Eskom	Report	Technology

Title:	**Detail Design Report for Replacement of Duvha Power Station Diesel Compressors and Dryers**	Unique Identifier:	**382-171063**
		Alternative Reference Number:	**N/A**
		Area of Applicability:	**Engineering**
		Documentation Type:	**Report**
		Revision:	**1**
		Total Pages:	**17**
		Next Review Date:	**N/A**
		Disclosure Classification:	**CONTROLLED DISCLOSURE**

Compiled by	Functional Responsibility	Authorised by
[redacted]	[redacted]	[redacted]
T. Masethe	**S. Tapala**	**M. Mamoleka**
System Engineer	**Aux Senior Engineer**	**Engineering Manager**
Date: 2025/08/27	Date: 2025/08/27	Date: 2025/08/27

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EXECUTIVE SUMMARY

The diesel compressors at Duvha Power Station are outdated and lack local support, leading to increased unreliability. When electric compressors are unavailable, the diesel compressors often fail, causing air shortages that contribute to load losses at the station. To mitigate this issue, the station frequently rents diesel compressors at a high cost, significantly increasing the operational expenses of the compressor plant.

This project aims to reduce these costs and enhance overall plant availability by ensuring the standby plant is operational. The upgrade will also address the low quality of compressed air the current diesel compressors produce. The solution involves replacing the existing diesel compressors with new oil-free diesel compressors of the same capacity and upgrading the existing dryers to heatless dryers to maintain design specifications.

Additionally, this project will mitigate the multiple unit trip (MUT) risks associated with the loss of the electrical services board, which supplies power to the pairs of electric compressors (Electric Compressors 1 and 2 from one board and Electric Compressors 3 and 4 from another). The MUT risk due to a common potable water supply loss affecting all four electric compressors simultaneously remains a concern. In such an event, the only viable action is to automatically shut off the service air supply and start the diesel compressors, although this does not guarantee that the units will not trip. This project represents the minimum action necessary to safeguard the station.

1. INTRODUCTION

This document provides the technical specifications for the replacement of the Diesel Compressors Duvha Power Station. The diesel compressors are currently relocated outside the compressor house.

1.1. Current Challenges

The primary ongoing challenge with the current diesel compressors is the lack of local support, which significantly impairs the ability to provide optimal maintenance for sustainable and reliable operation. Despite engaging various service providers over the years, no substantial improvement has been achieved.

This situation necessitates a comprehensive re-evaluation of the compressed air system design and operational strategy to ensure reliable, efficient, and cost-effective operation while maintaining the required redundancy for MUT prevention.

1.2. System Identification

The design will affect the area where the existing station diesel compressors are located, which is Low Pressure Services (LPS).

Table 1: System Identification for compressors and dryers within scope

Equipment	AKZ code
Diesel Compressor 1	00US15D001
Diesel Compressor 2	00US16D001
Diesel Compressors 1 Air Dryer	00US15G006
Diesel compressors 2 Air Dryer 1	00US16G006

1.3. System Overview

The compressed air system at Duvha Power Station is a critical, centralised plant located in the low-pressure services pump & compressor house. This system supplies both control air and service air throughout the facility. The plant's configuration consists of:

- Primary Compressors: Four electric water-cooled centrifugal compressors
- Standby Compressors: Two air-cooled diesel compressors
- Air Treatment: Each compressor is equipped with a dedicated desiccant dryer
- Storage: Four control air receivers and one service air receiver
- Distribution: A network supplying compressed air to various users across the station

1.3.1. Operational Challenges

- **Increased Air Demand:**

  The original design philosophy intended for one electric compressor to remain on standby. However, due to escalating air demand over time, all four electric compressors must operate continuously to meet the station's compressed air requirements.

- **Standby Capacity:**

  The diesel compressors, designed initially as standby units, are now critical for maintaining system reliability. However, the extended operation of these units is cost-prohibitive due to high maintenance and fuel expenses.

- **Air Quality:**

  The plant is experiencing issues with compressed air quality, primarily due to malfunctioning dryers. This project addresses this issue specifically for the standby diesel compressor system.

2. SUPPORTING CLAUSES

2.1 SCOPE

This document outlines the technical specifications and compliance with stakeholder requirements for the diesel compressed air system at Duvha Power Station.

2.1.1 Purpose

This document summarises the technical specification-related activities and describes the achievement of the design goals in terms of meeting the stakeholder requirements. Together with the design output documentation of this design phase, it is submitted to a project design review board for technical assessment.

2.1.2 Applicability

This document applies to Duvha Power Station only.

2.2 NORMATIVE / INFORMATIVE REFERENCES

2.2.1 Normative

[1] ISO 8573.1: Air Quality Classifications

[2] SANS 62: Pipes suitable for threading and of nominal size not exceeding 150 mm

[3] SANS 719: Electric welded low carbon steel pipes for aqueous fluids (large bore)

[4] SANS 121: Hot Dip Galvanized Coatings on Fabricated Iron and Steel Articles –

[5] Occupational Health and Safety Act, Act 85 of 1993

[6] SANS 347: Pressure Equipment Regulation

[7] Field Instrument Installation Standard (240-56355754)

[8] Field Instrument Installation for Junction Boxes and cable termination standard (240-56355815)

[9] Human Machine Interface Design Requirements Standard (240-56355728)

2.2.2 Informative

[10] 240-53113685 Design Review Procedure

[11] 240-53114026 Project Engineering Change Management Procedure

[12] 240-46953787 Manage Technical Risk

[13] 474-10987 Compressed Air Systems Group Technology Strategic Report 2018 Strategic report

[14] 240-53114002: Engineering Change Management Procedure

[15] 240-86973501: Engineering Drawing Standards

[16] 240-46977377: PCM for Manage interfaces.

