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1. INTRODUCTION

Lethabo Power Station Water Treatment Plant (WTP) uses reinforced concrete sumps to collect dirty regen effluents from demineralized and condensate polishing regeneration plants for neutralization. The two (2) Ash Conditioning Sumps (ACS), the Submerged Scraper Conveyor Sump (SSCS) and the Effluent Neutralization Sump (ENS) have deteriorated and need to be repaired to ensure full functionality and to extend its life span to the end of station life in 2041.

To conduct a thorough damage assessment and execute the necessary repairs a long-term outage will be required on the sumps. However, due to operational requirements, it is not possible to take the sumps out of service for an extended period. Therefore, a temporary bypass system will need to be designed and constructed. Figure 1 illustrated the location of the effluent neutralization sump.

This document provides the technical specification that would form part of the contract for Lethabo Power Station. It provides the necessary details to outline the scope of work for the design, manufacture, and construction/installation of the bypass system required to refurbish the effluent neutralization sump.

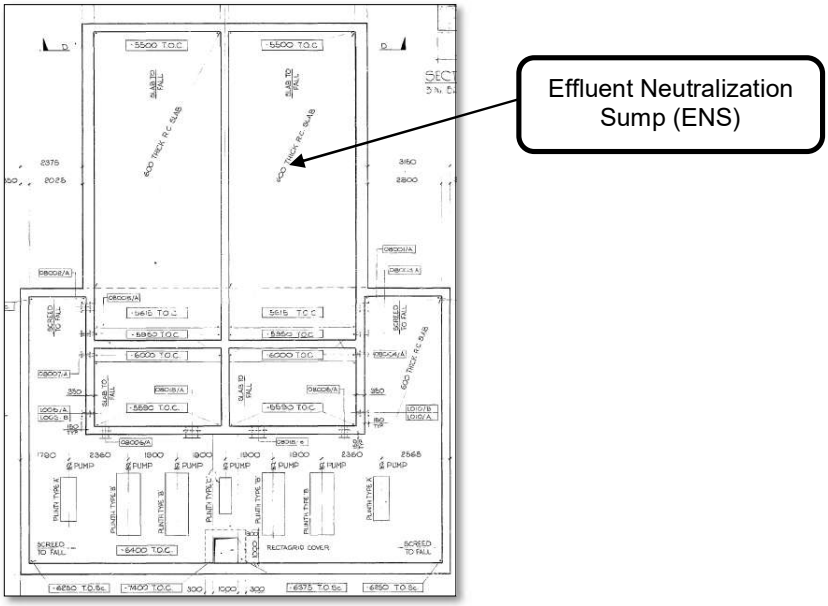


Figure 1: Plan view of effluent neutralization sump

2. SUPPORTING CLAUSES

2.1 SCOPE

This document covers the minimum scope of works and requirements relating to the design and construction of the bypass system, where the *works* are to be performed by the *Contractor*. The scope for the project includes the following:

- Design and construction of the temporary sump including emergency overflow to the medium conductivity sump.
- Design, construction and testing of temporary pumping system from temporary sump to effluent brine tank.

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- Re-design, modification, construction and testing of inlet pipe to temporary sump.
- Blanking off and redirecting other normal inflow (CIP reject and chemical drain) to the ENS to temporary sump.
- Blanking off all overflows to the ENS (to be able to re-instate when needed again)
- Design, manufacture, installation of impulse line for the pH analyser on the level probe outlet flange/pipe.
- Re-instate the overflow pipeline from the brine effluent tank to the ACS sump
- Perform HAZOP study in line with client requirements.
- Procure and supply all materials, tools, equipment and all resources required to execute the *works*.

2.1.1 Purpose

The purpose of this document is to outline the requirements required to be undertaken by the appointed *Contractor*.

2.1.2 Applicability

This document is applicable to Lethabo Power Station and all other stakeholders involved on the project.

2.2 NORMATIVE / INFORMATIVE REFERENCES

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

2.2.1 Normative

[1] 375-172738: Lethabo Power Station Effluent Neutralization Sump Temporary Bypass System Engineering Change Assessment

[2] 375-172737: Lethabo Power Station Effluent Neutralization Sump Temporary Bypass System Required Operational Capability

[3] 375-172762: Lethabo Power Station Effluent Neutralization Sump Temporary Bypass System Stakeholder Requirements Definition

[4] 375-172760: Lethabo Power Station Effluent Neutralization Sump Temporary Bypass System Stakeholder Requirements Definition End-of-Phase Review Report

[5] 375-172827: Lethabo Power Station Effluent Neutralisation Sump Temporary Bypass System Concept Design Report

[6] 375-172828: Lethabo Power Station Effluent Neutralisation Sump Temporary Bypass System Concept Design End-of-Phase Design Review Report

[7] 240-56364545: Structural Design and Engineering Standard

[8] 240-82526527 Managing of Fire Protection System impairments

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2.2.2 Informative

[9] SANS 10400: The application of the National Building Regulation

[10] SANS 10160-1: 2019: Basis of structural design and actions for buildings and industrial structures, Part 1: Basis of structural design

[11] SANS 10160-2: 2019: Basis of structural design and actions for buildings and industrial structures, Part 2: Self-weight and imposed

[12] SANS 10162: The structural use of steel

[13] 240-53113685: Design Review Procedure

[14] 474-58 (Rev1): Document and Records Management

[15] 240-53114002 Engineering Change Management Procedure

[16] 240-43898151: Perform verification and validation PCM

2.3 DEFINITIONS

2.3.1 Disclosure Classification

Controlled Disclosure: Controlled Disclosure to external parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
BOQ	Bill of Quantity
C&I	Control and Instrumentation
COC	Certificate of Compliance
ECSA	Engineering Council of South Africa
ENS	Effluent Neatrilsation Sump
ERA	Engineering Risk Assessment
ITP	Inspection Test Plan
NCR	Non-conformance Report
NOD	Notice of Defect
P&ID	Piping and Instrumentation Diagram
OHS ACT	Occupational Health and Safety Act
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
SANS	South African National Standards
UV	Ultraviolet
VDSS	Vendor Document Submission Schedule
WTP	Water Treatment Plant

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2.5 ROLES AND RESPONSIBILITIES

Roles and responsibilities shall be as per *The Employer's* Design Review Procedure [9].

Contractor

The Contractor will play the role of the design authority ensuring the following:

- The proposed materials and tools used for the *works* satisfies the *Employer's* requirements;
- Conduct the relevant designs, construction/installations, inspections and analysis as detailed in the works information;
- All relevant Eskom design standards, procedures and guidelines have been adhered to;
- The assessment is suitable and correct (calculations, philosophy, functionality, etc.);
- The design is integrated by identifying all interfaces with other packages/plant systems/assets and ensuring that these interfaces are catered for.

Eskom Engineering

Eskom Engineering will play the role of architect engineer and ensure that:

- The assessment satisfies the stakeholder requirements (i.e. validation of design deliverables against stakeholder requirements).
- Reviews all submissions made by the *Contractor*.
- Foreseen technical risks are identified and addressed/challenged with the Design Authority.
- General technical oversight is provided over the design and construction.

Design Review Committee

Establish agreed acquisition requirements baseline by:

- Verifying whether Works Information/Employers Requirements comply with previously set baseline
- Verifying that deviations from previously set baseline were identified and managed by means of formal Engineering Change Management.
- Reviewing complete scope of supply/services/extent of work
- Reviewing all requirements (such as system operating philosophies, performance requirements, and all particular system requirements)
- Reviewing the applicability of all specified codes, standards and procedures (internal and external).
- Reviewing technical schedules.
- Reviewing technical tender returnables.
- Reviewing referenced drawings in Works Information/Employers Requirements.
- Reviewing Bill of Quantities (BOQ) as applicable.
- Reviewing tender technical evaluation strategy.
- Reviewing all detailed system/package boundaries and interfaces.

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- Reviewing the technical contents of the contract strategy

2.6 RELATED/SUPPORTING DOCUMENTS

Refer to Section 5 for associated drawings and standards related to the *works*.

2.7 PROCESS FOR MONITORING

The process will be monitored via the Engineering Change Management process [15]. This process will allow relevant stakeholders and management to be informed of all decisions made in the design and construction phases by the relevant system engineer. The maintenance actions of the new structures and systems will be added to the relevant Plant Maintenance Strategies.

