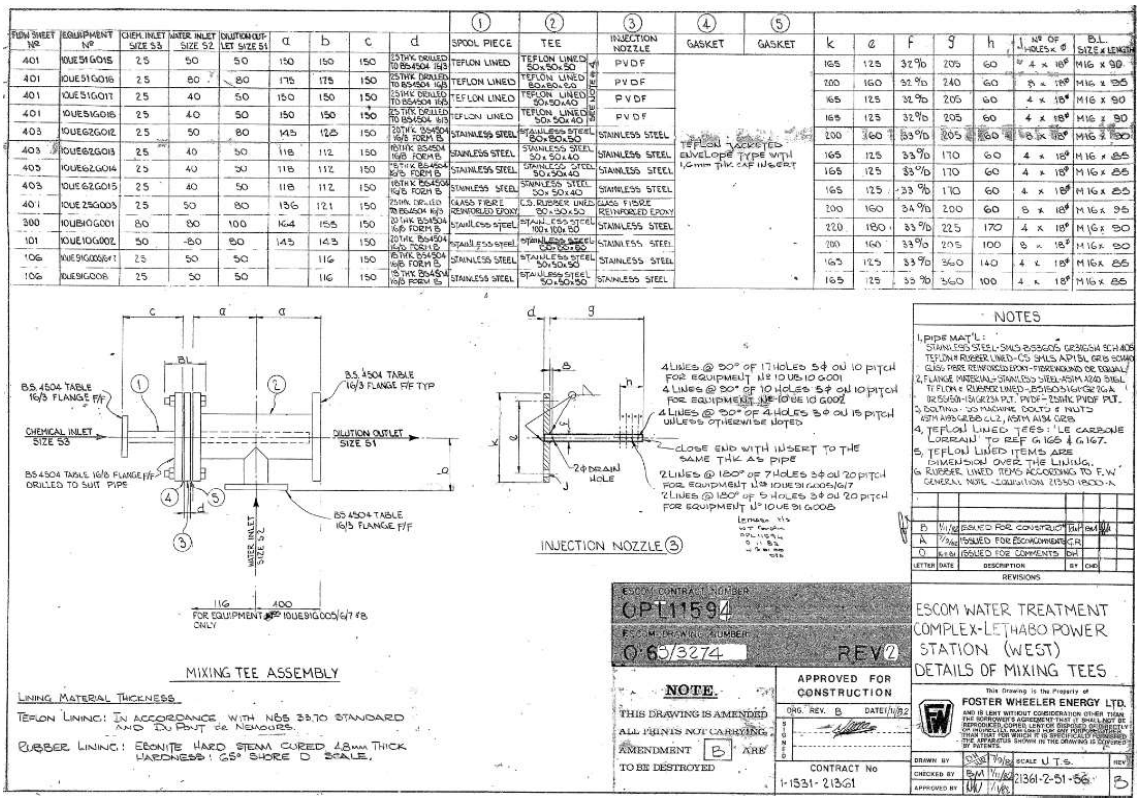
The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4.2.3 Piping Replacement

The acid dosing pipework is currently constructed out of Mild carbon steel and stainless steel. The Contractor shall replace all piping from the valve 10UE51S022 at the bulk storage tanks to the suction of the pumps with SS316L. From the discharge of the pumps the lines are SS316L up until the inlet to the vessels. This should also be replaced.

The motive water is mixed with Sulphuric Acid (98% concentration) in an inline static mixer. This must replaced with a SS316L equivalent of the current design seen in the illustration below (Better quality of the drawing available on the tender bulletin named: 063/03274.02 - WTP (WATER TREATMENT PLANT) (WEST) MIXING TEES DETAILS, which details UE51G01[5-8], EU52G01[2-5], EU25G003 & UB10G001). The *Contractor* is to re-design a mixing tee out of SS316L with the same PTFE lining across the different areas for the purpose of this scope. The PTFE lining must be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification



The pipes after the mixing of the acid and water experiences high temperatures as a result of the exothermic reaction caused by the mixing of acid and water. There is also a variable change in acid concentrations in the first 6m after the mixing point, based on the quality of mixing as a result of turbulence created by the static mixer. Hence, this first 6 meters after the static mixer must be constructed and designed with the following 2 materials:

Option A: SS316L/1.4404 Tube, Teflon lined

Option B: SS904L

After this initial 6m of the static mixer the pipe material to be used will be SS316L/1.4404 in line with the latest EN 10216-5.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings

- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps.
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification

The applicable drawing for this system is:

0.63	1736	Sulphuric Acid Metering and Dilution
0.63	3274	WTP (WATER TREATMENT PLANT) (WEST) MIXING TEES DETAILS. Which details UE51G01[5-8], EU52G01[2-5], EU25G003 & UB10G001
0.63	11385	Eskom WTP Complex Lethabo Power Station (west)

6.4.2.4 Valves Inspection and Replacement

Replacement of the valves is as per Appendix F1 – WTP Equipment list and pipes in line with the marked up P&ID's Appendix F2.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4.3 Caustic Soda Dosing System

The caustic soda dosing system is comprised of Pumps, Pipes, mixing tees, valves, flowmeters, analyser.

6.4.3.1 Caustic Soda Dosing Pumps

The caustic soda dosing system does not currently have pulsation dampeners. The Contractor is to include these as part of the new system.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4.3.1.1 Anion Caustic Dosing Pump (10UE62D001/2)

There are two anion caustic dosing pumps installed in the plant. The pumps are driven by an electrical motor which together with the pump is housed on a common baseplate. The pump draws caustic from the caustic storage tank. The delivery pipes discharges to the weak base and strong base anion vessels as well as the mixed bed ion exchange vessels.

The *Contractor* must supply 2 pumps in accordance with the technical specification in Appendix F1 – WTP equipment list:

6.4.3.1.2 Mixed Bed Caustic Dosing Pump (10UE62D003/4)

There are two mixed bed caustic dosing pumps installed in the plant. The pumps are driven by an electrical motor which together with the pump is housed on a common baseplate. The pump draws caustic from the caustic storage tank. The delivery pipes discharges to the weak base and strong base anion vessels as well as the mixed bed ion exchange vessels.

The *Contractor* must supply 2 pumps in accordance with the technical specification in Appendix F1 – WTP equipment list Type of pump = Positive displacement

6.4.3.1.3 CPR Anion Caustic Dosing Pump (10UE62D003/4)

There are two CPR anion caustic dosing pumps installed in the plant. The pumps are driven by an electrical motor which together with the pump is housed on a common baseplate. The pump draws caustic from the caustic storage tank. The delivery pipes discharges to the weak base and strong base anion vessels as well as the mixed bed ion exchange vessels.

The *Contractor* must supply 3 pumps in accordance with the technical specification in Appendix F1 – WTP equipment list

6.4.3.2 Piping and Valve Replacement

Piping and valve replacement is as per Appendix F1: WTP Equipment List. And pipes included refer to Appendix F2 – Marked up P&ID's.

The dilution water is mixed in an inline mixer (refer to acid dosing section for the drawing/illustration of the mixer). The same scope and functional requirements apply as per the acid dosing section.'

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4.4 Demin Regen Dilution Water System

Consists of Pump, pipes, valves, actuators, C&I instrumentation as per Appendix F1 – WTP Equipment list and the instrument schedule.

6.4.4.1 Demin/Regen Dilution Water Pumps

There are 2 dilution water pumps installed in the plant. The pumps are driven by an electrical motor which together with the pump is housed on a common baseplate. The pump draws demin water from the demin water storage tanks. The delivery pipes discharges to the demin cation vessels, Weak and Strong Anion vessels, & Mixed Bed Via the hot water tank, brine tank mixer, acid mixer and Caustic mixers based on the regeneration operation required.

The *Contractor* must make provision to supply 2 of the following pumps together with its Control instrumentation as per Highlighted P&ID's and Appendix F1 – WTP Equipment list.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).

- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4.4.2 Piping and Valve Replacement

Piping and valve replacement as per Appendix F1: WTP Equipment List. For the piping up until the mixer, the Contractor is to provide 2 options for the materials used:

OPTION A: Carbon Steel, rubber lined

OPTION B: SS316L

The consisting should be done on the more expensive option.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification.
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- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps
- GAM/MAT/22/126: Lethabo P/S Corrosion Protection of Water Treatment Plant (WTP) Carbon Steel Piping Systems (Internal: Rubber Lining & External: Organic Coating/Pipe Wrapping)The applicable drawings for this system is:

0.63	1739	Hotwater and dilution water system

6.4.5 Brine Treatment

Consists of piping, valves, tanks, air distribution pipework as per Appendix F1 – WTP Equipment List.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification.
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings.
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4.5.1 Brine Tank & Brine Measuring Tank

The conditions of the brine tank & Brine measuring tank is not known. These tanks are to be inspected and tested by the *Contractor* together with Eskom in order to determine whether they can be refurbished or replaced. The *Contractor* must allow for:

1. Inspection of the tanks
2. Minimum scope is to replace the anchor lugs (see below images of the current anchor lugs and also drawings of the tanks referenced below in applicable drawing for dimension and material for more details of the current anchor lugs).

Figure 12: Current Brine measuring tank anchor lugs condition

3. Refurbishment around the new anchor lugs to “as good as new condition” in line with materials suitable as per original drawing listed below.
4. Reline the current internal bottom of the tanks with a fibreglass epoxy coated membrane up to a height of 500mm.
5. Brine tank air distribution pipework replacement with material PVC.

The applicable drawing for this system is:

0.63	1741	Brine storage and metering station
0.63	1867	WATER TREATMENT PLANT (WEST) BRINE STORAGE TANK ARRANGEMENT (WTP)
0.63	1868	WATER TREATMENT PLANT (WEST) BRINE MEASURING TANK ARRANGEMENT (WTP)

The design specifications of this tank can be seen in Appendix F1: WTP equipment list:

6.4.5.2 Brine dosing pumps

There is one brine pump installed in the plant. The pump is driven by an electrical motor which together with the pump is housed on a common baseplate. The pump draws the brine alkaline mixture from the brine measuring tank. The delivery pipes discharges to the anion and mixed bed vessels respectively.

The pump specification is as per Appendix F1 – WTP Equipment list

6.4.5.3 Piping and Valve Replacement

Refer to “Appendix F1: WTP Equipment List”. Hot dilution water supplied from the hot water tank system is mixed in an inline mixer (shown in drawin 0.63/3274 as per Acid dosing section description) with brine caustic Soda mixture for the purpose of brine squeezes on the anion resin.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

The applicable drawing for this system is:

0.63	1736	Sulphuric Acid Metering and Dilution
0.63	11385	Eskom WTP Complex Lethabo Power Station (west)

6.4.6 Hotwater system

- Replacement/refurbishment of Pipes, Valves, Actuators, Tanks, Elements, heater bundles.

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All internal coating to be done in accordance with Appendix E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings

- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

6.4.6.1 Demin and CPP Hotwater tank

The condition of the Demin and CPP Hotwater tank is not known. These tanks are rubber lined and must be refurbished to as new condition.

The heater bundles need to be replaced. Drawing 55774 indicates the dimensions of hot water tank 2 heater bundle, any modification to the current drawing needs to be done and handed to the client. Hot water tank 1 does not have a drawing at the moment and a constructions drawings needs to be drawn up.

Elements for the heaters needs to be replaced.

The applicable drawing for this system is:

0.63	1739	Hotwater and dilution water system
0.63	1864	(WATER TREATMENT PLANT) WTP WEST HOT WATER TANK 1 ARRANGEMENT (OPL10UB30G002)
0.63	1865	WATER TREATMENT PLANT (WEST) HOT WATER TANK NO2 ARRANGEMENT (WTP)
0.63	5143	WATER TREATMENT BUILDING (WEST) PLATFORM TO HOT WATER TANK NO.1 AND 2 104B30G00 1 AND 2 LADDER TO WATER TREATMENT BUILDING ROOF
0.63	55774	WATER TREATMENT PLANT (WTP) HOT WATER VESSEL HEATER ARRANGEMENT - 10UB30G002

The design specifications of these tanks are as follows:

Table 11: Design specification of the demin hot water tank

Parameter	Dimensions	Units
Diameter	2.15	m
Height (tan-tan)	3.25	m
Design pressure	585	kPa
Design temperature	110	°C
Operating pressure	325	kPa
Operating temperature	80	°C

Table 12: Design specification of the CPR hot water tank

Parameter	Dimensions	Units
Diameter	1.9	m
Height (tan-tan)	3.25	m
Design pressure	585	kPa
Design temperature	110	°C
Operating pressure	325	kPa
Operating temperature	80	°C

6.4.6.2 Piping and Valves Replacement

Refer to "Appendix F1 - WTP Equipment List" for details on what is to be replaced in line with the P&ID's listed below for reference to the specification of pipes used.

6.4.6.3 Piping replacement

Refer to Appendix F2 – Marked up P&ID's for the battery limits and Appendix F1 – WTP Equipment list for the specification of the piping.

The applicable drawing for this system is:

0.63	1736	Sulphuric Acid Metering and Dilution
0.63	1739	Regen resin transfer system
0.63	1741	WEST BRINE STORAGE AND GLAND SEAL PUMPS ENGINEERING FLOW DIAGRAM
0.63	11385	Eskom WTP Complex Lethabo Power Station (west)

6.4.7 Chemical Effluent

The Contractor replaces the piping and valves of the effluent system.

- The system includes the chemical effluents from the different steps and sources during regeneration is directed to different sumps based on the measured conductivity of the effluent.
- All the dirty regeneration effluents with a high conductivity (K_{25} >1000 µS) which flows from the regeneration will be directed into the ENS (Effluent Neutrilisation Sump).
- Concentrated brine from the RO plant flows to the SSC sump.

- Medium regeneration effluents from condensate polishing regeneration plant and demineralisation plant with low conductivity (K_{25}<1000µS) flow into the ACS (Ash Conditioning Sump).

The *Contractor* applies the necessary corrosion protection layers on the entire system as per:

- Eskom Standard 240-106365693 (Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings).
- All surfaces must be painted and labelled as per ESKSCAAC6 (Specification for the Identification of the Contents of Pipelines and Vessels) and
- SANS 10140 (Identification of Colour Markings).
- All external corrosion protection to be done in accordance with Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
- All internal corrosion protection of valves and pumps must be done in accordance to Appendix E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps
- HDPE piping needs to adhere to SANS 4427 Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply
- Contractor needs to accommodate any additional pipe supports and expansion joints for HDPE replacements.

6.4.7.1 Piping replacement

The current chemical effluent pipework is constructed out of Mild carbon steel which is epoxy lined on the lines which discharges from all the vessels to the various sumps as discussed above.

The clean effluent pipelines as seen on the P&ID's are blanked off must not be replaced, and the old line are to be removed. The plant has been blanked off for many years due to the risk of medium or high conductivity going to the clarified water holding sumps.

The new material that the pipes need to be replaced with must be constructed out of SS316L up till the flange in the effluent trenches outside the WTP building.

Where the pipe is flanged in the bund the pipes material of construction needs to be replaced with HDPE lines up till where the battery limit allows as per Appendix F2 - Marked up P&ID's.

See below image of the pipes in the trench for reference purposes:

Figure 13: Chemical effluent pipes outside WTP indicated in red.

All pipe support, bellow/expansion joins to be installed for the new HDPE lines must be catered for in the offer in line with relevant SANS and 240-123801640: Standard for Low Pressure Pipelines.

The applicable drawing for this system is:

0.63	1633	WEST CATION EXCHANGERS ENGINEERING FLOW DIAGRAM
0.63	1635	WEAK BASE ANION EXCHANGERS ENGINEERING FLOW
0.63	1636	STRONG BASE ANION EXCHANGERS
0.63	1637	MIXED BEDION EXCHANGERS ENGINEERING FLOW DIAGRAM
0.63	2635	HIGH CONDUCTIVITY EFFLUENT NEUTRALISATION SYSTEM ENGINEERING FLOW DIAGRAM
0.63	11385	Eskom WTP Complex Lethabo Power Station (west)

6.4.7.2 Valve and actuator replacement

Replacement of valve as per “Appendix F1: WTP Equipment List”.

The current effluent lines do not have any NRV’s installed. It is required the contractor supplies suitable NRV for each line so that in the case any of the actuated valves on the any of the effluent lines are passing there is a back-up valve to restrict the flow from flowing back into the running demin vessels. These valves are mentioned on the equipment list as “NEW”

7. Corrosion protection Specifications

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

- 240-101712128 - Eskom Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings.
- 240-106365693 – Eskom Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings
- ESKSCAAC6 - Specification for the Identification of the Contents of Pipelines and Vessels
- SANS 10140 (Identification of Colour Markings).
- ISO 9001: Quality Management Systems – Requirements.
- SANS 1198: The manufacture of rubber sheeting for rubber lining.
- SANS 1201: The application of rubber linings to pipes, pipe fittings and vessels.
- Appendix E: Corrosion Protection Specifications

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

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. Before tender award, after tender submission, an assessment will be done at the *Contractor* premises to determine technical and quality competence.

If Eskom has not previously assessed a suitably approved applicator according to the requirements of the standards mentioned above (from date of first issue i.e., Rev1) then the *Contractor* shall conduct an assessment using the criteria in E11: Requirement Criteria for Corrosion Protection Paint and Rubber Lining Applicators and document/record the assessment using E12: Capability checklist for corrosion protection paint and rubber lining

applicators as a basis. The *Contractor* shall rate the applicator and sign the E12: Capability checklist for corrosion protection paint and rubber lining applicators form and submit it with the tender.

Contractor to submit proof of Qualifications to prove that all applicators, rubber-liners, supervisors and inspectors are NACE accredited/ qualified under SAQCC/ in-house qualified and trained or similar;

The *Contractor* shall ensure that there are at all times sufficient suitably qualified, experienced and skilled staff to carry out and supervise all activities.

8. Welding specifications

All welding fabrication related activities must be performed in accordance with the latest revision of the Standard for Welding Requirements on Eskom Plant (240-106628253)

The *Contractor* must be supplied with the latest revision of the Standard for Welding Requirements on Eskom Plant (240-106628253). All codes and standards related to Eskom welding fabrication are listed and summarised in the document listed above. The welding must be in accordance with the BS EN welding specifications.

8.1 Basic requirements

Welding procedure qualification for welds shall be in accordance with the appropriate welding standard incorporated into the relevant design and construction code. Combination or mixing of different codes shall not be permitted.

A WPS (welding procedure specification) shall be supported by a valid WPQR/PQR (welding procedure qualification record). The PQR/WPQR shall be approved by a registered IWE or IWT with minimum qualifications as defined in section 3.1 of the Standard for Welding Requirements on Eskom Plant (240-106628253).

The WPS shall be submitted to Eskom for review. Welders and welding operators shall be qualified in accordance with the requirements of the latest applicable construction code or engineering specification relevant to the plant.

The WPQR/PQR must be accompanied by the following documentation:

- Test coupon parent material certification.
- Consumable material certification.
- Destructive and non-destructive test results as required by code.
- Heat treatment chart (if applicable).

8.2 Additional Requirements

Welding documentation used for fabrication must be approved by an Eskom IWE or IWT.

Welder Qualification Records (WQR) must be made available for review by Eskom. Welders and welding operators shall be qualified in accordance with the requirements of the latest applicable construction code or engineering specification relevant to the plant. Welding and testing (destructive and non-destructive) of the test pieces shall be witnessed by an AIA or

Notified Body. Mechanical tests conducted during welding procedure qualification shall be performed at an accredited mechanical test laboratory conforming to the requirements of ISO/IEC 17025.

QCP's must be provided by the *Contractor* to the *Employer* as part of the tender returnables to be reviewed and accepted by Eskom before work can start. Acceptance levels for flaws for metallic welds must be evaluated according to Levels B, C or D as described in BS EN ISO 5817. These levels will be determined before work starts. For projects relating to ASME BPVC designs, evaluation methods and acceptance criteria stipulated in Sections V and VIII of the code will apply. When ASME BPVC designs are used, ASME IX should be used for welding procedure as well as welder qualifications. Refer to 240-106628253.

8.3 NDT Requirements

NDT shall be performed by an entity suitably independent from the welding operation to ensure unbiased inspection. Company to perform welding shall have accreditation to ISO 3834 Part 2 as a minimum (for Eskom Level 1 plant). 10% NDT is required on all welding done. If there are failures on the 10% NDT, then NDT must be done on all the welds. The *Contractor* must make allowance for this.

NDT on welds shall be performed according to the requirements of the relevant design and construction codes, applicable (additional) engineering or product specifications and Eskom standard 240-83539994 .All technicians performing NDT shall be Eskom approved and shall be employed by an Eskom approved company.

8.4 SANS ISO 3834-2 Fabrication Quality Requirements

According to 240-72273656 – Power Generation Asset Criticality Classification, for plant classification this plant is rated as Level 1 plant. Due to this factor the *Contractor* to be used for welding fabrication is required to be SANS ISO 3834-2 accredited (refer to 240-106628253 – Standard for Welding Requirements on Eskom Plant, Section 8.5: Accreditation of Companies Performing Welding on Eskom Plant). Records pertaining to the manufacture shall be compiled as per the requirements of QM 58.

9. Control and Instrumentation Scope of Work

The *Contractor* shall be responsible to design, procure, supply, store, install and commission all control and instrumentation related aspects of the demineralised and regeneration plants This scope relates to existing and new instrumentation, junction boxes, local control stations (LCS), cabling, racking, trunking, and Distributed Control System (DCS) hardware. The *Contractor* shall utilise Appendix D to assist quantifying the full extent of the works Limit of Supply and Service (LOSS), drive and actuator schedule, instrument schedule and; input and output diagram.

9.1 Standards

The *Contractor* shall be responsible to adhere to the following standards:

- 240-56355888: Temperature Measurement Systems Installation Standard.
- 240-56355754: Field instrument Installation Standard.
- 240-56355815: Field Instrument Installation Standard for Junction Boxes and Cable Termination.
- 240-56355815: Pressure Measurement Systems Installation Standard.
- 240-56227443: Requirements for Control and Power Cables for Power Stations Standard
- 240-89147446: Instrument Piping for Fossil and Hydro Power Plant Standard.
- IEC 62381: Automation systems in the process industry – Factory acceptance test (FAT), site acceptance test (SAT), and site integration test (SIT).
- SANS 60529: Degrees of protection provided by enclosures (IP code).
- SANS 10142-1: The wiring of premises part 1: Low-voltage installations.
- SANS 1411-1: Materials of Insulated Electric Cables and Flexible Cords.

9.2 Operating and Control Philosophy

The *Contractor* shall be responsible to provide an updated operating and control philosophy if any changes are made to the existing operating and control philosophy. Changes shall be made clear in the documents. The documents shall be provided in Word and PDF format. The *Employer* shall be responsible for implementing the changes on the existing DCS.

9.3 Sodium and silica analysers in analyser room

The *Contractor* shall be responsible for:

- removal of the wall-mount panels in the analyser room.
- replace the 3 junction boxes in this area that is included in section 9.5.
- replace racking and trunking. Possibly relocate to be adjacent to analysers to prevent leaks dripping on the trunking and junction boxes.
- install a new UVG40ACM cable from 10KW41M to an appropriate cubicle (according to the functional distribution) in the WTP control room for interfacing of the analyser analog outputs to the Foxboro DCS.
- install a new UVG40ACM cable from 10KW41B to an appropriate cubicle (according to the functional distribution) in the WTP control room for interfacing of the analyser binary inputs and outputs to the Foxboro DCS.
- as a minimum requirement install new multi-stream sodium and multi-stream silica analysers as per the Instrument Schedule - Appendix D4.
- as a minimum requirement replace the existing multi-stream sodium and multi-stream silica analysers as per the Instrument Schedule - Appendix D4.

- replacing the existing sodium and silica analysers are deemed similar to the new installations as they are only partially or not interfaced with the Foxboro DCS.
- each analyser shall be provided with a Swan 6 channel sample sequencer.
- each sample sequencer shall be capable to sample any of the six samples as described in the Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water and the six analog outputs shall be interfaced to the DCS.
- each sample sequencer shall have the capability and interface to the DCS to select which samples are taken on each analyser (i.e., one analyser shall sample the three cation samples and the analyser and the other analyser the mixed bed samples). This is to ensure that the analysers provide some redundancy in the event of an analyser failure.
- providing 2 Swan AMI Silitrace AC analysers for measurement of silica on the 3 strong base and the 3 mixed bed samples.
- providing 2 Swan AMI Sodium A AC for the 3 cation samples and 3 mixed bed samples.
- developing the IO (Input and Output) allocation for new equipment. Allocation shall be functionally distributed (i.e., WTCP02 for train 1, WTCP03 for train 2 and WTCP04 for train 3).
- providing loop and junction box drawings for the new equipment prior to installation.
- supply, delivery, installation and commissioning of equipment and consumables.
- providing as-built drawings.

9.4 Existing Instrumentation

The *Contractor* shall be responsible for:

- replacing existing instrumentation as per the Instrument Schedule - Appendix D4.
- rerouting or replacing and termination of cabling for instrumentation in Appendix D4 that require “No Action”.
- replacing cabling between instrument and junction box (average cable length is approximately 20m between junction box and instrument).
- providing updated loop and junction box drawings for the equipment prior to installation.
- supply, delivery, installation and commissioning of equipment and consumables.
- providing as-built drawings.

9.5 Junction Boxes

The *Contractor* shall be responsible for:

- replacement off all the junction boxes associated with the demineralised treatment plant and the regeneration plants.
  - disconnection and removal of old junction box and support.
  - installation of new support
  - installation and termination of new junction box
  - each junction box shall be provided with 80 terminals and all trunk cabling shall be terminated.
  - each junction box shall be provided with a screen connection strip for termination of all cable screens.
- the following junction boxes and supports shall be replaced:
  - 10KW01M
  - 10KW07M
  - 10KW08M
  - 10KW09M
  - 10KW10M
  - 10KW11M
  - 10KW12M
  - 10KW14M
  - 10KW15M
  - 10KW16M
  - 10KW17M
  - 10KW18M
  - 10KW19M
  - 10KW41M
  - 10KW11P
  - 10KW41P
  - 10KW01B
  - 10KW02B
  - 10KW08B
  - 10KW09B
  - 10KW10B
  - 10KW11B

- 10KW12B
- 10KW13B
- 10KW14B
- 10KW15B
- 10KW16B
- 10KW18B
- 10KW41B
- 10KW101B
- 10KW103B
- 10KW109B
- 10KW110B
- 10KW111B
- 10KW112B
- 10KW113B
- 10KW114B
- 10KW115B
- 10KW116B
- 10KW117B
- 10KW118B
- 10KW119B
- 10KW120B
- 10KW121B
- 10KW122B
- 10KW123B
- 10KW124B
- 10KW125B
- 10KW126B
- 10KW160B
- 10KW166B
- 10KW167B
- 10KW168B

- 10KW169B

9.6 Local Control Stations

The *Contractor* shall be responsible for:

- refurbishment of the existing LCS (Local Control Station) by replacing the open/close selector switch (3 position selector switch), local/remote selector switches (3 position selector switch) and indication light (1 lamp).
- refurbishment or replacement of the support depending on severity of corrosion damage.
- replacement of 4 isolation valves on each.
- replacement of 2 regulators and 2 water traps on each.
- new pneumatic valves will be supplied with an LCS interface open/close selector switch (3 position selector switch), local/remote selector switches (3 position selector switch) and indication light (1 lamp). The interface shall be installed up to the Foxboro DCS termination assembly in the equipment room.
- Pneumatic LCS (KP box) identified for refurbishment:
  - 10KP07
  - 10KP08
  - 10KP09
  - 10KP13
  - 10KP14
  - 10KP20
  - 10KP25
  - 10KP27
  - 10KP28
  - 10KP29
  - 10KP30
  - 10KP31
  - 10KP32
  - 10KP33
- new drives will not be installed with an LCS unless required by the process design part of the operating philosophy.
- existing drive LCS should be removed unless it is stated in the operating philosophy then it should be refurbished.

- LCS drives identified for decommissioning:
  - 10KN02
  - 10KN05
  - 10KN10
  - 10KN11
  - 10KN12
  - 10KN13
  - 10KN14
  - 10KN15
  - 10KN16
  - 10KN17
  - 10KN18
  - 10KN19
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  - 10KN31
  - 10KN32
  - 10KN33
  - 10KN34
  - 10KN35
  - 10KN36
  - 10KN115

- 10KN116
- 10KN141
- 10KN146
- 10KN162

9.7 Cabling

The *Contractor* shall make provision for:

- replacement of all cabling between junction boxes and equipment
- labelling of all cabling on both sides as per the section 3.1.3 of the Requirements for Control and Power

9.8 Anion supply pumps VFD

The *Contractor* shall be responsible for each of the three anion supply pumps:

- modifying the interface from the existing switchgear to the newly installed VFD to accommodate the following signal requirements:
  - Start command
  - Stop command
  - Running feedback signal
  - Fault feedback signal
- interfacing of a new analog signal for speed setpoint from the DCS to the VFD.

9.9 Racking and Trunking

The *Contractor* shall be responsible for:

- replacing damaged portions of racking and trunking that are bend or indicate signs of corrosion.
- installing new racking and trunking to support new cabling.
- existing cable racking in the main cable tunnels under the WTP for routing of cables to the WTP control/equipment room shall be utilised as far as possible.
- All new trunking and racking shall have 20% space remaining after project completion.

9.10 Distributed Control System (DCS)

The *Contractor* shall be responsible for:

- supply, delivery, installation, and termination of all DCS hardware.

- the Foxboro DCS hardware shall be procured from an authorised distributor.
- the DCS hardware shall be Foxboro I/A 200 Series IO hardware for the expansion of existing control processors (FCP270).
- new control processors shall be Foxboro I/A FCP280 series.

The Foxboro DCS part numbers that shall be utilised for expansion of the control system:

Control Processor	
FCP280	RH924YA
Network Adapter	RH924WA
Baseplate	RH924YF
Communication Modules	
FCM2F2	RH914YZ
FCM2F4	RH917JA
Baseplates	
2-SLOT FCM/FBM	RH926KE
8-SLOT FCM/FBM	RH926HT
BASEPLATE FIELDBUS TERMINATOR	RH916RB
BASE TO BASE FIELDBUS CABLE, 0.12 m	RH928BL
BASE TO BASE FIELDBUS CABLE, 0.25 m	RH928BM
BASE TO BASE FIELDBUS CABLE, 0.5 m	RH928BN
BASE TO BASE FIELDBUS CABLE, 1.0 m	RH928BP
BASE TO BASE FIELDBUS CABLE, 3.0 m	RH928BQ
BASE TO BASE FIELDBUS CABLE, 5.0 m	RH928BR
BASE TO BASE FIELDBUS CABLE, 10.0 m	RH928BS
BASE TO BASE FIELDBUS CABLE, 20.0 m	RH928BT
BASE TO BASE FIELDBUS CABLE, 30.0 m	RH928BU
BASE TO BASE FIELDBUS CABLE, 60.0 m	RH928BV
Digital Inputs	
FBM217	RH914TR

Termination Assembly	RH916CA
T/A Cables	TYPE 4
Digital Outputs	
FBM242	RH916TA
Termination Assembly	RH916JY
T/A Cables	TYPE 4
Analogue Inputs	
FBM201	RH914SQ
Termination Assembly	RH916AA
T/A Cables	TYPE 1
Analogue Outputs	
FBM237	RH914XS
Termination Assembly	RH916YE
T/A Cables	TYPE 1
T/A Cables	
TYPE 4, 0.5 m	RH916FG
TYPE 4, 1.0 m	RH916FH
TYPE 4, 2.0 m	RH931RQ
TYPE 4, 3.0 m	RH916FJ
TYPE 4, 5.0 m	RH916FK
TYPE 4, 10.0 m	RH916FL
TYPE 4, 15.0 m	RH916FM
TYPE 4, 20.0 m	RH916FN
TYPE 4, 25.0 m	RH916FP
TYPE 4, 30.0 m	RH916FQ
TYPE 1, 0.5 m	RH916DA

TYPE 1, 1.0 m	RH916DB
TYPE 1, 2.0 m	RH931RM
TYPE 1, 3.0 m	RH916DC
TYPE 1, 5.0 m	RH916DD
TYPE 1, 10.0 m	RH916DE
TYPE 1, 15.0 m	RH916DF
TYPE 1, 20.0 m	RH916DG
TYPE 1, 25.0 m	RH916DH
TYPE 1, 30.0 m	RH916DJ
POWER SUPPLIES	
POWER SUPPLY (24 VDC INPUT)	RH922YC
INPUT TERMINAL BLOCK	RH926DZ
INPUT CABLE, 0.4m	RH923DH
INPUT CABLE, 0.8m	RH923DG
POWER SUPPLY TO BASEPLATE CABLE, 0.4 m	RH926KK
POWER SUPPLY TO BASEPLATE CABLE, 0.9 m	RH926KL
POWER SUPPLY TO BASEPLATE CABLE, 1.2 m	RH926KM
POWER SUPPLY TO BASEPLATE CABLE, 1.5 m	RH926KN
POWER SUPPLY TO BASEPLATE CABLE, 1.8 m	RH926KP
POWER SUPPLY TO BASEPLATE CABLE, 2.1 m	RH926KQ
Y-CABLE	RH923NG
ALARM STATUS RELAY, 1.2 m	RH923DB
ALARM STATUS RELAY, 1.5 m	RH923DC
ALARM STATUS RELAY, 1.8 m	RH923DD

The *Employer* shall be responsible for:

- amending control logic as per the updated control philosophy.
- updating mimics for new valves and drives.