[17] 240-105929225 Compressed air system standard

[18] 240-53113953: Manage Engineering Accountability Procedure

[19] 240-49104627: Engineering Workload and Resource Planning Procedure

[20] 240-48929482: Tender Technical Evaluation Procedure

2.3 DEFINITIONS

Adsorption

The general working principle of adsorption is simple as moist air flows over hygroscopic material (typical materials used are silica gel, molecular sieves, activated alumina) and is thereby dried.

Air Quality
Quality of compressed air is guided by the degree of dryness and filtration needed and acceptable. contaminant level for the end users.

Compressor capacity
Capacity in m^3/min at a particular reference condition, including temperature, pressure and relative humidity, at a specific discharge pressure.

Pressure Dewpoint

The temperature of a given pressure at which a relative humidity of 100% will be reached. At this point the water vapour and partial pressures are equal and condensation will take place if the temperature is further reduced or if the pressure increase.

Relative Humidity
The ratio of the partial pressure of a vapour to the vapour saturation pressure at the dry bulb temperature of a mixture.

Stakeholder
Anyone that has an interest in the outcome of the project.

Standard Temperature and Pressure
Air at 20ºC, 1bar (101.30kPa) (atmospheric pressure at sea level) and 0% Relative Humidity (Completely dry air).

Surge
The reversal of flow within a dynamic compressor that takes place when the capacity being handled is reduced to a point where insufficient pressure is being generated to maintain flow.

System Pressure
The air pressure of a particular class of compressed air as measured at the air receiver directly after the dyers. Where multiple receivers are in service, the system pressure is average pressure of the receivers in service.

Vapour
A gas that is at a temperature below its critical temperature and that, therefore, can be liquefied by isothermal compression.

2.3.1 Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
CBS	Cost Breakdown Structure
CCCC	Central Change Control Committee
C&I	Control and Instrumentation
DCS	Distributed Control System
g	Gauge
HART	Highway Addressable Remote Transducer
kPa	Kilo Pascal
kpag	Kilopascal gauge (Gauge Pressure)
LPS	Low Pressure Services
mamsl	Metres above mean sea level
OEM	Original Equipment Manufacturer
OHSA	Occupational Health and Safety Act
P&ID	Piping and Instrumentation Diagram
PPE	Personal Protective Equipment
SANS	South African National Standards
SAT	Site Acceptance Testing

3. SCOPE OF WORK

3.1 SUMMARY OF SCOPE

Discipline	Scope
Mechanical	Replacement of air Diesel compressor number one and Diesel compressor number two.
Electrical	Provide electrical panel to comply with SANS 60896-21 and SANS 60896-22 for diesel compressor batteries, to ensure safety and performance.
C&I	Interface equipment in the compressor plant, i.e. electric compressors, diesel compressor, filters, dryers, cooling water, flow meters and dewpoint meters on the OPCR.
Civil	Ensuring adequacy of existing equipment supports and provision of supports and shelters for the new equipment's.

3.2 DESCRIPTION OF THE *WORKS*

The project involves designing, supplying, installing, commissioning, and testing two new diesel-driven oil-free air compressors with each having its new dryers at Employer Duvha Power Station. The scope also includes the removal of the existing diesel compressors to the Employer's disposal store. The *Contractor* will provide operating and maintenance manuals for the new diesel compressors and conduct training on on-site operational, monitoring, and maintenance activities for the Employer.

The electrical compressors are controlled by a PLC that maintains the system pressure at 640 kPa. If the system pressure drops below 580 kPa, a pressure switch automatically starts the diesel compressors. The diesel compressors run until the system pressure is restored, after which they are manually stopped by the operator or auto stopped by pressure switches.

1) Risk analysis

   i) Both the LP Services standby diesel compressors are more than 25 years old and have a history of being unavailable for long periods of time. Diesel compressor engine 1 has had numerous major engine repairs. Recently the compressor was repaired with a very long spares lead time. The compressor spares are now obsolete.

   ii) Diesel compressor 2 diesel engine also had numerous major engine repairs. At present the engine block is distorted due to many overheating events. The control system between the compressor and the diesel engine Is also problematic Both diesel engines are emergency standby plant for the station control and service air system.

2) The *Employer's* objective is to improve the reliability of the emergency diesel compressors at Duvha Power Station to better than 95%.

3.3 SYSTEM SPECIFICATION

(1) The compressor plant at Duvha Power Station consists of:

* Four electric-driven Ingersoll Rand CENTAC C400 centrifugal compressors, each rated to deliver 52 m^3/min at 700 kPa, oil-free air.

* Two oil-free screw diesel compressors:

  * Diesel Compressor 1: 52 m^3/min at 700 kPa minimum at 1615 meters above sea level.

  * Diesel Compressor 2: 52 m^3/min at 700 kPa minimum at 1615 meters above sea level.