3. EMPLOYER'S OBJECTIVES AND PURPOSE OF THE WORKS

The objective and purpose of the *works* is to:

- Design and construct a temporary bypass system for the EN sump which will allow for the detailed condition assessments and repairs to be undertaken.

4. SCOPE OF WORKS

4.1 DESCRIPTION OF THE *WORKS*

The Effluent Neutralization Sump has been identified as the most critical sump requiring an assessment and repairs. Previous inspections of the sump have found that the corrosion protection lining has failed and the concrete in some areas of the sump has been compromised. This is in part due to the harsh environment inside the sump (effluent is corrosive) and the unavailability of the plant to conduct the required planned maintenance. The sump has experienced several leaks which have been repaired, however the integrity of the sump walls is questionable. There is a risk that continued operation of the sump without conducting the necessary assessments and repairs may result in a total failure of the structure. The temporary bypass system will therefore be designed specifically for this sump.

The effluent neutralization sump (ENS) is a reinforced concrete structure situated within the water treatment plant. It is an underground sump with approximate dimensions of 21,500 mm (length) x 16,700 mm (width) x 7,400 mm (height). The sump comprises a 600 mm thick concrete floor slab, coated with screed to facilitate the gentle drainage of effluent. Its sidewalls are 450 mm thick and support a 200 mm thick roof slab. The sump is divided into compartments for effluent collection, storage, and the installation of electrical pumps. Refer to Figure 2 which illustrates the cross-sectional view of the sump.

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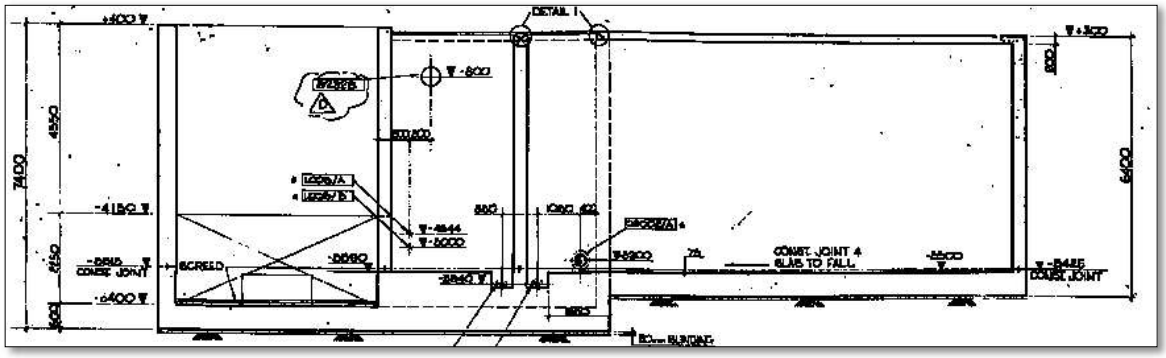


Figure 2: Cross-sectional view of EN Sump

4.2 *EMPLOYER'S* DESIGN REQUIREMENTS

All designs and construction are required to be in accordance with the following Employer's Design Standards and relevant SANS standards:

- 240-56364545: Structural Design and Engineering Standard
- 240-107981296: Constructability Assessment Guideline
- 240-99527377: Inspection Manual for Civil Works at Eskom's Power Station
- 240-53113685: Design Review Procedure
- 240-56227443: Eskom Requirements for Control and Power Cables for Power Stations Standard
- 240-56355815: Control & Instrumentation Field Enclosures and Cable
- 240-56355754: Field Equipment Installation Standard
- 240-123801640: Standard for Low Pressure Pipelines
- 240-105020315: Standard for Low Pressure Valves
- 240-56030558: Specification for Centrifugal pumps
- 240-106628253: Standard for Welding Requirements on Eskom Plant
- 240-49230111: Hazard and Operability Analysis (HAZOP) Guideline
- 240-106365693: Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings
- 240-101712128: Internal Corrosion Protection of Water Systems Chemical Tanks and Vessels with Linings Standard
- 240-145581571: Standard for the Identification of the Contents of Pipelines and vessels

4.3 *EMPLOYER'S* DESIGN

The *Employer* has conducted a conceptual design for the project. During this phase of the project, different alternatives were investigated along with a high-level assessment/analysis to ensure that all modifications will not compromise the existing infrastructure. The conceptual design revealed that the optimal solution for the project was to construct a reinforced concrete sump within the existing pipe

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trench. The high conductivity make-up line will be split to accommodate the temporary sump. The effluent entering the ENS will be bypassed into the temporary concrete sump. The sump will be equipped with a VFD controlled submersible pump, motor and valves, which will pump the effluent to a nearby brine effluent tank (500m3). The sump will contain an emergency overflow pipeline, which will be directed to the medium effluent sump in case there are any issues with the temporary bypass system.

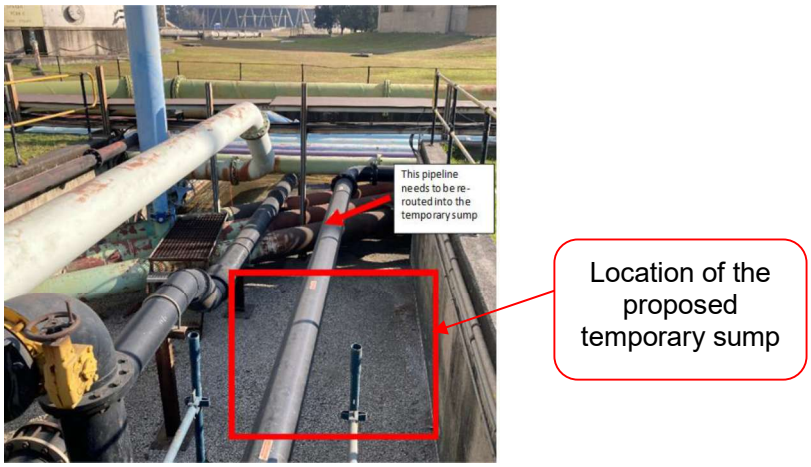


Figure 3: Proposed location of the temporary sump

4.3.1 Typical flow rates flowing into the ENS

The typical flow rate for the water going into the sump is based on the step that the program is in for the type of regenerations that is occurring. Where the highest flow rate reached 160m3/hr, and goes as low as 7.2m3/hr.

4.3.2 Typical characteristics of water/media flowing into the ENS

The typical water dilutions that flows into the ENS ranges from:

- 6% Sulphuric Acid with demineralised water dilution
- 5% Caustic Soda with demineralised water dilution
- 10% Brine with 4% Caustic Soda with demineralised water dilution

The typical temperature of the inlet water varies between:

- Ambient temperature
- Up to as high as 49 degree Celsius.

4.4 *CONTRACTOR'S* DESIGN

4.4.1 General

1. The *Contractor* takes full professional accountability and liability for the *works* as described in the *Works Information*.
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*.

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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 subcontractors 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 Works Information.
4. No deviation from this works information 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 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 scope of works.
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 *Works* Information, 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 *Contractors* 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.

4.4.2 Civil & Structural Requirements

The civil and structural scope for the project includes the procurement, design, construct and testing of the temporary effluent sump, whereby all *works* are to be undertaken by the appointed *Contractor*.

4.4.2.1 Temporary Effluent Sump

1. The *Contractor* is required to design and construct a new temporary effluent sump within the pipe trench located adjacent to the EN sump.
2. The construction material for the temporary effluent sump can be either steel or reinforced concrete. The choice of construction material will be based on the *Contractor's* design and ease of construction of the sump.
3. The *Contractor* is required to assess the available space within the pipe trench to accommodate the temporary effluent sump.
4. The overall dimensions of the sump will be based on the available space within the pipe trench and the required flow rate.
5. The temporary effluent sump is to be designed to accommodate the electrical, mechanical and C&I requirements as stated in the Works Information.