9.11 Pneumatic piping

The *Contractor* shall make provision for the complete replacement of pneumatic pipes (8mm and 10mm) for the valves from each KP box solenoid up to each actuator. The average distance between the KP box and the actuator is approximately 25m.

9.12 Solenoid valves

The *Contractor* shall use the existing HAFNER model solenoid valves currently used on the WTP plant for new pneumatic valve installations. The part numbers are listed below:

- HAFNER MH 511-701 G
- HAFNER HR 5703 GRD1
- HAFNER HR 5703 GLD1
- HAFNER HR5703 GD1

9.13 Drawings

The *Contractor* shall be responsible for:

- providing new drawings for all junction boxes.
- providing new loop drawings for all instrumentation.
- providing new loop drawings for all local control stations.
- providing new loop drawings for all drives.

The *Employer* currently has hard copy drawings for most of the loops with outdated IO references. The *Contractor* shall be responsible for:

- The drawings shall be re-drawn in a MicroStation v8 compatible format.
- Updating the drawings with the latest IO references.
- The drawings shall be issued in DGN, PDF and hard-copy formats.
- All meta data (cable numbers, junction box tags, functional locations, DCS IO references, etc.) with references to the drawings containing that data shall be made available in a searchable Excel-file.

Mechanical Hook-up drawings are to be supplied by the instrumentation supplier for each instrument installation. This shall include the following:

- Instrument Stands/Supports
- Instrument Process Hook-up
- Analyser Sample Loop Tubing
- Instrument Air Supply Tubing

9.14 General

The *Employer* will amend the current control logic and HMI to match the *Contractor*'s detailed design documents.

The *Contractor* will make provision in the design layout that instrumentation will not get damaged in the event of mechanical work being performed. The *Contractor* will also be responsible to ensure that the field equipment be installed according to the OEM specifications.

The *Contractor* will be responsible to supply a list detailing the unique identifier (AKZ) of each instrument with the corresponding model number, OE, order number and recommended stock level for each spare.

All analog instrument signals shall range between 4-20mA and the analog devices shall have a digital graphical display. The *Contractor* is required to use loop powered instrumentation (24V DC) where possible. Pressure transmitters, pressure switches and pressure gauges are equipped with 2-valve manifolds.

Every instrument shall be specified to function in the complete process range it will be used in. The range should preferably match the current process ranges where possible. Every instrument shall be specified to function in the process medium it will be used in. Unless other criteria are applicable all instrumentation shall be rated for ingress protection of IP65 or better according to SANS 60529.

Differential pressure transmitters are equipped with 5-valve manifolds, for gas applications they are equipped with 3-valve manifolds with two test connectors.

All instrumentation shall be provided with ½" BSP. All instrumentation and transducers shall have individual instrumentation isolation valves within reach of the instrument to allow for online removal of the instrument or transducer. The *Contractor* shall be responsible to standardise as far as reasonably possible. All instrumentation shall be tested by the *Contractor* and approved by the *Employer*.

The *Contractor* shall use the spare capacity of the existing control system to install additional IO on the control system. The functional distribution of the existing system must be supported in the detail design (i.e., valve limits being added on a demineralised train will be added to the associated processor of that train).

The *Contractor* shall demonstrate pilot instrument and support installations for each type of instrument which need to be approved by *Project Manager* before installation work is started.

In the case where manual control of a device is required remotely, the control room operator will be required to select the device from "automatic" to "manual" for remote manual operation on the control room HMI. The remote or local functionality shall be provided by *Contractor*.

The *Contractor* shall supply instruments and instrument stands as per the above-mentioned standards.

The *Contractor* shall complete the C&I Templates as per his detailed design. The C&I templates are found in Appendix D for the following:

- LOSS Diagrams

- Drive and Actuator Schedule
- I/O Block Diagrams
- Instrumentation Schedule

The *Contractor* shall be responsible to complete all columns in the attached C&I templates and verify the correctness of each detail provided.

The *Contractor* shall provide a commissioning report based on the following approved *Employer*'s template:

- 240-76394151 C&I Cold Commissioning Report Template

Each instrumentation loop will have to be thoroughly tested by the *Contractor* and needs to be accepted by *Project Manager*. The *Contractor* and the *Employer* shall test the control logic extensively. The *Contractor* shall lead the testing process and shall define the complete set of detailed test procedures, for each control logic, as per operating and control philosophy.

10. Electrical Scope of Work

10.1 Electrical Requirements

1) The *Contractor i*s responsible for the design, quality control, manufacture, procurement, transportation, storage on site, installation, testing, commissioning, and handover, including all documentation for the electrical reticulation from and including the 380V Water Plant Board 1A, 1B, 2A and 2B up to and including all loads forming part of the scope of this project such that it is a fully functional system.
2) The electrical reticulation of the 24VDC battery chargers and batteries (including battery chargers and batteries) right up to the distribution boards 10JD01 and 10JD02 in the Water Treatment Plant does not form part of the *Contractor's* scope. The *Contractor's* scope includes the allocation and equipping of circuits from the distribution boards 10JD01 and 10JD02 to supply all loads that form part of the scope of this project, such that it is a fully functional system. The *Contractor* shall complete their design for all loads that need to be supplied by the batteries in the Water Treatment Plant and send the documentation for acceptance to the *Employer* before equipment procurement or installation. The *Contractor* completes and submits the *Employer's* load list template 240-72345357 Appendix C7 enabling the *Employer* to verify if the new loads may be added and accommodated onto the existing Water Treatment Plant load profile.
3) The *Contractor* shall ensure that the equipment and systems are designed to interface with the *Employer's* existing plant and installations.
4) The *Contractor* shall comply with the electrical requirements of this specification, the *Employer's* standards, SANS and IEC standards for the electrical scope of this project.
5) All electrical equipment and installations must have a certificate of conformity provided to the *Employer*. All electrical reticulation that forms part of the scope of this project, the Contractor shall comply with SANS 10142-1.

Should there be any conflicts with any requirements in this specification and standards, the *Contractor* shall record these discrepancies and notify the *Employer* for resolution.

The *Contractor* is responsible for removal and transportation of decommissioned equipment to a dedicated demarcated area defined by the *Employer.*

10.1.1 Special Design Requirements

1) The Water Treatment Plant has 3 trains that produce demineralised water. The boards that supply each of these trains loads are as follows –
   a) Train 1 loads supplied by 380V Water Plant Board 1A
   b) Train 2 loads supplied by 380V Water Plant Board 1B and 380V Water Plant Board 2B
   c) Train 3 loads supplied by 380V Water Plant Board 2A

   Each trains loads are supplied in this manner to ensure that if one of the 380V Water Plant Boards 1A, 1B, 2A and 2B is lost, then only one train is affected. The *Contractor* to maintain the philosophy that if one board is lost then only one train will be affected when allocating loads to boards.
2) The *Contractor* to allocate loads that form part of the scope of this project to the existing switchgear. The *Contractor* shall submit the new load list to the *Employer* for review and acceptance. With reference to Figure 14 below, the loads on the switchgear shall be allocated such that:
   a) If Transformer 1 is out of service, then Transformer 4 must supply the total loads of 380V Water Plant Board 2A & 380V Water Plant Board 2B.
   b) If Transformer 2 is out of service, then Transformer 3 must supply the total loads of 380V Water Plant Board 1A and 380V Water Plant Board 1B.
   c) If Transformer 3 is out of service, then Transformer 2 must supply the total loads of 380V Water Plant Board 1A and 380V Water Plant Board 1B.

d) If Transformer 4 is out of service, then Transformer 1 must supply the total loads of 380V Water Plant Board 2A and 380V Water Plant Board 2B.

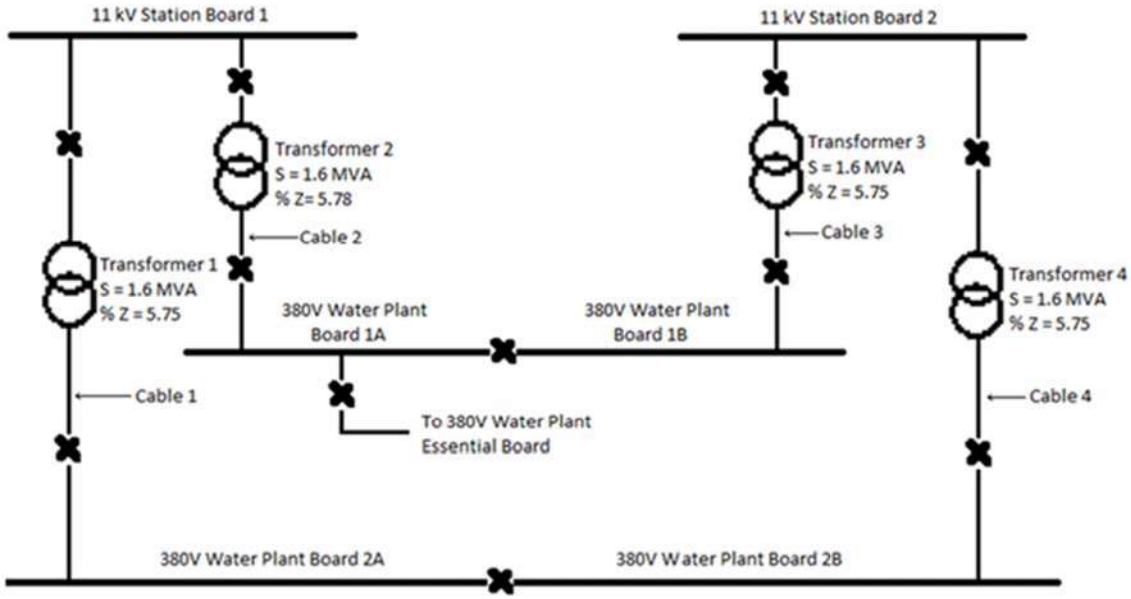

Figure 14: Water Treatment Plant Boards Electrical Reticulation

3) Installation of circuits does not compromise the guarantees and type test certification of the existing LV Switchgear.
4) All motor starters are of type II co-ordination and class 10 protections. Contractor to submit evidence of type 2 co-ordination of motor starter components.
   a) All MCB, fuse curves, CFS curves are provided by the *Contractor*. The *Contractor* provides these curves to the *Employer* in a hard copy format (as part of the technical manual).
   b) The *Contractor* to design the starter and feeder circuits taking into account the RMS Board Rating of the 380V Water Plant Board 1A, 1B, 2A and 2B being 50kA.

10.2 Low Voltage Switchgear

10.2.1 General

1) The *Contractor* shall reuse and utilize the *Employer's* existing (380V Water Plant Board 1A, 1B, 2A and 2B) LV Switchgear to supply all loads forming part of the scope of this project such that the plant is a complete and functional system.
2) The *Contractor* shall reuse and utilise the existing circuits for the supply of new equipment or motors that will form part of the scope of work.
3) The power circuit ratings for the affected existing motors are indicated in Appendix C6 (Load Schedules for Water Treatment Plant Board 1A, 1B, 2A and 2B).

4) Where the existing circuits cannot be reused, the *Contractor* is solely responsible for the design, modification and provision of all components required to affect a complete and functional system.
5) The *Contractor* shall design the functional unit circuits in line with *Employer's* existing switchgear, typical schematics provided in Appendix C1. The Contractor's design shall not compromise the type test certification and guarantees of existing switchgear i.e., temperature rise tests.
6) The *Contractor* shall populate, update and submit to the *Employer* for approval the documentation for this section as prescribed in the electrical vendor document list (Appendix C8) and further utilize the following Employers templates as a basis of design:
   a) 240-56227927 Electrical Load List Template in Appendix C7.
7) The Contractor shall in the *Employer's* load schedules Appendix C6, identify, update and decommission existing plant-related loads not applicable or required for this project.
8) The table below contains the only spare buckets on boards that the Contractor may utilise:

#	BOARD	CIRCUIT	CIRCUIT CURRENT LIMITATION (A)
1.	380V Water Plant Board 1A	GC 003	63A
2.	380V Water Plant Board 1A	GC 004	63A
3.	380V Water Plant Board 1A	GC 006 to GC 009	63A
4.	380V Water Plant Board 1A	GC 015	200A
5.	380V Water Plant Board 1A	Below GC 017	200A
6.	380V Water Plant Board 1A	GC 074	200A
7.	380V Water Plant Board 1A	GC 076	63A
8.	380V Water Plant Board 1A	GC 077	100A
9.	380V Water Plant Board 1B	Above GD123	200A
10.	380V Water Plant Board 1B	GD 132	16A
11.	380V Water Plant Board 1B	GD 133	10A
12.	380V Water Plant Board 1B	GD 134	10A
13.	380V Water Plant Board 1B	GD 142	6A
14.	380V Water Plant Board 1B	Below GD155	200A

15.	380V Water Plant Board 2A	GE 001	100A
16.	380V Water Plant Board 2A	GE 004	100A
17.	380V Water Plant Board 2A	GE 006	200A
18.	380V Water Plant Board 2A	GE 007	200A
19.	380V Water Plant Board 2A	Below GE008 Bucket 1	250A
20.	380V Water Plant Board 2A	Below GE008 Bucket 2	250A
21.	380V Water Plant Board 2A	GE012	200A
22.	380V Water Plant Board 2B	GF 067	200A
23.	380V Water Plant Board 2B	GF 104	100A
24.	380V Water Plant Board 2B	GF 106	100A
25.	380V Water Plant Board 2B	GF 108 to GF 110	100A
26.	380V Water Plant Board 2B	GF 111 to GF 113	200A
27.	380V Water Plant Board 2B	GF 124 to GF 126	16A
28.	380V Water Plant Board 2B	GF 127 TO GF 131	10A
29	380V Water Plant Board 2B	GF 146	100A
30.	380V Water Plant Board 2B	GF 149 to GF 151	100A
31.	380V Water Plant Board 2B	GF 152	200A
32.	380V Water Plant Board 2B	GF 153	100A

9) The heat tracing elements on the pipework that forms part of these Works, shall be replaced by the Contractor. The localised existing electrical distribution power supply panels for the heat tracing elements shall be replaced and provided by the Contractor.The new localised distribution panel material shall be suitable for the corrosive environment and ingress protection (IP) where it is currently installed.

10.3 Documentation

1) The *Contractor* submits all documentation in accordance with Appendix C8, Electrical Vendor Document Submital Schedule (VDSS).

2) The type test certificates and reports must be for the appropriate equipment offered. The certificates and reports must be referenced to the components and combination of the components. All type test reports and certificates must be accepted by the *Employer* prior to delivery to site.
3) During design phase, the *Contractor* develops, maintains and submits an electrical master document list. The master document list shall be provided for every design deliverable revision submitted by the *Contractor .*
4) The *Contractor* provides full sets of drawings per circuit to the *Employer* for acceptance prior to manufacture.
5) All drawings provided after circuit installation are signed “As Built” by the *Contractor*. The drawings to be signed by the ECSA registered Professional Electrical Engineer. After the handover, all drawings become the property of the *Employer*.
6) The *Contractor* to populate and update the switchgear load schedules and general arrangement drawings, as per design and submit to *Employer* for acceptance.

10.4 LV Cabling and Cable Racking

10.4.1 Cable Assessment and Reuse of Cables

1) The *Contractor* shall reuse the *Employers* existing circuits associated cables and cable rack servitudes.
2) The *Contractor* shall perform a technical cable assessment for the reuse of cables and produce a report for the Employers review and acceptance to indicate the condition of the cables with recommendations which cables may be re-used and which cables are recommended for replacement.
3) The Contractor shall provide a cable assessment methodology for the Works inclusive of the proposed inspections, cable test acceptance criteria performed to validate the replacement or reuse of the cabling systems.
4) The Contractor shall in the pricing schedules provide an itemised list for the cable assessment report and associated activities defined in the methodology.
5) The Contractor shall further make provision for new cables for the scope of this project.

10.4.2 Cable Works

1) The *Contractor* shall comply to the following standards for all cabling and racking that form part of the scope of this project,
   a) Requirements for Control and Power Cables for Power Stations Standard (240-56227443)
   b) All cabling shall comply to SANS1507, SANS10198 and SANS 10142-1.
   c) The *Contractor* completes and submits the 240-56227443 Cable Technical Schedule A&B for the *Employer* s acceptance in Appendix C2.
2) All LV power cables shall be low halogen, armoured, have stranded copper conductors and are of the flame retardant 600/1000V PVC/SWA/PVC type.

3) The electrical cable schedule template (240-56176097) in Appendix C7 to be populated by the Contractor and submitted to the Employer for acceptance before any cabling can be procured.
6) The *Contractor* designs, supplies and installs all low voltage power cables to supply all loads/equipment that forms part of the scope of this project. The *Contractor* indicates the power cable routing, compiles the cable schedules and cable block diagrams and issues to the *Employer* for approval. The *Contractor* also supplies and installs the cables, labels them, tests the cables, completes the quality documentation and issues to the Employer for acceptance.
7) The *Contractor* supplies and installs all cable accessories such as terminating and jointing kits, cable glands, lugs, bolts, washers and nuts for terminations, sleeves and other ancillary material for fitting the cables into position.
8) The *Contractor* shall use the existing cable racks in the cable tunnels to lay new cables as far as possible to supply the loads/equipment that form part of the scope of this project. Should the space on existing cable racks not be sufficient to accommodate all new cables that form part of the scope of this project, the *Contractor* to propose modifications to existing cable racks or installation of new cable racks so as to supply all loads/equipment to ensure a fully functional system. The *Contractor* designs, supplies and install cable racks and supplementary steelwork for cable racking. The *Contractor* to submit all documentation for new cable racking or modifications of cable racks for acceptance before procurement or modification of any equipment.
9) The *Contractor* records the existing and new cable loadings to assess the effectiveness of their cable rack designs.

10.4.3 Cable Management System, Pull cards and Documentation

1) The *Contractor* performs a detailed design for inter alia the size, length and route of the cabling. The *Contractor* compiles and submits cable schedules for acceptance by the Employer. The schedules will indicate the general cable requirements i.e., application, power, fault levels, cable source, cable destination, AKZ details, cable termination details and special routing requirements.
2) The *Contractor* installs the cables, tests, terminates the electrical plant and completes the cable pull cards. The cable pull card contains the as-built status of the cables and indicates the drum number from which the cable has been pulled. The *Contractor* is responsible to red line the existing cable block diagrams and submits such diagrams together with the as-built cable schedules as per the cable pull cards to the Employer.
3) The *Contractor* provides and implements a cable drum management system. This data is compared to the Employer's cable delivery to site management system and be consolidated on a regular basis. All cable deliveries to the project site are logged on a cable drum delivery schedule provided by the *Contractor* and approved by the Employer. The cable drum delivery schedule is signed by both the *Contractor* and the Employer.

10.4.4 Fire Barrier Requirements

1) The *Contractor* to design all Fire Barrier required for this project to comply with the Fire Protection & Life Safety Design Standard (240-54937450). All Fire barriers to have a fire

rating of 2 hours minimum. All Fire Barriers must be qualified by tests as required by the relevant SANS Standards. The *Contractor* to provide certificates for all Fire Barriers.

10.5 Earthing and Lightning Protection

1) The *Contractor* to design the earthing to interface with the existing earthing system at Lethabo Power Station. The existing earthing system is indicated in drawing 0.63/496 located in Appendix C5.
2) The *Contractor* shall design, install, test and commission the earthing and lightning protection system such that the system satisfies the requirements below -
   a) To limit the touch potentials on structures and equipment and to provide a low impedance return path to limit the damage to equipment by fault currents, during normal or abnormal system conditions.
   b) The installation is protected from lightning by conducting the strike through a preferred path to earth.
   c) All non-current carrying metal parts of the installation is earthed. This comprises earthing of metal conduits, metal cable racks, cable armouring, junction boxes, panels, motor frames, switchgear enclosures and metal enclosures for motor controllers, frames, metal enclosures for various electrical equipment, electrically operated equipment, main support structures, reinforcing etc.
   d) Provide earth fault current path that enables the electrical protection to prevent or, mitigate plant damage;
   e) Protect plant and people against the effects of lightning;
   f) Protect electrical components against incoming surges;
   g) Provide a path for the dissipation of electrostatic discharge; and
   h) To provide a reference point for electrical signals
   i) The installation shall be earthed in accordance with the requirements of 0.54/393.
3) The *Contractor* shall comply with the 240-56356396: Earthing and Lightning Protection Standard for earthing and lightning protection scope of this project.

10.5.1 Cable rack bonding

The *Contractor* verifies the electrical continuity of the existing cable racks that will be affected by this project. The *Contractor* ensures that all cable racks that are part of the scope of this project are connected to the earth mat of the Water Treatment Plant.

10.6 Motors

1) The Contractor shall provide new motors for the Works and determine the motor ratings and sizes for all these motors that form part of the scope of this project.

2) The Contractor shall comply to the New Low Voltage Motors Procurement Standard (240-57617975) in the procurement and selection of the motor ratings for a specific mechanical load. For all motors that form part of the scope of this project, the Contractor shall comply to the following standards -
   a) Transport of Power Station Electric Motors Standard (240-56361435)
   b) Storage of Power Station Electric Motors Standard (240-56360387)
   c) Procurement of Power Station Low Voltage Motors Specification (240-57617975)
3) The Contractor shall complete 240-77100923 schedule B in Appendix C2 and send to the *Employer* for approval before any motors can be procured.
4) Indication and monitoring, ammeter indication is required on all motors. The local and remote facility is required on all motor starters.

10.6.1 Variable Frequency Drives (VFD)

1) All Variable Frequency Drive's (VFD's) that form part of the scope of this project must comply with:
   a) SANS 61800-2 Adjustable speed electrical power drive systems Part 2: General requirements — Rating specifications for low voltage adjustable frequency A.C. power drive systems.
   b) SANS 61800-3 Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods.
   c) SANS 61000-2-4 Electromagnetic compatibility (EMC) Part 2-4: Environment: Compatibility levels in industrial plants with low frequency conducted disturbances.
   d) The Contractor completes and submits the *Employer*s template 240-132875144 LV AC VFD Technical Schedule A&B in Appendix C2.
   e) The Contractor is solely responsible to provide an optimum position for the VFD's. The Contractor may elect to position these new VFD's within the substation or closer to the motor in the field.
   f) The Contractor shall consider the VFD original equipment manufacturer prescripts for VFD location and cabling requirements. All specialised VFD cabling, harmonic filters and outside field based VFD enclosures of suitable ingress protection (IP - rating) required of the installation shall be provided by the Contractor.
   g) Variable frequency drives are recommended to be installed on the anion sump pump motors (110kW) feeding from circuit 18, 84 and 14 on the 380V Water Treatment Plant Board 1A, 1B and 2A respectively.

h) The *Employer* s substation equipment layout is constrained on available space for new equipment (VFD's), and thus the Contractor shall propose an optimum positioning and location for the VFD's. The new VFD equipment layout in the switchgear room forms part of the Contractors scope. The VFD's shall be supplied via switchgear feeder circuits. To create additional space within the substation, the Contractor shall decommission and move the two (2 x 10kVA) UPS and battery cabinets that are currently located in the switchgear room to an area to be indicated by the *Employer*.

10.7 Protection

1) The Contractor to design the protection for the scope of this project such that it complies with the requirements of Appendix C3 – MV and LV protection philosophy.
2) Protection relays comply with "List of Approved Electronic Devices to be used on Eskom Power Stations Standard (240-56227589)". The protection relays must be on the *Employer*'s approved protection relay list which is contained in the standard "List of Approved Electronic Devices to be used on Eskom Power Stations Standard (240-56227589)".

10.8 Testing of Electrical Equipment

1) Prior to delivery of electrical plant, the *Employer* witnesses the Factory Acceptance Tests and carries out Quality Assurance inspections at the Contractor's site for:
   a) Motors,
   b) Variable Speed Drives,
   c) Functional unit testing of motor control starters
2) All the electrical test certificates and reports will be supplied to the *Employer* prior to delivery of electrical equipment.
3) The Contractor is responsible to test electrical equipment in accordance with the requirements of this specification.

10.9 Material

1) All material supplied shall be in accordance with SANS 10198 and SANS 62262.

10.10 Installation, Operating and Maintenance Manuals

1) The Contractor to supply four (4) hardcopies and an electronic copy of the installation, operating and maintenance manuals for the VFD's and Motors that form part of the scope of this project.

10.11 Contract Documents

1) *Contractor* produces drawings showing all the cable routes, compiles the cable schedules and cable block diagrams and submit to the *Employer* for acceptance before any equipment is procured.
2) *Contractor* to produce drawings for the distribution boards and update all existing drawings (i.e., switchgear load schedules, general arrangement drawings, summary sheets) that are affected by the scope of this project and submit to the *Employer* for acceptance before any equipment is procured.
3) *Contractor* to produce earthing and lightning protection designs and drawings and submit to the *Employer* for acceptance before any equipment is procured.
4) Where necessary, manufacturers shall outline drawings showing required clearance for maintenance.
5) *Contractor* to submit all equipment schedules at the end of their detailed design phase for acceptance of the *Employer* before any equipment is procured.
6) All drawings to be submitted for *Employer* acceptance before procurement, manufacture, installation, testing and commissioning of any equipment or system.
7) The *Contractor* to produce a design report that indicate the design bases of the entire electrical reticulation that forms part of the scope of this project for acceptance by the *Employer* before any equipment is procured.
8) *Contractor* to produce four hard copies and one electronic copy of “As built” drawings.
9) *Contractor* to submit an electronic copy of the contract drawings for approval as stipulated in the Specification before manufacture is due to commence.
10) Acceptance will be by letter listing the drawings and the allocated numbers. If a drawing is not accepted, a mark-up print showing the required revisions may be returned to the *Contractor*.
11) No drawing which has been submitted may be cancelled by the *Contractor* without prior agreement and once issued, no alterations, additions or omission may be made to or from any drawing without re-issuing it under a new revision number.

11. Civil and Structural Scope of Work

11.1 Description of the *works*

11.1.1 Chemical Offloading Area

The chemical offloading facility is located outside the water treatment building. This facility consists of an elevated concrete loading slab that is surrounded by a slope acid resistance brick apron. A perimeter concrete channel encloses the facility, which lead to a drainage sump. Adjacent to the concrete slab, an elevated structural steel platform is installed. This structure provides access to the chemical tankers via a foldable steel stair. Furthermore, the structure serves as a support for the chemical piping system and electrical components. The approximate dimension of the offloading facility is 7 800mm x 12 500mm. Refer to drawings no. 0.63/51473 and 0.63/54201 for more information on the chemical offloading facility.

11.1.2 Water Treatment Plant Building

The Water Treatment Plant building is a single-storey building comprising of a large open floor area, which houses the installation of processing equipment and steel vessels. This building consists of an exterior reinforced concrete wall with a structural steel lattice roof. The layout of the water treatment plant can be divided into eleven zones, which is based on the process flow of treating the incoming raw water. The eleven zones identified are the chemical storage area, chemical dosing area, sand filter area, cation vessel area, degassed water vessels and sumps area, weak & strong based anion vessel area, mixed bed exchange vessel area, CPR vessel area, blowers, hot water tanks and the water supply pumps area.

A 150mm thick reinforced concrete floor slab is provided which is supported by a raft foundation. Incorporated in the slab are drainage channels and pipe trenches. The entire WTP building is supported by concrete piles. Compacted fill material is located between the ground floor slab and pile cap. The pile cap also supports the concrete stubs for all chemical vessels. Two cab tunnels are located below the ground floor slab. Each cable tunnel provides access for the routing of cables to all mechanical equipment

The roof for the water treatment plant consists of structural steel lattices which are supported by concrete columns and the perimeter concrete wall of the WTP building. The layout of the concrete columns is in a form of a grid with each column supported by pile foundation.

The approximate dimension of the WTP building is 48 100mm x 60 500mm. Refer to drawing 0.63/2499, 0.63/2500, 0.63/2861 and 0.63/2862 for more information regarding the WTP building.

11.1.3 Chemical Storage Area

The chemical storage area is located within the WTP building between grid lines 3A-4. The layout of the storage area entails compartments that house the installation of different chemical tanks/steel vessels. Each tank/vessel is support by concrete stubs/plinths. Acid resistance tiles protect the surface of the reinforced concrete bund wall. A total of three drainage sumps are located outside the WTP building. Each drainage sump collects spilled chemicals from two compartments. Access cat ladders and steel platforms are installed at each compartment. The dimension of the storage is approximately 8 100mm x 53 100mm x 2 200mm (width x length x height). Refer to drawings 0.63/2493 and 0.63/2500 for more information.

11.1.4 Chemical Dosing Area

The chemical dosing area comprises of a sloped 350 mm reinforced concrete floor slab, which is enclosed by a perimeter bund wall (150mm x 180mm). The floor slab consist of several concrete plinths on which motors, pumps, pipes and other critical equipment are mounted. Acid resistance bricks protect the surface of all concrete plinths. Adjacent to the dosing area is a drainage channel, which collects and transports spilled chemicals to an inlet drain. Surrounding the chemical dosing area is a series of portal frames (i.e., pipe support) mainly supporting pipes with varying diameters.

11.1.5 Cation Vessels Area

Within the WTP plant building, three cation vessels are installed. Each vessel is supported on four concrete stubs that protrude through the floor slab. The pile cap (600mm in thickness) supports all the concrete stubs. Located centrally of the three cation vessels, a pipe trench is positioned. This facility allows for the routing of connecting pipes to the cation vessels.

Each cation vessel is installed with a structural steel cat ladder and platform. This structure is supported and connected the vessel. This facility allows for maintenance activities of the vessel.

11.1.6 Degasser Water Vessels and Sumps

The degasser water vessels and sumps are located next to the cation vessels. This system comprises of three steel vessels, which are installed directly below a reinforced concrete sump. The roof of each concrete sump entails an access manhole, discharge point and a concrete plinth for an electrical motor. The base of the sump includes a screed layer, which is sloped towards a collection point within the sump. All three sumps are supported on concrete piles. The approximate dimensions of all three sumps are 7 300mm x 14 000mm x 2 900mm (width x length x height). Refer to drawings 0.63/2917 and 0.63/1634 for more information on the degasser water vessels and sumps.