3.4 SITE CONDITIONS

The Altitude of the low pressure services building at Duvha PowerStation is 1600 metres above sea level. Atmospheric pressure at the elevation is 85 kPa. Other site characteristics at Duvha PowerStation which shall be used for sizing equipment are listed on the table below:

Table 3: Ambient site conditions

Ambient condition	Minimum	Average	Maximum
Pressure	80kPa	85kPa	90kPa
Temperature	-10°C	35°C	40°C
Relative Humidity	20%	60%	80%

3.5 PLANT REQUIREMENTS

The new upgraded plant should provide clean, dry, oil free air to air users at Duvha Power Station to meet the following quality requirements.

- Discharge Pressure : 620-820 kPa(g)
- Dew Point : - 40 °C PDP
- Max Oil Content : < 0.1mg/m^3
- Max Particle Size : < 1micron

The Contractor supplies two identical diesel engine driven oil free compressors with associated dryers, each with a minimum capacity of at least 52 m^3 per minute at a discharge pressure of 700 kPa (g).

3.6 WORK TO BE PERFORMED BY THE CONTRACTOR FOR THE WORKS

3.6.1 Design

1) The *Contractor* designs the detailed installation of the new diesel compressors and the desiccant dryers to interface with the existing diesel compressor tie-in points in the compressed air storage and reticulation system.
2) The *Contractor* ensures that the integrity and capacity of the existing air dryers are adequate to dry the compressed air produced by the new diesel compressors to a dew point of -25°C to -40°C. The *Contractor* provides new air dryers with the supply of the new diesel compressors.
3) The *Contractor* designs the interface with the existing bulk diesel storage tanks to the new diesel compressor's fuel systems and ensure it auto fill the diesel compressors.
4) The *Contractor* designs the interface with the existing compressed air control system such that the diesel compressors will start when the system pressure drops below 580 kPa (g). The diesel compressor will run till shut down by the operator.
5) The Contractor designs the removal procedures for the old compressors and the installation of the new diesel compressors.
6) The *Contractor* designs the new diesel compressor installation such that it can be maintained/rigged with the existing LP services crane.
7) The *Contractor* designs and install the new diesel compressors so that noise and vibrations caused by the diesel compressors are minimised.
8) The exhaust fumes of the diesel engines and compressors situated outside next to LP services building unloading air releases must be routed away from the LP services building.
9) The diesel compressors are designed for an operational life of 20 years after installation and the *Contractor* supplies the warranty certificate for more than 24 months after installation.
10) The *Employer* performs weekly operational function tests on the diesel compressors. The new diesel compressors shall have a reliability and availability of at least 95%.

11) The *Contractor* designs and installs a sheeting shelter with adequate lighting for the two diesel compressors to be installed outside the compressor house. This shelter should provide protection from the elements while allowing for proper ventilation and accessibility for maintenance.

3.6.2 Pressure vessels requirements

Dryers will comprise of pressure vessels which shall meet all the requirements of Occupational Health and Safety Act Pressure Equipment Regulations.

- These pressure vessels shall meet the requirements of the OHS Act Pressure Equipment Regulations and 474-10327
- If the dryers are newly manufactured the pressure vessel design code shall be the latest version of Specification for unfired fusion welded pressure vessels (PD5500).
- The welding of the pressure vessels shall meet the requirements of Control of plant construction repair and maintenance welding standard. (240-56241933)
- The personnel doing the welding work must meet the requirements of Qualification certification and accreditation requirements for personnel and entities performing welding related work on Employer plant (240-56246601).
- Dryer NDT testing shall meet the Requirements for NDT on Employer plant standard. (240-83540088).
- The personnel doing the NDT tests must meet the requirements of Employer NDT personnel approval for quality related special processes om Employer plant (240-83539994)
- The specification of the flanges shall meet that of the interfacing piping (existing or new).
- Each dryer and filter vessel (if applicable) shall have a separate permanently fixed data plate in a conspicuous place on the vessel with the following minimum particulars in accordance OHSAct PER.
- Transport and storage shall conform to the following requirements:
    - On delivery the equipment shall be dry externally and internally and ready for installation.
    - The equipment shall be protected from any damage during transportation.
    - Each flange nozzle shall be protected by wooden blank to protect against damage.
    - The equipment shall be stored inside the building or in the ventilated covers. The storage area shall be clean, dry and dust free.

3.6.3 Supply

1) The *Contractor* supplies two identical diesel engine driven oil free compressors with associated dryers, each with a capacity of at least 45 m3 per minute at a discharge pressure of 700 kPa (g).

3.6.4 Delivery

1) The *Contractor* will supply and deliver the new diesel compressors to Duvha Power Station. Completion will only be certified once the new diesel compressors have been installed, commissioned, and tested to be in good working order.

3.6.5 Installation

1) The *Contractor* installs the new compressors into the positions where current diesel compressors are into the station's air storage and reticulation system.

2) Installation shall not interrupt the air supply to the station. No more than one working diesel compressor will be removed from the compressed air system at any one time.

3.6.6 Operating and control

- Equipment in the compressor plant, i.e. electric compressors, diesel compressor, and filters, dryers, cooling towers, flow meters and dewpoint meters shall be interfaced and monitored on the OPCR.