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6. Structural steel gratings are to be installed on the top of the effluent sump. Such gratings are to be designed to resist the imposed loads from maintenance activities.
7. The interior surface of the temporary effluent sump is to be coated with an acid resistant liner. Datasheets are to be submitted to the *Project Manager* for review and acceptance prior to being utilised.
8. The effluent sump is to be constructed/positioned away from the pipe trench wall to ensure that spillage occurs within the pipe trench.
9. The *Contractor* is required to conduct a water tightness test on the new temporary effluent sump. All defects observed during this test is to be rectified by the *Contractor*.
10. Prior to the construction of the effluent sump, the concrete surface of the pipe trench is to be assessed and repaired. As a minimum, 50mm of the concrete surface is to be removed and replaced with 35 MPa non-shrink grout.
11. The surface area of the concrete to be repaired will be based on the footprint of the effluent sump.
12. The *Contractor* is require to conduct a structural verification for the concrete floor slab of the pipe trench to determine that integrity of the structure is not compromised by the new temporary effluent sump.
13. All *works* are to done in accordance with the *Employer's* standard and relevant SANS codes.

4.4.3 Electrical Requirements

The electrical scope includes the procurement, design, manufacture, delivery, storage and preservation, off-loading, installation, site testing, decommissioning and commissioning, quality control, training and handover of a safe, integrated and fully functional electrical system , within the Contractors scope boundaries and Employers requirements.

4.4.3.1 Electrical System Battery Limits

The electrical battery is limited to the Effluent Neutralization Sump (ENS) and associated LV switchgear, cabling and electrical bonding for the loads defined in Appendix E1- Electrical Load List.

4.4.3.2 Applicable Electrical Standards, Specifications, Procedures and Schedules

1. 240-56227443 Eskom Requirements for Control and Power Cables for Power Stations Standard
2. 240-57617975 New Low Voltage Motors Procurement Standard.
3. 240-56361435 Transport of Power Station Electric Motors Standard
4. 240-77100923 Low Voltage Motors Schedule B Appendix C2
5. 240-132875144 LV AC VFD Technical Schedule A&B Appendix C2
6. 240-56356396: Earthing and Lightning Protection Standard
7. 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
8. SANS 61800-3 Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods.
9. SANS 61000-2-4 Electromagnetic compatibility (EMC) Part 2-4: Environment: Compatibility levels in industrial plants with low frequency conducted disturbances.
10. 380V Water Treatment Plant Board 1B Switchgear Schedule 0.63/5057 Sheet 7 .

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11. 0.63/8297 Sheet 4 S11
12. 0.54/393 Electrical Bonding and Earthing

4.4.3.3 Decommissioning of the Effluent Handling System LCP 10UH31B001

Due to the outdoor ambient and corrosive environment the Contractor is responsible for the decommissioning of the Effluent Handling System ENS-ACWS-TRO Tank Local Control Panel 10UH31B001.

- 10UH31B001 panel is energised from 50GD 380V Water Treatment Plant Board 1B (GD153).
- Circuit GD153: 380V/3PH+N fused isolator, circuit type S11 (0.63/8297).
- Power transfer from GD153 to the load (10UH31B001) is achieved through a 16mm²; armoured; 3-core, PVC sheathed cable (BVX3HCV), cable number WW 0741.

The applicable 10UH31B001 LCP Panel Drawings are provided in:

- 0.63/34515 Sheet 1/1 Effluent Handling System ENS-ACWS-TRO Tank LCP Layout
- 063/34516 Sheets 1-4 TRO Brine Tank Loop Diagram

The Contractor shall:

1. Apply for a Permit to Work (PTW).
2. Identity and disconnect all power, control and electrical bonding cables.
3. Label and mark disconnected cables as decommissioned. The cable tag numbers shall not be removed.
4. Dismantle, remove and transport the frame and panel to the Employers salvage yard.
5. The Contractor shall formally raise any plant and drawing discrepancies with the Employer for resolution.

4.4.3.4 New Temporary Sump Electrical Requirements

1. A new temporary concrete sump within the pipe trench located adjacent to the ENS shall be constructed for the effluent. The new temporary concrete sump shall be equipped with a low voltage (30kW, 380V) variable frequency drive (VFD) controlled submersible motor utilized to empty the effluent to the nearby existing brine effluent tank.
2. Due to the temporary nature of the works, on completion of the works, the Employer elects not to take over ownership of the VFD.
3. On completion of the project, in compliance to the PTW system, the Contractor decommissions and removes the VFD from site.
4. In addition to the prescripts defined in section 4.6.3 the Contractor provides the Employer with specific Engineering, Operating and Maintenance training for the VFD however the maintenance and fault-finding and spare holding activities related to the VFD remain the sole responsibility of the Contractor during the stipulated defects period

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5. The power cabling systems shall be not removed, however isolated and disconnected and labelled "Decommissioned" at both ends. The cable tag numbers shall not be removed.

4.4.3.5 VFD Point of Connection

The Contractor shall reuse the previous supply utilized for the Effluent Handling System ENS-ACWS-TRO Tank LCP 10UH31B001 as the point of connection for the (VFD) circuit.

The (VFD) point of connection is as follows:

1. 50GD 380V Water Treatment Plant Board 1B
2. Circuit GD153
    - Fused Isolator Circuit Eskom type S11 (0.63/8297 sheet 4)
    - 380V AC /3PH+N
    - 100A Max Fuse rating
3. Eskom switchgear schedule 0.63/5057 Sheet 7.

4.4.3.6 VFD Location

The Contractor shall :

1. Position the (VFD) in the outside environment as close as practically possible to the new temporary sump motor.
2. The VFD shall be adequately enclosed and ingress protected (IP65) by an enclosure suitable for the harsh corrosive and outdoor ambient conditions.

4.4.3.7 LV Cabling and Cable Racking

1. All cabling, cable racks and accessories shall conform to (240-56227443) Eskom Requirements for Control and Power Cables for Power Stations Standard.
2. The existing cables and cable rack servitudes shall be reused as far as practically possible; however the Contractor remains solely responsible for the design, rating, installation and commissioning of all power cables required for the Works and VFD installation.
3. The Contractor submits all cable rating calculations in accordance with 240-56227443.
4. The Contractor shall thus:
    - Position the VFD to enable reuse of the Employers existing 16mm²;armoured;3-core,PVC sheathed cable (BVX3HCV), LV power cable number WW 0741 supplied from 50GD 380V Water Treatment Plant Board 1B, circuit GD153.
    - The WW 0741 cable was previously utilized by the decommissioned Effluent Handling System ENS-ACWS-TRO Tank LCP 10UH31B001.

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- The WW 0741 cable number shall be decommissioned and new (VSD) cable number assigned by Eskom.

4.4.3.8 Low Voltage Switchgear

1. The Contractor utilises the Employers existing switchgear, circuits and functional unit schematics for the Works.
2. The Contractor is solely responsible for the provision on of all components required for the design, modification and commissioning of the Employers existing switchgear functional units, where required.
3. The Contractor shall amend, update and submit the Employers Electrical Load List Appendix E1 240-56227927.
4. The Contractor shall ensure alignment between Appendix E1 240-56227927 and 240-61379755 Control & Instrumentation Drive & Actuator Schedule Template.

4.4.3.9 Motors

Motors shall comply with the following:
1. 240-57617975 New Low Voltage Motors Procurement Standard
2. 240-56361435 Transport of Power Station Electric Motors Standard
3. The 240-77100923 Low Voltage Motors Schedule B Appendix C2 shall be submitted prior procurement of any motors.

4.4.3.10 Variable Frequency Drives (VFD)

All Variable Frequency Drive's (VFD's) that form part of the project shall comply with:

1. Eskom 240-132875144 LV AC VFD Technical Schedule A&B in Appendix C2 shall be submitted by the Contractor demonstrating design specification and technical assurance.
2. 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.
3. SANS 61800-3 Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods.
4. SANS 61000-2-4 Electromagnetic compatibility (EMC) Part 2-4: Environment: Compatibility levels in industrial plants with low frequency conducted disturbances.
5. The VSD provided shall be of the free-standing type and thus not integrated within the existing LV switchgear.
6. The final optimised VFD rating, location, specialised cabling , harmonic filters or any outside field based VFD enclosures of suitable ingress protection (IP - rating) required for the installation shall be performed by the Contractor in accordance with the VFD original equipment manufacturer prescripts.