The degasser water vessels are fitted with a steel cat ladder and platform elevated above the vessel. This platforms provides a level surface to conduct maintenance on the vessel. Refer to drawing 0.63/5135 for more information on the degasser vessel.

11.1.7 Weak Base Anion (WBA) and Strong Base Anion (SBA) Area

Within the WTP plant building, there a six vessels dedicated to the anion system (i.e., 3 x WBA vessels and 3 x SBA vessels). Each vessel is supported on four concrete stubs that protrude through the floor slab. The pile cap (600mm in thickness) supports all the concrete stubs. Located centrally of the vessels, a pipe trench is positioned. This facility allows for the routing of pipework to the vessels.

Each anion vessel is installed with a structural steel cat ladder and platform. This structure is supported and connected to the vessel. The steel platforms allow maintenance activities to be conducted on the vessels.

11.1.8 Mixed Bed Area

The mixed bed system comprises of three steel vessels. Each vessel is supported on four concrete stubs that protrude through the floor slab. The pile cap (600mm in thickness) supports all the concrete stubs. Located centrally of the three cation vessels, a pipe trench is positioned. This facility allows for the routing of connecting pipes to the cation vessels.

Each vessel is installed with a structural steel cat ladder and platform. This structure is supported and connected to the vessel. This facility allows for maintenance activities of the vessel.

11.1.9 Blowers and Water Supply Pumps

The blowers and water supply pumps are located on the northern part of the WTP building. This area comprises of a sloped 350mm concrete floor slab, which entails several concrete plinths that support various mechanical equipment. The installed plinths vary in size. Along the length of the area, a pipe trench is positioned which serves as the routing of pipework and the drainage of spilled water from the mechanical equipment.

11.1.10 Hot Water Tanks

Between the blowers and the water supply pumps, two hot water tanks are installed. Four concrete stubs that protrude through the floor slab support each tank. A drainage channel is located adjacent to the tanks. This allows for the collection of spilled water from the tanks during maintenance activities.

11.1.11 Brine Measuring Tank

The brine measuring tank is located within the chemical dosing building. The tank is installed on a circular concrete plinth, which is protected by acid resistance tiles. The system also comprises of a mechanical equipment that is installed on concrete plinth.

11.2 *Employer's* Design

The *Employer* has conducted a high-level visual assessment of the water treatment plant building. The intent of this assessment was to assess, describe and categorise the extent of deterioration on the civil infrastructures. During the assessment, various defects were identified and classified according to the Structural Condition Classes.

The contents contained in the visual assessment report is for information and costing purposes only.

Refer to Appendix F for the conditional visual assessment report of the water treatment plant building.

11.3 *Contractor* Design

11.3.1 General

1) The *Contractor* takes full professional accountability and liability for the *works* as described in the Specification.
2) The *Contractor* is required to confirm and verify all information supplied by the *Employer* prior to being using in the design and/or works.

3) It is the *Contractor's* responsibility to provide design and construction, which is fit for purpose, in accordance with sound engineering principles and prudent industry practice. The *Contractor* and his *Sub-Contractors* perform the *works* in compliance with legislation, rules and regulations, applicable national and international engineering codes, environmental standards, other applicable standards, statutory requirements and this Specification.
4) No deviation from this specification and its referenced documents is permissible without documented acceptance from the *Project Manager*. The *Contractor* includes a list of exceptions and/or clarifications as part of his tender. This list of exceptions and/or clarifications includes the section deviated from as a reference number, the requirement in question and a detailed explanation of the deviation. In the event of conflicts or discrepancies between any of the specifications, the *Contractor* notifies the *Project Manager* for resolution in writing.
5) The *Contractor* adheres to all design requirements, codes of standards and regulations stated in this Specification.
6) Any discrepancy or ambiguity between the *Employer's* Specifications or requirements is to be immediately brought to the attention of the *Project Manager* for clarification.
7) Where the *Contractor* requires additional information to design or install certain components of the Plant, the *Contractor* notifies the *Project Manager* of the *Contractor's* requirements a minimum of one (1) week before continuing with the works.
8) All documentation, as specified in this Specification, forms part of the works and is supplied to the *Project Manager* by the *Contractor*. The *Employer* reserves the right to issue the *Contractor's* design or drawings to other *Contractor's* for purposes of maintenance, spares, verifications, modifications in future or any other purposes required by the *Employer.* The *Employer* has total rights to use the design, as the *Employer* requires. The *Contractor* notes that all drawings and other documentation supplied to the *Employer* become the property of the *Employer* upon completion of the works.
9) Datasheets of the proposed materials are to be submitted to the *Project Manager* for review and acceptance. Upon receipt of written acceptance by the *Project Manager*, only then can the *Contractor* order, purchase and use such materials. All datasheets and guarantees are to form part of the handover package (i.e., data books) which is submitted to the *Project Manager*.
10) All corrosion protection in the areas mentioned below must conform to:
    a. Appendix E7: GAM/MAT/22/245: Lethabo Corrosion Protection Specification for Effluent and De- Gasser Sump (Walls and Floor)
    b. Appendix E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings
    c. Appendix E5: RTD/MAT/19/123: Protective Coating Specification
    d. Appendix E7: GAM/MAT/22/245: Lethabo Corrosion Protection Specification for Effluent and De- Gasser Sump (Walls and Floor)
    e. Appendix E8: GAM/MAT/21/064: Lethabo Corrosion Protection of Off-Loading Bay/Apron, Bulk Storage Bunds and Chemical Dosing areas

f. Appendix E9: GAM/MAT/21/066: Lethabo Power Station Corrosion Protection of Dosing/Mixing Bunds and Floors, Hardstands, Plinths, Steel Base Plates, Structural Members and Encased Columns
g. Appendix E10: GAM/MAT/21/067: Lethabo Power Station Corrosion Protection of Water Treatment Plant General Walkways

11.3.2 Conditional Assessment

1) The *Contractor* is required to undertake a detailed conditional assessment of the water treatment plant building, which is in accordance with the Inspection Manual for Civil Works at Eskom Power Stations (240-99527377).
2) The conditional assessment includes both non-destructive and destructive testing on the civil infrastructures to determine the extent of damage/deterioration.
3) As a minimum, the non-destructive tests are to determine the following:
    - Anchor bolts breakage and bond length to all holding down bolts.
    - Compressive strength evaluation of the damaged concrete elements.
    - Inspection of cavities, voids, delamination and cracks in the concrete elements.
4) As a minimum, the destructive tests are to determine the following:
    - Depth of carbonation of concrete elements.
    - Determine the severity of damage/chemical attack on the steel reinforcement.
5) The *Contractor* is required to propose the method of testing, the number of tests to be conducted (i.e. both destructive and non-destructive tests) and required equipment in order to determine the results as noted in 11.3.2 (3) and (4). This information is to be submitted to the *Project Manager* for review.
6) Prior to conducting non-destructive and destructive testing, written approval is to be obtained from the *Project Manager*.
7) The *Contractor* compiles and submits a conditional assessment report to the *Project Manager* for review and acceptance.
8) The conditional assessment report is to include the following as a minimum:
    - Description and photographic evidence of all defects.
    - Possible root cause of the defects.
    - Type of destructive and non-destructive tests undertaken.
    - Results of the destructive and non-destructive tests.
    - Remedial recommendation to correct the defect.

11.3.3 Structural Verification

1) In the event that either mechanical or electrical equipment and/or components are to be replaced or refurbished, the *Contractor* is required to conduct a structural verification/assessment on the existing civil infrastructures (e.g., concrete plinths, floor slab, columns/stubs, etc.) to determine if the new imposed loads will not compromise the structural integrity of the supporting infrastructures.
2) If the structural integrity of the supporting infrastructure is found to be compromised, based on the structural verification/assessment, the *Contractor* will be required to design new supports and/or modify the existing supports to accommodate the new equipment and/or components.

3) The *Contractor* takes full professional accountability for any modifications made to the existing structure.
4) In the event that modifications to the support infrastructures are implemented, the *Contractor* is responsible for producing as-built drawings for such areas/locations.
5) All structural designs/modification are to be in accordance with 240-56364545 - Structural Design and Engineering Standard as well as all other standards and specifications referenced in this Specification.
6) All designs or modifications are required to be designed for the remaining life of Lethabo Power Station, which is approximately 23 years to the end of 2046.

11.3.4 Chemical Offloading Area

1) The *Contractor* is required to visually inspect the acid resistance brick apron to identify any loose and/or damaged acid resistance bricks.
2) Based on the results from the visual inspection, all damaged and/or loose acid resistance bricks are to be replaced with new bricks of similar properties.
3) The grout lose between the acid resistance bricks are to be stripped (i.e., removed) and re-grouted. This activity is to be done for the entire acid resistance brick apron.
4) All concrete defects observed on the ground floor slab, plinths, concrete stubs and drainage channels are to be repaired. This activity includes the necessary surface preparations (e.g., removing all contaminated concrete) that are required prior to concrete repairs.
5) The minimum strength of the repair concrete grout and/or concrete is to be 30MPa.
6) The *Contractor* ensures that the correct final elevation and profile is maintained to all concrete structures (e.g., floor slab, drainage channel, etc.) that are repaired, as per the original design.
7) All damaged and/or dislodged acid resistance tiles installed on the concrete plinths are to be replaced with tiles that are of similar properties to the original design.
8) In the event that the embedded steel reinforcement is found to be damaged, such reinforcement is to be replaced as per the original design (i.e., similar properties and diameter) prior to concrete repairs.
9) All reinforcement that is replaced by the *Contractor* is to be coated with one layer of zinc primer to protect the reinforcement from corrosion.
10) The *Contractor* is required to paint the perimeter concrete slab and drainage channel with a green floor paint. The necessary surface preparations are to be undertaken prior to painting. The surfaces to be paint is to be verified as indicated on site.
11) All sumps within the chemical offloading area are to be assessed, as per the requirements noted in Section 11.3.2, to determine the degree of concrete degradation. If the sumps are severely damaged, the *Contractor* is required to repair the sumps are per the original design.

12) All grating covers, for the sumps are to be replaced. This includes replacing the severely corroded embedded angle support frames for the gratings. Cover gratings for the sumps are to be replaced with Fibre Reinforced Plastic gratings with the appropriate fixing clips.

13) The damaged and/or dislodged perimeter bund wall is to be repaired as the original design. The bricks and motor used in the repairs is to be of similar properties as per the original design.

14) All severely corroded structural steel members are to be replaced as per the original design for the structural steel platform. This activity includes the bolts, welds and end plates that may be used for the connection.

15) Structural steel members with minor surface corrosion and/or stains are to be sandblasted (i.e. surface preparation) and coated with a single layer of primer and two layers of anti-corrosion paint.

16) Prior to painting, the surface of the steel members is to be free from chemical contaminates, grease and oil.

17) The required dry film thickness for the primer and anti-corrosion paint is to be in accordance with the manufacturer's datasheet.

18) All handrailing's are to be re-painted (i.e., black paint for stanchions and yellow paint for hand and knee rails). This includes conducting the necessary surface preparations prior to painting.

19) All damaged and/or severely corroded gratings are to be replaced as per the original design for the structural steel platform.

11.3.5 Chemical Storage Area

1) The *Contractor* is required to visually inspect the interior and exterior surface of the chemical storage area to determine and quantify the extent of damage to the acid resistant tiles and concrete surface of the bund wall. The visual inspection is to be done in accordance with the requirements as stated in Section 11.3.2.

2) Prior to conducting the visual inspection, the *Contractor* is to clean (i.e., pressure wash) the chemical storage area so that all defects can be observed.

3) The *Contractor* is required to replace all damaged (e.g., chipped, broken, dislodged, stained, etc.) acid resistant tiles found within the interior surface of the chemical storage area. The new acid resistant tiles are to be similar in properties to the original design.

4) All surface preparations are to be undertaken (e.g., removing residual grout, repairing the waterproofing layer, etc.) prior to installing the new acid resistant tiles.

5) Each of the structural steel platforms that is used to enter the different compartments of the chemical storage area is to be refurbished. This includes repainting and recoating the different steel elements found in the platform as well as repairing or replacing the platform grating, connection bolts and anchor bolts.

6) In the event that the structural steel platforms are severely corroded and cannot be repaired, the *Contractor* is required to design, remove and replace the steel platforms. The location and design of the new steel platforms is to be as per the original design.

7) In the event that the storage vessels and/or tanks are replaced, the *Contractor* conducts a structural verification/assessment for the supporting infrastructures as defined in Section 11.3.3.

8) The *Contractor* is required to refurbish the elevated steel platform that is spanning across the entire length of the chemical storage area. This activity includes as a minimum the following:
    - Repainting/recoating the corrosion protection paint on all steel members.
    - All handrailing's are to be re-painted (i.e., black paint for stanchions and yellow paint for hand and knee rails).
    - Repairing or replacing damaged platform gratings and steel columns supporting the platform.
    - Conducting the required surface preparation prior to repainting/recoating.

9) The *Contractor* is required to refurbish the sulphuric and caustic sump. This entails repairing all concrete defects in the sump, coating the interior surface of the sump with an acid resistant liner (refer to GAM/MAT/22/245 document for specific requirements of the liner) and repainting the safety barrier enclosing the sump.

10) The height of the sulphuric and caustic sump is to be extending by 150mm above natural ground level. This can be achieved with the installation of two layers of acid resistant bricks around the perimeter of the sump.

11) In the event that the protruding inlet pipes within the sump is replaced, the *Contractor* will be required to carefully chip the concrete to expose the inlet pipes, remove and install the new inlet pipes and repair the concrete surface using a 30 MPa cementitious grout. Care is to be taken not to damage the embedded steel reinforcements.

12) If the steel reinforcement is damaged from the activities undertaken for 11.3.5 (11), the *Contractor* is required to replace the damage reinforcement as per the original design. All exposed steel reinforcement is to be coated with a layer of Zinc primer.

11.3.6 Chemical Dosing Area

1) Within the chemical dosing area, there are a number of mechanical equipment/components that are installed, which do not form part of the project. However, due to the concrete degradation observed, the structural integrity of the supporting infrastructure has been compromised. The *Contractor* is required to repair all plinths located within reference lines PR 208 to PR 224 (i.e., total of 21 plinths). Plinths located within reference lines PR 202 to PR 208 (i.e., total of 6 plinths) do not form part of the civil scope. Refer to drawing number 0.63/2499 for more information on the layout of the plinths and reference lines labelling.
2) The *Contractor* is required to remove all damaged, cracked and/or dislodged acid resistant tiles, bricks and/or coatings from the surface of the 21 plinths, floor slab and drainage channel. Acid resistant tiles or bricks that are not damaged will remain installed.
3) All acid resistant tiles and/or bricks that are removed, is to be replaced. Refer to GAM/MAT/22/245 document for specific requirements on the acid resistant tiles and/or bricks.
4) The *Contractor* conducts corrosion and pH testing on all reinforced concreted structures (i.e. concrete plinths and drainage/pipe channel) found within the chemical storage area. The aim of this test is to determine the depth of contamination in the concrete.
5) Contaminated concrete, as indicated by the corrosion and pH testes, is to be removed/chipped-off and lime washed to neutralise the surface.
6) All concrete defects (e.g., spalling, cracks, etc.) observed are to be repaired. The repair motor to be used is non-shrink grout (minimum strength of 30 MPa) with chemical resistant properties.
7) Reinforcement that are severely corroded are to be replaced with new reinforcement with similar properties. All exposed reinforcements, including newly installed rebar, are to be coated with a layer of Zinc primer prior to the application of concrete motor/non-shrink grout.
8) The *Contractor* ensures that the profile, cross section and finish level of all repaired concrete plinths, floor slab and drainage channel are as per original design to allow for the re-installation of the removed equipment/components.
9) Prior to any concrete repairs, the *Contractor* ensures that the necessary surface preparations (e.g. removal of dust, debris, water, etc.) have been conducted.
10) The *Contractor* is required to clean, strip and remove the existing acid resistant epoxy/coating layer from the surface of the concrete drainage channel located adjacent to the acid dosing plant.
11) All concrete defects observed in the drainage channel is to be repaired with a non-shrink cementitious grout (minimum strength of 30 MPa). The appropriate surface preparations (e.g. removal of dust, debris, water, etc.) are to be conducted prior to concrete repairs.
12) The *Contractor* takes note that there is a continuous flow of flush/dilution water in the trench. During the refurbishment of the drainage channel, the Contractor will be required to divert the flowing water so that such repairs can be undertaken.

13) The bund wall, floor slab and drainage channel are to be lined with an acid resistant membrane. Refer to GAM/MAT/22/245 document for specific requirements on the acid resistant membrane.

14) The top layer of the acid resistant membrane is to be coated with two layers of chemical resistant paint. The properties of the chemical resistant paint is required to resist the chemicals as listed in Table 13.

Table 13: Chemical found in the Acid Dosing Plant

Chemicals	Concentration
Sulphuric acid	Up to 98%, but diluted by potable water.
Caustic soda	Up to 45%, but diluted by potable water.
Ammonium Solution	Up to 6%, but diluted by potable water.
Potable water	Continuous flushing of trench with potable water.
Demin water	Occasional flushing of pumps with demin water.

15) The *Contractor* is required to refurbish the existing drainage outlet by repairing the cover grating and screen. The size of the drainage outlet is approximately 500mm x 1 000mm.

16) The two-steel walkway platform, located within the chemical dosing area, is to be refurbish as per the original design. This includes repairing or replacing corroded steel elements, connection bolts, anchor bolts, cover grating, repainting of the handrailings and repainting of corrosion protection to all steel elements.

17) The Walkway platform gratings (as noted in section 11.3.6 (16)) is to be replaced with fibreglass gratings (resin base: vinyl ester). The surface of the grating is to be anti-slippery. The gratings are to be secured with the use of fibreglass grating fixing clips.

18) The *Contractor* is required to dismantle and dispose-off the existing acid resistant curtains, including the steel frames that are installed within the chemical dosing area.

19) The *Contractor* designs and installs a new acid resistant curtain for the chemical dosing area, which is to be installed within reference lines PR 208 to PR 222. Refer to drawing number 0.63/2499 regarding the reference lines labelling.

20) The *Contractor* is required to refurbish the structural steel pipe supports (i.e., series of portal frames) found within the chemical dosing area.

21) Severely corroded steel columns, beams, plates and bolts, for the pipe supports, are to be replaced as per the original design.
22) All steel members are to be coated with two layers of corrosion protection paint. The *Contractor* ensures that the necessary surface preparations are conducted prior to painting.
23) The *Contractor* ensures that the stability of the pipe support structure is maintain throughout the refurbishment by making use of temporary supports.
24) During the refurbishment of the pipe supports, the *Contactor* takes note that the pipe supports also support the installation of electrical conduits and components.
25) Due to the corrosive nature of the chemical dosing area, the *Contractor* is required to design and construct an encasement system to protect the steel columns form chemical attack. Especially from the baseplate to 1500mm above ground.

11.3.7 Cation Vessels

1) In the event that the cation vessels are replaced, the *Contractor* conducts a structural verification/assessment for the supporting infrastructures as defined in Section 11.3.3.

2) The *Contractor* is required to design a structural steel access platform, for the new cation vessels, to access the vessel and viewing points (i.e., viewing glass). The new platform is to be similar in design as indicated on site.

3) The *Contractor* designs and installs anchor bolts (i.e., connection detail) for the new cation vessels.

4) The *Contractor* is required to conducts corrosion and pH testing on all concreted stubs supporting the cation vessels.

5) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.

6) All concrete defects (e.g., spalling, cracks, etc.) observed are to be repaired. The repair motor to be used is non-shrink cementitious grout (minimum strength of 30 MPa) with chemical resistant properties.

7) The *Contractor* is required to paint the concrete stub with two layers of acid resistant paint.

8) The *Contractor* ensures that the profile, cross section and finish level of the concrete stubs is maintained as per original design.

9) If the decision is taken to reuse the existing cation vessels, the *Contractor* is required to refurbish the access cat ladder and platforms installed on the vessel. The refurbishment entails replacing corroded steel elements and connections, replacing damaged gratings and reapplying corrosion protection paint on all steel elements/members.

11.3.8 Degasser Water Vessels and Sumps

1) The current condition of the degasser sumps is unknown. The *Contractor* is required to conduct a detailed visual inspection of the degasser sumps to determine the condition of the different concrete elements. The visual inspection is to be done in accordance with the requirements as stated in Section 11.3.2.
2) The *Contractor* conducts corrosion and pH testing on all reinforced concreted elements (i.e., slab, walls and roof slab) found within the degasser sumps. The aim of this test is to determine the depth of contamination in the concrete.
3) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.
4) All concrete defects (e.g., spalling, cracks, etc.) observed are to be repaired. The repair mortar to be used is non-shrink cementitious grout (minimum strength of 30 MPa) with chemical resistant properties.
5) There is no indication, on the concrete layout drawings, that the interior surface of the degasser sump is lined or protected. However, the *Contractor* is required to price for activities associated with stripping/breaking of acid resistant tiles or membrane in preparation for installing the new acid resistant system.
6) The interior surface of degasser sumps is to be waterproof, followed by the installation of an acid resistant membrane and acid resistant tiles. The jointing mortar used is to be acid resistant. Refer to GAM/MAT/22/245 document for specific requirements on the corrosion protection system for the degasser sumps.
7) The *Contractor* ensures that the profile, cross section and finish level of the degasser sumps are maintained as per original design.

11.3.9 Weak Base Anion (WBA) and Strong Base Anion (SBA) Vessels

1) In the event that the WBA and SBA vessels are replaced, the *Contractor* conducts a structural verification/assessment for the supporting infrastructures as defined in Section 11.3.3.
2) The *Contractor* is required to design a structural steel access platform, for the new WBA and SBA vessels. The new platform is to be similar in design as indicated on site.
3) The *Contractor* designs and installs anchor bolts (i.e., connection detail) for the new WBA and SBA vessels.
4) The *Contractor* is required to conducts corrosion and pH testing on all concreted stubs supporting the WBA and SBA vessels.
5) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.

6) All concrete defects (e.g., spalling, cracks, etc.) observed are to be repaired. The repair motor to be used is non-shrink cementitious grout (minimum strength of 30 MPa) with chemical resistant properties.

7) The *Contractor* is required to paint the concrete stub with two layers of acid resistant paint.

8) The *Contractor* ensures that the profile, cross section and finish level of the concrete stubs is maintained as per original design.

9) If the decision is taken to reuse the existing WBA and SBA vessels, the *Contractor* is required to refurbish the access cat ladder and platforms installed on the vessel. The refurbishment entails replacing corroded steel elements and connections, replacing damaged gratings and reapplying corrosion protection paint on all steel elements/members.

11.3.10 Mixed Bed Vessels

1) In the event that the mixed bed vessels are replaced, the *Contractor* conducts a structural verification/assessment for the supporting infrastructures as defined in Section 11.3.3.

2) The *Contractor* designs and installs anchor bolts (i.e., connection detail) for the new mixed bed vessels.

3) The *Contractor* is required to conducts corrosion and pH testing on all concreted stubs supporting the mixed bed vessels.

4) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.

5) All concrete defects (e.g., spalling, cracks, etc.) observed are to be repaired. The repair motor to be used is non-shrink grout with chemical resistant properties.

6) The *Contractor* is required to paint the concrete stub with two layers of acid resistant paint.

7) The *Contractor* ensures that the profile, cross section and finish level of the concrete stubs is maintained as per original design.

11.3.11 Blowers and Water Supply Pumps

1) In the event that the mechanical equipment is replaced, the *Contractor* conducts a structural verification/assessment on all plinths as defined in Section 11.3.3.

2) The *Contractor* conducts corrosion and pH testing on all concreted plinths supporting the mechanical equipment.

3) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.

4) All concrete defects (e.g., spalling, cracks, etc.) observed is to be repaired. The repair motor to be used is non-shrink cementitious grout (minimum strength of 30 MPa) with chemical resistant properties.

5) The *Contractor* is required to paint the concrete plinth and floor slab with two layers of acid resistant paint.

6) The *Contractor* ensures that the profile, cross section and finish level of the concrete stubs is maintained as per original design.

11.3.12 Hot Water Tanks

1) In the event that the hot water tanks are replaced, the *Contractor* conducts a structural verification/assessment for the supporting infrastructures as defined in Section 11.3.3.

2) The *Contractor* designs and installs anchor bolts (i.e., connection detail) for the new hot water tanks.

3) The *Contractor* is required to conducts corrosion and pH testing on all concreted stubs supporting the mixed bed vessels.

4) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.

5) All concrete defects (e.g., spalling, cracks, etc.) observed are to be repaired. The repair motor to be used is non-shrink grout with chemical resistant properties.

6) The *Contractor* is required to paint the concrete stub with two layers of acid resistant paint.

7) The *Contractor* ensures that the profile, cross section and finish level of the concrete stubs is maintained as per original design.

11.3.13 Brine Measuring Tank and Chute Table

1) In the event that the brine measuring tank is replaced, the *Contractor* conducts a structural verification/assessment for the supporting concrete plinth as defined in Section 11.3.3.

2) The *Contractor* designs and installs anchor bolts (i.e., connection detail) for the new brine measuring tank.

3) The *Contractor* conducts a visual assessment on the circular plinth and acid resistant tiles to determine the current condition.

4) The *Contractor* is required to remove all damaged, cracked and/or dislodged acid resistant tiles on the circular plinth. Acid resistant tiles that are not damaged will remain installed.

5) All acid resistant tiles that are removed, is to be replaced as per the original design or similar approved. The jointing mortar is to be acid resistant.

6) The *Contractor* conducts corrosion and pH testing on all concreted surfaces supporting the brine measuring tank.

7) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.

8) All concrete defects (e.g., spalling, cracks, etc.) observed are to be repaired. The repair motor to be used is non-shrink grout with chemical resistant properties.
9) The *Contractor* ensures that the profile, cross section and finish level of the concrete plinth is maintained as per original design.
10) The *Contractor* designs, manufactures and installs a new chute table for the brine measuring tank.
11) The concrete elements (e.g., floor slab) supporting the chute table is to be structural verification/assessment as defined in Section 11.3.3.
12) The layout, positioning and dimensions of the new chute table should not restrict or encroach on the space needed to access the staircase.

11.3.14 Pipe Trench and Drainage Channels

1) The *Contractor* is required to refurbish all pipe trenches and drainage channels found within the water treatment plant.
2) The *Contractor* conducts corrosion and pH testing on the channel/trench bottom and sidewall.
3) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.
4) All concrete defects (e.g., spalling, cracks, erosion etc.) observed are to be repaired. This activity includes the necessary surface preparations (e.g., removing all contaminated concrete) that are required prior to concrete repairs.
5) The repair motor is to be non-shrink cementitious grout (minimum strength of 30 MPa) with chemical resistant properties.

6) Reinforcement that is severely corroded and/or damage is to be replaced with new reinforcement of similar properties. All exposed reinforcements, including newly installed rebar, are to be coated with a layer of Zinc primer prior to the application of concrete motor/non-shrink grout.

7) The *Contractor* is required to install a chemical/acid resistant membrane within the interior surface of all pipe trenches and drainage channels. The top layer of the acid resistant membrane is to be coated with two layers of chemical resistant paint. Refer to GAM/MAT/22/245 document for specific requirements on the acid resistant membrane.

8) The *Contractor* ensures that the profile, cross section and finish level of the channels are maintained as per original design.

9) All cover gratings, for the pipe trenches and drainage channels, are to be replaced. This includes replacing the severely corroded embedded angle support frames and intermediate steel supports for the gratings. All cover gratings are to be replaced with fibreglass gratings (resin base: vinyl ester). The surface of the grating is to be anti-slippery and is to be designed to resist imposed loads from scaffolding and the movement of employees. The gratings are to be secured with the use of fibreglass grating fixing clips.

10) During the refurbishment of the pipe trenches, the *Contactor* takes note that some pipes are out of the project scope and will be in operation. The *Contractor* will need to work around such pipes when undertaken the refurbishment.

11) Since the water treatment plant will be in operation, there may be continuous flow within the drainage channels and pipe trenches. During the refurbishment, the *Contractor* will be required to divert the flowing water so that such repairs can be undertaken.

11.3.15 Pipe Supports within the WTP

1) The *Contractor* is required to refurbish the structural steel pipe supports (i.e., series of portal frames) found within the water treatment plant.
2) Severely corroded steel columns, beams, plates and bolts, for the pipe supports, are to be replaced as per the original design.
3) All steel members are to be coated with two layers of corrosion protection paint. The *Contractor* ensures that the necessary surface preparations are conducted prior to painting.
4) The *Contractor* ensures that the stability of the pipe support structure is maintain throughout the refurbishment by making use of temporary supports.
5) During the refurbishment of the pipe supports, the *Contactor* takes note that the pipe supports also support the installation of electrical conduits and components.

11.3.16 WTP Floor Slab

1) The *Contractor* is required to refurbish the entire concrete floor slab within the water treatment plant.
2) The *Contractor* conducts corrosion and pH testing on the entire floor slab to determine the depth of contamination in the concrete slab.
3) Contaminated concrete, as indicated by the corrosion and pH tests, is to be removed/chipped-off and lime washed to neutralise the surface.
4) All concrete defects (e.g., spalling, cracks, erosion, etc.) is to be repaired with a non-shrink grout.
5) Reinforcement that are severely corroded are to be replaced with new reinforcement of similar properties. All exposed reinforcements, including newly installed rebar, are to be coated with a layer of Zinc primer prior to the application of concrete motor/non-shrink grout.
6) The *Contractor* is required to repair all expansion joints that are damaged. This activity entails replacing the sealant backing cord and reapplying the flexible sealant.

7) The *Contractor* ensures that the profile and finish elevation of the floor slab is in accordance with the original design.
8) Prior to any concrete repairs, the *Contractor* ensures that the necessary surface preparations (e.g., removal of dust, debris, water, etc.) have been conducted.
9) The *Contractor* is required to clean, strip and remove the existing demarcating paint on the floor slab.
10) The *Contractor* reapplies the demarcating paint across the floor slab. The *Project Manager* will provide the demarcation layout and paint colours. For coating purposes, the existing layout can be used.

11.3.17 Detail Design Report

1) The *Contractor* submits a detailed design report of the entire Civil and Structural *works* for review and acceptance by the *Project Manager*.
2) All designs, detailed construction drawings and specifications are to be submitted in a design pack and is reviewed and approved by the *Contractor's* responsible Professional Engineer/Technologist prior to being submitted to the *Project Manager* for acceptance.
3) The detailed design also includes a full constructability analysis for the execution of the *works*. Refer to Section 11.4.5 for more information on the constructability analysis is to be undertaken.
4) The *Contractor* is required to obtain written acceptance, from the *Project Manager*, regarding the detailed design report and finalised drawings prior to any construction and/or fabrication taking place.

11.3.18 Production of As-Built Information

1) In the event that the existing baseline designs for the Water Treatment Plant Building (i.e., civil infrastructures) has been altered/modified during the project, the *Contractor* is required to produce as-built drawings indicating all modifications and replacements which have occurred.
2) Refer to Section 11.4.7 for documentation and drawing requirements.
3) The *Contractor* submits electronic drawings in dgn. format and scanned drawings in pdf format to the *Project Manager* for review and acceptance. Drawings issued to the *Employer* may not be "Right Protected" or encrypted.