3.6.7 Removal of old compressors

1) At installation of the new diesel compressors, the *Contractor* removes the old diesel compressors to the *Employer's* stores for disposal.
2) The *Contractor* may submit an offer to buy the old diesel compressors from the *Employer.*

3.6.8 Commissioning and Testing

1) The *Contractor* provides a commissioning and test procedure for the new diesel compressors.
2) Commissioning is defined as bringing into service all items of the *works* as specified, meeting the requirements of the functional Works Information, as well as the control system and Plant and Materials performance including all necessary testing and verification of the stated performance.
3) The Contractor provides factory commissions and tests certificates for new diesel compressors.
4) The *Contractor* commissions and tests the new diesel compressors to proof that it meets the user requirement specifications of the *Employer.*
5) The *Contractor* develops a commissioning procedure that is submitted to the *Employer* for acceptance.

3.7 SPECIFICATIONS

3.7.1 Mechanical

3.7.1.1 Material Selection

1) All the materials are selected to ensure long life as indicated in the *Contractor's* Works Information
2) All Plant and Materials supplied are new.

3.7.2 Welding

1) All welding is conducted according to a welding procedure, accepted by the *Project Manager,* in line with the recommendations as per the manufacturers data sheet.
2) All welding is earned out by a suitably qualified welder.
3) This suitably qualified welder will be tested by the *Employer* on the accepted welding procedure before any welding Is carried out.

3.7.3 Corrosion Protection

- The diesel compressor and the dryer components shall be externally coated in accordance with the coating system listed in table below or the Supplier’s equivalent coating standard. The Supplier’s standard colours may be used.

- All internal components shall be suitable protected against corrosion, considering the environmental conditions.
- All piping shall be galvanised, except for small bore tubing which shall be stainless steel.
- All piping, fittings and flanges shall be hot dipped galvanized in accordance SANS 121: Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.
- Pipes shall be painted according to Duvha Power Station colour coding standard.

Table 6: Corrosion protection specification for compressors and dryers

PROCESS:	ACTIVITY	DFT
SURFACE PREPARATION:	Abrasive blast-clean to Grade Sa 2,5 (ISO 8501-1).	
PRIMER COAT	Apply by brush, airless spray or dipping, one coat Single Pack Etch Primer.	15 to 25 micrometres
UNDERCOAT:	After allowing sufficient time for the primer coat to dry, apply by brush or airless spray, one coat of Alkyd Universal Undercoat.	20 to 30 micrometres.
FINAL COAT:	After allowing sufficient time for the undercoat coat to dry, apply one coat of High Gloss Alkyd Enamel.	25 to 30 micrometres
	Total dry film thickness of coating system:	60 to 85 micrometres
GENERAL:	After installation, lining up, grouting etc., all damage shall be repaired, and coatings made good to the Engineer's approval.	

3.7.4 C&I Specification

- Diesel compressor should come with the latest technology to be able to interface or connect to Siemens S7 PLC that is used at Duvha Power station for control, operating, monitoring and protection of the entire compressor system.
- Should be interfaced with LPS Master controller that includes the following (electric compressors, diesel compressor, filters, dryers, cooling water, flow meters and dewpoint meters on the OPCR)

3.7.5 Electrical Specification

- Interface the new diesel compressors with the existing compressed air control system to start when the system pressure drops below 580 kPa (g).
- Design the interface with the existing compressed air control system such that the diesel compressors will run until shut down by the operator
- Provide electrical panels for the new diesel compressors that meet the requirements of the latest version of SANS 61439 Low-voltage switchgear and control gear assemblies.

- Ensure the diesel compressor batteries meet the requirements of SANS 60896-21 and SANS 60896-22 Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test and Part 22: Requirements.

3.7.6 Civil

This section covers the Civil and Structural Design requirement.

All Civil and Structural Designs shall be carried out in line with Eskom Structural design and Engineering standard (240-56364545) and the relevant SANS codes. The required civil and structural works include design, fabrication, supply and construction for steel containers to house 2 diesel compressors to be installed and placed outside of the existing low-pressure services (LPS) building in Duvha power station, the containers shall include double leaf doors, well-ventilated, weather proof, liquid containment bund with drainage system to the nearest used oil drain. The drainage system from the liquid containment structure to the nearest use oil drain manhole shall be installed underground which will be impacting the existing tarred surface driveway to the LPS building. Pipe supports are also required for the compressed air pipe work.