4.4.3.11 Earthing and Lightning Protection

The Contractor ensures the following:
1. All non-current carrying metal parts comprising of metal conduits, metal cable racks, cable armouring, junction boxes, panels, motor frames, switchgear enclosures and metal enclosures for

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motor controllers, frames, metal enclosures for various electrical equipment, electrically operated equipment, main support structures, reinforcing etc shall be electrically bonded to earth.
2. The installation shall be electrically bonded in accordance 240-56356396: Earthing and Lightning Protection Standard and associated the requirements provided in 0.54/393.
3. No additional lightning protection is required for the works.

4.4.3.12 Electrical Control and Instrumentation Interface

1. The interface between the electrical drives and outside plant room are defined by (IO block diagrams defined in the control and instrumentation section.
2. The new temporary system shall further be equipped with a new sump level transmitter. The control interface of the VFD is addressed in the control and instrumentation section.

4.4.3.13 Electrical Operating and Maintenance

The Contractor develops, provides and conducts the following:
1. Electrical alarm response procedures, operating and maintenance procedures for electrical systems provided and specifically VFD systems.

4.4.3.14 Electrical Quality Management System

1. In accordance with SANS 10142-1 prior to commissioning of the electrical systems the Contractor shall issue the Employer with an Electrical Certificate of Compliance (CoC) issued by an accredited and authorised person.
2. The Contractor shall compile and submit a technical Quality Control Plan (QCP) that is specific to Works for approval by the Employer prior to execution of the Works,
3. The Contractor's quality control plans cover inspection and test proposals for items or activities to be supplied as part of the Works.
4. The Contractors QCP shall include :

    a) The identification of the specification, drawings or procedures for each operation.
    b) The acceptance criteria with reference to the appropriate technical specification or standard.
    c) The inspections and tests the Contractor has nominated for hold and witness points.
    d) The Contractor and Employer shall allow for insertion of specific requirements, including hold, review the quality control plans and witness points, prior to commencement of work.
    e) Sign of by the Contractor for Works performed prior to request for inspection and safety clearance by the Employer.
    f) Inspection and test records which are generated by the *Contractor*.
    g) Provision for inspections and tests nominated by the Employer.
    h) Provision for inspection status indication.

4.4.4 C&I Requirements

The *Contractor* shall provide a detailed design for the installation of level transmitters, pH measurent, junction boxes, splitter boxes, cabling, VFD interfacing, actuator interfacing with the existing water treatment plant Foxboro Distributed Control System (DCS).

The Contractor shall reference the following documents for additional details:

- Drive and actuator schedule

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- Instrument schedule
- Limits of supply and service
- Input output block diagrams

The Contractor shall provide a design including but not limited to the following documentation:

- Hook-up drawings
- Loop drawing
- Junction box drawings
- Splitter box drawings
- Cable block diagrams
- Operating and control philosophies

The Contractor shall be responsible for the supply, delivery, installation and commission of the following

- Instrumentation as per the instrumentation schedule
- Actuators as per the drive and actuator schedule
- Three junction boxes
- Three splitter boxes
- All instrument and trunk cabling
- All terminals
- Trunking and racking
- Stands and supports
- All labelling

4.4.4.1 Variable frequency drive (VFD)

The DCS shall be configured with logic to start, stop and performs PID control within a certain range which depends on the pump characteristics, size of the tank, to prevent overflowing and cavitation of the pump as per the mechanical philosophy.

The VFD shall be interfaced to the DCS with the following signals as a minimum:

- Start command (digital input @24VDC)
- Stop command (digital input @24VDC)
- Running feedback (Potential free contact, rated @24VDC)
- VFD Ready (Potential free contact, rated @24VDC)
- Remote (Potential free contact, rated @24VDC)
- VFD speed setpoint (4-20mA input)
- Motor speed (4-20mA output)

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The temporary sump instrument shall be setup and capable of going to a default minimum to stop the pump in the event of the level transmitter going into an error state.

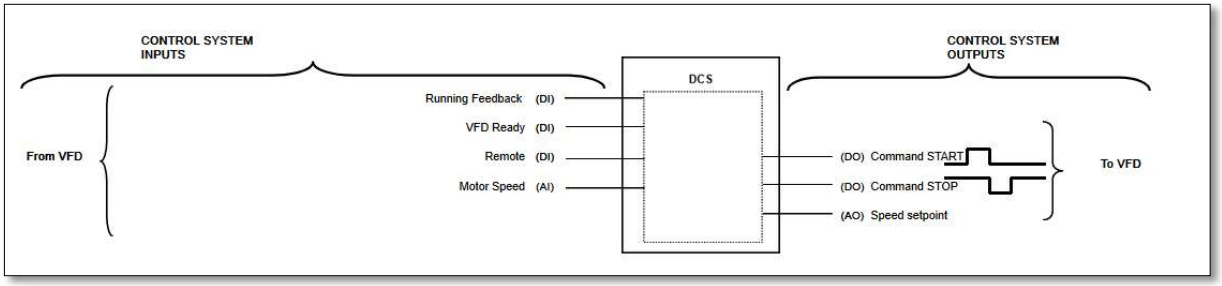


Figure 4: VFD Interface

4.4.4.2 Low Voltage Control Valves

4.4.4.2.1 Actuators

The system is currently fitted with a local control panel which controls the three actuators listed in the drive and actuator schedule. These actuators shall each be replaced with a regulating control actuator (3-phase, 380V @50Hz) that is controlled via a 4-20mA position setpoint. The control valves are electrically fed via a feeder circuit. The actuator shall have the following signals as a minimum and interfaced to the DCS:

- Position setpoint (4-20mA input)
- Position feedback (4-20mA output)
- Open limit (potential free contact)
- Close limit (potential free contact)
- Fault (potential free contact)

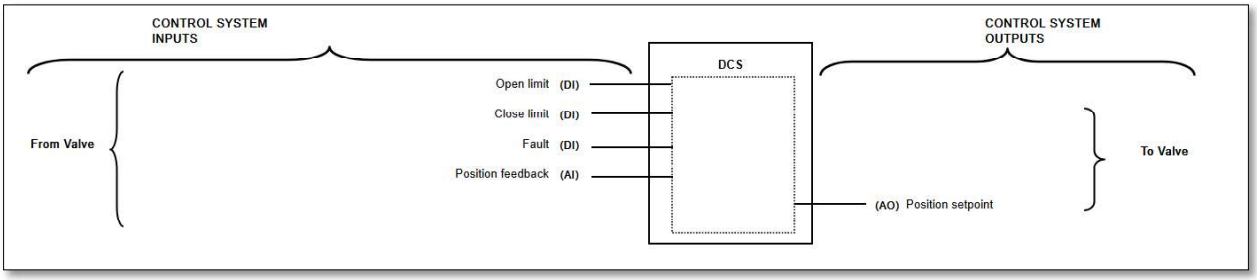


Figure 5 : Low Voltage Control Valve Interface

4.4.4.2.2 Splitter boxes

The current splitter boxes (terminal housing for signals and 380V) is not currently to standard and requires replacement. The three splitter boxes shall be replaced by appropriate splitter boxes according to the Control & Instrumentation Field Enclosures and Cable standard. The splitter box has the same requirements as the junction box. Refer to section 4.4.4.6 for a summary of the requirements.

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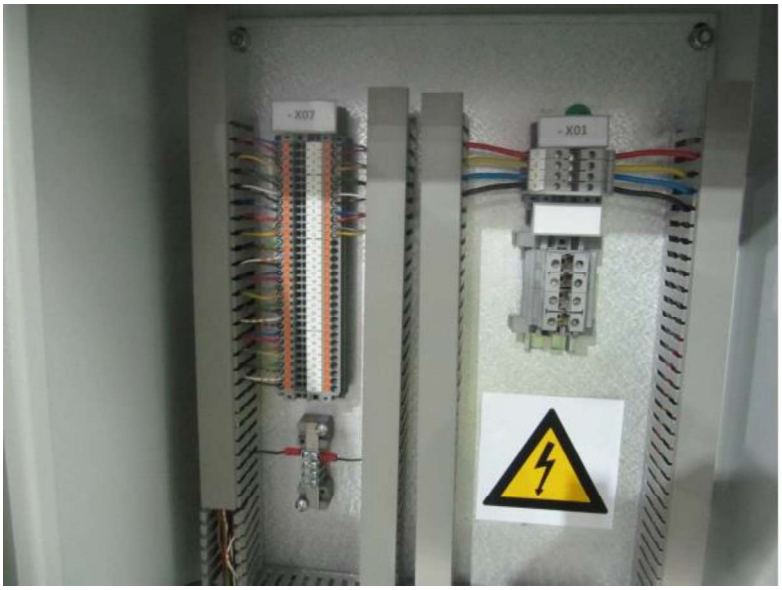


Figure 6 : Typical Internal Layout of a Splitter Box

4.4.4.3 Cabling

The instrument cabling has been damaged at several places and is currently routed to the local control panel which shall be decommissioned as part of this works. New cabling for the actuators shall be installed between:

- Splitter box and analog input junction box
- Splitter box and analog output junction box
- Splitter box and binary junction box
- Splitter box and actuator head unit

It is recommended to consider using armoured instrument cabling in this area due to regular grass cutting activities.