11.4 Other requirements of the *Contractor's* design

11.4.1 Temporary *Works*

1) The *Contractor* designs all temporary works necessary to execute the works in accordance with the applicable codes and standards as stated in this document and as required by good engineering practices

2) The *Contractor's* appointed ECSA professionally registered engineer/technologist:
   - Reviews and approves (by signature) the designs and drawings of all temporary works and additional supports and method statements produced by the *Contractor*; and
   - Supervises, inspects and approves the works as per such.

2) All temporary works designs, where existing infrastructure are impacted by the *works*, are submitted to the *Project Manager* for review and acceptance, to prove that the existing infrastructure can withstand the induced load. The *Contractor* therefore submits all design calculations, in a design report, which includes, but is not limited to, all inspection reports, survey data, design analysis models, assumptions, drawings/sketches, etc.

3) The *Contractor* takes full professional accountability and liability for all temporary items required for the execution of the works.

4) The *Contractor* designs, procures, manufactures and constructs all temporary works required for the execution of the works. The *Contractor* dismantles/demolishes temporary works when such works are no longer required.

5) The *Contractor* takes note that review and acceptance of any document/ drawing/ design calculations by the *Project Manager* in no way relieves the *Contractor* of his liability for the works. The *Contractor* remains liable for all works conducted as per this Specification.

11.4.2 Plant and Material supply

1) The *Contractor* provides all tools and equipment for the handling of material and the proper execution of the works.

2) The *Contractor* takes reasonable care to ensure that equipment used does not cause damage to any existing infrastructure. In the event that such damages do occur to the surrounding infrastructures, the *Contractor* is responsible for repairing such damages and is liable for all costs associated with the repairs.

3) The *Contractor* is to supply, deliver, offload and temporarily store (as may be required) all materials needed to carry out the works.

11.4.3 Storage Facility

1) The *Contractor* is to make his own arrangements with regard to storage facilities and laydown areas that are required to complete the works. All laydown areas on Site are as per agreement with the *Project Manager*.

2) All storage facilities (Plant, Material and Equipment) will be within the boundaries of the Site in order not to affect the operations of Others.

11.4.4 Method Statement

3) This Method Statement clearly illustrates how the *Contractor* accounts for the risks of this project and is tailored to address the specified project objectives and requirements.

4) The Method Statement includes, as a minimum and where applicable, the following:
   - Constraints identified and considered by the *Contractor*.
   - Interfacing with *Others*; the *Contractor* illustrates an understanding of the work that is to be completed by *Others* and accommodates for the completion of such work in his methodology.
   - Description and illustrations of a construction traffic plan, use of laydown areas and plot plan.
   - Shifts and hand overs for the various sections of the works, this information is to enable the *Employer* to integrate the programmes of the various *Contractor*s.
   - Design tools and systems that the *Contractor* plans to use.
   - Construction methodology and sequence of construction taking into consideration access restrictions and safety requirements.
   - Detailed risk assessment which lists risks specific to the works and is accompanied with associated proposed mitigations.
   - List and description of plant and machinery required to carry out the civil and structural components of the works.
   - Inspection and quality control plan.
   - A clear description of the responsibilities of the *Contractor's* personnel involved with the works, including (where applicable) his *Project Manager*, Site Quality Manager, Site Engineer, Health and Safety Manager, Technical Office Manager, Production Manager, Supervisor, Environmental Officer, Fabricator, Erection Engineer, Shop detailer, Transporter and other personnel required for the civil and structural works.
   - Construction sequencing considerations, which takes into account any constraints.
   - Health, safety and quality control for the activity.
   - All plant, equipment and machinery required to complete activity.
   - Manufacturer's literature/ Technical Data Sheets for all materials used including product description, composition, material and performance properties, installation and application procedures, use limitations and recommendations.
   - Plan for confining, collecting and disposing of waste materials as a result of removal operations, where applicable.
   - Works required to safeguard existing infrastructure and services.

11.4.5 Constructability Analysis

1) The *Contractor* uses the *Employer's* standard: 240-107981296, Constructability Assessment Guideline to perform the constructability analysis.

2) The *Contractor* has a structured process in place for constructability analysis, for the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve the *Employer's* objectives.

3) Qualified people with adequate skills in construction knowledge and experience are involved from the beginning of the project, to maximize the benefits of the constructability analysis. This process includes examining design options, where applicable, that minimize construction costs while maintaining standards of safety, security, quality, cost and schedule, and is initiated in the front-end planning process. The *Contractor* considers various phases of the project and demolition activities, where applicable, that includes manpower plans, organization, construction equipment usage, material storage and handling and preparation of construction facilities.

4) The *Contractor* submits a Constructability Analysis Report, based on the Method Statement, to the *Project Manager* for review and acceptance. The report is to clearly indicates how the *Contractor* takes into account interfaces with other *Contractors* where applicable, together with the Site and time constraints. This report clearly illustrates how the construction would be completed within the allowable timeframes and highlights the risks of meeting this requirement. The *Contractor* is required to plan his activities to avoid the following interface risks and any other risks relevant to the works:

    - Interface issues arising from working in close proximity to Others;
    - Access to Site;
    - Material storage;
    - Delivery;
    - Other Works related risks;

5) This report clearly illustrates the construction sequencing and durations for the completion of the works within the contract period. The *Contractor* submits a risk assessment as part of the Work Method Statement, which is informed by the Constructability Analysis Report that advises on a proposed approach and methodology to mitigate risks described above and any other risks, which may impede successful execution of the works.

11.4.6 Project Schedule

7) The *Contractor* submits a Level 3 construction programme considering all the interfaces and time constraints.

8) This programme does not omit key activities. Timing of the activities is consistent with the Method Statement.

9) The programme is to show that the *Contractor* has a clear understanding of the full scope of works, including the accompanying risks. The programme is to be logical and realistic.

10) The *Contractor* submits a Programme for all the phases of the works to the *Project Manager* for review and acceptance.

11) This programme is accompanied with the following:

    - A comprehensive narrative which describes the basis of the programme;

- A list of assumptions that the programme was based on;

12) The programme clearly indicates the following:

- Activities of all the project work to be done by the *Contractor* and the other work covered by the contract that is being done by the sub-*Contractor*s;
- Logical links/ sequence/ relationships that connect the various activities together (showing all hold points);
- Master schedule is to show Links/logic, the CPM (Critical Path Method) technique is used for programme and planning. The critical path is clearly illustrated.
- The works is completed within accepted durations that are in consistence with key dates provided in the Contract Data. Milestone dates in line with Key Date/Contract Data shown on the schedule.
- Schedule Work Package Classifications (Deliverable, Engineering, Procurement, Manufacturing, Supply, Construction and Installation Work Packages)
- The number of shifts planned per day for each section of the works.
- The way in which the *Contractor* plans to interface with Others. Interface points with Others are identified in the programme;
- A comprehensive description of each activity, including the name and designation of the responsible person;
- Full details of all terminal point release requirements;
- Any erection or commissioning activities that may affect other maintenance and construction activities on Site;
- Identifies when services are required for commissioning purposes;
- Sufficient information with regard to the activity duration and a description to enable measurement of the progress of the activity within the required update period;
- Each description in the programme explains and represents the performance of the activity, including tangible deliverables or products;
- Resources required to perform an activity for each activity that requires resource assignment;
- Single source of responsibility or ownership per activity.

11.4.7 Documentation and Configuration Management

11.4.7.1 Document identification

1) All documents supplied by the *Contractor* are subject to the *Employer's* approval. The language of all documentation is required to be in English.
2) The *Contractor* adheres to the following standards:

- Documentation Management Review and Handover Procedure for Gx Coal Projects (240-66920003).
- Project / Plant Specific Technical Documents and Records Management Work Instruction (240-76992014).

11.4.7.2 Document Submission

1) All project documents must be submitted to the delegated *Employer's* Representative with transmittal note according to Project / Plant Specific Technical Documents and Records Management Work Instruction (240-76992014). In order to portray a consistent image, it is important that all documents used within the project follow the same standards of layout, style and formatting as described in the Work Instruction.
2) The *Contractor* is required to submit documents as electronic and/or hard copies. Both forms of copies must be delivered to the *Employer Employer's* Representative with a transmittal note.

11.4.7.3 Email Subject

1) The *Contractor* submits all documentation to the *Employer's* Representative in the following media:
    - Electronic copies that are too large for email are delivered on CD/DVD, large file transfer protocol and/or hard drives to the Project Documentation Centre. In a case where CD has been submitted, a notification email, with the transmittal note attached, is sent to the project generic email address. The Representative is copied on the email as well.
    - Hard copies are submitted to the *Employer's* Representative accompanied by the Transmittal Note.

11.4.7.4 Drawings Format and Layout

1) The creation, issuing and control of all Engineering Drawings will be in accordance with the latest revision of 240-86973501 - Engineering drawing Standard.
2) Drawings issued will be a minimum of one hardcopy and an electronic copy in both pdf and DGN. format.
3) Drawings issued may not be "Right Protected" or encrypted.

11.4.8 Documentation Review Requirements

1) The *Contractor* submits all documentation to the *Project Manager* for review and acceptance. The *Project Manager* reviews the *Contractor*'s submitted documents in accordance with the *Employer*'s Design Review Procedure (240-53113685).

2) During the development of the project schedule, the *Contractor* accounts for all activities associated with the design review period as well as the required durations for each activity.
3) The *Contractor* ensures adherence to the Specification and that a technically sound design approach is followed in carrying out the designs.
4) The designs submitted is to be complete packages with all elements (all related drawings and design reports) included in order for the *Project Manager* to review as a whole.
5) The *Contractor* takes note of the *Employer's* Design Review Procedure (240-53113685) and participates in all design reviews as specified by the *Project Manager*. The *Project Manager* may "Accept"; "Accepted with Comments" or "Not Accepted with Comments". If required, the *Contractor* makes the necessary revisions on the documentation and ensures acceptance is obtained from the *Project Manager*. All designs, drawings and specifications must be reviewed, accepted and frozen before manufacturing and construction of the relevant plant item starts

11.4.9 Project Deliverables

The *Contractor* provides the following document deliverables as part of the works.

11.4.9.1 Planning phase

1) A Level 3 schedule (schedule with defined activities) for the design scope clearly highlighting all activities involved, major milestones and provision.
2) Design methodology for the works.
3) Risk Assessments.
4) Project specific safety file.
5) Project Quality Control Plan.
6) Detailed Risk Assessments (updated)

11.4.9.2 Design Phase

1) Consolidated conditional assessment report for all civil infrastructures located within the water treatment plant building.
2) Consolidated technical detailed design report signed by a Professional Engineer/Technologist, which includes (where applicable):
    - Survey drawings, design criteria/parameters, specifications and standards that were used, loadings, assumptions, calculations and results including detailed design calculations, design models, sources of information and any record of other information associated with the completed works.
3) Detailed construction drawings signed by a Professional Engineer/Technologist. Drawings are to be submitted in DGN. format.

4) Detailed constructability analysis report for the execution of the works.
5) Bill of Quantities (if applicable).
6) Construction Specification (if applicable).
7) Progress reports (if applicable).

11.4.9.3 Pre-Construction/Installation

1) Detailed method statements for the works.
2) Inspection and Test Plans (ITP's) indicating all intervention points.
3) Quality Control Plans (QCP's).
4) Construction Programme/schedule (if different from the project schedule).
5) Project Specific Safety File (updated).
6) Any temporary works required as part of construction signed by a professionally registered Structural Engineer/Technician.
7) Detailed Risk Assessments (updated).
8) Process reports.

11.4.9.4 Post Construction/Installation

1) QA returnables (monthly)
2) As-Built drawings
3) Data books as detailed in Section 11.5.2.
4) Certificate of completion, signed by the ECSA registered engineer/technologist, confirming that the works has been constructed in accordance with the design.

11.5 Quality and Project Handover Requirements

11.5.1 Quality Management

1) The *Contractor* submits a fully detailed Quality Control Plan (QCP) for acceptance within four (4) weeks of the Contract Date, which details all the aspects of the quality management system to be applied. It includes the methods that will be utilized to ensure quality assurance, control and improvement of the identified activities as stated in the Specification.
2) The *Contractor* is responsible for defining the level of QA/QC (Intervention Points) or inspection to be imposed on his Sub*contractor* and suppliers of material in the Quality Control Plans (QCPs). This level is based on the criticality of equipment and must be submitted to the *Project Manager* for acceptance.
3) Product data sheets, product samples, and any other documents is to be submitted to the *Project Manager* for review and acceptance prior to the commencement of work.

4) All quality control documentation is submitted to the *Project Manager* within four (4) weeks of Contract date.

11.5.2 Handover

1) Apart from any statutory data packages required, the *Contractor* also submits a data package of the relevant drawings, test certificates etc. to the *Project Manager* for acceptance. These include, but are not limited to:
    - Approved ITP's, QCP's
    - Method statements and specifications adhered to
    - Risk assessments
    - Approved construction and fabrication drawings
    - Inspection reports
    - Notifications
    - Approved modifications
    - Technical Queries, Engineering responses and communications with *Project Manager / Employer*
    - Non-conformance reports
    - Transport notifications
    - Calculations and drawings for any temporary works that may be required for the safe execution of the works
    - Material certificates and product datasheets
    - As-built data and drawings of the completed works upon handover. As-built drawings are submitted in PDF and native CAD formats.

11.6 Construction

11.6.1 General

The *Contractor*:

1) Adhere to the South African Environment Protection Act, the waste management code of practice and the South African Occupational Health and Safety Act No. 85 of 1993, the regulations promulgated thereunder and Eskom Safety, Health, Environment and Quality (SHEQ) Policy 32-727 and Waste Management Procedure, as well as the National Building Regulations and SANS 10400 for all works.
2) Submits a comprehensive method statement (including a comprehensive risk assessment) detailing the proposed methods for the entire works to the *Project Manager* for acceptance prior to the start of the works. Refer to Section 11.4.4 for method statement requirements.

3) Submits a project specific safety file to the *Project Manager* for comments / acceptance.
4) Takes all necessary precautions to ensure that none of the existing structures / facilities not forming part of the *works* is damaged during the assessment/inspection. The *Contractor* is liable for all damages that may occur and repairs are to be done at no additional cost to the *Employer.*
5) The *Contractor* disposes of all waste material at the waste disposal facility on site as per the instruction and direction of the *Project Manager*.
6) Continuously monitors the conditions within the working and surrounding areas for any hazardous substances or situations, and in such case, the *Contractor* is required to take necessary precautionary measures.
7) The *Contractor* ensures that a complete QCP, risk assessment, method statement and ITP's, temporary works calculations, where applicable are submitted to the *Project Manager* for review and acceptance before the works can commence. During reviews of the ITP's, the *Project Manager* provides the necessary intervention points.
8) All items that are assembled and constructed off site are listed and provided to the *Project Manager*. From this, an ITP is developed between the *Project Manager* and the *Contractor* to determine the intervention points.
9) Manages access to the working areas and the Site.
10) Manages activities on Site to ensure that no interference takes place between the *works* and that of others.
11) Liaise with the *Project Manager* regarding utilities and telephone facilities required for his site establishment.
12) Liaises with the *Project Manager* regarding the location of waste disposal sites and rubbish dumps.
13) The *Contractor* is responsible for the design and erection of all the temporary supports required for the *works*. In addition to the aforementioned, the *Contractor* adheres to the following:
    - The *Contractor* is restricted to the designated working areas
    - The *Contractor* is not to enter any other areas and ensures that his employees abide by the applicable regulations
    - The *Contractor's* Equipment does not impair the operation or access to the plant/building
    - The *Contractor* provides any temporary or expendable materials required for the storage of materials
    - The *Contractor* safeguards and secures all items whilst in the *Contractor's* custody and control, until completion of the works;
    - Plant and equipment not forming part of the *works* are not to be modified without written permission from the *Project Manager*. Modification in this sense includes, but is not limited to the following:

- Welding onto existing plant,
- Drilling into structural steel or concrete,
- Cutting or removing
- Loading adjacent structures.

11.6.2 Construction, Erection and Monitoring

1) The *Contractor* is responsible for the construction of all *works* in accordance with the accepted designs, drawings and specifications.
2) The *Contractor* is responsible for the safety of all personnel involved in the *works* as well as the safety of all personnel at Lethabo Power Station affected by the construction of the *works*.
3) The Contractor is required to confirm all site dimensions, levels and cast-in items positions on site prior to any fabrication of steel or casting of concrete
4) The *Contractor* notifies the *Project Manager* of any defects that have occurred or are foreseen in order to reduce further damages that may occur.
5) The *Contractor* is responsible for the design, erection, maintenance and removal of all temporary works required for the execution of the *works*. Refer to Section 11.4.1 for requirements for temporary works.
6) The *Contractor* provides the required level of construction monitoring in order to ensure that the construction is completed in accordance with the approved designs, drawings and specifications.
    - Technical quality assurance during construction to ensure that the construction is executed as per the approved design, specifications and procedures
    - Witnessing and approval (by signature) of intervention points where applicable to Engineering
    - Review and acceptance by signature of construction data books, as-built drawings and Operations and Maintenance manuals (where applicable) developed by the *Contractor*
    - Responding to technical queries and clarifications from the *Contractor* utilising documentation templates provided by the *Employer / Project Manager.*
7) The *Contractor* takes full professional accountability and liability for all temporary items required for the execution of the *works*.
8) Any request for deviation from specified requirements is submitted in writing and include the proposed deviation, rationale for the deviation, any technical data supporting the deviation, and historical experience supporting the deviation.

11.7 Plant and Materials Standards and Workmanship

11.7.1 Applicable Standards

1) All references to standard/codes/publications are to be the latest issue of each, together with the latest additions and/or amendments thereto, as of the date of contract, unless otherwise indicated. This list is not all-inclusive and shall not relieve the *Contractor* from complying with all applicable codes.

Number	Title
240-56364545	Structural Design and Engineering Standard
240-86973501	Engineering drawing Standard
SANS 10400	The Application of the National Building Regulations
240-107981296	Constructability Assessment Guideline
240-99527377	Inspection Manual for Civil Works at Eskom's Power Station
240-106365693	Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings
240-86973501	Engineering drawing Standard
240-53113685	Design Review Procedure
240-53114002	Engineering Change Management Procedure
240-76992014	Project / Plant Specific Technical Documents and Records Management Work Instruction
240-53665024	Engineering Quality Manual
240-53114186	Document and Records Management
240-83539994	Standard for Non-Destructive Testing (NDT) on Eskom Plant
240-106365693	Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings
240-107981296	Constructability Assessment Guideline
240-99527377	Inspection Manual for Civil Works at Eskom Power Stations
240-66920003	Records Management Work Instruction Documentation Management Review and Handover Procedure for Gx Coal Projects
240-105658000	Supplier Quality Management Specification
32-245	Eskom Waste Management Standard
32-727	Eskom Safety, Health, Environment and Quality (SHEQ) Policy
32-6	Document and Records Management Procedure
32-727	Eskom Safety, Health, Environment and Quality (SHEQ) Policy
ISO 9001	Quality Management Systems
OHS Act 85 of 1993	Construction Regulations, 2014
SANS 10400	The Application of the National Building Regulations
SANS 2001-CC1	Construction works Part CC1: Concrete works (structural)
SANS 2001-CC2	Construction works Part CC2: Concrete works (minor works)
SANS 2001-CM1	Construction works Part CM1: Masonry walling
SANS 2001-CS1	Construction works Part CS1: Structural steelwork
SANS 10111	Engineering drawing principles
SANS 1393	Construction management systems - Requirements
SANS 684	Structural steel paint
SANS 1200 (series)	Standardised specification for civil engineering construction
SANS 10109-1	Concrete floors Part 1: Bases to concrete floors

11.7.2 Masonry Walling

The following codes are required to be complied to:

i. SANS 2001 CM1: Masonry walling
ii. SANS 227: Burnt clay masonry units
iii. SANS 1090: Sand for plaster and mortar
iv. SANS 28: Metal ties for cavity walls
v. SANS 50413-1: Masonry cement
vi. SANS 10164: The structural use of masonry
vii. SANS 10249: Masonry walling

The table below indicates particular specifications pertaining to SANS 2001-CM1 and must be read in conjunction with the code.

Clause	Particular Specification
4.1	**Materials**
4.1.1	Masonry Units
4.1.1.2	Burnt Clay masonry units comply with the requirements of SANS 227 and have the following properties: 1. Class of unit is to be as shown on the Drawings. 2. Limit of water absorption: Refer to 4.7 of SANS 227 3. Limit of water-soluble salts content: Refer to 4.7 of SANS 227 4. Limits of selected radicals: Refer to 4.7 of SANS 227 5. Limits of pH value of water extracts: Refer to 4.7 of SANS 227 6. Limits of moisture expansion: Refer to 4.7 of SANS 227 7. The quality verification is to be as follows: See Appendix F of SANS 227 8. The test for efflorescence is required.
4.1.4	Sand
4.1.4.1	Sands that comply with the requirements of SANS 1090 are required.

Clause	Particular Specification
4.1.6	Mortar Admixtures
4.1.6	Mortar plasticizers and set-retarder admixtures are permitted.
4.1.9	Reinforcement
4.1.9.1	Brickforce
4.1.9.1.2	Permitted brickforce are shown on the Drawings
4.1.12	Wall Ties
4.1.12.1	Permitted wall ties are shown on the Drawings.
4.2	**Mortar**
4.2.1	General
4.2.1.2	Mortar plasticizers and set-retarder admixtures are permitted.
4.16	Roof anchors are to be in accordance with the requirements of SANS 10400.
4.9	**Weepholes and damp-proof courses**
4.9.2.1	Damp-proof courses to be provided.
5	**Compliance with the requirements**
5.1	**Permissible deviations**
5.1.1	Degree of accuracy
5.1.1	The degree of accuracy is II

11.7.3 Structural Steelwork

The following codes are required to be complied to:

i. SANS 2001 CS1: Structural Steelwork
ii. SANS 1200 H: Structural Steelwork (Only Clause 8 – Measurement and Payment)
iii. AWS D1.1: Structural welding code – steel

iv. SANS 1921-3: Construction and management requirements for works contracts, Part 3: Structural steelwork

v. SANS 50025-2: Hot rolled products of structural steels – Part 2- Technical delivery conditions for non-alloy structural steels

vi. SANS 1700: Fasteners

vii. SANS 10162: The structural use of steel

The table below indicates particular specifications pertaining to SANS 2001-CS1 and must be read in conjunction with the code.

Clause	Particular Specification
4.1	**Materials**
4.1.1	Add the following: All structural steelwork is required to be grade S355JR
4.1.4.1	Electrodes for electric welding are required to be E7018.
[1] 4.1.5.1	Ordinary bolts to be grade 8.8 with class 8 nuts, as a minimum
4.2	**Drawings**
4.2.4	Fabrication drawings (shop detailing)
4.2.4	The following clause is added: "Fabrication drawings are to be prepared by the *Contractor*. These are issued to the *Project Manager* for acceptance in the form of two paper prints and in "PDF" electronic format. The *Contractor* may not commence with fabrication until written acceptance from the *Project Manager* is received."
4.2.4.2	Attachments to facilitate erections may not remain as part of the permanent structure.
4.2.4.7	Connections to allow movements are as shown on the Drawings.
4.3	**Workmanship (General)**
4.3.1.1	All steel elements are marked to be traceable to a specific cast or heat of steel.
4.3.6	Holing

Clause	Particular Specification
4.3.6	The following clause is added: "Flame cutting of holes is not permitted."
4.4	**Workmanship (Welding)**
4.4.4.3	Tack welds are not to be incorporated into the final welds.
4.5	**Workmanship (Bolting)**
4.5.1.3	The maximum protrusion beyond the nut is not less than 3mm, but not greater than 5mm.
4.5.1.4	Washers under nuts and bolt heads on flat surfaces are required.
4.6	**Workmanship - Erection**
4.6.5	▪ On site welding is not permitted
5.3	**Non-destructive testing of welds**
5.3.3	▪ Fillet welds are required to undergo magnetic particle inspection (20 % of welds)
5.3.4	▪ All butt welds and full penetration welds are required to undergo ultrasonic non-destructive testing (100 % of welds)
Variations	
Cl 5.2	Add the following: Properly documented evidence of previous qualification of welders are acceptable.
Additional Clauses	
1	All materials are to be new and as specified in this document and on the relevant Drawings.
2	Materials not listed in this specification or on the relevant Drawings are not permitted.

Clause	Particular Specification
3	In the event of any specified steel not being available, the *Contractor* advises the *Project Manager* in writing. The *Project Manager* is to reply in writing on alternative materials and / or sections.
4	Fabrication drawings are prepared by the *Contractor*. The drawings are issued to the *Project Manager* for acceptance in the form of two paper prints and in "PDF" electronic format and in Native Format (dgn or dwg). The *Contractor* does not commence with fabrication until written acceptance from the *Project Manager* is received.
5	All gutters and down pipes are provided to ensure free water flow away from the *works*.
6	Handling and lifting plant have sufficient capacity to ensure that steelwork is placed in its final position without distortion or undue stressing of members.
7	Except where otherwise authorised in writing by the *Supervisor*, the *Contractor* ensures that the work is carried out strictly in accordance with the relevant drawings supplied to the *Contractor* by the *Project Manager* or supplied by the *Contractor* and accepted by the *Project Manager*
8	Tolerances: • Tolerances for overall dimensions (length, width, height, etc.) are 3mm unless otherwise specified by the drawing. • Tolerances for door locations are +/- 9mm. • Tolerances for stiffener, channels, angles and bars are +/- 3mm non-accumulative, unless noted of the drawing. • Tolerances for attachments such as supports, plates and pipes are located within 3mm of the required drawing location. • The centre line of a bolt hole is aligned within 1.5mm of the drawing dimension. • Bolt hole spacing is 3mm (non-accumulative) and 6mm (overall) of the drawing dimension.

Clause	Particular Specification
	• Bolt hole diameter is within 2mm of the drawing dimension. • Special tolerances are shown on the *Employer's* drawings and take precedence. Unless otherwise specified by the drawing, tolerances for all overall dimensions (length, width, height, etc.) are within 3mm.
9	The *Project Manager* may instruct the *Contractor* to replace any welding equipment which is unsuitable or unsatisfactory for the service in which it is being used.

The table below indicates particular specifications pertaining to SANS 1921-3 and must be read in conjunction with the code.

Clause	Particular Specification
4.2	**Responsibility for design and construction**
4.2.1	The responsibility strategy assigned to the *Contractor* is "B" for the portion of *works* designed by the *Employer* .
4.2.2	The structural engineer is The *Employer's*, Lethabo Power Station for the *works* designed by the *Employer*.
4.3	**Planning, programme and method statement**
4.3.2	Programme
4.3.2.1	The requirements for sequencing of the *works* are: The sequence of the work is as per the project Schedule.
4.3.2.1	The procedures to be followed where required are as shown on the Drawings or defined within the scope of work.
4.3.3	Method Statements
4.3.3.2	The steelwork *Contractor* provides the steelwork structural engineer with a detailed method statement for the erection of each structure. Add the following:

Clause	Particular Specification
	The methodology for any work that will be carried out after hours must be accepted one week prior to the event.
4.4	**Quality assurance**
4.4.3	Inspections, tests and certification
4.4.3.4	The following items and procedures need to be tested/certified by a recognised body: Welders' qualification Material certificates
4.5	**Drawings, information and calculations**
4.5.1	Format, number and register
4.5.1.1	Information, Drawings and calculations provided to the steelwork *Contractor* will be provided in the following format: 2D drawings provided electronically in PDF format.
4.5.1.2	The steelwork *Contractor* is to provide information in the following format: Electronic in PDF format.
4.5.3	Drawings and other information provided by the steelwork *Contractor*
4.5.3.1	Drawings and other information are to be submitted in accordance with the steelwork *Contractor*'s accepted programme.
4.5.3.4	The steelwork *Contractor* is required to submit the following additional information with general arrangement drawings to the *Employer* for approval: Erection methodologies. Detail drawings marked up for each part, if different from the supplied details
4.7	**Site establishment**
4.7.6	The steelwork *Contractor* is required to make his own arrangements for the provision of the following services:

Clause	Particular Specification
	Compressed air Welding machines Cutting torches and gas Lifting attachments
4.11	Health and Safety
4.11.1	The specific health and safety requirements are as per the requirements in conditions of contract.
4.11.3	The steelwork *Contractor* is required to submit a report on the assessment and management of risk.
4.11.4	The steelwork *Contractor* is required to enclose the steelwork for the protection of the public and others.

11.7.3.1Additional Requirements and Specifications

1) The *Contractor* is responsible for the stability of the entire structure and all structural elements during all the erection stages.
2) All dimensions are required to be verified on site by the *Contractor* before any fabrication of steelwork commences.
3) All welding is required to be conducted by coded welders. Supporting documentation is also required to be submitted to the *Project Manager* for acceptance. All welding is required to comply with AWS D1.1 and 240-106628253 - Standard for Welding Requirements on Eskom Plant.
4) All welds are required to be inspected using visual aids.
5) The *Contractor* is required to supply all bolts, washers, nuts etc. for the structural steelwork.
6) Welded connections are required to be welded all around with a minimum of 6 mm fillet welds unless otherwise stated on the Drawings. Butt welds are required to be full penetration welds.
7) Minimum thickness of gusset plates is to be 10 mm.
8) No deviation from member sizes, dimensions or setting out points unless permission has been obtained from the Project Manager in writing.

11.7.4 Structural Steelwork (Sundry Items)

The following codes are required to be complied to:

i. SANS 1200 **HA: Structural steelwork (sundry items)**

The table below indicates particular specifications pertaining to SANS 1200 HA and must be read in conjunction with the code.

Clause	Particular Specification
Variations	
▪ Cl 5.1.2	▪ Add the following: ▪ The said shop details and other drawings are to be submitted in duplicate to the *Project Manager* for acceptance at least 10 working days prior to fabrication.
▪ Cl 5.2.10	▪ Add the following: ▪ Where no corrosion protection system is specified, open grid flooring is to be hot dipped galvanised.
▪ Cl 7.1	▪ Add the following: ▪ Test certificates and cast analysis certificates are to be supplied to the *Project Manager* by the *Contractor*.

11.7.5 Cladding and Sheeting

The following codes are required to be complied to:

ii. SANS 1200 HB: Cladding and Sheeting

The table below indicates particular specifications pertaining to SANS 1200 HB and must be read in conjunction with the code.

Clause	Particular Specification
Variations	
▪ Cl 3.2.1	▪ Add the following: ▪ Galvanized steel sheeting is to be coated with a minimum of 275 g zinc per m^2 and is free from white rust.
▪ Cl 5.1.4	▪ Add the following:

Clause	Particular Specification
▪	▪ The *Contractor* is solely responsible for ensuring that the materials and method of installation comply with the details set out on the Drawings. Any further modifications and additional details are to be accepted by the *Project Manager*.
Additional Clauses	
1	Where the use of nails and screws is required: Galvanised iron nails and screws are to be used for galvanized sheet iron and sheet zinc.
2	Galvanised IRB sheeting requirement is indicated on the Drawing.

11.7.6 Corrosion Protection of Structural Steel

The following codes are required to be complied to:

i. SANS 1200 HC: Corrosion Protection of Structural Steel
ii. SANS 10064: The preparation of steel surfaces for coating
iii. SANS 121: Hot dip galvanized coatings on fabricated iron and steel articles
iv. 240-106365693: Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings.

The table below indicates particular specifications pertaining to SANS 1200 HC and must be read in conjunction with the code.

Clause	Particular Specification
Variations	
▪ Cl 5.3	▪ Add the following: ▪ All burrs and sharp areas are to be removed by: Chamfering or Ground to a smooth radius of at least 1mm.
▪ Cl 5.4.1	▪ Add the following:

Clause	Particular Specification
	▪ The method of cleaning and preparing the substrate of steelwork prior to the application of the coating system is to be in accordance with the applicable provisions of SANS 10064
Cl 5.4.3.1. b)	▪ Add the following: ▪ Dry abrasive blast cleaning: Silica sand abrasive material not permitted. Blast cleaning media is not recycled.
▪ Cl 5.7	▪ Add the following: ▪ The coating system is to be hot-dip galvanising which is carried out in accordance with SANS 121:2011.
Additional Clauses	
1	Surface preparation and painting is to be carried out as indicated on the Drawing.

