 Eskom	Scope of Work	Engineering
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Title: **Temporary Power Supply
Installation for Ash Dam
Projects**

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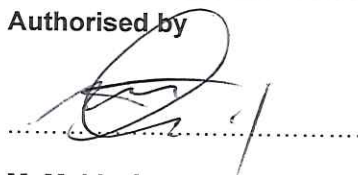
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1. Introduction

The power station's existing ash dump facility is nearing its operating capacity and therefore, there are projects which seek to remedy the situation. These projects are going to run for about three years. The project personnel are going to be stationed near ash dams for the duration of the project. Therefore, there is a need to power up their park homes.

2. Supporting Clauses

2.1 Scope

The scope of this document covers the installation of power supply for ash dam projects park-homes.

2.1.1 Purpose

The purpose of this document is to capture the detailed requirements for the installation of power supply for ash dam projects park homes.

2.1.2 Applicability

This document is applicable, but not limited, to all stakeholders identified within this report. This includes, among others, individuals within Kendal Power Station Engineering, Maintenance and Operating.

2.2 NORMATIVE / INFORMATIVE REFERENCES

2.2.1 Normative

- [1] ISO 9001: Quality Management Systems.
- [2] ISO 14001: Environmental management Policy
- [3] ISO 7919: Mechanical Vibrations

2.2.2 Informative

- [4] 240-53114002: Engineering Change Management Procedure.
- [5] 36-667 Generation Division Project Management Policy
- [6] 36-40 Plant Asset Management Directive
- [7] 36-155 Generation Project Execution Model and Reference Book (Project Model) Manual
- [8] 36-300 Project and Outage Risk Management Guideline
- [9] *1017523 Kendal Power Station Business Roles and Responsibilities
- [10] ESKASAAA3 Approval of personnel performing quality related special processes on all Eskom plant

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2.3 Definitions

Term	Definition
Contractor	In the context of this document, the "Contractor" will be regarded as the service provider who is authorised by the station to execute the specific work outlined in this document.
Employer	In the content of this document, the "Employer" will be regarded as the Eskom power plant receiving the service from the Contractor.

2.3.1 Classification

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

2.4 Abbreviations and Acronyms

Abbreviation/Acronym	Description
IP	Ingress Protection
KKS	Kraftwerks Kennzeichen System
OHAS	Occupational Health and Safety ACT
PLC	Programmable Logic Controller
QCP	Quality Control Plan
SHEQ	Safety, Health, Environmental and Quality

2.5 Roles and Responsibilities

Each department plays a pivotal role in making sure that projects are successful and systems are returned to service on time, and efficiently. Refer to the Kendal Power Station business Organisation Roles and Responsibilities *1017523. The roles and responsibilities of each department are summarised below:

2.5.1 Outage Department

- Develop optimized outage networks
- Management of contract services provided during outages
- Ensure quality control of activities during outages
- Management of time cost and quality of outages
- Develop Kendal specific outage readiness indicator as per generation outage planning principles
- Submit financial plan spread sheet

2.5.2 Engineering Department

- Is responsible for the system control philosophy
- Compiles scope of work
- Ensuring plant and documents are technically compatible
- Proposing and implementation of modifications
- Assist with the review of quality control plans

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2.5.3 Technical Support Department

- The supervision of activities to ensure quality and productivity targets are achieved
- The control of spares and consumables
- Technical review of work instructions at pre-determined intervals
- Provision of quality work history
- The notification of all failures not attributed to normal wear and tear and/or frequent/repeated failures of components.
- To assist in the investigation of incidents and the root cause analysis
- Monitor spares stock holding

2.5.4 Inventory Management Department

- N/A

2.5.5 Safety and Environment Department

- Implementation of SHE systems
- Ensure compliance with OHS Act and putting in place of enforcement mechanism
- Regular internal communication at all levels by way of meetings and discussions concerning health and safety
- Identify hazards in different areas and conduct task risk assessments regarding employees acts
- Coordinate and identify SHE training gaps
- Development and implementation of safety policies and procedures
- Report incidents

2.5.6 Quality and Assurance Department

- Ensure quality control processes are in place.
- Ensure adherence to Eskom operating procedures, policies, guidelines and plant safety regulations
- Review and accept quality plans

2.5.7 Projects Department

- Implement projects in line with the planned programme
- Management of contract services for the projects
- Ensure quality control of activities during projects
- Management of time cost and quality of projects

2.5.8 Contractor

- The responsibilities of the contractor are as per NEC, compliance to the scope and the relevant standards.