New cabling for the VFD shall be installed between:

- VFD and analog input junction box
- VFD and analog output junction box
- VFD and binary junction box

New cabling for junction boxes shall be installed between:

- New analog output junction box and 10JB04 (UVG20ACM)
- New analog input junction box and 10JM02 (UVG40ACM or 2 x UVG20ACM)
- New binary junction box and 10HD09 (UVG40ACM 2 x UVG20ACM)

Instrument cabling shall comply with the Eskom Requirements for Control and Power Cables for Power Stations Standard. All cabling shall:

- Be sufficiently supported
- Does not interfere with access to the area
- Does not hinder maintenance activities

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- Shall be protected from maintenance and grass cutting activities.

All remaining cabling shall be handed over to Lethabo Power Station within one week of commissioning and be delivered at a location on site as specified by the Eskom project manager.

Refer to Figure 7 for the high-level cable block diagram of the required installation.

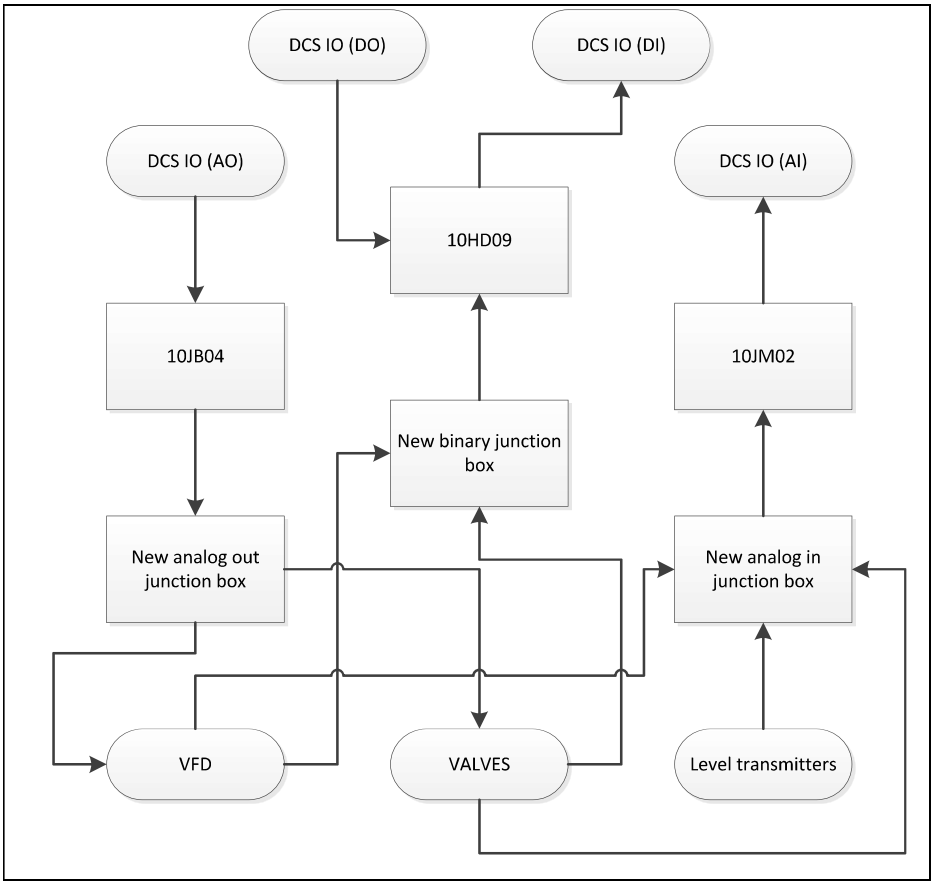


Figure 7 : High-level cable block diagram

4.4.4.4 Junction boxes

The current junction boxes in the field are corroded and damaged. Three new junction boxes shall be installed by appropriate junction boxes according to the Control & Instrumentation Field Enclosures and Cable standard. The junction boxes shall be provided with a new support stand which shall be floor mounted as per the standard and not attach to the current structures. Refer to section 4.4.4.6 for a summary of the requirements.

4.4.4.5 Racking, trunking and cabling pipes

The Contractor shall install new racking, trunking and piping in the area highlighted (Figure 8) in yellow for support and protection of cabling. The racking, trunking and piping shall be corrosion resistant to chemicals such as acid and caustic as the area are prone to leaks. The racking and trunking shall be installed in such a way to minimise the collection of fluids when leaks occur and preferably routed away from the pump house.

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The contractor is allowed to utilise existing racking outside the yellow area should there be sufficient space for the trunk cabling.

Instrument cabling shall be protected from UV as far as possible to minimise deterioration of the cable's integrity. The racking, trunking and piping shall not interfere with maintenance activities or access to the area.

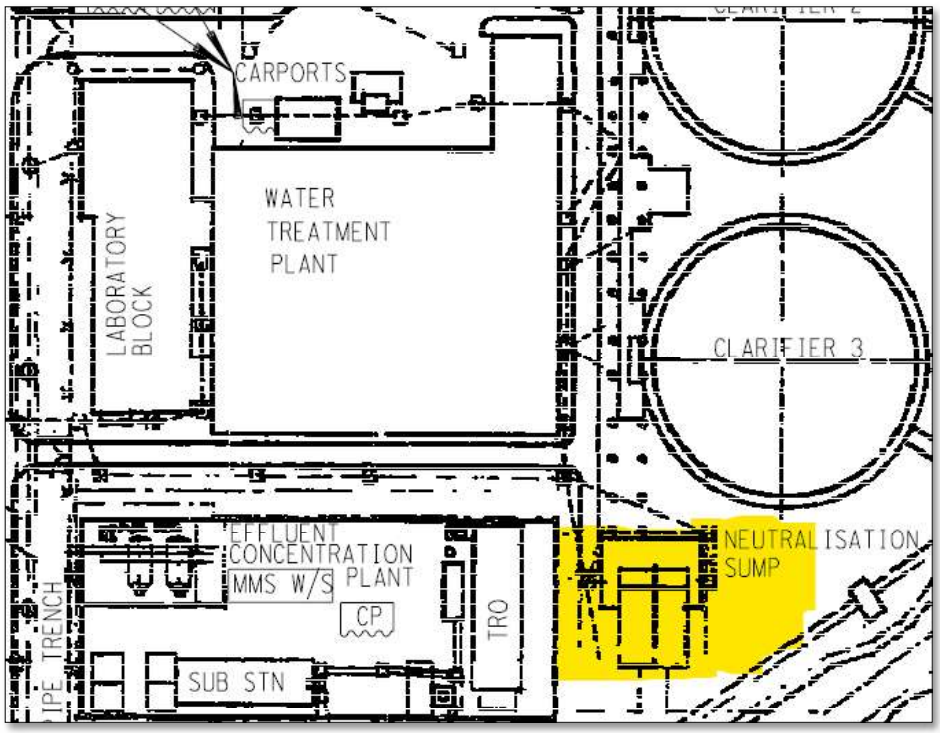


Figure 8 : ENS sump area

4.4.4.6 Field enclosure requirements

Field enclosures shall comply with the Control & Instrumentation Field Enclosures and Cable standard. The minimum requirement for the enclosure is:

- 500W x 400W x 200D
- 3CR12 or higher stainless steel
- Powder coated RAL7035
- Minimum thickness of 1.6mm
- IP66
- Enclosure shall be lockable with 6mm square key 304 stainless steel with a seal
- Hinges shall also be made of 304 stainless steel

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Figure 9: Typical Junction Box

4.4.4.7 pH analyser

A new pH analyser shall be installed on the outlet of the tank and interfaced with the Foxboro DCS. The pH analyser shall be preferably be standardised with existing models used on site for standardisation purposes. The transmitter shall be installed as per OEM recommendations. The display should be preferably be oriented to the south to prevent glare and UV damage. The transmitter shall be rated for a minimum of:

- IP67
- 1-13pH range

4.4.4.8 Foxboro DCS interfaces

The instruments, actuators and drives shall be interfaced with control processor WTCP15 as it is dedicated for the effluent system. The temporary system shall utilise existing spare capacity on the Foxboro DCS.