11.7.7 Concrete Works (Structural)

The following codes are required to be complied to:

i. SANS 2001 CC1: Concrete Works (Structural)

ii. SANS 1200 G: Concrete (Structural) (Only Clause 8 – Measurement and Payment)

The table below indicates particular specifications pertaining to SANS 2001-CC1 and must be read in conjunction with the code.

Clause	Particular Specification
4.2	**Materials**
4.2.1	Cementitious binders
4.2.1.1	Cement is to comply with the relevant requirements of CEM1-42.5N, Ordinary Portland Cement in accordance with SANS 50197
4.2.3	Aggregates

Clause	Particular Specification
4.2.3.1 (b)	The coarse aggregate nominal size is to be specified as follows: Cover to rebar < 25 mm – 13.2 mm diameter Cover to rebar >= 25 mm – 19 mm diameter
4.2.3.4	Plums are not permitted
[2] 4.2.3.5	[3] The following tests are required: drying shrinkage on fine and coarse aggregates; drying shrinkage of concrete; flakiness index of the stone; alkali-aggregate reaction.
4.2.4	Admixtures, air-entrainment agents and curing agents
4.2.4.1	The use of admixtures is permitted, provided that the results of trial tests which demonstrate their suitability and the following are made available: The trade name of the admixture, its source and the manufacturers' recommended method of use. Typical dosages and possible detrimental effects of under and over doses. Whether compounds are likely to cause corrosion of the reinforcement or deterioration of the concrete. The average expected air content of freshly mixed concrete containing an admixture that causes air to be entrained when the admixture is used at the manufacturer's recommended dose.
4.2.6	Grade of concrete
4.2.6	The grade of concrete is required to be as follows, unless otherwise stated on the Drawings. Class 15 MPa/ 19 mm for Blinding/Mass Concrete (28 days), Class 35 MPa/ 19 mm for Structural Concrete (28 days). Class 35 MPa/ 13.2 mm for Screed/Topping

Clause	Particular Specification
4.2.7	In general, one of the following types of non-shrink grout are required to be used: Cement-based non-shrink grout, not less than 50 MPa; Special proprietary non-shrink or expansive grout, not less than 50 MPa.
4.2.11.4	Galvanising of cover plates is required.
4.3	**Formwork**
4.3.1	General
4.3.1.5	Earth cuts may not be used as forms for vertical surfaces
4.3.1.8	The formed surfaces are as follows: Foundations (below 150 mm from finished floor level) – Rough finish is acceptable. All concrete from 150 mm below finished floor level which receives an additional finish – Smooth finish is required Off-shutter exposed concrete (not receiving any further finishes) – Smooth special finish is required.
4.4	**Reinforcement**
4.4	▪ Add the following: All reinforcement is stamped with a SANS quality assurance mark
4.4.1.3	Bars may not be hot bent
4.4.2.2	Welding of bars is not permitted
4.4.3	Cover
4.4.3.1	Cast in-situ concrete cover is required to be: 50 mm or as shown on the Drawings
4.5	**Holes, chases and fixing bolts**
4.5.1	Fixtures to be embedded in the concrete are attached as shown on the Drawings.

Clause	Particular Specification
4.6	**Embedded items**
4.6.3	Pipes, conduits and ducts
4.6.2.1	The type and location of pipes are as specified on the Drawings.
4.7	**Quality of Concrete**
4.7.1.1	*Contractor* submits to the *Project Manager* full details and samples of all materials which he proposes to use for making concrete at least 28 days before the concreting of the works is due to commence.
4.7.3.2	Pumping of concrete is permitted.
4.7.4	Chloride and sulphate content
4.7.4.1	Efflorescence on exposed concrete surfaces is not permitted
4.7.6	Prescribed-mix concrete
4.7.6.1	The mix proportions for the prescribed mix are as determined by the *Contractor* for the required grade based on test results using the cement, fine and coarse aggregate available. Mix designs and the mix test results are to be submitted to the *Project Manager* for acceptance prior to the commencement of work on site.
4.7.10	▪ Add the following: • A layer of blinding concrete of 50 mm minimum thickness is required to be placed under foundations, sumps and trenches • A polyethylene sheet with a minimum thickness of 375 microns is required under ground slabs
4.7.10	Placing
4.7.10.11	Plums are not permitted.
4.7.10.15	Pumping of concrete is permitted.
4.7.12	Joints

Clause	Particular Specification
4.7.12.1	Construction joints
4.7.12.1.1	Construction joints are not permitted, unless where shown on the Drawings.
4.7.12.2.3	All angled corners are chamfered 25 mm x 25 mm, unless such other larger size is detailed on the Drawings.
4.7.12.1.4	Where construction joints are shown on the Drawing, the follow is required: • Proprietary bonding compounds between old and new concrete is permitted.
4.7.12.4	Sealing of joints
4.7.12.4	Joints are sealed as shown on the Drawings.
4.7.19.3	• *Contractor* submits a detailed procedure for acceptance by the *Project Manager* on how he intends to carry out the repairs of structural concrete defects
4.7.22	• For concrete pour records, the *Contractor* submits a detailed Quality Control Plan to the *Project Manager* for acceptance. • In addition, the *Contractor* supplies the *Project Manager* with two copies of these records each day covering works carried out the preceding day.
5.1	**Testing**
5.1.1.4	• Six 150 mm cube samples taken from each batch or place of concrete deposition, three cubes are tested at 7 days and three at 28 days. • Strength at 7 days is required to be at least two thirds of 28 day strength.
5.1.1.8	The test for the percentage of alkali-aggregate is to be ASTM C289 – Potential reactivity of aggregate (chemical method) or alternative method accepted by the *Project Manager*.
[4] 5.1.3.3	[5] Add the following:

Clause	Particular Specification
	• …, unless no more than three batches of concrete are being mixed.
5.2	**Tolerances**
5.2.1.1	• Tolerances on all concrete work is required to be a level II degree of accuracy as specified in SANS 2001-CC1 with and is to be carefully maintained throughout the construction.
Variations	
Cl 4.7.8.2	▪ Add the following: ▪ Should "ready-mixed" concrete be used, the uninterrupted supply of the correct volume to Site should be guaranteed.
Cl 4.7.8.2	▪ Add the following: ▪ The *Project Manager* may permit production of concrete at a central production facility other than on the Site of construction and reserves the right to inspect for acceptance of these central production facilities. The *Contractor* is responsible for conducting all control testing.
4.7.10	▪ Add the following: ▪ Concrete may not be placed before the *Project Manager's* acceptance has been given in writing and a minimum written notice period of 24 hours prior to pouring is required for each part of the structure.

11.7.7.1Additional Requirements and Specifications

1) All concrete work is required to be in accordance with SANS 2001-CC1 and SANS 10100-2 unless otherwise stated.
2) All concrete surfaces and cast-in items is required to be inspected and accepted by the *Project Manager* in writing before casting of concrete may commence.
3) The *Contractor* is required to obtain written acceptance from the *Project Manager* for the use of any add-mixture or the use off ready mixed concrete, to pump concrete, or to use cement or cement blends other than Ordinary Portland Cement (OPC)
4) Compaction of concrete is required to be done by means of mechanical vibrators only.

5) The *Contractor* is required to demonstrate, by means of a report from an approved laboratory, that the aggregates do not exhibit excessive shrinking properties in accordance with SANS 1083 and is also required to demonstrate that the aggregates do not have a potential alkali silica reaction.
6) All concrete is required to have a maximum water/cement ratio of 0.45 with a minimum cement content of 420 kg/m^3
7) The *Contractor* is required to perform a slump test on the same batch of concrete every time a sample is taken and the result recorded.

11.8 Information issued by the *Employer*

11.8.1 Drawings issued

The following drawings are issued to the Contractor for information.

Document Number / ID	Document Title	Revision
0.63/2862	Concrete Layout of Sections through Ground Slab	2
0.63/2317	Water Treatment Plant Demin. Building Elevations and Details	0
0.63/2794	Ground Slab Layout South	2
0.63/2861	Concrete Layout of Raft Slab	2
0.63/2500	Water Treatment Plant Plot Plan Sections	4
0.63/2555	Water Treatment Plant Piling Layout and Reinforcement Detail	3
0.63/2499	Water Treatment Plant Plot Plan	7

11.8.2 Standards issued

The following standards are issued to the Contractor for information.

Document Number / ID	Document Title	Revision
240-53113685	Design Review Procedure	3
240-56364545	Structural Design and Engineering Standard	
240-107981296	Constructability Assessment Guideline	1

240-86973501	Engineering drawing Standard	3
240-76992014	Project / Plant Specific Technical Documents and Records Management Work Instruction	1

12. Mobile demin plant requirements

12.1 Executive overview

Lethabo Power Station requires maintenance work to be performed on the demineralised (demin) plant vessels. During this time, the affected demin train will be out of service which impacts the final volume of demin water produced. This poses a production risk to the Power Station especially with the combination of high demin water consumption by the units and reliability of the current demin trains (without demin water electricity production is impaired).

A rapid deployment, containerised demin plant is required to enable the total demin production from the system not be impacted during the demin train(s) outage.

The integration of the mobile demin train with the existing plant must be done in such a manner that there is minimal disruption to the operation of the Lethabo WTP processes.

The aim of the project is to:

1) Have a mobile plant that can replace the train that is under refurbishment.
    - Design throughput of one train 220 m3/hr. The mobile plant needs to be able to match this throughput. Any deviation to this throughput to be listed as a deviation.
2) The Eskom Standard 240-53113712 - Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water governs demineralised water production. The mobile plant is required to comply with:
    - The final water quality as well as the minimum monitoring requirements as stipulated in the Standard.
3) Have a mobile plant with its own chemical cleaning system.
4) Have a stand-alone PLC and HMI for control and operation of the plant. A interface for the stand-alone PLC to the WTP DCS shall be provided for via a DP-DP coupler.
5) The mobile plant shall be electrically energergised through the Employers electrical reticulation bulk supply, limited to 3P+N, 1MVA, 380V AC.

The scope is inclusive of the engineering design, manufacture, supply, installation, testing and commissioning of the mobile demin plant. Further, the scope includes the provision of operations and maintenance services for a period of 12 months, commencing from successful commissioning of the mobile plant.

12.2 *Employer*'s requirements for the *service*

The C*ontractor* must execute the *works* according to the scope of work (inclusive of design, manufacture, install, commission, provision of services for operation and maintenance of the plant for 12 months).

The *Contractor's* obligation for the provision of operating and maintenance services for a period of 12 months commences on successful commissioning of the mobile plant. The rental contract shall be transferable between Eskom business units. The requirements for personnel which must be made available during design, construction/manufacture and commissioning are provided in Section 12.3.3 of this document.

The O&M cost must be all-inclusive and must indicate the cost per ML of demin produced, which includes:

- Manpower cost for Operating (24-hour coverage)
- Manpower cost for Maintenance
- Manpower cost for administration work
- Plant maintenance material cost
- Chemical and Consumables Supply (list chemicals and quantities with Material Safety Data Sheets & Product Data Sheets). Chemical's storage must be compatible.
- Sample bottles and glassware for sampling and analysis of the grab samples for its own process analysis. Sample bottles will be provided by Eskom for final water analysis.

The *Contractor* shall submit his plan for executing the service with his tender. The *Contractor* shall include in this plan:

a. Training (in line and in fulfilment of the requirements of this scope of work)
b. Safety
c. Quality

The operations and maintenance scope are inclusive of all interfaces with the *Employer's* WTP. The interfacing installation will be required to remain at Lethabo Power Station on termination of the operations contract. The mechanical installation must cater for valves and flanges to enable safe isolation and removal of the mobile demin production plant after the rental period or decommissioning of the mobile plant. The electrical terminations to the Employers point of connection shall safely be executed by the Contractor in accordance with SANS 10142 and the Eskom Plant Safety Regulations (PSR).

The *Contractor* provides operating and maintenance personnel and resources for the duration of the contract.

The *Contractor* provides transport and accommodation for their people.

The *Contractor* provides Chemical Resistant PPE for personnel, office consumables, etc.

The *Contractor* provides office space for their people.

12.2.1 Plant Performance Penalties

a) The *Contractor* will be paid for the volume of total demineralised water produced.

b) The *Contractor* will not be penalised if the Employer causes loss of production.

c) The mobile plant output water quality shall be maintained by the *Contractor* as specified in the *Works*. In an event where the quality of the final water produced is out-of-specification, the water shall be recycled through the mobile plant and thus no production for that period of recycling will be valid. The water produced will be deemed as the volume of water, within specification, fed to the demin storage tanks.

The key performance indicators requirements are consolidated in Table 1. Any key parameters listed below to be formally communicated before contract placement by means of deviations listed by the Contractor.

KPI	Requirement	Source of Evidence
Volume of effluent sent to the effluent system.	< 1.3Ml/day	Monthly report
Conductivity of effluent sent to the effluent system	<3000 uS/cm	Monthly report
Quality of demin water produced	<0.1 uS/cm	Continuous, Daily and weekly report

Table 14 Key Performance Indicators for the Mobile Demin Plant

Furthermore, any downtime due to Contractors under performance that results in failure to produce contracted minimum demin water requirements shall attract a penalty of 5% deduction of the total targeted monthly demin quantities. Investigation reports shall serve as evidence in such instances including metering records.

The *Contractor* shall duly notify the *Employer* of incidents within two days of occurrence and shall investigate and submit the report where applicable within 1 week for internal investigations and 2 weeks where external investigators are involved from the date of occurrence.

12.2.2 General scope requirements

a. Liaison meetings shall be held with the *Employer's* Representative or his/her delegate on regular basis to discuss any technical details or concerns. The Employer can call Adhoc meeting as and when required to address any issues pertaining to this contract.
b. Analysis shall be carried out on the feed and final demin water quality as per the Eskom Standard 240-53113712 (Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water) with respect to the parameters and frequency of analysis. The Lethabo laboratory will conduct the final demin water analysis as per the agreed routine. Samples that may result in a dispute must be conducted by the Contractor using accredited analytical methods or at a SANAS accredited lab. All other samples required by the Contractor for internal plant monitoring and optimisation purposes can be conducted using the Contractor's internal process control methods.
c. The *Contractor* shall ensure that results are recorded on analyses sheets, signed off and submitted to the Employer.

d. The *Contractor* shall ensure that the work area is left in same or better state on completion of any work, good housekeeping shall be maintained on all areas of the plant all the time, before, during and after work.
e. All instrumentation and equipment on the final demin water must be maintained and calibrated according to quality control system (QCS) proposed in the instrument OEM manual.
f. Quality Control Standards must be checked on every instrument before use. If the QC is above or below by a margin of 5 the instrument must be calibrated, and QC checked to verify instrument reliability and availability.
g. Instrument files must be updated every Monday (as a minimum) and kept current.
h. The Contractor shall ensure competency declaration of plant operators and maintenance personnel to support plant availability and reliability.

12.2.3 Reporting requirements during operational period

The Chemical Services Manager shall be immediately notified when any part of the mobile system becomes unavailable and is required to be removed from service.

Continuous communication between the operator of the mobile plant and the Chemical Services operator of the installed demin trains is critical. Prior to performing any activities on the mobile plant, consultation with the WTP operator must be conducted to ensure there is no risk to demin production.

The Chemical Services Laboratory at an agreed frequency shall verify all samples taken by the operator of the mobile plant. Sampling and reporting of the water quality across the train shall be conducted in accordance with the Eskom Demin Water Standard.

Detailed weekly reports should include but not limited to (every Monday):

- Interpretation of plant performance (qualities of all streams, volumes of all streams, plant availability, run length, chemical clean efficiency, etc.).
- Defects raised and maintenance activities performed.
- Quantity of water treated and produced (full water balance across the mobile plant).
- Summary of log sheets.
- Chemical consumption log sheet and chemical stock levels.
- Highlight any general issue that may affect continuous operation or performance of the plant.

Monthly report should include (third working day of the new month):

- Consolidated report of weekly activities.
- Final demin volume recovered as per the valid meter reading certificate (per train and overall).
- Highlight any general issue that may affect continuous operation or performance of the plant.
- Trending of the Demin water production system (for example, UF's, RO's, EDI etc) regarding actual performance vs design, chemical consumption, cleaning efficiency, water quality produced, etc.).

All communication pertaining to this contract shall be in the form of properly compiled letters or forms attached to emails.

Any verbal communication shall be followed up with a written communication within two working days.

All communication shall be in English and shall be properly numbered. It shall indicate the source, recipient, contact details of both parties, the contract number, communication number/reference and the date.

12.2.4 Plant Personnel Requirements

The *Contractor* must submit an organogram of all the personnel involved in operation of plant during the O&M contracting period, indicating numbers and qualifications. The *Contractor* shall provide evidence that the operating staff are competent in the operation of the plant to ensure the reliable production of compliant demin water to the station, at the stipulated availability. As a minimum, each operating shift shall consist of a competent process controller and a senior plant operator.

It is a requirement that the control desk is manned at all times (24 hours a day, 7 days a week). The controller/assistant shift supervisor (ASS) is responsible to ensure that the control desk is manned at all times.

12.2.5 Contractor's management of his personnel

a. All personnel shall comply with specified PPE requirements for all plant areas and operations and shall report any unsafe condition to the supervisor or in his absence, shall report to the Eskom safety officer and/or the CSM or his/her delegate.
b. The number, duties, training, qualifications and compulsory medical examination of personnel employed at the Mobile Demin Plant must be submitted to the *Employer*.
c. The *Employer* may have stated reasons to instruct the *Contractor* to remove any person from the Contract /Site. This can be done by a formal instruction, early warning, email etc.

The *Contractor* arranges and ensures that after one day of receiving the instruction to remove any person, the person has no further responsibilities with the work included in this contract.

Failure to comply with the instruction to remove any key person from site shall be a breach in contract and shall result in termination of the contract.

d. The *Contractor* ensures that all staff being brought to Lethabo Power Station has a valid medical screening and fitness certificate based on the WTP man job specification. The *Employer* shall provide the *Contractor* with the man job specification.
e. The *Contractor* must ensure that his personnel are in possession of a valid National driver's licence and Eskom Lethabo's access permit.
f. The *Contractor* provide his own transport and accommodation for personnel
g. Two-way radio communication/cell phones will be used for communication between the WTP control room and the mobile demin plant. One radio will be provided by Eskom. All staff brought onto site in connection with this scope of work should be able to fluently speak and write in English and have computer skills.
h. Proof of qualification to be supplied for all personnel when requested by the Employer.

i. The *Contractor* shall adhere to all provisions within the National Water Act No 36 of 1998 and the National Environmental Waste Act No 59 of 2008.
j. All the *Works* will be subject to anytime inspection from by the *Employer* at any point in time.
k. Damage to the Eskom facilities/properties, which can be clearly attributed to negligence on the Contractor, shall be for the *Contractor* account.
l. The *Contractor* shall record all as found conditions (state of plant, including defective equipment), outstanding corrective actions and the condition of the measuring and testing equipment.
m. The *Contractor* shall ensure that each shift has a full staff complement at all times.
n. The *Contractor* shall inform the *Employer* in advance of all approved leave (annual leave, sick leave, etc.) of his personnel and the arrangements for cover for the duration of the approved leave of said personnel.
o. The *Contractor* ensures that each shift has competent personnel or safe isolations for maintenance purposes).

12.2.6 Plant Maintenance Requirements

The *Contractor* shall provide qualified and competent maintenance personnel to conduct all disciplines of maintenance work required on the plant (i.e., mechanical, electrical, instrumentation and control & automation). A list of competencies/qualifications of these individuals is to be provided to the *Employer* prior to the commencement of work on site.

12.2.7 Corrective Maintenance Interventions

a) It is the responsibility of the *Contractor's* operations team to highlight all plant defects as and when they occur.

b) Once a plant defect is noticed, the Project Manager is to be immediately notified by the operator.

c) The *Contractor's* operations team is to safeguard the plant to prevent any further plant damage.

d) Should it be required for the Eskom Battery Limits/tie-ins to be isolated (mechanical or electrical) permit applications will be applied for by the relevant Responsible Person (RP) appointed by the Contractor.

e) Once the permit has been issued, work can commence by the *Contractor's* personnel in assessing and rectifying the defect.

f) Any defect, which may affect overall plant production or result in plant downtime must be assessed within two (2) hours of the occurrence, irrespective of time of day. An action plan is to be formulated and defect correction duration is to be discussed and agreed with the Employer before the work commences.

g) All tools required to carry out the corrective maintenance action, shall be provided by the *Contractor*.

h) The onus will fall on the *Contractor* to source, provide and install the relevant spares to execute the maintenance work.

i) All spares required to carry out piping leak repairs or replacement must be provided for by the *Contractor*, including site installation.

j) In the event where the membrane / module / media replacement is required, the *Contractor* shall provide the services of competent personnel to carry out such services. Any deviations found in the final demin water qualities from expected design conditions will need to be immediately rectified and the mobile demin train retested. This will ensure the desired demin water qualities are achieved post membrane / module / media replacement.

k) A detailed record (maintenance action, durations, permits issued, utilities utilised, etc.) of all corrective maintenance activities shall be kept by the *Contractor* and must be produced when requested upon by the *Employer*.

12.2.8 Limited Access Register (LAR) or Similar System to Manage Plant Access and Maintenance

The *Contractor* must submit the details of the plant safety system that will be used to manage access and repairs within the treatment plant for approval by the *Employer*.

The Eskom LAR system is explained below:

a) The LAR is for the person in charge of the plant to maintain control over activities taking place on his plant that are not covered by the Plant Safety Regulation and Operating Regulations for High Voltage Systems.

b) Activities that are allowed to be carried out under the LAR must not require a permit and must satisfy the following criteria:

i) They must not involve danger to the person carrying out the activity;

ii) No plant isolations must be required;

iii) The activity must be performed by a skilled person and there must be no risk of a production loss;

iv) The duration of the activity must be less than 24 hours.

c) The Supervisor accompanies the *Contractor* during the first instances of working under a LAR on a specific plant area.

d) It is very important that the person who plans to do an activity on a plant under the LAR inform the person in charge of the demin plant of what will be done.

e) This means verbally telling the person in charge of the plant what will be done and not just signing the LAR book. The *Contractor* is also responsible for signing the LAR book.

f) It is also important that as soon as the activity is completed the person, who was doing the activity, notify (verbally) the person in charge of the plant that conditions are back to normal and that the LAR has been signed off. Just signing the LAR book is not sufficient.

12.2.9 Transference of Mobile Plant to Another Power Station during the Rental Period

a) The mobile plant will be required to be transferred to another Power Station during the 12 month rental period until the completion of the agreement or additional extension of the contract as and when required.
b) The Contractor will be responsible to decommission the plant at Lethabo Power Station, mobilise the plant, recommission and continue the O&M contract with the receiving Power Station.
c) The time utilised to transfer the system and recommission at the new Power Station shall not be billed to Eskom. The monthly rental arrangement will continue when the plant is recommissioned at the receiving Power Station.

12.3 Management strategy and start up.

12.3.1 The *Contractor*'s plan for the *service*

Before the *Contractor* can start with the work, they must submit their working plan to the *Project Manager.* The *Contractor* ensures that the working plan takes into consideration the following:

a) Maintaining the chemical stock levels to ensure continuity of the demin production process, but within the limit of 80m^3
b) All operating shifts must be fully resourced with provision for shift cover as may be required from time to time.
c) Management of spares and consumables for the plant in order to meet the availability and reliability requirements as specified in the scope.

12.3.2 Management meetings

Regular meetings of a general nature may be convened and chaired by the *Supply Manager* as follows:

Title and purpose	Approximate time & interval	Location	Attendance by:
Risk register and compensation events	Weekly on Friday at 08H00	Lethabo Power Station	*Employer*, *Contractor*
Overall contract progress and feedback (project meetings – during	Weekly on Thursday at 08H00	Lethabo Power Station	*Employer*, *Contractor*

design and construction phase)			
Overall contract progress and feedback meeting (during operations and maintenance service period)	Monthly on every last Thursday of the month at 08H00	Lethabo Power Station	*Employer*, *Contractor*

Meetings of a specialist nature may be convened as specified elsewhere in this Service Information or if not so specified by persons and at times and locations to suit the Parties, the nature and the progress of the *service*. Records of these meetings shall be submitted to the *Service Manager* by the person convening the meeting within five days of the meeting.

All meetings shall be recorded using minutes or a register prepared and circulated by the person who convened the meeting. Such minutes or register shall not be used for the purpose of confirming actions or instructions under the contract as these shall be done separately by the person identified in the *conditions of contract* to carry out such actions or instructions.

Attendance of meetings as required by *Service Manager* Such as

- *Contractor*'s Safety Officer to attend Lethabo Power Station *Contractor*s Safety Meeting (monthly)
- Departmental Safety Meetings (monthly)
- Section daily meetings
- Any meeting requested by the *Employer* or *Contractor*
- Assessment Meeting
- Outage meeting

12.3.3 *Contractor*'s management, supervision and key people

The *Contractor* must submit an organogram (including minimum qualification level) to the *Project Manager.* The organogram must clearly indicate the project structure during the design, manufacturing and commissioning phase, as well as the structure during the operating and maintenance service period.

12.3.4 Documentation control

- Each instruction, certificates, submission, proposal, record, acceptance, notification, reply and other communication which this contract requires is communicated in a form which can be read, copied and recorded.
- Writing is in the Language of this contract.
- Monthly and weekly and daily reports to be discussed compiled and handed to the *Employer*'s Supervisor and *Service Manager*.
- All communications must be printed and filed in the *Service Managers* file

12.3.5 Invoicing and payment

Within one week of receiving a payment certificate from the *Service Manager* in terms of core clause 51.1, the *Contractor* provides the *Employer* with a tax invoice showing the amount due for payment equal to that stated in the *Service Manager*'s payment certificate.

The *Contractor* shall address the tax invoice to and include on each invoice the following information:

- Name and address of the *Contractor* and the *Service Manager;*
- The contract number and title;
- *Contractor*'s VAT registration number;
- The *Employer*'s VAT registration number 4740101508;
- Description of service provided for each item invoiced based on the Price List;
- Total amount invoiced excluding VAT, the VAT and the invoiced amount including VAT;
- (add other as required)
- The *Employer*'s Finance department and the *Contractor's* delegated person to determine the monthly / assessment CPA.
- *Employer*'s Invoicing and payment procedure/ instruction to be followed.

12.3.6 Contract change management

- Where *Contractor* does Name Changes, Mergers, Acquisitions and Cessions the *Employer*'s procedures must be followed. (Eskom Procurement and Supply Management)
- In a case where one *Contractor* takes over from another *Contractor*, the Site *Service Manager* must be notified in writing immediately.
- The *Contractor* does not cede, delegate or assign any of its rights or obligations to any person without the written consent of the *Employer*
- Changing the service information
- Access
- Provision by the *Employers*
- Stopping work
- Work of the *Employer* or others
- Reply to communication
- Changing a decision
- Withholding acceptance
- Delayed tests or inspections
- Change of affected property
- Materials, facilities etc. for tests
- *Employer's* risks
- Assumption about compensation events
- *Employer's* breach of contract

12.3.7 Records of Defined Cost to be kept by the *Contractor*

N/A

12.3.8 Insurance provided by the *Employer*

Refer to contract data section 8 of the NEC document.

12.3.9 Training workshops and technology transfer

Training workshops and technology transfer is required so that Employer and Contractor can both resolve plant problems when they do arise.

12.3.10 Design and supply of Equipment

The design and supply of equipment shall comply with the technical specification requirements detailed in Section 12. The *Contractor* remains responsible for the design and functionality of any equipment supplied.

12.3.11 Things provided at the end of the *service period* for the *Employer*'s use

12.3.11.1 Equipment

All equipment that forms part of the mechanical, electrical and control interfaces to the Eskom plant (including isolation valves), supplied under this contract remain the property of the *Employer* at the end of the service period.

12.3.11.2 Information and other things

All logs, records, reports (condition monitoring, inspections, plant performance, investigations, etc.), monitoring sheets, etc. for the mobile plant, both in hard copy and in electronic format must be handed over to the Employer at the end of the service period.

All instrument files, as well other information files must also be handed over to the Employer.

12.3.12 Management of work done by Task Order

- A Task Order / Purchase Order is the instruction to commence work.
- No work shall commence until Task Order / Purchase Order is issued and has been finalised and accepted and signed by both the *Employer* and *Contractor's* delegated person.
- Completion certificate to be issued after total services on Task Order is completed.
- Task orders, Assessments and Completion Certificates will be used for work required.

- All work will be issued via SAP Maintenance or as per Task order system.

12.4 Engineering and the Contractor's design

12.4.1 *Employer's* Engineering Design

12.4.1.1 Control and Instrumentation Design

There is no concept design from the *Employer*. The *Contractor* to comply with the requirements stipulated under the *Contractor's* design portion.

The *Contractor* is required to provide an interface to the *Employer's* Distributed Control System (DCS) via the profibus port 2 interface on WTCP17 in the WTP equipment room. The interface shall be provided by installing a fibre optic link between the WTP equipment room cubicle and the mobile plant stand-alone PLC interface point.

The interface between the two systems shall be separated via a DP-DP coupler. The coupler shall be of GSD revision 4 or lower as the profibus module does not support version 5 GSD files. The two systems shall therefore both act as profibus DP master systems.

The Contractor shall be responsible for supplying, installing and commissioning the fibre optic link between the two locations, conversion modules, coupler and accessories.

The PLC shall write data to the coupler. The Contractor shall make the following data available via the interface as a minimum but not limited to:

- Final outlet flow rate
- Final outlet conductivity
- Plant/train status (offline, regeneration/cleaning, online, fault)
- Other data to be discussed at a later stage depending on the plant type

The DCS shall read the data from the coupler and display the data on a WTP Foxboro DCS mimic.

12.4.1.2 *Works* Function and Performance Requirements

The mobile plant will be operated from the stand-alone control system to be provided as part of the *Works*.

12.4.1.3 *Works* life-expectancy

The plant will be rented for a period of 12 months; however, the permanent tie-ins are required to have minimum operating life of 15 years.

12.4.2 Parts of the *works* which the *Contractor* is to design

The *Contractor* shall be responsible for the design, manufacture, procurement, factory acceptance testing, delivery to site, off-loading, erection, installation, site testing and commissioning of all Plant and Material required for ensuring a fully functional system.

12.4.2.1 Mobile Treatment Plant Design

The *Contractor* is required to carry out all design required for the *Works*.

The *Contractor* assumes final responsibility to ensure that the *Works* comply with all requirements of the *Works* Information, and any other governing laws or codes. Compliance with the *Works* Information does not relieve the *Contractor* of this responsibility.

The entire plant must be supplied as rapid deployment, containerised units, which are required to be placed at the site for the duration of its operation. No civil preparation in the form of plinths will be permitted.

12.4.2.2 Scope of the work

The scope of work describes the major activities, plant and material that falls within the scope of the *Contractor*. It is the responsibility of the *Contractor* to ensure that all the activities are carried out and all equipment, plant and material is supplied to complete the *Works* in every respect.

The *Works* comprises the following:

a) Detail Design

b) Manufacture and procurement

c) Factory acceptance test

d) Delivery to and offloading at site

e) Installation

f) AKZ labelling (tie in points)

g) Corrosion protection of tie-in systems

h) Interfacing with existing plant

i) Commissioning, testing and optimisation

k) Documentation as specified

l) Quality management for all activities

m) Safety and plant signage

n) Storage on site

o) HAZOP study for the interfaces to the main plant and not for the mobile demin plant being rented.