2.5.9 Training Department

- Sufficient training must be arranged for the Engineering, Operating and Maintenance department's prior handover.

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3. Works Information

The works information is outlined in the sections below.

3.1 Detailed Scope Requirements

The Contractor is responsible for providing the procurement, delivery, installation, configuring, testing, commissioning, decommissioning of the old system, documentation and handover of all items of the scope listed in the sections below, as well as all items and consumables required to realise the requirements stated in this document.

3.1.1 Codes and Standards

The following codes and standards are applicable to the design, installation and commissioning of the solution and shall be adhered to at all times and for all of the scope defined in this document:

- 240-56227443 *Requirements for Control and Power Cables for Power Stations Standard*
- 240-56355815 *Control & Instrumentation Field Enclosures and Cable Termination Standard*
- 240-56356396 *Earthing and Lightning Protection Standard*
- 240-86973501 *Engineering Drawing Standard*
- 240-71432150 *Plant Labelling Standard*
- 240-93576498 *KKS Coding Standard*
- 1017822 *Functional Location (KKS) Coding and Labelling Work Instruction*
- 1024102 *Kendal Waste Management Work Instruction*
- 240-47172520 *Standard for the Construction of Overhead Powerlines*
- 240-75883906 *Medium Voltage Reticulation Section 0: General Information and Requirements for Overhead Lines Up To 33 kV Standard*
- 240-147806256 *Determination of Conductor Ratings in Eskom*

3.1.2 Scope Requirements

The works entail:

- Supply, erection and commissioning of 1 km long 11 kV medium voltage overhead reticulation line fed from 11 kV ash overhead 1 as depicted in figure 1 ,
- Supply, installation and of gang isolator as illustrated in figure 1
- Supply, installation and commissioning of 500kVa mini substation as illustrated in figure 1
- Supply, installation, termination and commissioning of linking power cable as illustrated in figure 1

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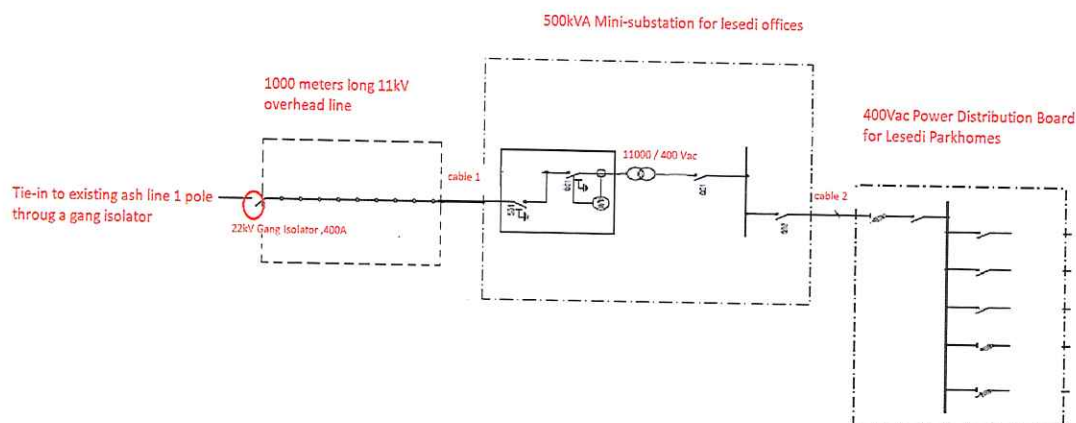