The VFD and DCS shall be interfaced with one another via:

- W15132 for analog inputs (cubicle JM02)
- W15131 for analog outputs (cubicle JB04)
- W15126 for digital inputs (cubicle HD09)
- W15125 for digital outputs (cubicle HD09)

Refer to Appendix – Input Output Block Diagram for detailed interface requirements between the VFD and the DCS.

The low voltage control valves will utilise the same IO cards as the VFD.

Table 1 indicates the IO reserved for the project.

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Table 1: Reserved DCS IO

Address	RESERVED	Project
W15125.13	Temp bypass sump VFD start command	ENS bypass project
W15125.14	Temp bypass sump VFD stop command	ENS bypass project
W15126.13	Temp sump bypass VFD running feedback	ENS bypass project
W15126.14	Temp sump bypass VFD ready	ENS bypass project
W15126.15	Temp sump bypass VFD Remote	ENS bypass project
W15126.16	RESERVED	ENS bypass project
W15126.17	10UH31S502 open limit	ENS bypass project
W15126.18	10UH31S502 close limit	ENS bypass project
W15126.19	10UH31S502 fault	ENS bypass project
W15126.20	10UH31S505 open limit	ENS bypass project
W15126.21	10UH31S505 close limit	ENS bypass project
W15126.22	10UH31S505 fault	ENS bypass project
W15126.23	10UH31S508 open limit	ENS bypass project
W15126.24	10UH31S508 close limit	ENS bypass project
W15126.25	10UH31S508 fault	ENS bypass project
W15131.5	Temp sump bypass VFD speed setpoint	ENS bypass project
W15131.6	10UH31S502 position setpoint	ENS bypass project
W15131.7	10UH31S505 position setpoint	ENS bypass project
W15131.8	10UH31S508 position setpoint	ENS bypass project
W15132.5	Temp sump bypass VFD motor speed	ENS bypass project
W15132.6	10UH31S502 position feedback	ENS bypass project
W15132.7	10UH31S505 position feedback	ENS bypass project
W15132.8	10UH31S508 position feedback	ENS bypass project

4.4.5 Mechanical Requirements

4.4.5.1 Mechanical Scope requirements

The Contractor is required to:

- Design a temporary pumping system including all the necessary pumps, valves, pipes and fittings from the temporary sump to the effluent brine tank.
- Design and modify the existing spool inlet pipe to the ENS sump to accommodate the temporary sump.
    - The pipe needs to be modified such the temporary sump can be built around the pipes without affecting the flow during the temporary sumps construction. The spool then needs to be removed once the sump is completed so that the high conductivity can be diverted to the temporary constructed sump, and also needs to be reinstated once there are any permanent/ongoing issues during testing off the temporary pumping facility.
- Design of impulse line for the pH analyser on the level probe outlet flange.

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- To perform a HAZOP study.
- Supply and installation of 30kW submersible pump inside the temporary sump with all necessary brackets and fittings to ensure sound and neat installation of the pump.
- Manufacture, supply and installation of discharge piping, pipe supports and fittings from the submersible pump to the brine effluent tank.
- Supply and installation of the valves on the discharge piping which include an isolation valve and a NRV seized to the line.
- Supply and installation of the new valves for the current inlet and outlet valves for the following locations:
    - 08-10UH31S502 (80NB butterfly valves)
    - 08-10UH31S508 (300NB butterfly valves)
    - 08-10UH31S506 (250NB butterfly valves)

    These valves are to be supplied with electrical actuators (as per section 4.4.4.2.1 Actuators) as a fully functional assembly by the Contractor.

    Contractor to measure the face to face at Tender phase to make sure the right valves are Tendered for.
- Blanking of the overflow to the ENS sump from the ACS sump. (to be able to re-instate the overflow after the bypass system is no longer in use)
- Re-instate the overflow pipeline from the brine effluent tank to the ACS sump. The current overflow is blanked off at the bottom of the brine effluent tank.
- Manufacture and installation of impulse line for the pH analyser on the level probe outlet flange.
- Diverting the flow to the temporary by-pass sump from the following high conductivity inlets in addition to the above:
    - CIP reject to the ENS sump.
    - Chemical drains inlet to the ENS sump.
- Cold commissioning of the completed installed system.
- Hot commissioning of the completed installed system.
- Testing and of the completed installed system.
- Technical assistance with the optimisation of the plant based on the test and commissioning phase.
- The Contractor is to provide training on mechanical equipment installed with the works to the Employers staff on the operation and maintenance requirements of the individual and agreed upon components/equipment between the Contractor and Employer as well the as the completed fully tested pumping system. The Contractor should allow as a minimum x2 sessions per section (Operation & Maintenance) to allow all staff to attend training required.

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4.4.5.2 Mechanical Drawings requirements

The Contractor is required to supply as a minimum set of new/revised mechanical drawings:

- Revise General Arrangement Drawings – 34152_001.08 – Effluent Handling System Pipework At Water Treatment Plant General Arrangement And Details (WTP) & 34152_002.05 - Effluent Handling System Pipework At Water Treatment Plant General Arrangement And Details (WTP)
- New Isometric drawings
- Revise Piping and Instrumentation Diagrams (P&ID's) - 2635.16 - WTP (Water Treatment Plant) West High Conductivity Effluent Neutralisation System Engineering Flow Diagram
- New Pipe Support Drawings for the parts of the works the Contractor is responsible for.

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 the required drawing package is required for the entire plant the Contractor was responsible for.

4.4.5.3 Mechanical Functional and technical requirements

The Contractor to adhere to all the below standards together with additional comments specified below the standards:

- 240-123801640 - Standard for Low Pressure Pipelines
  - Pipe material to be Carbon steel rubber lined (240-101712128 - Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings) pipes, Contractor can cost for Stainless steel 316L as an alternative option.
  - Contractor to supply all the latest standards and specification as listed as per Appendix F1 – Piping specification (originally designed in accordance to these standards and specification listed, to be used as reference) during the design phase of the project for review.
  - Pipe to be designed for at least 10 bar pressure if not clearly stated in the document.
- 240-105020315 - Standard for Low Pressure Valves
  - Valve material to be suited for the application media.
  - Contractor to supply a valve schedule in the design report phase of the project for review.
    - Minimum requirements to be specified on the schedule are as follows:
      - Design standard for the valve
      - Design pressure rating
      - Design temperature of the valve
      - Flange drilling and pressure rating
      - Material of construction of all wetted parts of the valves
      - Face to face (in mm)
      - Material of construction of the body

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- 240-56030558 – Specification for Centrifugal pumps
  - Pump not to be able to pump more than 10 bar pressure or design pressure of the pipelines.
  - Pump material of construction to be suited for the application media.
- 240-106628253 - Standard for Welding Requirements on Eskom Plant
- 240-101712128 - Standard for the Internal Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings
- 240-49230111 – Hazard and Operability Analysis (HAZOP) Guideline

4.4.5.4 Mechanical battery limits:

1) Flange on the high conductivity inlet let where temporary sump starts.
2) Inlet into the effluent brine tank from the temporary sump pump.
3) Brine effluent tank outlet and inlet valves as indicated.
   - 08-10UH31S502 (80NB butterfly valves)
   - 08-10UH31S508 (300NB butterfly valves)
   - 08-10UH31S506 (250NB butterfly valves)
4) Overflow from the temporary sump to the medium conductivity sump tie-in with current piping.
5) Overflow from brine effluent tank blanked flange to the inlet of the ACS sump.
6) Level indicator flange/pipe to the inlet of the ACS sump (pH analyser impulse line for sampling)

4.4.6 Production of As-Built Information required for the *Works*

1. In the event that the existing baselined designs for the Auxiliary Bay area (28m level) 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 5 for documentation and drawing requirements
3. All as-built drawings issued to the *Project Manager* will be a minimum of one (1) hard copy (A0 in size) signed by the responsible professionally registered structural engineer/technician and in electronic format. The *Contractor* submits electronic drawings in AUTOCAD or MicroStation (DGN) format and scanned drawings in pdf format. Drawings issued to the *Employer* may not be “Right Protected” or encrypted.