All plant, material and equipment are required to be designed for operation in a power plant environment.

It is not the intention of this scope of work to describe in detail all the activities the *Contractor* is required to carry out, nor to describe in detail everything to be supplied by the *Contractor*.

The *Contractor* provides the whole of the *Works* as defined in section 12 of the *Works* Information except where explicitly stated as otherwise.

The *Contractor* designs according to the requirements of the *Employer's* design stated on section 12 of the *technical specification*.

The *Contractor*'s design of the interfacing systems is required to be reviewed and accepted by the *Employer* before any manufacturing work begins. The *Contractor's* design of the mechanical and electrical tie-ins is required:

- To comply with the requirements of the *Works* Information,
- To be carried out by qualified, experienced and registered professional engineers.
- Prior to submission of the final design should be approved by a qualified competent person, professionally registered with an internationally recognised engineering body, in the relevant engineering discipline.

12.4.2.3 *Contractor*'s scope for the operating, control and maintenance philosophy

The *Contractor* is responsible for the provision of a detailed operating and control philosophy as per the *Contractor*'s detailed design of the *Works* and submits this to the *Project Manager* for review prior to commencing with the construction activities.

The *Contractor* provides operations and maintenance service, together with spares and resources for a period of 12 months.

12.4.2.4 General Design and Manufacturing Process Constraints

In providing the *Works*, the *Contractor* is fully responsible for the delivery to, offloading and storage of all plant, equipment and materials required for the *Works* on site. The *Employer* reserves the right to carry out any checks of his/her own on any plant, equipment and materials that have been delivered to site for the *Works*.

The *Contractor* is fully responsible for the installation of all mechanical, civil, electrical, process control and instrumentation components, equipment and material as well as the interfacing and tie-ins with existing plant and equipment as required for the *Works*.

The *Contractor* is responsible for the complete optimisation of the *Works* in order to meet or exceed the guaranteed performance levels.

The *Contractor* is required to indicate the full extent of the guarantees they are prepared to offer with respect to water quality, volumetric flow, efficiency and availability of the *Works*.

12.4.2.5Engineering Design Phase

The design of the Plant and Materials that forms part of the design for the *Works* shall conform to the following requirements:

Below is an illustration of possible tie-in points as per current Lethabo Power Station layout:

Figure 15: Possible tie-in points

12.4.2.5.1Process Design

12.4.2.5.1.1.1 General Requirements

The raw water quality analysed for Lethabo pre-treatment plant is as indicated in section 5.2.1 Table 2:

The frequencies of exceeding the average values for the parameters listed in the table are depicted in the graphs below. The *Contractor* shall take note of the water quality variation in the design / plant offered to ensure the mobile plant is capable of operating under these instances.

The final demineralised water quality required is as indicated in the table below and as per table 15 of 240-53113712 - Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water:

Parameter	Units	Target	Limit
Turbidity	NTU		0.2
Conductivity at 25°C	µS/cm	< 0.07	0.1
Silica as SiO_2	µg/l	ALARA	10
Sodium as Na^+	µg/l	< 1	2
TOC as C	µg/l	ALARA	250
Chloride as Cl^-	µg/l	< 1	2
Sulphate as SO_4^{2-}	µg/l	< 1	2

Table 15: Final Demineralised Water Quality

The *Contractor* shall clearly indicate the maximum and minimum feedwater conditions that will not be treatable by the plant provided. If any additional parameters for testing on the feed quality are required for the *Contractor*s design, the *Contractor* will sample and test at his own expense. The *Employer* will not take responsibility for parameters not tested that ultimately affects the *Contractor*s *Works*.

12.4.2.6 Sample Requirements

Provision shall be made for a sample to be collected on the outlet of the final demin water production. Should a final product water tank be installed, a sample point on the outlet of the tank as well as the water being pumped to the demin storage tanks. As a minimum, online continuous monitoring of specific conductivity / Resistivity (@ 25°C), sodium and silica must be installed on the final demin water supplied to the Eskom demin storage tanks. The use of a final product tank before supply to the demin storage tanks will be evaluated during the commissioning phase. Should the tank have a significant negative influence on the final demin water supplying the main demin storage tanks, it may be required to bypass the product tank in the mobile plant.

12.4.3 Waste Management

Depending on the salinity of the final effluent, it may be directed to the CW sludge sump via the collection launder (combined waste conductivity ≤ 3000uS/cm), or to the effluent neutralisation sump (final conductivity > 3000uS/cm).

All chemical tanks must be equipped with a bund to contain any leaks at 110% of the contents of the tank. The waste chemicals from the bunds shall be directed to the effluent sump if required via the common effluent pipeline.

The *Contractor* shall indicate in the design how this requirement can be met. The *Contractor* must implement the containment of possible leaks across interconnecting pipework as well as in the operating vessels.

Should membrane / module / media replacements be required during the time of providing the O&M services on the mobile unit, the supplier shall be responsible to remove the spent consumables offsite for disposal to the *Employer's* hazardous waste site.

12.4.4 On-line Monitoring Requirements (Chemical Online Analysers)

The *Contractor* makes provision for the supply of spares and consumables for the analysers on the final demin water quality for the duration of the operations and maintenance contract.

The *Contractor* submits all calibration certificates, commissioning procedures, technical data sheets, operating and maintenance manuals for these analysers.

12.4.5 Chemical storage and safety requirements

The volume of chemicals stored at the mobile plant shall not exceed 80 m^3, at any point in time, in order to meet the conditions of the Environmental Decision Note. The *Contractor* shall indicate the total chemical storage provided for as well as the expected frequency of semi bulk chemical storage supply replacement.

A lockable container (or similar alternative) for the chemicals shall be provided as part of the design. The design ensures that any spillages can be contained, and that there is provision for extraction of chemical fumes from the container to the outside environment to prevent corrosion on all equipment and safety of personnel.

Diphoterine eyewash stations shall be provided in the vicinity of the chemical areas in the mobile plant where chemical leaks, spills, etc. or other accidental contact with corrosive chemicals might occur.

12.4.6 Provision of Operations and Maintenance for the Mobile Plant

The *Contractor's* scope is inclusive of the provision of operating and maintenance services for a period of 12 months. This period commences on successful commissioning of the mobile plant.

The O&M cost must be all-inclusive and must indicate the cost per ML of demin produced, which includes:

- Manpower cost for Operating (24-hour coverage)
- Manpower cost for Maintenance
- Manpower cost for administration work
- Plant maintenance material cost

- Chemical and Consumables Supply (list chemicals and quantities with Material Safety Data Sheets & Product Data Sheets)
- Sample bottles and glassware for sampling and analysis of the grab samples.

The Contractor shall indicate the shift cycles and team members that will be on site for the duration of the contract. The *Contractor* shall submit his plan for executing the service with his proposal. The *Contractor* shall include in this proposal:

a. Training (in line and in fulfilment of the requirements of this scope of work)

b. Safety

c. Quality

12.4.7 Mechanical design

The mechanical design explained below is for the mechanical tie-ins to Eskom plant from the mobile demin plant. This refers to plant that will remain behind on termination of the rental period.

12.4.7.1 Mechanical Interfaces

The mechanical interfaces into the existing systems are in the following locations:

12.4.7.1.1 Raw water supply:

The suction for the mobile demin production plant will be taken from the raw water supply valve pit situated near raw water clarifier 1. The connection point is a 450NB Carbon Steel Flange drilled to BS 4504 (Table 10/3). Refer to drawing 0.63/08437.05 - CLARIFIED WATER FEED AND RAW WATER MAKE-UP GENERAL ARRANGEMENT FOR TOWER 2 for more information for the possible tie-in point.

12.4.7.1.2 Effluent drainage:

Depending on the salinity of the final effluent, it may be directed to the CW sludge sump via the collection launder (combined waste conductivity ≤ 3000uS/cm), or to the high conductivity effluent neutralisation sump (final conductivity > 3000uS/cm). It must be noted that a grid covers current the sump. The *Contractor* shall evaluate the grid design and propose any modifications for implementation to allow the tie-in to the sump. The effluent must be directed into the sump avoiding direct contact with the walls of the sump. Refer to 0.63/3676.17 - (WATER TREATMENT PLANT) WTP (WEST) EFFLUENT NEUTRALISATION SUMP PIPING GENERAL ARRANGEMENT for more information.

12.4.7.1.3 Product to Eskom plant tie-in:

The product line will be directed into the mixed bed outlet lines, three (3) in total. These lines are:

- Size: 200NB
- Material Carbon Steel (APL 5L GrB) hard rubber lined.
- Flange: BS4504 (Table 10)

The *Contractor* ensures integrity of the liner is not affected during the tie-ins and corrects any damage that may occur as a result of work done to effect tie-ins. Refer to 0.63/03675.09 - (WTP) WATER TREATMENT PLANT (WEST) DEMINERALISATION TANKS AND PIPE TRENCH GENERAL ARRANGEMENTS for more information of the possible tie-in point.

12.4.7.1.4 Potable water supply:

The potable water supply to the mobile plant shall be taken from the potable water supply line to the Cooling water pumphouse. Estimated distance is 30 meters. Contractor to confirm on site whether the possible tie-in points identified on site would be sufficient for the need on the demin mobile plant. Refer 0.63/17936.31 - (LOW PRESSURE SERVICES) LPS GENERAL SERVICE WATER SYSTEM (HIGH PRESSURE) HP POTABLE WATER SUPPLIES PIPING AND INSTRUMENTATION DIAGRAM (P AND ID) - 08-00UR & 17735.32 - (LOW PRESSURE SERVICES) LPS GENERAL SERVICE WATER SYSTEM AIR HEATER WASHING P AND ID (PIPING AND INSTRUMENTATION DIAGRAM)

12.4.7.1.5 Clean drains:

Clean Drains from the mobile plant shall be directed to the station drains.

12.4.7.1.6 Functional requirements of the above works:

- The Contractor is responsible for the supply, installation, testing and commissioning of all the pipe work listed above.
- All of the above interfaces must be done such that there is no disruption to the operating plant. It must also be done in a manner that does not cause contamination of the system.
- Facilitate compliance with the latest regulatory requirements and incorporate any additional design improvements that can be justified by a cost-benefit analysis.
- Determine what (if any) plant process modifications are necessary with regards to the tie-ins
- Perform engineering design for mechanical plant modifications to support upgraded or additional measurements, as required.
- Design of all pressurised components shall comply with Pressure Equipment Regulation and classified as per SANS 347.

12.4.7.2 Pipework requirements

The *Contractor* designs, supplies, installs, tests and commissions piping and valves for the off take and delivery lines from the mobile plant to designated discharge points in accordance with Engineering Best Practice.

The *Contractor* ensures that all pipework is adequately supported and fastened to prevent excessive stresses.

Piping material selection is part of the *Contractor's* design. The *Contractor's* design verifies and ensures the integrity of all pipe work. The *Contractor* takes into consideration the requirements below:

(1) Piping is sized to minimise pressure drop.

(2) Piping is welded and flanges are provided where openings are necessary for maintenance and repair purposes.

(3) The *Contractor* submits the pipe data sheets and complete design to the Project Manager for acceptance.

(4) The *Contractor* marks all pipe work associated with the *Works* with the description of the medium and direction of flow clearly displayed and visible from a normal operating perspective and in accordance with the specification SANS 1091: National colour standards of paint and SANS 10140: Identification colour markings.

(5) Crossing of existing pipelines and sumps: the *Contractor* is required to be aware of all existing pipelines and sumps along the routing. Should the new pipeline be required to cross an existing pipeline or sump, the *Contractor* will do so without damaging and interfering with the existing pipeline. The *Contractor* may either cross over or underneath the existing pipeline. In a case where the pipe is crossing over, the pipe must not rest on the existing pipeline, and it must cross such that it does not restrict any maintenance on the existing pipeline. Prior to construction, the *Contractor* will submit a method of construction for when crossing existing pipelines and sumps. If the pipeline crosses a clean water sump, then allowance must be made for leak containment in the event that the pipe leaks, so that it does not contaminate the sump. This method will need to be accepted by the *Project Manager* prior to commencing the installation.

12.4.7.3Valves and Actuator requirements

(1) All valves are to be lockable and meet requirements of the PSR.

(2) All valves are flanged so that they can be removed for maintenance purposes.

(3) Valves are selected by the *Contractor* to ensure that the pressure and temperature ratings can withstand the various operating pressures and temperatures as per the design in accordance with Engineering Best Practice.

(4) The *Contractor* installs, tests and commissions all valves for the interfaces to the mobile plant

(5) The *Contractor* ensures that the valves are compatible with the chemicals they are in contact with as well as with process conditions as determined in his design.

(6) All actuated valves must be provided with positioners and limit switches. Provision should be made for manual operation of these valves.

(7) All valves must fail in their fail-safe mode/position according to the HAZOP study.

(8) The *Contractor* submits a valve schedule with the design. This includes details of actuators, and actuator sizing for all electrically actuated valves.

(9) The following minimum requirements apply:

a) All valves are arranged and positioned at accessible locations to ensure safe, efficient and easy operation and maintenance. The *Contractor* provides clear access to the valve hand wheels and avoids valve hand wheels being tucked behind other valves or components.

b) All valves for the *Works* are numbered for identification purposes. The *Contractor* uses the codification provided to them by the *Employer*. All tie-ins the *Contractor* must use and comply to Eskom's coding requirements.

c) The *Contractor* supplies the following minimum valve information to the *Project Manager:*

- Recommended spares list,
- Valve assembly and dis-assembly procedure,
- Maintenance procedure.
- All mechanical parts list

12.4.8 Mobile Plant Electrical Design

(1) The Contractor shall provide a mobile demin plant inclusive of a Motor Control Centre (MCC) such that the required loads are subdivided in the MCC provided.

(2) The Contractor utilizes the Employer's existing single, non-redundant 400V AC low voltage bulk power supplies as specified below, to supply all electrical loads forming part of the mobile demin plant.

(3) The Employers non redundant, 3 phase, 400V (± 0.05%), 50Hz (±0.025%), bulk power supplies and point of connection (POC) and rating limitations for the Contractors use, are specified as follows:

- At the LV terminals of the 1MVA, 11-kV / 400V, Dyn11, ONAN, (AKZ: 50ET 050) Effluent Concentration Plant Board (B) transformer.
- Spare functional units 51 GD 380V Effluent Concentration Plant Board A.
- The Employers proposed point of connection is estimated to be 200 meters from the mobile plant location.

#	POINT OF CONNECTION	AKZ/ CIRCUIT	RATING LIMITATION
1.	Effluent Concentration Plant Board Transformer 1MVA 11-kV / 400V, Dyn11, ONAN LV Terminals	50 ET 050	1MVA
2.	380V Effluent Concentration Plant Board A	51 GD 023	200A
3.	380V Effluent Concentration Plant Board A	51 GD 024	100A

12.4.8.1Contractors Design

(1) The Contractor is solely responsible for the design, procurement, manufacture, transport, installation, commissioning, operating and maintenance of all major electrical components and associated accessories in support of a fully functional and safe mobile demin plant.

(2) The Contractors electrical scope boundary is provided in Appendix C9 Electrical LOSS Mobile Plant Point of Connection (POC)

(3) The Contractor submits and electrical system description, operating and control philosophy and Single Line Diagram (SLD) of the proposed mobile plant design.

- The SLD depicts all proposed subdivided loads as per MCC design and short circuit protection device ratings for both the MCC incomer and MCC loads.

(4) The Contractor provides voltage monitoring on the mobile plant 400V incomer for alarm routing through the PLC to the Eskom plant control room.

(5) The Contractor as a tender returnable submits the Employers 240-56227927 Electrical Load List Mobile Demin Plant template - Appendix C7. The load list informs the Employer of the Contractors required bulk electrical supply capacity affirming the proposed point of connection (POC).

(6) The Contractors cable works shall conform to the requirements stipulated in 10.4.

- The Contractor is solely responsible for the cable rating designs, cable routing, racking and accessory design and installations from the Employers point of connection defined.
- The Contractor is responsible for the disconnection and capping preservation of the existing seven (7), 400V cables on the LV transformer (AKZ: 50ET 050) terminations.
- The Contractor installs, tests and terminates all cabling from the point of supply to the mobile plant, taking note that the termination point at the POC shall be performed in conjunction with appointed Eskom maintenance and operating personnel.

(7) The Contractor develops and provides electrical protection independent to that of the Employer, for the mobile plant MCC incomer breaker and MCC feeders.

- The Contractor submits as a tender returnable a mobile plant electrical protection philosophy, incomer data sheet and proposed settings document to enable the Employer to perform protection grading with the mobile plant.

(8) The Contractors mobile plant electrical bonding requirements shall conform to the requirements stipulated in 10.5.

(9) The Contractor shall provide a COC for the electrical Works performed.

(10) The Contractor shall be required to make provision for any spares necessary to achieve a safe and fully operational mobile plant.

12.4.9 Control and Instrumentation Design

The *Contractor* is required to provide an interface to the *Employer's* Distributed Control System (DCS) via the profibus port 2 interface on WTCP17 in the WTP equipment room. The interface shall be provided by installing a fibre optic link between the WTP equipment room cubicle and the mobile plant stand-alone PLC interface point.

The interface between the two systems shall be separated via a DP-DP coupler. The coupler shall be of GSD revision 4 or lower as the profibus module does not support version 5 GSD files. The two systems shall therefore both act as profibus DP master systems.

The Contractor shall be responsible for supplying, installing and commissioning the fibre optic link between the two locations, conversion modules, coupler and accessories.

The PLC shall write data to the coupler. The Contractor shall make the following data available via the interface as a minimum but not limited to:

- Final outlet flow rate
- Final outlet conductivity
- Plant/train status (offline, regeneration/cleaning, online, fault)
- Other data to be discussed at a later stage depending on the plant type

The DCS shall read the data from the coupler and display the data on a WTP Foxboro DCS mimic.

The *Contractor* must provide an on-board local operating panel to allow full plant operational functionality, diagnostics and alarm viewing.

- Computer equipment provided shall comply with the following cyber security features (not limited to):

    a. Employment of a user management system

    b. Installed with Security Technologies (Anti-malware software), allowing for manual virus definition updates and patch management,

    c. Locking of all USB ports

    d. Employment of a fully configured Back-up and Restore software

The *Contractor* must ensure that a minimum of 6 months of plant operating data is stored in the historian.

12.4.10 Civil and Structural Design

12.4.10.1 Geotechnical Investigation:

A geotechnical investigation is required to determine the geotechnical parameters required for the detail design of the foundation for the Mobile Demin Plant. The works comprises of the excavation of test pits, in-situ testing, laboratory testing and the compilation of a comprehensive geotechnical report. The Contractor provides all equipment and resources required to execute the works.

Field Testing:

1. Geophysical tests are to be carried out to locate any sub-surface structures both metallic and non-metallic prior to excavation of any type.
2. The geophysical scans are implemented throughout the proposed layout area prior to any excavation. The geophysical scanning aims to minimize the risk against intersection of existing underground services during the geotechnical investigation. furthermore, the *Contractor* must obtain construction permit before any excavations.
3. The type of Geophysical scanning employed is to be at the discretion of the *Contractor*. The survey area is located on an active site (i.e. Lethabo Power Station), therefore the *Contractor* is to consider the working environment prior to selection of testing methodology and equipment.
4. The *Contractor* shall consider possible signal interferences which may be experienced by the geophysical scanning equipment caused by equipment, services and/or the prevailing weather conditions at the survey areas and the surrounds.
5. The scans are implemented to a minimum depth of 5m.
6. Hand excavations are required where possible to confirm the findings of the scans. All hand excavations are adequately supervised to ensure that no underground services are impacted by the visual confirmation and verification of underground services.

7. Excavation and supervision of a minimum 5 test pits, maximum 10 test pits. Test pits are to be excavated to a depth of not less than 3 m or until refusal.
8. The *Contractor* complies and submits a layout drawing indicating the test pit locations, for the *Employer* review and acceptance. The *Contractor* may change the locations, provided the newly proposed test pit locations are reviewed and accepted by the Employer prior to excavation.
9. DCP tests are to be conducted adjacent to each and every test pit that has been excavated.

Laboratory Testing:

The following laboratory tests are required for each test pit excavated:

1. Foundation Indicator tests (particle size distribution, hydrometer analysis and Atterberg Limits) at relevant depths. Tests to be carried out on a maximum of 2 samples from a test pit.
2. CBR with Modified AASHTO (Moisture Density Relationship). Tests to be carried out on a maximum of 2 samples from a test pit.
3. Direct Shear Tests. Tests to be carried out on a maximum of 2 samples from a test pit.
4. Density Tests. Tests to be carried out on a maximum of 2 samples from a test pit.

12.4.10.2 Design and Construction of Platform/Foundation:

From the geotechnical study the contractor is needed to determine whether the current proposed area would be sufficient for the proposed mobile plant. If there is any need for design and “permanent” construction an Environmental Impact assessment would need to be done first, as the current proposed area does not have any concrete plinth that can be utilised for the construction of the proposed mobile demin plant. As far as possible the Contractor is to use non-permanent supports for the mobile plant. Otherwise other areas of the plant that already have stable ground support is to be identified and proposed by the Contractor at tender phase.

Only if there is no other way around temporary supports or other possible already built areas for the demin mobile plant the contractor would be required to design and construct a levelled and stable foundation. As described below:

1. The *Contractor* is required to design and construct a levelled and stable foundation which will be used to support the installation of the temporary Mobile Demin Plant.
2. The design inputs, from the geotechnical investigation, is to be used in the design of the foundation/platform. The *Contractor* ensures that the load bearing capacity of the foundation is not exceeded by the Mobile Demin Plant.
3. If required, the *Contractor* modifies the existing ground by designing the required layerworks (included the required compaction levels) to improve the overall bearing capacity. If sufficient bearing capacity cannot be generated from a shallow foundation then a deep foundation may be designed and provided for.

4. At present, the loadings, dimensions and movement tolerances of the individual components for the Mobile Demin Plant is unknown. The Civil *Contractor* interfaces with the main *Contractor* to obtain the required information.
5. The *Contractor* is required to divert the surrounding stormwater runoff away from the mobile demin plant area.

12.4.10.3 Pipe route

- The *Contractor* utilizes the existing pipe racks and pipe trenches to do site runs.
- The *Contractor* ensures in his design that all pipework is suitably supported/anchored.
- The *Contractor* ensures that the additional load can be accommodated by the existing infrastructure and makes provision for the necessary modifications where required.

12.4.10.4 Deliverables:

The Contractor provides the following document deliverables as part of the works.

i. Underground Service Scans

Upon completion of the Geophysical scan, the professional engineer is required to prepare and submit a report that includes:

- Equipment used to undertake underground services scans.
- The required information of the presence of existing underground services.
- Layout drawings, in XYZ format, illustrating the size, identity/material, and accurate positioning of the existing infrastructure.
- All deliverables are to be compiled into a final report with the relevant annexures, recommendations and drawings.
- The *Contractor* may only commence with the in-situ testing once the *Employer* has evaluated the findings of the underground scanning and has given the approval to do so.

ii. Geotechnical Investigation

Upon completion of the fieldworks and laboratory testing, the professionally registered geotechnical/civil engineer or geologist, prepares and submits a detailed geotechnical investigation report for review and acceptance by the Employer. The final geotechnical report includes:

- Site Location.
- Site Description (includes: observed relief, vegetation, drainage, man-made features).
- Detailed results and discussion of all in situ and laboratory tests.
- Description of the properties of soil and/or rock strata.
- Calculation of estimated bearing capacity versus depth (every 0.5m) to refusal.

- Calculation of maximum Shear modulus (G) of the soil versus depth and variation of shear modulus with varying levels of strain.
- Recommendations regarding foundation types, layer works, backfill, excavation, and remediation measures for potential hazards (if applicable).
- All field data and laboratory results are to be included in the appendices.
- All raw data, calculations, tables, formulae, etc. used to draw recommendations are included in the report.
- The final report is signed by the responsible Professional Engineering Geologist registered with SACNASP or Professional Geotechnical/Civil Engineer registered with ECSA.
- The final report must be delivered as one electronic copy and one hard copy.
- All interim reports must be delivered as electronic copies (1 copy for each report only)

iii. Design Phase

- Consolidated detailed design report signed by a Professional Civil Engineer which includes:
    - Design criteria/parameters, specifications and standards that were used, loadings, assumptions, methodology, calculations and results including detailed design calculations, design models, sources of information and any record of other information associated with the completed works.
- Detailed drawings for construction signed by a Professional Civil Engineer. Drawings are to be submitted in dgn. and pdf formats.
- Detailed constructability analysis for the execution of the works.

iv. Construction Phase

- Detailed method statements for the construction of the works
- Inspection and Test Plans (ITP's) indicating all intervention points
- Quality Control Plans (QCP's)
- Workshop/fabrication drawings
- Material certificates

v. Post Construction Phase

- As-Built drawings.
- Data books.
- Structural Certificate signed by Professional Civil Engineer confirming that works have been constructed in accordance with the design.

12.4.11 Design Review

12.4.11.1 HAZOP Study

The *Contractor* shall conduct a HAZOP study with the participation of Eskom prior to the finalisation of the design, prior to construction and prior to commissioning of the system. Upon completion of the study, the HAZOP report shall be issued to Eskom for review.

12.4.11.2 Reliability

The plant shall be provided such that known failure mechanisms will not prevent the system from achieving its design life or meeting the availability. This means that the plant components must be 100% reliable for the duration of the operation of the plant at 90% availability (minimum).

12.4.11.3 Availability

The system shall be designed for an availability of >90% during the course of the operation at Lethabo Power Station.

Should an extended outage be required on any part of the system, the *Contractor* shall ensure that a replacement unit is provided within 48 hours such that the production of 5.28Ml/day of demin water production is sustained during the period of the service contract.

12.4.12 Procedure for submission and acceptance of *Contractor*'s design

The *Contractor* is to supply the following documentation as the minimum requirements of this specification in the design package for the interfacing systems, before any manufacturing, construction or commissioning commences:

- Line Sizing Calculations and Material Selection
- General Arrangement Drawing of System and boundaries
- Piping and Instrument Diagrams
- Component material datasheets
- Constructability Assessment
- Quality Manual
- Quality Control Procedures
- Quality Control Plan and Inspection and Test Plan
- Method Statements
- Commissioning procedures for the mobile demin plant as well as interfaces

- Assembly procedures
- Operating and Control Philosophies for interfaces with the main demin water production
- Chemical Safety Data Sheets and Safe Handling Procedures
- Water and salt balance across the plant
- Field termination drawings
- Pipe Schedule
- Valve schedule
- Mechanical Hook-up diagrams
- Power distribution drawings
- LOSS diagrams
- Electrical load schedules
- Electrical cable schedules
- Electrical termination schedules
- Instrument calibration certificates for raw and final demin water flow and quality

12.4.13 Other requirements of the *Contractor*'s design

12.4.13.1 Physical Characteristics Requirements

It must be noted that the environment experiences air borne fly ash.

12.4.13.2 Fire Protection

The *Contractor* must provide a fire risk analysis as part of the design approval process to the *Employer* for approval. The *Contractor* is to implement the protection measures required to mitigate the risks identified in the fire risk analysis.

12.4.13.3 Testing and Commissioning

Testing and commissioning shall include as a minimum:

(1) The services of skilled Engineers to supervise the testing, commissioning, and making ready for the full duty operation of the complete *Works*.

(2) All management, supervision, labour, tools, instruments, chemicals, test apparatus, calibration equipment and any other equipment and facilities as may be necessary.

The *Contractor*'s preliminary trials and commissioning of the *Works* shall be carried out by the *Contractor*'s representatives, who shall remain in attendance until the *Works* are working to

the *Employer's* satisfaction. A requirement of these trials is a 72-hour test to determine that all activities as laid down in the contract as per the final demin water production are correct and are carried out in the correct sequence regarding automatic trips / recycle to protect the final demin storage tanks from contamination, and to determine that all the plants have been provided as required in the scope of work.

The operating and maintenance manuals shall be submitted at least 2 weeks prior to the start of commissioning for acceptance by the relevant *Employer's* representative. The *Contractor* is responsible for commissioning of the mobile plant control system logic included in the *Works* and provides a functional logic commissioning procedure for testing the applied logic and plant functionality in accordance with the plant operating and control philosophy requirements. The functional logic commissioning procedure is developed with reference to the mobile plant operating and control philosophy and is subject to the approval of *Project Manager* before functional testing commences.

The Contractor's staff with the Employer's dedicated operations /commissioning staff shall do commissioning of the system.

The mobile plant will be commissioned ensuring that the final demin water is not fed into the Demin Storage Tank until the water quality is proved compliant. The water shall be diverted to the cooling tower pond.

The *Contractor* submits a commissioning schedule and program for acceptance by the *Project Manager* by the contract date.

Before plant and equipment is placed in service, the *Contractor* certifies that it is in a suitable and safe condition. In addition, the *Contractor* provides a complete list of numbered schematics, wiring and cable diagrams which are a true record of the plant and equipment as installed and certifies that the system has been wired in accordance with these diagrams.

Prior to the time when commissioning is to commence, the *Project Manager* will appoint a representative who will co-ordinate the commissioning of all plant and equipment forming an integral part of the system being commissioned. The *Contractor* is responsible for the commissioning of all the plant and equipment he/she is to supply to the requirements of this specification in conjunction with the *Project Manager* and the *Employer's* representatives. Where various components are already in place or are supplied by the *Employer* to form an integrated system, the *Contractor* at the time of commissioning, carries the responsibility for the correct functioning of the whole system.

In the event of incorrect functioning, the *Contractor* determines the cause and he/she corrects the defect if the defect is within plant and equipment of his/her own supply. The *Contractor*, at the time of commissioning, has the agreement, or alternatively, the attendance of the *Project Manager* involved in a particular phase, before proceeding with commissioning. Consequently, the *Contractor* must assure himself/herself as to the safety of his/her own plant and equipment in respect of any particular commissioning test and in the event of damage accept responsibility for such plant and equipment.

12.4.14 Equipment required to be included in the *works*

12.4.15 *Contractor*'s Equipment (including temporary *works*).

The *Contractor* is liable for all plant & equipment in the designated area under his control. The *Employer* will not take any responsibility for any loss or damage to the equipment.

Units	Description
C	Celsius
H	Hour
Hz	Hertz
K_{25}	Specific conductivity of a solution, with units of µS.cm^{-1} (micro-Siemens per centimetre - or occasionally milli-Siemens per metre, mS.m^{-1}), measured/reported at the reference temperature of 25°C.
K	Kilo (10^3)
Pa	Pascal
L	Litre
M	Meter
M	Mega (10^6)
MA	Milliamps
NTU	Nephelometric Turbidity Units
µ	Micro
V	Volt

12.5 Standards and Specifications

The *Contractor* is required to adhere to the following standards and procedures is executing the *Works*.