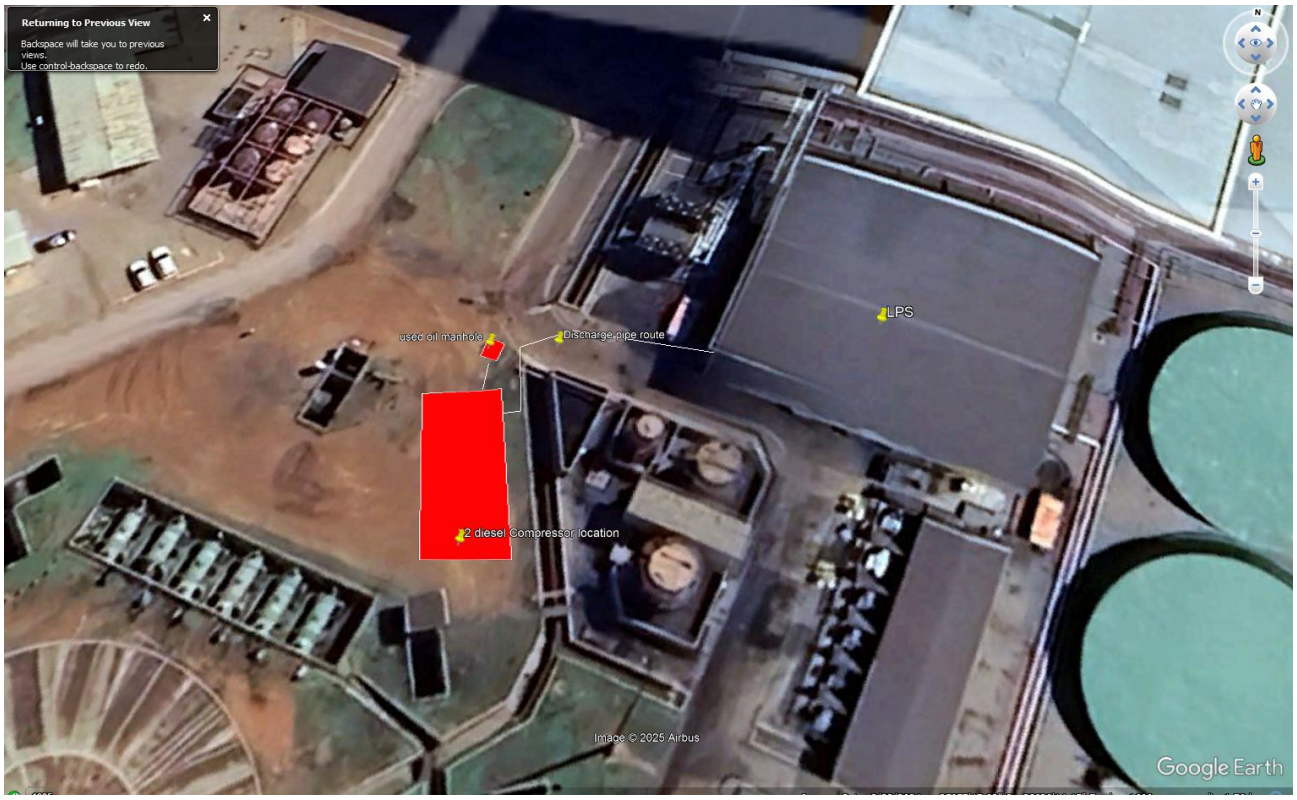

Figure 1: Plant layout showing proposed location of the compressors, drainage line and existing used oil drainage manhole.

The appointed Contractor is responsible for the analysis and verification of any existing infrastructure impacted by the works, which includes existing road, drainage and mechanical equipment within the area. Where the Contractor finds that, the existing infrastructure is not fit for purpose the Contractor is required to perform the detailed design and construction of any modifications required. The Contractor submits a comprehensive proposal, which is based on

justification from his assessment for the modifications required to the Project Manager for his acceptance prior to the start of design. The Contractor takes full professional accountability for the existing infrastructure and any modifications made by the Contractor. The following existing structural element designs shall be verified for their structural suitability to accommodate the new equipment or identify and design suitable modifications where necessary.

- Access road
- Subsurface services, (water pipes, electrical cables, compressed air pipes)
- Roadside walkways
- Buildings
- Air receivers

3.7.6.1 Design requirements

The design shall include the following.

- 2 Steel container houses for 2 diesel compressors.
    - The house shall be well ventilated, weatherproofed and provision for maintenance and operational space i.e. Minimum 1.0 m clear space shall be maintained on all sides of major equipment within the container for routine operation and maintenance activities.
- Geotechnical investigations
- Reinforced concrete base design for supporting the container houses
- Bund and drainage system to be connected to an existing infrastructure.
    - The bund shall contain 110% of the liquid (oil and diesel) capacity in the diesel engine.
- Lifting facility to cater for removal and replacement of equipment.

It is the Contractor's responsibility to provide the design and construction of the container houses 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.

The Contractor assumes full responsibility for the design of the whole and every portion of the works, whether the design work is undertaken specifically in relation to this contract and whether or not the Contractor is directly involved in the design work. Where the Employer has provided design requirements and a contradiction occurs, the most stringent requirement applies.

The relevant detailed design is approved by the Contractor's professionally registered engineer or technologist, registered with the Engineering Council of South Africa (ECSA). The Contractor is mandated in terms of Construction Regulations 2014: Duties of Designer, 6(1) g to fulfil the duties described therein. Any risk associated with the Contractor's design is highlighted to the Employer together with mitigation measures.

The contractor shall conduct underground scan to determine presence of buried services to consider prior construction.

3.7.6.2 Detailed design report

The *Contractor/Consultant* submits a detailed design report for each component of the *works* for review and acceptance by the *Project Manager*. All designs detailed comprehensive structural drawings and specifications are to be submitted in a design pack and are reviewed and approved by the *Contractor's* responsible Professional Engineer prior to submission to the *Project Manager* for acceptance. This design pack is complete, therefore the *Employer* can reproduce the structural design portion of the *works* and reach the same outcome as the *Contractor,* where there is no need for the *Employer* to make any assumptions or inferences about the designs or drawings.