4.5 CONSTRUCTION

4.5.1 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-

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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 4.6.6 for method statement requirements.
3. Submits a project specific safety file to the *Project Manager* for comments / acceptance.
4. Submits a detailed level 3 schedule for the *works* to the *Project Manager* for acceptance after contract award.
5. 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*.
6. The *Contractor* disposes of all waste material at the waste disposal facility on site as per the instruction and direction of the *Project Manager*.
7. 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.
8. 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 Employer provides the necessary intervention points.
9. 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.
10. Manages access to the working areas and the Site.
11. Manages activities on Site to ensure that no interference takes place between the *works* and that of others.
12. Liaise with the *Project Manager* regarding utilities and telephone facilities required for his site establishment.
13. Liaises with the *Project Manager* regarding the location of waste disposal sites and rubbish dumps.
14. 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;

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- 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.

4.5.2 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 members.
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 4.6.1 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
7. The *Contractor* takes full professional accountability and liability for all temporary items required for the execution of the works.

4.6 OTHER REQUIREMENTS OF THE *CONTRACTOR*'S DESIGN

4.6.1 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

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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.
3. 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.
4. The *Contractor* takes full professional accountability and liability for all temporary items required for the execution of the works.
5. 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.
6. 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 *Works* Information.

4.6.2 Hazop Study

1. The Contractor leads and carries out a formal Hazard and Operability (Hazop) study involving the Employer's design team, which includes Engineering, Operation and Maintenance team members.
2. The Contractor is responsible for appointing a trained facilitator, independent of the project team, to conduct the HAZOP study.
3. The Hazop report is sent to the Project Manager for review before the final report is issued to the Project Manager for acceptance.
4. The Contractor makes provision for the submission and review of the Hazop in the programme.
5. The Contractor is responsible for updating the design as per the actions noted during the HAZOP study to address the deficiencies noted.
6. This study is done in accordance with the requirements as laid down in Eskom Hazop Guideline: 240-49230111.

4.6.3 Training and Technology Transfer

4.6.3.1 General

1. The *Contractor* provides training on the equipment and systems included as part of the *works* to the various categories of the *Employer's* technical staff for the duration of the *works*.
2. All training (except that of the Up-front Engineering and Operator training) provided by the *Contractor* is customised for the Lethabo Power Station and is directly applicable to the actual equipment and software supplied for the *works*.
3. Training is focused on the specific bypass systems, configuration, layout, equipment, hardware and design that the *Contractor* provides for the *works*.
4. The training is provided on site at Lethabo Power Station.

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5. The training schedule is incorporated in the Accepted Programme.

4.6.3.2 Training Categories

1. Theoretical and practical hands-on training for each individual trainee forms an integral part of each of the courses in these categories:
   - Training of maintenance staff.
   - Training of operators.
   - Training of engineering staff

4.6.3.3 Training Requirements

C&I training requirements:

1. The Contractor shall train relevant personal on the operating and control philosophy of the new plant. The training shall also include equipment specific training:
   - Actuator interface, setup and operation
   - Level transmitter interface, setup and operation
   - VFD interface, setup and operation

4.6.3.4 Trainee Participants

1. The *Project* Manager will indicate the total number of participants to be trained.
2. The *Employer* bears the cost of salaries, accommodation, travelling expenses and other allowances of his personnel during the training, but all other training costs are borne by the *Contractor*.
3. The *Contractor* provides additional (repeat) training courses as and when instructed by the *Project Manager*.

4.6.3.5 Training Documentation

1. The *Contractor* provides all course material including manuals in accordance with the requirements of VGB R171, 2nd edition, 2010.
2. The course material is in English and includes all third party documentation.
3. Printed and soft copies of the training documentation are supplied for each trainee plus an additional 3 hardcopy master sets and 3 soft copies.
4. All training documentation provided by the *Contractor* is customised for the Power Station.
5. The training documentation contains the specific Power Station Systems' architecture, configuration, layout, hardware, equipment, and design provided by the *Contractor* as part of the *works*.
6. Training manuals are continuously updated by the *Contractor* up to the date of issue of the Defects Certificate for the whole of the *works*.

4.6.4 Plant and Material Supply

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

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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.

4.6.5 Storage Facilities

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*.

4.6.6 Method Statement

1. The *Contractor* submits a Method Statement taking into consideration the various phases of the project.
2. 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.
3. 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 contractors.
    - 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,

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Supervisor, Environmental Officer, Fabricator, Erection Engineer, Shop detailer, Transporter and other personnel required for the civil and structural works.

- Construction sequencing considerations, which take 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.

4. The *Contractor* submits a new Method Statement, a month prior to commencing with any construction activities and after Contract Award, which covers all the aspects listed above, and any additional requirements or changes arising from negotiations or clarifications, for acceptance by the Project Manager. This Method Statement is to include interfaces with *Others*. This new method statement includes a sequential erection procedure which clearly shows detailed consideration for stability requirements of the structure (if applicable) at all stages during erection.

4.6.7 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 C*ontractors* 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;

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- 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.

4.6.8 Construction Programme

1. As part of the Method Statement and as a tender returnable, the *Contractor* submits a Level 3 construction programme considering all the interfaces and time constraints.
2. This programme does not omit key activities. Timing of the activities is consistent with the Construction Work 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 his 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-contractors;
    - 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 amount 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;

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- 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.

4.6.9 Documentation and Configuration Management

a. Document identification

All documents supplied by the *Contractor* are subject to the *Employer's* approval. The language of all documentation is required to be in English.

b. Document Submission

- 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.
- The *Contractor* is required to submit documents as electronic and hard copies and both copies must be delivered to the *Employer's* Representative with a transmittal note.

In addition, 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)

c. Email Subject

The *Contractor* submits all documentation to the *Employer's* Representative in the following media:

- Electronic copies are submitted to Eskom Documentation Centre through generic email address (drmsharedservices@eskom.co.za). The email subject as a minimum has the following: ***(Station_Project Name_Discipline_Subject)***. 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.

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- Hard copies are submitted to the *Employer's* Representative accompanied by the Transmittal Note.

d. Drawings Format and Layout

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

4.6.10 Documentation Review Requirements

1. The Contractor submits all documentation to the *Project Manager* for acceptance. The *Project Manager* reviews the *Contractor's* submitted documents in accordance with the *Employer's* Design Review Procedure (240-53113685).
2. The *Contractor* conducts design reviews of the *Contractor's* design as per the *Contractor's* official design review procedure. The *Contractor* ensures adherence to the Scope of Work and that a technically sound design approach is followed in carrying out the designs.
3. The designs submitted are complete packages with all elements (all related drawings and design reports) included in order for the *Project Manager* to review as a whole.
4. 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.

4.7 QUALITY AND PROJECT HANDOVER REQUIREMENTS

4.7.1 Quality Management

1. The *Contractor* submits a fully detailed Quality Control Plan (QCP) for acceptance within three (3) 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 Scope of Works.
2. The *Contractor* submits a schedule of unpriced orders to be placed and this is updated regularly.
3. The *Contractor* is responsible for defining the level of QA/QC (Intervention Points) or inspection to be imposed on his *sub-Contractor*s 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.
4. Product data sheets, product samples, and any other documents are submitted for review and acceptance by the *Project Manager* after contract award and prior to the commencement of work.
5. All quality control documentation is submitted to the *Project Manager* within seven (7) days of Contract date

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4.7.2 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 drawings
    - Inspection reports
    - Notifications
    - Modifications
    - Technical Queries, Engineering Responses and communications with *Project Manager*/*Employer*
    - Non-conformance reports
    - Transport notifications
    - Calculations for any temporary works that may be required for the safe execution of the works
    - Material certificates and datasheets
    - As-built data and drawings of the completed works upon handover. As-built drawings are submitted in PDF and native CAD formats.