12.5.1 Civil and Structural Standards

(1) SANS 10400 - Application of the National Building Regulations
(2) BS5531:1988 Code of Practice for Safety in Erecting Structural Frames
(3) ISO 9001 Quality Management Systems.
(4) All laboratory testing is conducted in accordance with the latest standard methods and procedures as outlined by the appropriate authorities (B.S/ Euro Code equivalent, A.S.T.M, A.A.S.H.T.O, I.S.R.M, S.A.B.S / S.A.N.S)

(5) All Soil profiling is conducted in accordance with guidelines outlined in: Jennings, J.E, Brink, A.B.A, & Williams, A.A.B, (1973) "Revised Guide to Soil Profiling for Civil Engineering purposes in Southern Africa" Trans. S.A.I.C.E, Vol. 15, No. 1, page 3 – 12.
(6) Site Investigation Code of Practice, 1st Edition, South African Institution of Civil Engineering - Geotechnical Division, January, 2010
(7) All work is conducted in accordance with the requirements of the Occupational Health and Safety Act (Act 85 of 1993) as amended.
(8) 240-56364545: Structural Design and Engineering Standard
(9) 240-85549846: Standard for Design of Drainage and Sewerage Infrastructure
(10) SANS 2001-BE1 Construction works Part BE1: Earthworks (general)
(11) SANS 2001-BS1 Construction works Part BS1: Site clearance
(12) SANS 1200 A Standardized specification for civil engineering construction Section A: General
(13) SANS 1200 D Standardized specification for civil engineering construction Section D: Earthworks
(14) SANS 1200 ME Standardized specification for civil engineering construction Section ME: Subbase
(15) SANS 1200 MF Standardized specification for civil engineering construction Section MF: Base

12.5.2 Electrical Standards

(1) 240-150642762: Generation Plant Safety Regulations
(2) SANS 10142-1: The wiring of premises Part 1: Low-voltage installations
(3) 240-56227516: LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and Including 1000V AC and 1500V Standard
(4) 240-115583001: LV Switchgear Schedule A and B Template
(5) 240-56227443 - Requirements for Control and Power Cables for Power Stations Standard
(6) 240-56176097: Electrical Cable Schedule Template
(7) 0.00/1310: Eskom Standard Code for Power and control cables
(8) 240-56356396: Earthing and Lightning Protection Standard
(9) 054-393: Earthing Standards
(10) 240-55714363: Coal Fired Power Stations Lighting and Small Power Installation Standard
(11) 240-57617975: Procurement of Power Station Low Voltage Electric Motors Specification Standard
(12) 240-56178825: New Low Voltage Motors Procurement Standard
(13) 240-77100923: New LV Motor Technical Schedule AB Template
(14) 240-56361435: Transport of Power Station Electric Motors Standard
(15) SANS IEC 60034-1: Rotating Electrical Machines: Part 1 Rating and Performance
(16) 240-56227927: Electrical Load List Template

12.5.3 Mechanical Standards

(1) 32-632: Requirements for Non-Destructive Testing (NDT) on Eskom Plant
(2) 240-56241933: Control of Plant Construction, Repair and Maintenance Welding Activities
(3) 240-56355225: Welding of High Pressure, Temperature Tube and pipework
(4) 240-56246601: Personnel and Entities Performing Welding Related Special Processes on the Employer's Plant
(5) SANS 1091: National colour standards of paint
(6) SANS 10140: Identification colour markings
(8) SABS BS 4994 (1987:1) - Design and construction of vessels and tanks in reinforced plastics
(9) 240-123801640 Standard for Low Pressure Pipelines
(10) 240-101712128 Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings
(11) 240-106365693 Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings
(12) 240-106628253 Standard for Welding Requirements on Eskom Plant
(13) 240-150642762: Generation Plant Safety Regulations
(14) 240-105020315 - Standard for Low Pressure Valves

12.5.4 Control and Instrumentation

(1) 240-56227443: Requirements for Control and Power Cables for Power Station Standard
(2) IEC62381 Acceptance Testing
(3) 240-129014618 Generation Cyber Security Compliance Guideline
(4) 240-56355754 Field Equipment Installation Standard
(5) 240-56355731 Environmental Conditions for Process Control Equipment Used at Power Stations Standard
(6) 240-56355728 Human Machine Interface Design Requirements Standard
(7) 240-56355910 Management of Plant Software Standard
(8) 240-61379755 Control & Instrumentation Drive & Actuator Schedule Template
(9) 240-61379718 Control & Instrumentation Instrument Schedule Template
(10)240-72345357 24 VDC Load Schedule Consumer Per Battery Charger Template
(11)240-72350241 C&I Hardwired Signal List for External Signal Exchange Template
(12)240-72351455 C&I Typical Loop Wiring Diagram Template
(13)240-85521112 C&I Documentation Requirements from Vendors Template
(14)240-61532190: C&I Cabling, Earthing and Racking
(15)240-56355815: Junction Boxes and Cable Termination Standard
(16) 240-56355888: Temperature Measurement Systems Installation Standard

12.5.5 Chemistry standards

(1) 240-53113712: Chemistry Standard for the Pre-treatment and Production Processes of Demineralised Water

12.5.6 Other Standards

(1) 15ENG MN-676 Lethabo Power Station AKZ Coding Manual
(2) 240-62937990 - Lethabo AKZ Plant Labelling Guideline
(3) Occupational, Health and Safety, Act Number 85 of 1993
(4) 240-49230111: Hazard and Operability Analysis (HAZOP) Guideline (Rev 1)
(5) 240-30008949: Safety, Health and Environmental Specifications for Contractors
(6) 240-105658000 Supplier Quality Management Specification (QM 58)
(7) 240-28463367: SHE Organization
(8) 240-62196227: Life Saving Rules
(9) SANS 10083 The measurement and assessment of occupational noise for hearing conservation purposes

12.6 List of drawings

12.6.1 Drawings issued by the *Employer*

This is the list of drawings issued by the *Employer* at or before the Contract Date and which apply to this contract.

Drawing number	Revision	Title
0.63/1897	8	(WATER TREATMENT PLANT) WTP WEST RECARBONISERS ENGINEERING FLOW DIAGRAM ISOMETRIC PIPEWORK
0.63/03349	9	(WATER TREATMENT PLANT) WTP WEST DEMIN WATER TANKAGEEFFLUENT ENGINEERING FLOW DIAGRAM
0.63/02635.16	16	WTP (WATER TREATMENT PLANT) WEST HIGH CONDUCTIVITY EFFLUENT NEUTRALISATION SYSTEM ENGINEERING FLOW DIAGRAM
0.63/3676	17	(WATER TREATMENT PLANT) WTP (WEST) EFFLUENT NEUTRALISATION SUMP PIPING GENERAL ARRANGEMENT
0.63/08437	05	CLARIFIED WATER FEED AND RAW WATER MAKE-UP GENERAL ARRANGEMENT FOR TOWER 2

13. Procedure for submission and acceptance of Contractor's design

- The *Contractor* submits a preliminary detailed design package for construction, for approval by the *Project Manager* before any fabrication commences.
- The *Project Manager* provides the new AKZ codes (plant codification) where necessary and provides the coded drawings back to the *Contractor* to have all relevant plant AKZ labels manufactured and installed.
- The *Contractor* notes that the *Employer* requires a minimum of thirty (30) working days for review of all engineering information for acceptance before continuing with construction. A Detailed Design review is conducted once the detailed designs are compiled by the *Contractor*. The *Contractor* provides an allowance for this review in the project programme. The detailed design report is compiled by the *Contractor* using the Eskom Document Template number 240-49910707.
- The 240 - 53113685 Design Review Procedure is followed for the review of the *Contractor*'s design at the end of the Detailed Design phase. The *Contractor* ensures that at least thirty (30) working days' notice is provided before any acceptance is required. All documentation required for the detailed design phase is submitted prior to the start of the thirty working day notice period.
- The *Contractor* notes that incomplete design submissions are rejected for re-submission by the *Contractor*.
- The End-of-Phase Review is a milestone and hold point in the project and is approved before moving onto the next phase.
- The *Contractor* allows for time in the schedule to address comments from the review and for rework, if required.
- Interim reviews are recommended to ensure that major issues are rectified during the design phase and to prevent delays that could result from an End-of-Phase review being rejected.
- Supply and installation of the components are subject to the *Project Manager* approval of the final design package and written approval to implement the solution. The approved design package must be available prior to the start of installation activities.
- The final detailed design package, including all 'as-built' general arrangement drawings and datasheets for the new cation exchanger vessels, is signed off by the *Project Manager* and *Contractor* representative prior to contract completion.
- The *Contractor* ensures that the detailed design is reviewed, approved and signed off by an ECSA professionally registered mechanical or process engineer, as well as an ECSA professionally, registered electrical or control & instrumentation engineer.

13.1 Hazop Study

- The *Contractor* leads and carries out formal Hazard and Operability (Hazop) study involving the *Employer*'s design team, which includes Engineering, Operation and Maintenance team members. This study is done in accordance with the requirements as laid down in Eskom Hazop Guideline: 240-49230111. The Hazop report is sent to the *Project Manager* for review before the final report is issued to the *Project Manager*

for acceptance. The *Contractor* makes provision for the submission and review of the Hazop in the programme.

13.2 Use of *Contractor*'s design

- There are no restrictions imposed on the *Employer*'s use of the *Contractor*'s design.
- The *Employer* may use, copy and distribute the *Contractor*'s design for any purpose including use for procurement, construction, modification, alteration and demolition of the works.
- The *Contractor* grants the *Employer* full rights and ownership of the *Contractor*'s design, drawings, datasheets, specifications and other documentation obtained as part of the works.
- Construction and As-built drawings, operating manuals and maintenance schedules
- The *Contractor* provides both construction and As-built drawings in MicroStation (DGN) format as well as Tiff and/or PDF formats. Three (3) A1 size, hard copies and an electronic copy of each drawing is submitted to the *Project Manager*.
- The approved design package with designs, drawings, installation and operating manuals and maintenance schedules, material and equipment datasheets etc. must be available prior to installation and are necessary to conduct commissioning activities.
- The *Contractor* re-draughts all drawings listed in Table 4 and submits them in hard copies and electronically (requirements as stated above) to the *Project Manager* for review and acceptance. The existing isometric drawings that pertain to the same plant sections may be combined, where proposed and agreed.

14. Commissioning and Testing

The *Contractor* tests and commissions the *works* whereby all sections of the system are made ready for full duty operation. For the demineralised portion of the works each train will be tested and commissioned individually by the *Contractor*.

Testing and commissioning includes:

- The services of skilled Engineers to supervise the testing and commissioning and making ready for the full duty operation of the complete *works*.
- All management, supervision, labour, tools, instruments, chemicals, test apparatus, calibration equipment and any other equipment and facilities as may be necessary.

14.1 Requirements Before Starting Commissioning

Prior to start of commissioning, the *Contractor* shall ensure:

- That all re-assembled and newly installed components are correctly installed, including the directions of flows, alignments, bolt tightness/torquing and matching the existing plant configurations with the necessary plant labels installed.
- The plant is cleaned of waste, scrap and debris and unnecessary equipment removed.
- An erection check/plant walk is arranged between all the relevant parties and a snag list generated for immediate rectifications to be done by the *Contractor*.

- The *Contractor* verifies the signals from all electrical and Control & Instrumentation (C&I) components to the control desk with the *Employer*'s C&I department.
- The *Contractor* is responsible for the drawing up of commissioning plans, in conjunction with the input of the *Employer's* engineering, maintenance and operating personnel.
- A commissioning plan is developed and submitted for *Employer's* acceptance.
- All engineering requirements for the Pre-Commissioning Review (as per the Design Review Procedure) is submitted. This includes as a minimum, all system commissioning procedures, As Built drawings and Safety Clearances.
- The purpose of the Pre-Commissioning Review is to verify that the plant is built as per the detailed design, to confirm that all identified interfacing services are available, to review the commissioning procedures and confirm that all required safety clearances are in place.

14.2 Cold Commissioning and Hot Commissioning

The *Contractor* shall be fully responsible to commission the plant *Contractor* with the *Employer*'s engineering, maintenance, project and operating personnel.

- The *Contractor* commissions the system and ensures conformance to the *Employer's* performance requirements for the system.
- Prior to the time when commissioning is to commence, the *Project Manager* will appoint a representative who will co-ordinate the commissioning of all plant and equipment forming an integral part of the system being commissioned.
- The *Contractor* is responsible for the commissioning of all the plant and equipment that they supply to meet the requirements of this specification in conjunction with the *Project Manager* and the *Employer's* representatives.
- Where various components are already in place or are supplied by the *Employer* to form an integrated system, the *Contractor* at the time of commissioning, carries the responsibility for the correct functioning of the whole system.
- In the event of incorrect functioning, the *Contractor* determines the cause and corrects the defect, if the defect is within plant and equipment of his/her own supply.
- The *Contractor* must assure the safety of all plant and equipment in respect of any particular commissioning test and in the event of damage accept responsibility for such plant and equipment.

15. Performance and Acceptance Testing

Acceptance tests shall be carried out to prove all the plant guarantee figures as required by the plant performance criteria for this scope of work.

The following is required as a minimum:

(2) Quality of the demineralised water produced shall meet the requirements of 240-55864811: Chemistry Standard for Coal Fired Units with Drum Boilers Operating at greater than 16 MPa.

(3) The volume of demineralised water produced by the process is a minimum of 220m^3/hr per train. The hydraulic requirement through the pipework is 660m^3/ hr through three (3) trains.

(4) The quantity of effluent that is generated with the proposed solution is to be less than or equivalent to the current plant. The total effluent volume produced shall be 7% or less than the total production volume.

The following is also to be considered as part of the performance and acceptance testing:

- Where the results of the performance tests performed don't correlate with expected results (concentration values, flow rates, run lengths, pressures etc.) and/or the control functions as per the operating philosophy do not meet the specifications guaranteed, the *Contractor*, at his own expense, carries out all necessary adjustments and modifications to the *works* required to obtain the stated tolerances.
- Fully detailed proposals are submitted in writing to the *Project Manager* for approval before any adjustments and modifications are made and work in this respect is carried out when convenient to the *Project Manager*. All adjustments and modifications are subject to inspection and approval by the *Project Manager*.
- When adjustments and modifications are completed, the *Contractor* advises the *Project Manager* in writing to this effect and applies for a further acceptance test. From the results obtained, and provided that the *Employer* is satisfied that it will be lasting, the *works* will be finally accepted by the *Employer*.
- Each newly refurbished train is required to run a predetermined (calculated theoretical simulation throughput result for the resin throughput at the time of the test run) acceptance test run for maximum operational conditions to confirm throughput before resin exhaustion. During the first run all important parameters are to be logged as to check running conditions of the trian. These includes parameters conditions such as flow rates, pressures and pressure drops, resin disturbances, leaks, normal valve operations, Sample analysis at sample points etc.
- At least three resin regeneration sequences is to be carried out (at least every train needs to be tested) before any regen station is deemed tested and accepted. to determine that all mechanical works meets the operational specifications. The

Employer takes over sections of the system as required once the system performance requirements have been verified by the *Contractor and Employer.*

- The *Contractor* ensures that proper housekeeping is done before during de-establishing site (once-off).
- The *Contractor* shall further be on call for a period of 1 month after commissioning is complete to provide assistance on any plant operational issues that may arise.

16. Performance Guarantees

The *Contractor* is required to indicate the full extent of the guarantees they are prepared to offer with respect to integrity of mechanical work, civil work, electrical work, corrosion protection and C&I work offered. These guarantees shall encompass the installation of all components of the design and compatibility of all materials used in the design with the process and regeneration fluid.

The performance criteria will include the design criteria and parameters for both production as well as regeneration processes. This should be provided by means of a signed letter in the tender submission. The employer will use these letters to compare between contractors at Tender phase, to ensure quality of products delivered by Contractor, and for willingness of the contractor to show technical support after the project is finished. Special points will be awarded to Contractor that give more than NEC defects periods.

17. Plant Coding and Labelling

17.1 Plant Coding

The *Employer*'s AKZ Coding Manual (15ENG MN-676) shall be used to allocate codes to plants or systems included in the works. Plant Coding shall be undertaken by the *Employer* and as such the *Contractor* shall make available the following documentation to code:

- Mechanical
  - Piping and Instrumentation Diagrams (P&IDs)
  - Interface list
  - Process flow diagrams (PFDs)
- Electrical
  - Single line diagrams
  - Switchgear general arrangements (GA)
  - Summary Sheets
  - Cable schedules
  - Load lists
  - Cable block diagrams
- C&I
  - C&I architecture drawings

- C&I Cubicle GA
- Cable block diagrams
- Remote control station lists
- Cable schedules

• Civil

- Site layouts
- Building layouts
- Building sectional layouts
- Building floor plans per level
- Underground services layouts
- Cable rack & support
- Building lists (including room equipment lists)

The *Employer* will only code the AKZ code defining Documentation listed above. The *Employer* will assign a coding technician who will interact with the *Contractor* in coding the plant as listed above. It may be required that the person be based at the *Contractor*'s offices full time. The *Contractor* will then be required to include allocated codes to all other designs and related documentation. It is also the responsibility of the *Contractor* to consistently apply the AKZ codes throughout the rest of the technical documentation which shall include, but not limited to:

- load schedules
- cable schedules
- cable schedules
- board parts lists
- cable block diagram
- termination diagram
- drive & actuator schedules
- instrument schedules
- alarm lists, loop diagrams
- signal lists
- schematic diagrams
- termination diagrams
- logic diagrams, etc.

The *Contractor* shall ensure that all documentation is coded (as per the codes assigned by the technician) prior to submission to the *Project Manager* for acceptance.

17.2 Plant Labelling

It is the responsibility of *Contractor* to manufacture and install AKZ coded equipment's labels. Labels are manufactured and installed according to Lethabo AKZ Plant Labelling Guideline (240-62937990). The *Contractor* will label all AKZ coded equipment. The Coding Technician shall facilitate baselining of all equipment lists, and only baseline equipment lists shall be used as a basis for the production of labels.

Coding and labelling of components inside electrical and C&I panels shall be done by the *Contractor*.

All equipment shall be labelled according to the Lethabo requirements as follows:

- List of labels (AKZ system to be used (LIM 103)) to be finalised in the detail design.
- All labels shall be manufactured by *Contractor*.
- All labels shall be installed by the *Contractor*.
- Labelling material will be blended acrylic or aluminium/stainless steel in case of corrosive environment.
- Label fixing devices shall not penetrate the equipment housing or constitute a potential source of corrosion.
- All labels shall be securely mounted by the *Contractor*.
- Labels shall not be mounted in such a way as to cover equipment specification plates.
- Labels or back plates/brackets installed by the *Contractor* will not have sharp edges or protrude in such a way as to pose a safety risk.
- Labels will not cover equipment specification plates.

18. Configuration Requirements

The *Contractor* must ensure they comply to the requirement of the document:

- 1037836: Configuration Management "*Contractor* SOW" for technical projects Work Instruction

18.1 ECM Process and Design Changes

The "ECM Process" refers to plant configuration change control and captured in the Engineering Change Management Process (240-53114002 ECM Procedure) of the *Employer*. The physical and functional configuration of plant is managed through this process by ensuring all proposed changes to plant are reviewed and approved for implementation or construction.

The *Contractor* may not commence with any work related to configuration changes (modifications) on the plant without proof of approval of such works. This may be in the form of an approved Emergency Engineering Change Approval document, or implementation authorisation by the Site Change Control Committee (SCCC). This information will be supplied to the *Contractor* by the *Employer*'s Project Engineer or System Engineer via the *Project Manager* on request.

Any proposed changes to the approved design for construction, shall follow the *Employer*'s ECM process for approval before proposed changes may be implemented (irrespective if these changes came about during construction or commissioning). The *Contractor* shall be assisted by the *Employer*'s Project Engineer or System Engineer on request when such a situation arises.

18.2 Plant Configuration Audit/verification

The plant configuration audit/verification process will undertake to identify any unauthorised changes to the plant configuration. Through plant inspections, the plant will be validated against the approved design.

During construction, commissioning and hand-over, configuration verification audits will be carried out by the *Employer* 's plant Configuration Management technician's and or the system or Project Engineer at intervals as agreed upon by the *Employer*'s *Project Manager*, Project Engineer and plant Configuration Management technician. These actions will be captured as activities in the project program.

Findings will be documented in a report and reasons for plant configuration anomalies will be determined and addressed. Typical reasons for discrepancies might be, modifications done without approval or wrong interpretation of drawings during construction.

18.3 Functional Location Codes

The *Employer* shall allocate all functional location codes and cable numbers. The allocation of functional location codes shall form part of the detail design phase. Where applicable, functional location codes and cable numbers will be allocated on the following drawing types:

- P&ID's
- Plant layout's
- Switchgear load schedules
- Switchgear Layout
- Cable block diagrams
- Network topologies
- C&I cabinets and module layout
- Wiring diagrams
- Termination diagrams
- Logic diagrams

FLOC's shall also be carried over and used in manuals, QCP's, reports, CI lists and (at a later stage in the project) in certificates, performance tests, etc.

FLOC labelling will also be done by the *Contractor*.

18.4 Configuration Item (CI) identification

Again, only where applicable, the *Contractor* must complete the Configuration Item (CI) Template (Annexure A of the Works instruction) to be handed over to Eskom before commissioning of the works. The following information shall be captured on this template by the *Contractor* for each serialised component:

- Functional Location Code (Supplied by Eskom)
- Component Description (Supplied by *Contractor*)
- Part Number (Supplied by *Contractor*)
- Serial Number (Supplied by *Contractor*)
- Specification Document Number (Supplied by *Contractor*)

Furthermore, the *Contractor* must supply

- the specification document/procurement specification for each component
- the information required on the cataloguing form for items designated for spare holding where applicable

18.5 Draughting requirements

a) All drawings shall be drawn natively in MicroStation V8 by the *Contractor*.

b) The *Employer* shall not accept any drawings from the *Contractor* drawn in any application other than MicroStation V8 and then converted to MicroStation V8.

c) Drawings shall strictly comply with 240-86973501-Eskom Drawing Standard.

d) The *Employer* drawing office will supply the *Contractor* with MicroStation cell libraries and border sheet upon request.

e) Numbers for new drawings must be requested from the *Employer.* This request must be submitted in the form of the document register as specified in “Annexure B”.

f) It is the *Contractor*s responsibility to ensure all drawings are “As Built” before the works is commissioned.

g) All approved “as-built” drawings shall be handed over before commissioning of the works.

h) All final drawings shall be handed over as follows and accompanied by the updated master document register:

- Electronic MicroStation v8 natively drawn drawing file.
- Signed hard copy, approved by design engineer, accepted by Project/System Engineer and authorised by the *Employer* (for new drawings).
- Scanned electronic file of the signed drawings in pdf format.
- Electronic files may be supplied on CD or DVD.

i) The *Employer* drawing office personnel shall be available to assist the *Contractor* with any drawing related queries.

j) All existing *Employer* drawings related to the plant, as specified in the scope of work, for affected and interfacing plant shall be red-lined and updated, superseded or cancelled by the *Contractor*.

k) All drawings shall be submitted to the *Employer* for quality check before hand-over. It is recommended that the *Contractor* send a sample drawing for each drawing type to the drawing office as soon as the first drawings are generated, to ensure the correct standard is followed before creating all drawings.

18.6 Manuals

18.6.1 Maintenance Manuals

Shall include as a minimum

- Table of Content
- Revision sheet
- Overview
- Proposed maintenance strategy
- Maintenance procedures
- Proposed spares holding
- Illustrated parts catalogue

18.6.2 Operating Manuals

Shall include as a minimum

- Table of Content
- Revision sheet
- Overview
- Operating philosophy
- Operating procedure (commissioning, stand-by, start-up, running, shut-down, etc.)
- Standard isolation procedure
- Alarm response procedure

There must be at least one master set and two working sets for the technical library, and then a controlled set for each section that require the manuals, as determined by the System Engineer/Author of the SOW. A minimum of 4 sets of manuals shall be handed over. An electronic version of the manuals is also required. These manuals shall be formally presented to the respective maintenance, operational and engineering teams as a form a training so that maintenance, operating and engineering is familiar with the new equipment installed in the plant after the project is completed.

Contractor is required to issue of certificate of attendance after training has been provided to the list of employees issued to the contractor.

18.7 Master Document List and Vendor Document Submittal Schedule (VDSS)

The *Contractor* shall refer to the VDSS for documentation as the minimum requirements of this specification in the design package before any manufacturing, construction or commissioning commences. The VDSS may be amended to add any other documents that the Contractor deems necessary. These are documents and records required to be handed over to Eskom through various stages of the project as stipulated in the project program.

The Master Document List will consist of a list of all submitted documents and records as stipulated in the SOW and VDSS.

It is the responsibility of the *Contractor* to keep the MDL current.

18.8 Transmittal Management

Transmittal Management for Technical Documentation Work Instruction 240-122887026 shall be adhered to.

18.9 Handing over process (before construction, commissioning and at completion of the works).

The *Contractor* establishes a document tracking system to record the dates for the supply and receipt of all documentation.

The *Contractor* is to supply the following documentation as the minimum requirements of this specification before any manufacturing, procurement, construction or commissioning commences:

- Document submittal schedule indicating when all documents will be submitted
- Drawing Register indicating when drawings will be submitted
- Final isometric and general arrangements illustrating pipe dimensions, pipeline layouts and showing pipe supports
- Component material datasheets
- Loop Diagrams
- Field termination drawings
- Pipe Schedule
- Valve schedule
- Instrument schedule
- Drive and Actuator Schedules
- Mechanical Hook-up diagrams
- Power distribution drawings
- I/O block diagrams
- Software drawings
- LOSS diagrams
- Functional Distribution (Allocation of field devices to I/O)
- Detailed I/O List and Channel Assignments

- C&I cable schedules
- C&I termination schedules
- Cable installation and loop check sheets
- Instrument datasheets
- Instrument calibration certificates
- Valve datasheet
- Parts list for all components
- Quality Manual
- Quality Control Procedures
- Quality Control Plan and Inspection and Test Plan
- Method Statements
- Product data sheets for all products to be used
- Batch certificates
- Welding Procedure Specifications
- Welding Procedure Qualification Record
- Maintenance Manuals of all plant equipment
- Maintenance Philosophy
- Critical Spares List
- Maintenance Training Manuals

19.Quality Dossier

The *Contractor* continually updates the QCP as work progresses and submits a complete, signed quality dossier to the *Employer* containing the following:

- QCP and/or Inspection and Test Plan (ITP).
- Equipment Control Sheets.
- NDE Reports.
- Material Test Certificates.
- Materials Data book.
- Handover Certificate.

20.System Characteristics

Reliability and availability of the refurbished plant should be 100% as per operating instruction.

The refurbished plant is required to last at least ten years before requiring refurbishment again.

21.Inspection and Testing on Site

Refer to section 13 and 14

22. SHEQ Requirements

Refer to NEC contract for SHEQ requirements.

23. Technical Tender Returnables

This section serves to highlight the tender returnables per each/combined engineering discipline.

23.1 Documents/information required for Mandatory scoring

A1. Submit proof of ECSA registered engineers

Contractor submits a list with details (Full name and surname, registration number) of ECSA registered engineers with proof of registration for Mechanical Engineer that will be responsible to sign off the designs for the respective sections of the scope or documentation that requires sign-off.

If the Mechanical Engineer is not working for the Contractor tendering there must be a letter submitted at tender phase signed by both parties, indicating that the mechanical engineer will do design work and sign of drawings when needed to do so in the contract, the NEC will detail further details as to timelines for the availability of the mechanical engineer.

A2. Submit proof of ISO3834 Part 2 Certificate

Contractor submits proof of ISO 3834 Part 2 Certification on company/entity/contractor performing welding for all parts of this work, including a letter of intent should the welding company not be the main contractor tendering for this tender.

An expired ISO 3834 part 2 certificate or an e-mail indicating that the tenderer has been successful in their ISO3834 Part 2 application is not valid. The contractor needs to make sure the copy of the valid certificate is submitted for evaluation at tender phase.

Minimum requirement on the ISO 3834-2 certificate is that the products stated on the certificate are relevant to this works information and include as a minimum, pressure vessels, piping and structural steel.

23.2 Documents/Information required Qualitive scoring

B.1 Chemical and Process Engineering Tender Returnables

The tenderer submits the following as a minimum in the tender submission:

1. Contractor is to submit document containing the full process description for the *works* with simulation data of the demin input and output chemistry, with a process flow diagram. The data should take into account the newly designed cation vessel dimensions with the current resin data as per Appendix A with “as new” state resin. The output chemistry of the water after theoretical throughput should adhere to Eskom standard and functional throughput requirement as specified in this document in section 5.3.

2. Contractor submits Proof of Chemical ECSA registered engineer/technologist and CV of the ECSA registered professional chemical design engineer who will be responsible for the chemical design of the *works*. Engineer is to have at least 6 years working experience in the ION-Exchange process design field.
3. The Contractor submits a set of marked-up P&ID's to depict their understanding of the full scope of work with their tender. All plant that is deemed to be included in the scope should be clearly highlighted. The P&ID's associated with the scope of work are included in Appendix F2 – Marked up P&ID's as an example of what the Employers feels to be inclusive in the scope of work.
4. Deviations schedule listing all deviations related to the process design.

B.2 Mechanical Engineering Tender Returnables

1. Submit a list of deviations schedule listing all deviations related to pressure vessels, piping and piping components, valves, pumps and control system.
2. Submit a detailed method statement with sufficient degree of detail to show full understanding of the scope of work to be done on the following key activities:
    - Replacement of the Cation vessel
    - Upgrade of the current Sinert base technology as per work information requirement.

    PLEASE NOTE: Contractor needs to indicate on the method statement as a minimum in the method statement how the replacement will be done for each of these activities, for example either the vessels will be removed and replaced through means of removing the roof, or the vessels will be cut out in situe and replaced in situe, or any other method deemed plausible by the contractor at time of tender.
3. Submits the following documents for Welding:
    - Submit sample data pack of a recently completed project that includes details on:
        - Heat treatment charts,
        - Welding procedure,
        - NDT results after welding,
        - Welder's certification and procedure qualification record,
        - Non-destructive testing procedures to be used during construction and installation;

- Non-destructive testing operator's qualifications;
- Non-destructive testing equipment calibration certificates;

- Submit the following welding documents as a minimum:
  - Copy of Welding/welders qualifications
  - Welders CV showing experience gained in welding completed.
  - Welding contractor's IWT/IWE certificate or equivalent,
  - WPS
  - QPR.
- Submit a letter of intent indicating the NDT contractor which is on the Eskom approved list.

4. Submit a copy of a CV of the ECSA registered professional design engineer who will be responsible for the mechanical design of the works. Engineer needs to have experience with the design code specified in the scope of work or similar. The engineer should have relevant experience and provide proof that he/she has designed similar vessels (as per this scope of work) in the past.
5. Submit a copy of the Appendix F1 – WTP Equipment list with all the contractors' proposed component specifications as per current layout of the spreadsheet.
6. Submits data sheets for all of the following proposed equipment from the contractor:
   - Valves,
   - Actuators,
   - Pumps,
   - Blowers

B.3 Civil and Structural Engineering Tender Returnables

The tenderer submits the following as a minimum in the tender submission:

1. The Tenderer submits a high-level technical proposal detailing the design and construction methodology, which is in accordance to the works information:

   The technical proposal is to include the following as a minimum:

- Proposed plant, equipment and tools for the entire works.
- Proposed tests for condition assessment
- Proposed repair methodology for concrete and structural works and repair materials.
- Methodology for the required structural verification.
- Foreseen risks, concerns and deviations

2. Tenderer to submit the CV of the Lead Structural Design Engineer or Technologist as per the project organogram.

   Lead Structural Design Engineer or Technologist is to have a minimum of 5 years relevant design experience in concrete and/or structural steel works.

   The lead Civil Engineer or Technologist is to be professionally registered with the Engineering Council of South Africa (ECSA). Copy of valid ECSA registration certificate to be submitted.

   If the Lead Design Engineer or Technologist is not employed by the main Contractor, then a letter of intent signed by both parties where the subcontractor will be used for resources is to be submitted. The letter should be specific on the roles and responsibilities for the resources.

3. Contractor's relevant experience in conducting design and construction works related to concrete and structural steel works:

   The Tenderer submits a list of verifiable references (minimum of 3 projects). The main Contractor must submit evidence of reference projects and/or the proposed sub-contractors that will be appointed to conduct the civil works, if the main Contractor does not have the required in-house capabilities.