The design report includes all detailed calculations used to perform the design as appendices. Print outs from an analysis software may complement design calculations, however, does not replace design calculations.

Each design calculation includes, as a minimum where applicable, the following:

- Design criteria statement and general information:
    - Design philosophy, including a narrative that explains the design approach,
    - List of applicable codes and literature that was used in the design,
    - List of assumptions made about the design (verified and unverified),
        - Mitigations for unverified assumptions are included,
- Calculation of loads:
    - All the applicable loads as required are calculated and shown in the report, including but not limited to:
        - Permanent loads,
            - More detail/calculations about where and how the loads are applied (point loads, line loads, area loads, etc.),
        - Variable loads,
            - Imposed loads on roof, structure and platforms,
            - All operational conditions are considered,
            - Dynamic loads
- All load combinations are according to SANS 10160, applicable international standards
- Foundation or base design,
    - Applicable soil information must be recorded,
    - The following checks must be in the design report:
        - Stability and soil verifications,
        - Soil bearing capacity,
        - Sliding safety,
        - Foundation settlements,

3.7.6.3 Drawings

All drawings shall be in accordance with 240-86973501 - Engineering Drawing standard - common requirements - Lists and standardises all requirements for Engineering drawings. Which includes: classification, format, changes, issuing, numbers, review, Title blocks and sizes

The *Contractor* submits editable electronic drawings in MicroStation (DGN/DWG) format and in PDF format. Drawings issued to the *Employer* are not “Right Protected” or encrypted.

Drawings submitted by the *Contractor* to the *Project Manager* for acceptance includes signatures as required by Eskom Engineering Drawing Standard (240-86973501).

Electronic drawings have a water mark indicating the approval phase of a drawing and hardcopies are to be stamped to indicate the approval phase.

Drawings are submitted in native format (dgn), pdf (digitally signed) and the original hard copy signed in ink (A0).

3.7.6.4 Professional Engineering Certification

The *Consultant’s* professional structural engineer who is registered with the Engineering Council of South Africa provides design certification in accordance with SANS 10400-A, declaring the design “fit for purpose” in terms of the relevant design codes and the OHS Act.

Where the *Consultant* is appointed for both design and construction monitoring, the *Consultant* is required to provide a 2-part certification:

- The first certificate is issued after the completion of the design (as above),
- The second certificate is issued upon completion of the construction in accordance with SANS 10400-A, declaring that the construction was carried out in accordance with the approved design and the OHS Act.

A professional structural engineer who is registered with the Engineering Council of South Africa (ECSA) provides both certifications.

3.7.6.5 Transfer of rights

The *Employer* retains the total rights to the *Employer’s* design. There is no transfer of rights to the *Consultant*.

The *Consultant* has the right to use material provided by the *Employer* only to Provide the Services. The *Consultant* may make this right available to a sub-consultant.

3.7.6.6 Construction requirements and Specification

3.7.6.6.1 Excavation

No excavations are permitted without an excavation permit obtained from the Project Manager. The Contractor complies with the requirements of the Construction Regulations. Excavations are performed such that it imposes a minimum restriction on access to Site for Others. Excavation permits are only issued if the area has been scanned by the Contractor, to ensure that there are no underground services in the area to be excavated. Refer to 32-727, Eskom Safety, Health, Environment and Quality (SHEQ) Policy.

3.7

3.7.6.7.1 Concrete works

All concrete & concrete work shall comply with: SANS 2001-CC1:2012

Minimum sample sizes for strength concrete (concrete test cube results) to be according to SANS 5863

The grade of concrete is as follows:

- The minimum concrete grade for structural concrete is 35/19MPa.
- The minimum grade of blinding is 15/19MPa.
- The minimum grade of mass concrete is 15/19MPa.

Formwork

- Formwork with damaged edges or faces is not used. Open joint in timber forms are sealed. Plywood surfaces and cut edges are sealed to prevent the absorption of moisture.
- Immediately before concreting, the forms and all other surfaces which are in contact with the fresh concrete, are cleaned of loose materials and debris including shavings, woods chips, sawdust, pieces of wire, nails, foamed plastic, fragments of hardened concrete and mortar.

Concrete Mix design

- The Contractor designs the mixes which he proposes to use in the works to meet the specified criteria including the requirements for durability, hot and cold weather, and temperature control and curing of concrete.
- The Contractor submits full details of all the mixes he proposes to use to the Supervisor not less than 21 days (unless stated otherwise on the project schedule) prior to the intended use of the concrete.

Concrete Placing

- Concrete is not placed in any pour to any part of the works until the Supervisor's acceptance has been given in writing, and the Contractor gives the Supervisor at least 24 hours' notice of his intention to place concrete in any pour
- When the Contractor has completed all preparatory work such as concrete surface preparation, formwork, reinforcement, and the like, he requests the Supervisor for acceptance to commence concreting at a particular time. The Contractor provides every facility necessary to enable the Supervisor to inspect prepared surfaces, formwork, and reinforcement, built in parts, and does not place the mortar layer or concrete until he has obtained the written acceptance of the Supervisor.
- If concrete placing is not commenced within 4 hours of the Supervisor's acceptance, the Contractor again requests written acceptance as specified above.