4.8 SPECIFICATIONS FOR THE *WORKS*

4.8.1 Applicable Standards

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
240-85549846	Standard for Design of Drainage and Sewerage Infrastructure
240-56364545	Structural Design And Engineering Standard
240-86973501	Engineering drawing Standard
240-107981296	Constructability Assessment Guideline
240-99527377	Inspection Manual for Civil Works at Eskom's Power Station
240-86973501	Engineering drawing Standard
240-53113685	Design Review Procedure
240-53665024	Engineering Quality Manual
240-53114186	Document and Records Management
240-105658000	Supplier Quality Management Specification
32-245	Eskom Waste Management Standard
32-727	Eskom Safety, Health, Environment and Quality (SHEQ) Policy

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Number	Title
OHS Act 85 of 1993	Construction Regulations, 2014
SANS 10400	The Application of the National Building Regulations
SANS 791	Unplasticised poly(vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings
SANS 677	Concrete non-pressure pipes
-	SANRAL Drainage Manual
SANS 10400	Building Code

4.8.2 Additional Requirements and Pre-requisites

1. 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
2. The *Contractor* is required to submit a comprehensive method statement of the works to the *Project Manager* for acceptance prior to the start of the works
3. Any request for deviation from specified requirements are submitted in writing and include the proposed deviation, rationale for the deviation, any technical data supporting the deviation, and historical experience supporting the deviation.
4. Combining or mixing of different codes is not permitted
5. The *Employer* will arrange a mandatory site clarification meeting with all tenderers so that tenderers are afforded the opportunity to visually inspect the works to be done.

4.8.3 General

The following codes are required to be complied to:

i. SANS 1200 A: General

ii. SANS 1921-1: Construction and management requirements for works contracts, Part 1: General engineering and construction works

The table below indicates particular specifications pertaining to SANS 1200 A and must be read in conjunction with the code.

Clause	Particular Specification
5.1	**Survey**
5.1.1	**Add:** The *Contractor* is responsible for the complete surveying and setting out of the *works* including the establishment of any beacons and benchmarks required to complete the works. The *Contractor* is required to consult the Surveyor-General's office to obtain information on available registered beacons near Lethabo Power Station to use for the establishment of any required benchmarks close to the *works*.
6.2	**Degrees Of Accuracy**
6.2 b)	Degree of accuracy II is applicable to the *works*.

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4.8.4 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
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
4.2.3.5	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

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Clause	Particular Specification
	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
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**

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Clause	Particular Specification
4.5.1	Fixtures to be embedded in the concrete are attached as shown on the Drawings.
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
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.

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Clause	Particular Specification
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*.
5.1.3.3	Add the following: • …, unless no more than three batches of concrete is 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 uninterupted supply of the correct volume to Site should be guaranteed.

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Clause	Particular Specification
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.

4.8.4.1 Additional Requirements and Specifications

i. All concrete work is required to be in accordance with SANS 2001-CC1 and SANS 10100-2 unless otherwise stated.

ii. 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.

iii. 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)

iv. Compaction of concrete is required to be done by means of mechanical vibrators only.

v. 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.

vi. All concrete is required to have a maximum water/cement ratio of 0.45 with a minimum cement content of 420 kg/m^3

vii. 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.

4.8.5 Structural Steelwork

1. All work is required to be in accordance with the latest edition of SANS 2001-CS1
2. The *Contractor* is responsible for the stability of the entire structure and all structural elements during all the erection stages.
3. All dimensions are required to be verified on site by the *Contractor* before any fabrication of steelwork commences.

- Design loading is in accordance with SANS 10160, and structural steel design is in accordance with SANS 10162.

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6. All structural steelwork to be in accordance with SANS 50025-2/ EN 10025-2 grade S355JR, for hot rolled sections & structural plate work. Cold formed sections to be commercial quality steel (Fy=200MPa).
7. Fabrication, workmanship etc. to be in accordance with SANS 2001 and 1200, where applicable.
8. Grade 8.8 bolts are used throughout.
9. Where H.S.F.G. bolts are used, they must be tightened as specified in SANS 10094 using the "turn of nut method".
10. Once tightened, the H.S.F.G bolt cannot be re-used & must be discarded.
11. Hardened washers are to be used with high tensile bolts & H.S.F.G bolts.
12. Tapered washers are to be used where required.
13. The *Contractor* is required to supply all structural steel elements, bolts, washers, nuts etc. for the structural steelwork.
14. All welding is required to be conducted by coded welders. Supporting documentation is also required to be submitted to the *Project Manager* for acceptance.
15. Welding to be carried out in accordance with ANSI/AWS D1.1 (all welds 6mm cont. fillet) U.O.N.
16. All welds are required to be inspected using visual aids
17. Welding on site should be avoided if possible.
18. Welded end plates to be used in end connections where possible. Welded connections are required to be welded all around with a minimum of 6 mm fillet welds or the appropriately designed fillet weld size. Butt welds are required to be full penetration welds.
19. No deviation from member sizes, dimensions or setting out points unless permission has been obtained from the *Project Manager* in writing.
20. All steelwork to be colour coded, if specified on arrangement drawing and the No. to be indicated in white paint.
21. *Contractor* to supply temporary bracing as required for safe transportation & erection.
22. Fabrication drawings to be submitted per level upon completion of each associated level to the *Project Manager* for review and acceptance prior to fabrication.

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.
4.1.5.1	Bolt grade 8.8 is required as a minimum

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Clause	▪ Particular Specification
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)

4.8.6 Corrosion Protection

1. Corrosion protection is required for all steelwork in accordance with 240-75655504: Corrosion Protection Standard for new Indoor and Outdoor Eskom Equipment, Components, Materials and Structures Manufactured from Steel Standard.
2. The Contractor submits the proposed corrosion protection measures to the Employer for approval.

4.9 DELIVERABLES

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

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)

4.9.2 Design Phase

1. Consolidated and integrated technical detailed design report signed by a Professional Engineer/Technologist which includes:
    - 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.
2. Detailed drawings for construction signed by a Professional Engineer/Technologist. Drawings are to be submitted in CAD formats (.DGN).

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3. Detailed constructability analysis report for the execution of the works.
4. Bill of Quantities
5. Construction Specification
6. Progress reports

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
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

4.9.4 Post Construction/Installation

1. QA returnables (monthly)
2. As-Built drawings
3. Data books as detailed in Section 4.7.2
4. Operation and Maintenance (O&M) manual.
5. Certificate of completion, signed by the ECSA registered engineer/technologist, confirming that the works has been constructed in accordance with the design.

5. INFORMATION ISSUED BY THE *EMPLOYER*

The following list of standards and list of drawings are issued to the *Contractor* for information.

Table 2: List of standards

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
	Drive and Actuator Schedule	1
	Input Output Block Diagram	1

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	Instrument schedule	1
	Limits of supply and service	

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Table 3: List of drawings

Drawing Number / ID	Document Title	Revision
0.63/7648	Effluent Neutralisation Sump Concrete Details	6
0.63/7649	Effluent Neutralisation Sump Concrete Details (Sht 2)	6
0.63/8043	Effluent Neutralisation Sump Reinforcement Details (Sht 1)	2
0.63/8064	Effluent Neutralisation Sump Reinforcement Details (Sht 2)	1
0.63/8065	Effluent Neutralisation Sump Reinforcement Details (Sht 3)	1
0.63/34160	Effluent handling plant 500m3 concrete tank concrete layout	1
0.63/ 34152/001	Effluent handling system pipework at water treatment plant general arrangement and details (WTP)	8
0.63/34152/002	Effluent handling system pipework at water treatment plant general arrangement and details (WTP)	5
0.63/3676	(Water treatment plant) WTP (west) effluent neutralisation sump piping general arrangement	17
0.63/3710	(Water treatment plant) WTP west pipe track north of water treatment building pipework general arrangement	12

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