   The list of verifiable references should contain the following information:

   - Project Name.
   - Description of work performed.
   - Project start and end date.
   - Name, designation and contact number of the reference person

B.4 Electrical Tender Returnables

1) The Contractor for the largest equipment type offered, completes and submits schedule B for the following Technical Schedules:

- SANS 1507 Cable test certificate
- 240-77100923 Motor Technical Schedule B
- 240-132875144 LV AC VFD Technical Schedule B

2) The Contractor to submit a technical methodology and execution plan demonstrating compliance and any deviations for the electrical design, installation, commissioning and handover requirements.

3) The Tenderer submits a CV and valid ECSA Certificate for the Electrical Engineer/Technologist with minimum of 5 years work experience.

B.5 C&I Tender Returnables

The *Contractor* is to provide the following documents as part of their tender returnable documents:

1. Datasheets of the instrumentation they are planning to use with a list indicating where it will be installed. (see Technical evaluation strategy for more information of what is expected of the Contractor).
2. Contractor to submit all the required schedules as per Technical evaluation strategy.

B.6 Corrosion protection Tender Returnables

The *Contractor* is to provide the following documents as part of their tender returnable documents:

1. Qualifications to prove that all applicators, rubber-liners, supervisors and inspectors are NACE accredited/ qualified under SAQCC/ in-house qualified and trained or similar;
2. Provide material technical datasheets for all products to be used for corrosion protection. Include abrasive blast material, primer, cleaning solvents, adhesives for rubber lining, resins, mortars, laminates/mating compounds, grout/bedding material, tiles, acid tiles/bricks and organic coating systems. As minimum the datasheets shall contain the following requirements, which are:
   - A description of the generic type of lining.
   - Lining physical and chemical properties.
   - Recommended and non-recommended uses.
   - Service temperatures and chemical resistance limits. For the lining chemical resistance as per ASTM C-279-88, Type II.

- Maximum recommended service temperature which shall be a minimum of 30 % greater than the maximum temperatures as is indicated in the table at the top of this specification sheet.
- Surface preparation requirements.

3. Provide a detailed procedures/method statements which detail all the steps, procedures and activities of the lining/coating/tiling/brickwork application process. The steps to be considered when compiling method statement/procedures includes.
   - The methods, steps, sequence and equipment required for ventilation and dust mitigation. The required ventilation for the prevention and/or management of fumes and dust build-up. The number of extraction fans; mounting diameters, sizes and mounting methods of fans to manholes; power rating of fans; positioning of fans and direction of intended air flow shall be described and detailed.
   - Grease decontamination and washing.
   - Soluble salt decontamination.
   - Methods for dust and debris removal, maintaining and ensuring cleanliness between adhesives and lining (or any other coating process as per works information) shall be described. The method statement shall detail the precise sequence and breakdown of work areas/activities in order to apply the system with due consideration of dust contamination.
   - The Method Statement shall also consider the most efficient methods and sequencing to avoid unnecessary delays that may have an impact i.e. time required for removal of spent abrasive grit and dust/debris.
   - All inspection interventions during and after completion of corrosion protection installation shall be considered and included.
   - The Method Statement shall describe all measures and details for establishing and maintaining the environmental conditions as required by this specification.
4. Provide a typical detailed quality control plan (QCP) detailing all inspections and tests with acceptance criteria. Inspections during application shall at least cover compressed air blotter test for blasting and spray applications, surface preparation, environmental parameters, coating dry film thickness, rubber material thickness, hardness, adhesion, continuity and visual tests. The typical QCP provided shall cover activities as per the scope of works in this project.

5. Deviations schedule listing all deviations related to corrosion protection. If there are none then a definitive statement in this regard needs to be provided.

B.7 General Tender Returnables

The *Contractor* is to provide/submit the following documents as part of their tender returnable documents:

1. An organogram illustrating the key project team. Additionally the organogram illustrates clearly all of the Sub-Contractors that will be used during fabrication. The roles and responsibilities to include the following as a minimum:
    - Engineering team (Chemical, Electrical, C&I, Mechanical, Civil)
    - Welder/s (qualifications as stipulated in the Eskom welding standard)
    - NDT Inspector
    - Coating applicator
    - Coating inspector
    - Rubber-liner
2. A detailed overall project execution plan describing the details of the strategy on how the Contractor will go about the execution of the project throughout the different phases of the project. Refer to project scope, only activities named in the brackets (under project scope) to be included in the project execution plan. This should show that the Contractor has an understanding of the project scope and the complexities around the execution without compromising running of the water treatment plant.

    Detailed project execution plan that is to include:

    - Project scope (Cation vessel, degasser vessel, Degasser sump, Anion supply pump, Weakbase vessel, Strong base Vessel, Mixed bed vessel, Mobile plant, chemical injection plant (acid and caustic), civil works, electrical works, and C&I works related these sections)
        - Summary of work to be performed and what the tenderer proposal entails (per sections above):
            - Design in accordance with which code, (if applicable)
            - Long lead time items noted (any items longer than 4 weeks) and time specified or risk of delay noted (if applicable)
            - Decommissioning, (if applicable)
            - Plant component removal and methodology, (if applicable)
            - Waste management, (if applicable)
            - Installation/Refurbishment/Replacement/Inspection (whichever is applicable)

- Commissioning methods.
- Testing and performance testing methods (make note of time allowed for for performance testing etc.)

  - Chronological sequency of works for these points

- Project goals
- Allocation of resource
- Management of risk (which format and tracking tools the Contractor are to use)

3. A Project schedule for the project, indicating high level activities and milestones. Refer to section 4.11.2 for more information of what is required from the project schedule.
4. Refer to section 16 for letter that contractor needs to submit with regards to the requirements for the letter of guarantee.
5. Contractor's relevant experience in design and construction of similar works for the process (1.5.1), mechanical (1.5.2)l and corrosion protection (1.5.3):

Tenderer submits a list of verifiable reference projects (minimum of 3 projects or multiple projects which covers the full scope of work from the project list). Evidence of reference projects is to include with the following information:

- Project Name and Order number/project reference number for traceability purposes
- Description of work performed
- Project start and end date
- See below typical size of project for reference (need to be specified)
- Name, designation and contact number of the reference person

List of projects completed to include as a minimum:

1) Ion exchange vessel design, manufacture, installation and refurbishment (Minimum throughput of 50m3/hr).
2) Manufacturing and installation of piping (200NB or above or total length of pipe replacement exceeding 100 meters).
3) Replacing and commissioning pumps (55kW and above).
4) Design, manufacture, installation, and commissioning of vessel/s in accordance with PD5500 or equivalent international code (10m3 or larger)
5) Replacement of chemical dosing systems (Chemical dosing rate of 300l/hr or above).

   Installation of corrosion protection systems:
6) Rubber lining of vessels of at least 200m^2.
7) Piping of at least 50$m^{2.}$
8) Seamless organic coating of at least 100m^2
9) Acid tiling/bricking of at least 100m^2.

All of these shall form the reference project/s.

24. Acceptance

This document has been seen and accepted by:

Name	Designation
Johnshaw Drake	EDWL O&M Engineer
Lauritz Clasen	LDE: Control and Instrumentation engineer
Hassen Cassim	Corrosion specialist
Jonathan Magano	Electrical Engineer
David Kunene	LDE Electrical Engineer
Suven Govender	LDE Civil Engineer
Sumayyah Sulliman	Chief Engineer

25. Revisions

Date	Rev.	Compiler	Remarks
August 2017	0.1	T Moodley	Draft Document
September 2017	0.2	T Moodley	Update of user specification
October 2017	0.3	T Moodley	Update to incorporate comments
March 2019	1	T Moodley	Final version for signature
April 2023	2	J Drake	Updated to incorporate comments

26. Development Team

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

- Carl Woodhouse
- Lauritz Clausen
- Sumayyah Sulliman
- Retief Ras
- David Kunene
- Jonathan Magano
- Dhelia Raman
- John Drake

Appendix A: Current Ion Exchange Resins

Table 16: Ion Exchange Resins in the Demineralised Water Trains - Cation Vessel

DATA			
Train 1 – Current Resin	Weak Acid Cation		Amberlite IRC86SB
	Strong Acid Cation		AMBERJET 1300H
Train 2 – Current Resin	Weak Acid Cation		Amberlite IRC86SB
	Strong Acid Cation		AMBERJET 1300H
Train 3 – Current Resin	Weak Acid Cation		Amberlite IRC86SB
	Strong Acid Cation		AMBERJET 1300H
Stratified bed **Weak Cation is co-current regeneration** **Strong Cation is counter-current regeneration**		Y/N	Y
Resin Volume per vessel	Cation (WAC)	L	7500
	Cation (SAC)	L	10500
	Inert	L	N/A
Column Diameter		mm	3000
Cation Regeneration	H_2SO_4 Concentration (used)	%	Existing max: 3.2
	H_2SO_4 Concentration (storage)	%	96% - 98%
Cation Outlet Expected Quality	pH		~3
	Sodium	ppb	50 Max Normal <3
Degasser		Y/N	Y
Number of Cation Vessels		Number	3

To be continued on next page

Table 17: Ion Exchange Resins in the Demineralised Water Trains – Anion Vessels

DATA			
Train 1 – Current Resin	Weak Base Anion		Puralite A100
	Strong Base Anion		Dowex Marathon A
Train 2 – Current Resin	Weak Base Anion		Amberlite IRA 96
	Strong Base Anion		Amberlite 405
Train 3 – Current Resin	Weak Base Anion		Amberlite IRA 96RF
	Strong Base Anion		Amberlite 405
Separate bed **Weak base: Co-current regeneration** **Strong base: Counter-current regeneration**			
Resin Volume per vessel	Anion (WBA)	L	8500
	Anion (SBA)	L	7900
	Inert	L	Weak base N/A Strong base 1800
Column Diameter	WBA	mm	3000
	SBA	mm	2800
Anion Regeneration	NaOH Concentration (used)	%	Existing Max: 3.2
	NaOH Concentration (storage)	%	45
Anion Outlet Expected Quality	Conductivity (WBA)	µS/cm	<25
	Conductivity (SBA)	µS/cm	<5 (RFR)
	Silica	ppb	<10 (RFR)
Number of Anion Vessels		Number	3

Table 18: Ion Exchange Resins in the Demineralised Water Trains – Mixed Bed Vessel

DATA			
Train 1 – Current Resin	Strong Base Anion		Lewatit MP500OH
	Strong Acid Cation		Lewatit S200KR
Train 2 – Current Resin	Strong Base Anion		Lewatit MP500OH
	Strong Acid Cation		Lewatit S200KR
Train 3 – Current Resin	Strong Base Anion		Lewatit MP500OH
	Strong Acid Cation		Lewatit S200KR
Stratified for regeneration Strong Anion is co-current regeneration Strong Cation is counter-current regeneration		Y/N	Y
Resin Volume per vessel	Cation (SAC)	L	2700
	Anion (SBA)	L	2700
Column Diameter	SAC/SBA	mm	2400
Regeneration	H_2SO_4 Concentration (used)	%	Existing max: 6
	NaOH Concentration (used)	%	Existing max: 4
Number of Mixed Bed Vessels		Number	3
Mixed Bed Outlet Expected Quality (AT END OF RUN)	Turbidity	NTU	<0.2
	Conductivity at 25°C	µS/cm	<0.1 normal 0.06
	Silica as SiO_2	ppb	<10
	Sodium as Na	ppb	<2
	TOC as C	ppb	<250
	Chloride as Cl^-	ppb	<2
	Sulphate as SO_4^{2-}	ppb	<2

Appendix B: Regeneration Log Sheets

B1. Cation Vessel

Eskom

Lethabo Power Station

WATER TREATMENT PLANT
DEMIN TRAIN REGEN CONTROL LOG

Doc No	LFM12053	Rev.	03
Ref.	WTP523001		
Date	2014/08/19		
Page	1 of 1		

Train No.:		Throughput		Regen No.:		Date:		Train Taken O/C On:	

Step No	Operator	Activity	Duration	Flow (m^3/h) Demin H_2O	Flow (m^3/h) Filter H_2O	H_2SO_4 % Strength	Cond S/cm	Pump % Stroke	Volume Demin Water Used	Volume Filter Water used
1		Backwash Top	10 min		60					10.0
2		Settle	20 min							
3		Forced Settle	1 min		32.65					0.54
4		Acid Pre-inject Top Acid Pre-inject Bottom	1 1 min	10.51 20.51	32.63				0.17 0.34	0.54
5		Acid Inject Top Acid Inject Bottom	130 min	10.51 20.51	32.63	% 0.5 % 2.5	mS/cm		11.39 22.22	35.35
Step 5 or 6 :		Step 5 (Normal Regen)	&	Step 6 (Total Backwash Regen)						
6		Acid Inject Top Acid Inject Bottom	360 min	10.51 20.51	32.63	% 0.5 % 2.5	mS/cm		11.39 22.22	35.35
7		Slow Rinse Top Slow Rinse Bottom	30 min 30 min	20.51	12.32				10.26	6.16
8		Fast Rinse Top Fast Rinse Bottom	60 min 60 min	20.51	32.63				20.51	32.63
9		Down Rinse	30 min		40					
10		Recycle Cation Anion	30 min	1.1			5µS/cm.			

Cond at End of Rinse		Total Volume Demin Used	m3	Total Volume Filter Water Used	m3
Total Acid Used	1578.4 kg	Resin Level Before Regen		Resin Level After Regen	
		Calculations Used	Mins / 60 x Flow = Amount Water Used Per Step Add Up Total Demin Water for Regen from Separate Steps		

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B2. Weak base Anion vessel (separate regeneration)

Eskom

Lethabo Power Station

WATER TREATMENT PLANT
DEMIN REGEN CHECK SHEET
(Weak Base)

Doc No	LFM12017	Rev.	02
Ref.	WTP523004		
Date	2014-06-12		
Page	1 of 1		

Weak Base No.:		Regen.:	
Date:			
Volume Water Treated		Reason for Regen	

Step No	Activity	Duration	Operator	Flow (m3/hr)	Strength (%)	Cond. (mS/cm)	Pump Stroke	Temp	Volume H_2O Used
1	Drain Weak Base	10							
2	Refill Lines	3		40					
3	Backwash Weak Base	10		32					
4	Drain Weak Base	15							
5	Caustic Pre-injection	1		14					
6	Caustic Injection	50		14	3.3				
7	Pump Flush Slow Rinse	10 65		14					
8	Fast Rinse	60		40					
9	Refill Weak Base	6		40					
10	Final Rinse Weak Base	50		40					

Total Water used for Weak Base		Cond. at End of Rinse			
Amount of Caustic Used					
End of Recycle: Cation:		Strong Base		Weak Base	
Resin Level Before Regen		Resin Level After Regen			

B3. Strong base Anion vessel (separate regeneration)

Eskom

Lethabo Power Station

WATER TREATMENT PLANT
DEMIN REGEN CHECK SHEET
(Strong Base)

Doc No	LFM12018	Rev.	02
Ref.	WTP523005		
Date	2013-09-18		
Page	1 of 1		

Strong Base No.:		Regen No.:	
Date:			
Volume Water Treated		Reason for Regen	

Step No	Activity	Duration	Operator	Flow (m3/hr)	Strength (%)	Cond. (mS/cm)	Pump Stroke	Temp	Demin Used
1	Drain Strong Base	15							
2	Caustic Pre-Injection	3		14					
3	Caustic Injection	120		14	3.3				
4	Pump Flush Slow Rinse	15 60		14					
5	Fast Rinse	50		40					
6	Refill Strong Base	14		34					
7	Recycle Cation & Anion	80		140					

Total Water used for Strong Base		Cond. at End of Rinse	
Amount of Caustic Used			

End of Recycle

Cation		Strong Base		Weak Base	
Resin Level Before Regen		Resin Level After Regen			

B4. Weak and strong base parallel (thorough fare) regeneration

Eskom

Lethabo Power Station

WATER TREATMENT PLANT
DEMIN REGEN CONTROL LOG
(THOROUGHFARE)

Doc No	LFM12015	Rev.	02
Ref.	WTP523002		
Date	2013-09-18		
Page	1 of 1		

Anion No.:		Regen.:	
Date:		Train Taken O/C On:	
Throughtput:			

Step No	Activity	Duration	Operator	Flow (m3/hr)	Strength (%)	Cond. (mS/cm)	Pump % Stroke	Temp	Volume Demin Water Used
1	Drain Weak Base	10 min							
2	Refill Lines	10 min		14					2.33
3	Backwash Weak Base	10 min		32					5.33
4	Drain Weak Base	15 min							
5	Drain Strong Base	15 min							
6	Pre-Inject to Strong Base Drain	3 min		14					0.7
7	NaOH Inject to Strong Base	60 min		14	3.3			27	14.0
8	NaOH Inject to Strong Base Spent NaOH to Weak Base Drain	50 min		14	3.3			27	11.67
9	Flush Pump Slow Rinse Strong Base & Weak Base	10 min 65 min		14 14					17.5
10	Fast Rinse Strong Base & Weak Base	50 min		50					
11	Drain Weak Base & Strong Base	15 min							
12	Refill Strong Base	14 min		32					7.47
13	Refill Weak Base	16 min		32					8.53
14	Final Rinse Weak Base	20 min		40					13.33
15	Recycle Cation & Anion	140 min							

Final Conductivities:	Cation:		Weak Base		Strong Base
Resin Level After Regen					
Calculations:	Total volume water used: Time / 60 x Flowrate				
Remarks:	Total volume caustic used = 847 kg		Total volume water used =		

B5. Mixed bed regeneration

Eskom	**Lethabo Power Station** WATER TREATMENT PLANT DEMIN STREAM MIXED BED REGEN CHECK SHEET	Doc No	LFM12016	Rev.	02
		Ref.	WTP523003		
		Date	2013-09-18		
		Page	1 of 1		

Mixed Bed No:		Regen.:	
Date:		S.P.O	

Volume Water Produced	

Step No	Activity	Duration	Operator	Flow (m^3/hr)	Strenght (%)	Cond. (mS/cm)	Pump Stroke	Temp	Volume H_2O Used
1	Backwash	10		20					
2	Separation	10		7.7					
3	Settle	10							
4	Caustic Pre-Inject			Anion 7.7					
				Cation 7.7					
5	Caustic Inject 1 Backflow Cation	45 45		7.7 7.7	4%			42	
6	Flush Pump Slow Rinse Anion Pre-Inject Cation	10 5 5		7.7 7.7 7.7					
7	Slow Rinse Anion Acid Inject Cation	32 32		7.7 7.7	6%				
8	Fast Rinse Anion Slow Rinse Cation	30 30		25 7.7					
9	Rinse	25		25					
10	Drain	15							
11	Air Mix	15		150					
12	Forced Settle	2		25					
13	Refill	12		25					
14	Recycle	30		80					

Final Conductivity after Recycle Cation:	

Weak Base		Strong Base		Mixed Bed	

Total Volume Water Used			
Total Volume Caustic Used		Total Volume Acid Used	
Resin Level before Regen		Resin Level after Regen	

Appendix C: Electrical

C1: Electrical Typical Schematics

C2: Electrical Technical schedules AB

C3: Electrical MV and LV Protection Philosophy

C4: Electrical Reticulation for Batteries and Chargers

C5: Electrical Existing Earthing System

C6: Electrical Load Schedules

C7: Electrical Standard Templates

C8: Electrical VDSS

C9: Electrical LOSS Mobile Plant Point of Connection (POC)

Appendix D: Control & Instrumentation

Appendix D1: LOSS Diagrams

Appendix D2: Drive and Actuator Schedule

Appendix D3: Input Output Block Diagram

Appendix D4: Instrument Schedule

Appendix E: Corrosion Protection Specifications & additional information

E1: GAM/MAT/21/61: Lethabo Power Station Corrosion Protection of New Fabricated IX and WTP Vessels and Associated Carbon Steel Piping by Rubber Lining

E2: GAM/MAT/21/62: Lethabo Power Station Corrosion Protection of Existing IX and WTP Vessels (Rubber Lining Repair or Complete Relining)

E3: GAM/MAT/22/174: Lethabo Power Station Acid Dilution Piping Corrosion Protection Specification

E4: GAM/MAT/21/63: Lethabo Power Station Corrosion Protection of Atmospheric External Exposed Surfaces Protection of New IX, WTP Vessels and Associated Piping by Organic Coatings

E5: RTD/MAT/19/123: Protective Coating Specification

E6: GAM/MAT/21/069: Lethabo Corrosion Protection Considerations for Chemical Resistant Valves and Pumps

E7: GAM/MAT/22/245: Lethabo Corrosion Protection Specification for Effluent and De- Gasser Sump (Walls and Floor)

E8: GAM/MAT/21/064: Lethabo Corrosion Protection of Off-Loading Bay/Apron, Bulk Storage Bunds and Chemical Dosing areas

E9: GAM/MAT/21/066: Lethabo Power Station Corrosion Protection of Dosing/Mixing Bunds and Floors, Hardstands, Plinths, Steel Base Plates, Structural Members and Encased Columns

E10: GAM/MAT/21/067: Lethabo Power Station Corrosion Protection of Water Treatment Plant General Walkways

E11: 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:

1. **Quality Assurance**
   Fully operational Quality Management System that meets the intent of ISO900. Required documentation to include:

   - Quality Control check sheets to record paint batch numbers, psychrometric conditions, surface preparation, paint application and special tests as required.
   - Works Procedures
   - Daily Activity Reports
   - Quality Control Plans
   - Inspection and Test Plans
   - Contract/Works Programmes
   - Non-Conformance Reports
   - Release Certificates
   - Certificates of Conformance
   - Data Books

2. **Personnel and Skills**

   - Appointed Site Manager / representative with project management skills.
   - Competent site supervisors qualified to SAQCC (Corrosion Protection) Module PS1 'General Painting Supervisors'.
   - Coating applicators/painters qualified to SAQCC (Corrosion Protection) Module PA1 'General Heavy Duty Coatings Applicator'.
   - Coating inspectors qualified to SAQCC (Corrosion Protection) 'Coating Inspectors' Level 1 (shop inspections) or Level 2 (site inspections) or NACE Coating Inspection Programme (CIP)
   - Sufficient personnel must be available to carry out the work within the required time frame.

3. **Safety**

   - Appointed safety officer.
   - Fully comprehensive Safety File satisfying both the OHS Act as well as Construction Regulations.

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

Rating	Activity Type	Equipment
1	On-site patch repairs and top coats. Maintenance painting where abrasive blast cleaning and spraying not required or possible.	Mechanical Cleaning: needle guns, power wire brushes etc. Hand cleaning: wire brushes, scrapers, sand paper etc. Paint Applications: brushes and rollers.
2	Rating 1 activities + Abrasive blast cleaning and priming at fabricator's works or on site. Spraying of any or all coats.	Rating 1 equipment + Surface preparation: compressors, blast pots. Paint Applications: conventional and/or airless spray equipment.
3	Rating 1 & 2 activities + Working in confined areas such as tank linings, Cooling Water duct linings, penstock linings etc.	Rating 1 & 2 equipment + Blast media removal equipment, vacuum cleaners, high pressure water washers, dehumidifiers. Lighting and ventilation equipment. Additional qualified staff required when time constraints require night shifts.

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.

E12: Capability checklist for corrosion protection paint and rubber lining applicators

CAPABILITY CHECKLIST FOR CORROSION PROTECTION PAINT AND RUBBER LINING APPLICATORS (Continued)		
Main Contractor:		
Company Representative Name and Title :	Date:	
	Signature:	
Applicator:	Report No:	
Date of Evaluation:	Vendor Number:	
Scope: Quality Management System compliance, facilities, equipment, skills & general rating.		
Requirements	**Y/N**	**General Comments**
1. Quality Assurance		
Is a Quality Management System in place		
QC check sheets		
Works Procedures		
Daily Activity Reports		
Quality Control Plans		
Inspection & Test Plans		
Contract/Works Programmes		
Non-Conformance Reports		
Release Certificates		
Certificates of Conformance		
Data Books		
Requirements	**No:**	**General Comments**
2. Personnel Skills		
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		

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

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

E13: GAM/MAT/22/126: Lethabo P/S Corrosion Protection of Water Treatment Plant (WTP) Carbon Steel Piping Systems (Internal: Rubber Lining & External: Organic Coating/Pipe Wrapping)

Appendix F1: WTP Equipment List

See attached appendix for reference.

Appendix F2: Marked-up P&ID's

See attached appendix for reference.

APPENDIX F3: Drawings and Datasheets

Table 19: Table of drawings supplied by the *Employer*

DRAWING NO.		TITLE
0.63	1849	CATION UNIT NO. 1, 2 and 3
0.63	04683 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET CATION ARRANGEMENT
0.63	04683 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET CATION LATERAL DETAILS
0.63	04683 Sheet 3	WTP (WATER TREATMENT PLANT) TOP INLET CATION CLIPS ON VESSEL DETAILS
0.63	04683 Sheet 4	WTP (WATER TREATMENT PLANT) TOP INLET CATION SUPPORT ANGLE DETAILS
0.63	04684 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET CATION PARTS LIST
0.63	04684 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET CATION PARTS LIST
0.63	04685 Sheet 1	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) LATERAL DETAILS
0.63	04685 Sheet 2	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) LATERAL DETAILS
0.63	04685 Sheet 3	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) CLIPS ON VESSEL DETAILS
0.63	04685 Sheet 4	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) SUPPORT ANGLE DETAILS
0.63	04686 Sheet 1	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) PARTS LIST
0.63	04686 Sheet 2	WTP (WATER TREATMENT PLANT) TOP REGENERANT DISTRIBUTOR (CATION) PARTS LIST
0.63	04687 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR (CATION) ARRANGEMENT
0.63	04687 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR (CATION) LATERAL DETAILS
0.63	04688 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR (CATION) PARTS LIST
0.63	04688 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR (CATION) PARTS LIST
0.63	04689 Sheet 1	WTP (WATER TREATMENT PLANT) BOTTOM REGENERANT DISTRIBUTOR (CATION) ARRANGEMENT

0.63	04692 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET DEGASSER ARRANGEMENT
0.63	04692 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET DEGASSER CLIPS ON VESSEL DETAILS
0.63	04693 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET DEGASSER PARTS LIST
0.63	04693 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET DEGASSER PARTS LIST
0.63	04717	WTP (WATER TREATMENT PLANT) DEGASSER DETAILS
0.63	1850	DEGASSER UNIT NO. 1, 2 and 3
0.63	1634	Degasser General arrangement
0.63	04696 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) ARRANGEMENT
0.63	04696 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) CLIPS ON VESSEL DETAILS
0.63	04696 Sheet 3	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) LATERAL DETAILS
0.63	04696 Sheet 4	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) SUPPORT ANGLE DETAILS
0.63	04697 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) PARTS LIST
0.63	04697 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR TOP (ANION WEAK) PARTS LIST
0.63	04699 Sheet 1	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR WEAK BASE ANION EXCHANGER MATERIAL LIST
0.63	04699 Sheet 2	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR WEAK BASE ANION EXCHANGER PARTS LIST
0.63	04702	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM (STRONG BASE ANION) ARRANGEMENT
0.63	04703	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM (STRONG BASE ANION) PARTS LISTS
0.63	04704 Sheet 1	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR (WITH REGENERANT DISTRIBUTOR) MATERIAL LIST
0.63	04704 Sheet 2	WTP (WATER TREATMENT PLANT) BOTTOM COLLECTOR (WITH REGENERANT DISTRIBUTOR) PARTS LIST
0.63	04724 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) ARRANGEMENT

0.63	04724 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) LATERAL DETAILS
0.63	04724 Sheet 3	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) CLIPS ON VESSEL DETAILS
0.63	04724 Sheet 4	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) SUPPORT ANGLE
0.63	04725 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) PARTS LIST
0.63	04725 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET (ANION WEAK) PARTS LIST
0.63	1851	WEAK BASE ANION UNITS NO. 1, 2 AND 3
0.63	04694 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) ARRANGEMENT
0.63	04694 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) LATERAL DETAILS
0.63	04694 Sheet 3	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) CLIPS ON VELLEL DETAILS
0.63	04694 Sheet 4	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) SUPPORT ANGLE
0.63	04695 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) PARTS LISTS
0.63	04695 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET ANION (STRONG) PARTS LIST
0.63	04700 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR STRONG ANION ARRANGEMENT
0.63	04700 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR STRONG ANION LATERAL DETAILS
0.63	04701 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR STRONG ANION PARTS LISTS
0.63	04701 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR STRONG ANION PARTS LISTS
0.63	04702	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM (STRONG BASE ANION) ARRANGEMENT
0.63	04703 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM (STRONG BASE ANION) PARTS LISTS
0.63	1852	STRONG BASE ANION VESSEL No. 1, 2 and 3
0.63	04705 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED ARRANGEMENT?

0.63	04705 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED LATERAL DETAILS
0.63	04705 Sheet 3	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED CLIPS ON VESSEL DETAILS
0.63	04705 Sheet 4	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED SUPPORT ANGLE DETAILS
0.63	04706 Sheet 1	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED PARTS LIST
0.63	04706 Sheet 2	WTP (WATER TREATMENT PLANT) TOP INLET MIXED BED PARTS LIST
0.63	04707 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED ARRANGEMENT
0.63	04707 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED LATERAL DETAILS
0.63	04707 Sheet 3	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED HEADER SUPPORT DETAILS
0.63	04708 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED PARTS LIST
0.63	04708 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT COLLECTOR MIXED BED PARTS LIST
0.63	04709 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM MIXED BED ARRANGEMENT
0.63	04709 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM MIXED BED LATERAL DETAILS
0.63	04710 Sheet 1	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM MIXED BED PARTS LIST
0.63	04710 Sheet 2	WTP (WATER TREATMENT PLANT) REGENERANT DISTRIBUTOR BOTTOM MIXED BED PARTS
0.63	04711 Sheet 1	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED ARRANGEMENT
0.63	04711 Sheet 2	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED LATERAL DETAILS
0.63	04711 Sheet 3	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED CLIPS ON VESSEL DETAILS
0.63	04711 Sheet 4	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED SUPPORT ANGLE DETAILS
0.63	04712 Sheet 1	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED PARTS LIST
0.63	04712 Sheet 2	WTP (WATER TREATMENT PLANT) TOP DISTRIBUTOR REGENERANT MIXED BED PARTS LIST

0.63	1853	MIXED BED VESSEL NO. 1,2 AND 3
0.63	2499	PLOT PLAN WATER TREATMENT BUILDING
0.63	2500	PLOT PLAN SECTIONS
0.63	2317	WATER TREATMENT PLANT DEMIN. BUILDING ELEVATIONS AND DETAILS
0.63	2318	WATER TREATMENT PLANT DEMIN BUILDING ARCH. DETAILS
0.63	2861	CONCRETE LAYOUT OF RAFT SLAB
0.63	2862	CONCRETE LAYOUT OF SECTIONS THROUGH GROUND SLABS
0.63	54201	WATER TREATMENT PLANT – CHEMICAL OFFLOADING PLATFORM LAYOUT
0.63	51473	WATER TREATMENT PLANT – CHEMICAL OFFLOADING PLATFORM LAYOUT DRAINAGE TRENCH CONCRETE, REINF. DETAILS & SCHEDULE
0.63	54204	WATER TREATMENT PLANT – CHEMICAL OFFLOADING PLATFORM FLODING STAIRS, HANDRAIL DETAILS
0.63	2917	WATER TREATMENT PLANT – CONCRETE LAYOUT AND DETAILS OF DEGASSER SUMP
0.63	3113	WATER TREATMENT PLANT – REINFORCEMENT DETAILS OF DEGASSER SUMP

Appendix G: Civil and Structural Condition Assessment of the WTP

See attached appendix for reference.