Concrete testing

- The slump of the concrete carried out in accordance with SANS 5862 is recorded.
- Six cubes are made from each batch for testing. Three cubes are tested for compressive strength at 7 days and 28 days
- The tests will be considered satisfactory if the average value of the crushing strength of each set of 3 cubes tested at 28 days exceeds the characteristic strength plus 3 MPa by a margin sufficient to ensure that the quality control criteria specified is met. If the difference between the highest and lowest results exceeds 15% of the average the tests are discarded and repeated.

At all stages of fabrication, all structural steel shall be positively identified by grade by means of a suitable marking system. In addition, all steelwork shall be marked to facilitate erection.

Cutting or hole forming may be done by sawing, shearing, cropping using a mechanical saw, guillotine, cropper, punch, drill, profile cutter or combinations thereof. When cutting the following shall be observed:

- The standards to which edge profiles are produced shall obviate dressing using hand grinders;
- The profile of cut outs shall have no sharp corners (to inhibit stress-raising effects);
- Gussets shall be profiled by cropping corners to avoid burning of corners during welding and to prevent the interruption of continuous fillet welds; and
- Edges shall be free from any defects or distortions and burrs. Notches shall be removed. Holes for fasteners shall comply with the following:
- Flame cutting or forming of holes by flame cutting is prohibited
- Holes may be punched, provided the diameter of the hole is the lesser of 12 mm or the thickness of the structural material involved;
- Holes for ordinary bolts and HSFG bolts of diameter up to 24 mm shall not exceed the diameter of the Bolt by more than 2 mm. For bolt diameters larger than 24mm, the diameter of the holes shall not exceed the diameter of the bolt by more than 3 mm;
- Holes for HD bolts of diameter up to 24 mm shall not exceed the diameter of the Bolt by more than 6 mm. For bolts with diameters between 24mm and 36mm, the diameter of the holes shall not exceed the diameter of the bolt by more than 10 mm. For bolt diameters larger than 36mm, the diameter of the holes must be as per the specification data or shown on the design drawings.

3.7.7 Quality

1) All work is earned out under the supervision of an experienced supervisor.
2) The *Contractor* complies with the *Employer's* Quality Requirements as specified in Employer Generation Standard GGS 0462 Annexure B to this Standard indicates the specific application thereof.
3) All quality control documentation is submitted to the *Project Manager* within 7 days of Contract date.

3.8 TRAINING

1) The Contractor provides training and the associated training documentation to the Employer on the on- site operational, monitoring and maintenance activities to ensure the safe reliable operation of the new diesel compressors.
2) The Contractor will also provide operating and maintenance manuals for the new diesel compressors and conduct training on on-site operational, monitoring, and maintenance activities for the Employer.

3.9 MAINTENANCE AND SUPPORT

1) The *Contractor* maintains the new diesel compressors during the defects period and provides on-

job training to the Employer on the on-site operation and maintenance of the new diesel compressors.

2) The *Contractor* provides a maintenance philosophy and plan for the new diesel compressor detailing what operational, monitoring and maintenance activities need to be performed on the new diesel compressors. The plan shall specify what level of skill (e g operator, Employer's artisan, supplier's technician) and what level of repair (in-situ, Employer's workshop, supplier's depot, or manufacturer's works) are required for each activity.

3) The *Contractor* ensures that service support and spares for the new diesel compressors are available from a supplier within a 200 km radius of Duvha Power Station

4) The new compressor will have a mean time to repair of 2 weeks or less.

3.10 DOCUMENT MANAGEMENT

All documents supplied by the *Employer* shall be subject to Employer's approval. The language of all documentation shall be in English. All documentation shall be controlled and managed in accordance with Document and Records Management Procedure (32-6).

3.10.1 Document Identification

The *Employer* is required to submit the Vendor Document Submission Schedule (VDSS) and 240-85521112 C&I Documentation Requirements from Vendors as per agreed dates to the delegated *Employer*. Employer will pre-allocate document numbers on the VDSS and send back to the Employer through the delegated Employer. The VDSS is revisable, and changes must be discussed and agreed upon by all parties. Changes in the VDSS can be additional documentation to be submitted, changes in submission dates or corrections in documentation descriptions, document numbers, etc. The Employer's VDSS shall indicate the format of documents to be submitted.

3.10.2 Document Submission

All project documents must be submitted to the delegated Eskom Representative with transmittal note. 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* with a transmittal note.

3.10.3 Electronic Submission

Electronic submissions shall be done using the ZendTo Larger File Transmittal Site functionality and route. The submission we use the following link can be used https://zendto.eskom.co.za/ .

Emails and other submission methods

Where applicable and contractually agreed, e-mail submissions can be used, as well as other submission methods employed in the relevant project e.g., Box, Norman Secure, etc.

3.10.4 Project Engineering Change Management

All Design change management shall be performed in accordance with the latest revision of the Eskom Project Engineering Change Management Procedure (240-53114026) and the *Employer* shall ensure that the *Contractor* is provided with latest revisions of this procedure. Any uncertainty regarding this procedure should be clarified with the Employer. All design reviews will be conducted according to the Design Review Procedure (240-53113685).

3.10.5 DRAWINGS FORMAT AND LAYOUT

The creation, issuing and control of all Engineering Drawings will be in accordance with the latest revision of engineering drawing Standard 240-86973501. Drawings issued to *Employer* will be a minimum of one hardcopy, a PDF file, and an electronic editable copy (.DGN). All *Contractors* are required to submit electronic drawings in Micro Station (DGN) format, and scanned drawings in pdf format. No drawings in TIFF, AUTOCAD or any other electronic format will be accepted. Drawings issued to *Employer* may not be "Right Protected" or encrypted. The *Employer* reserves the right to use these drawings to meet other contractual obligations. The *Contractor* shall include the *Employer's* drawing number in the drawing title block. Drawing numbers will be assigned by the *Employer* as drawings are developed. The *Employer* shall provide an Electronic *Contractor's* Drawing Title Block.

3.10.6 PLANT CODING AND LABELLING

3.10.6.1 Plant Coding

Coding of the design shall be based on the latest revision of Station AKZ Coding Standard and the *Employer* shall undertake the coding in line with its standards. The AKZ coding shall be applied during the design review stage(s) and cross referenced to all arrangement drawings, schematics, instructions, and manuals and where practical to spare parts list/manuals. The *Contractor* shall be required to include allocated coding to the electronic design drawings.

Plant Coding shall be undertaken by the *Employer* and as such the *Contractor* shall make available the following documentation to code:

Mechanical

- Piping and Instrumentation Diagrams (P&IDs)
- interface list
- process flow diagrams (PFDs)
- Detailed layout drawing.

Electrical

- single line diagrams
- electrical board general arrangements (GA)
- cable schedule

C&I

- C&I architecture drawings
- C&I Cubicle GA
- cable block diagrams
- remote control station lists
- cable schedules

Civil

- building floor plans per level
- underground services layouts

- cable rack & support
- building lists (including room equipment lists)

Employer will only code the AKZ code defining Documentation listed above. The *Contractor* will then be required to include allocated codes to all other designs and related documentation. It is also the responsibility of the *Contractor* to consistently apply the AKZ codes throughout the rest of the technical documentation which shall include, but not limited to:

- load schedules
- board parts lists
- cable block diagram
- termination diagram
- drive & actuator schedules
- instrument schedules
- alarm lists, loop diagrams
- signal lists
- schematic diagrams
- logic diagrams, etc.

The *Contractor* shall ensure that all documentation is coded (as per the codes assigned by the technician) prior submission to Employer for review.

3.10.6.2 Plant Labelling

The *Contractor* shall also manufacture and install AKZ labels to the new installed system. Labels shall be manufactured and installed according to the *Employer's* Plant Labelling Standard 240-71432150. The labelling standard shall be supplied as part of the enquiry documents. *Contractor* shall provide a label sample to be inspected and provided prior to bulk manufacturing of labels.

3.10.7 CONFIGURATION MANAGEMENT STANDARDS

- 240-109607332 Eskom Plant Labelling Abbreviation Standard
- 240-71432150 Plant Labelling Standard
- 240-86973501 Engineering Drawing Standard
- ENS0002_AKZX PLANT LOCATION CODING
- ETS0004 AKZX PLANT LOCATION LABELLING

3.11 DESIGN BASIS FOR PIPEWORK

- All pipes shall conform to SANS 62.
- Steel pipes complying with the requirements of SANS 62-1 or SANS 62-2 subject to a minimum wall thickness of 3.25mm are deemed suitable for use in a water-based fire suppression system. Any pipe used should be at least equivalent to medium grade black steel tube, and medium grade black steel tube when downstream of the installation control valve.
- Fabricated flanged steel pipe and fittings used shall comply with the requirements of SANS 1476.

- All pipes up to 50NB shall be screwed and anything above 50NB shall be flanged.
- All pipes must be provided with class 3.2 material certificate.

3.11.1 Design basis for Pipe Supports

- Pipe supports are to be provided for all the pipework installed i.e. for the detection pipework and the sprinkler pipework.
- All hangers and hanging material will be hot dipped galvanized to SANS 121[12] after fabrication, and either welded or bolted on site. Site repairs and welding will be touched up with cold galvanizing in accordance with SANS 121.
- The fire protection system pipe supports shall be capable of supporting the loads of the system without exceeding the maximum permissible deflection. Pipes shall be positioned to maintain a clearance to any other fixed structure, except the members to which such pipes are clamped. Supports shall be designed in accordance with SANS 10287.
- Structural pipe supports are to be provided at intervals not exceeding 2.5 m for the piping up to 50 mm Nominal Bore (NB) and all other piping shall be supported at 4.5 m intervals.

4. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Mary Maunye	Corp Specialist Plant Eng
Lucky Mtembu	Manager Maintenance
Andries Nxumalo	HMD maintenance supervisor
Devilliers Moll	Welding Snr Engineer Prof Engineer
Nsizwa Mhlongo	C&I System Engineer
Elliot Mamba	Electrical System engineer
Sibonokuhle Tapala	Auxiliary Snr Engineer Prof Engineer
Edzie Mohlala	Snr Advisor Technical Support
Alisha Surjoobhalee	Technician Configuration

5. REVISIONS

Date	Rev.	Compiler	Remarks
Month 2024	1	T Masethe	Draft Document

6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Thabiso Masethe
- Nsizwa Mhlongo