Figure 1: Functional layout of the required power reticulation

3.1.2.1 General Cable requirements

- Install new low voltage 11kV, XLPE insulated with flame-retardant reduced halogen emission PVC outer sheath and bedding (emit a mass of not more than 15% halogen)
- Install single core unarmoured PVC insulated PVC sheathed 600/1000 V cables manufactured to SANS 1507-3
- The scope includes procurement, provision of proof of factory acceptance testing (FAT), supply, delivery, off-loading, storage, installation, site acceptance testing (SAT), commissioning, certification and handover of *works to EMD*.
- Supply and install all cable accessories such as terminations and jointing kits, cable glands, lugs, bolts, washers and nuts for terminations, sleeves and other ancillary material for fitting the cables into position.
- The cable lengths provided is an estimate and must be verified upon a routing assessment.
- The cables shall be manufactured to SANS 1339 and SANS 1411 Parts 1, 2, 4, 6 and 7.
- The new power cables are installed in accordance with 240-56227443 -Requirements for Control and Power Cables for Power Stations Standard

3.1.2.2 Cable specification

Table 1: Required Linking Power Cable

Voltage Grade (V)	Insulation	Finish Construction	No of Cores	Core Area (mm ²)	Conductor Material	Serving or Protection	Distance(m)
11kV	XLPE insulated	General PVC	03	95	Stranded Copper	Low Halogen, PVC Sheathed, armoured	100

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Table 2: required Linking Power Cable

Supply and Install							
Voltage Grade (V)	Insulation	Finish Construction	Single cores	Core Area (mm ²)	Conductor Material	Serving or Protection	Distance(m)
600/1000	General PVC	General PVC	04	300	Stranded Copper	Low Halogen, PVC Sheathed	350

3.1.2.3 Gang isolator requirements

- Type: Gang operated Rocking Isolator, Off Load
- Rated Voltage: 22kV
- Rated Current: 400A
- Contacts material -copper
- Plating: Nickel 15-25 microns
- Insulator material: Porcelain
- Creepage distance: 550mm
- Impulse Withstand Voltage: 170kV
- Equipped with fast blow fuse selected as per specification Eskom Standard 240-75883906.

3.1.2.4 Overhead line requirements

3.1.2.4.1 Wooden Poles

- Wood poles shall be used as the standard pole for the overhead lines.
- Wood poles shall have fibre strength of at least 55 MPa and shall be in accordance with Eskom standard DSP 34-1647.
- Power line structures are considered optimised when the full capacity of the pole is optimised i.e. the wind, weight, maximum electrical and level ground spans are similar. The detail design shall ensure this optimisation.
- When selecting pole sizes for the Kendal 11kV Ash Overhead line , it should be noted that the line path may be undulating and may require the wind, weight and electrical spans to be longer than the level ground spans. In all cases the most suitable pole that meets all the required parameters shall be selected.
- Pole foundations shall be designed to withstand the overturning moment due to windage on conductors, poles and insulators.

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- Foundation design shall also take account of the rupturing capacity of the ground. In excavating foundation holes, the minimum amount of soil shall be disturbed in order to take advantage of the load bearing value of the virgin ground as far as possible. Back-filled soil shall be compacted using hand or mechanical compaction methods. Not more than 150 mm of loose soil shall be returned between each ramming operation.
- In accordance with Eskom Standard 240-75883148, a Dynamic Cone Penetration (DCP) soil test is not required at each pole. A DCP test is however required at each pole stay.
- All organic or other foreign materials shall be removed from back fill earth.
- Where the quality of back fill material is unsuitable it shall be necessary to replace the excavated material with a suitable imported backfill.
- Planting of poles, stays and backfilling of holes shall be in accordance with Eskom distribution standard 240-75883148. The design shall refer to Eskom Distribution standard 240-75883906 for planting depths of wood poles.
- The design shall refer to the structure selection guide (Table 9) in Eskom Distribution standard 240-75883906 for the selection of the structure configuration for conductor type Mink.
- The structure designs shall be for a 11 kV three-phase distribution system.
- Poles shall always be planted in a straight line as far as possible.
- The finish of the top end of the pole shall be square cut single, not less than 11 meters with a proposed diameter of 180-199 mm.
- Poles shall be loop tension banded at both ends
- The poles shall be provided with aluminium identification tags bearing:
 - The identification mark of the plant at which the pole was treated
 - The year during which the pole was treated,
 - The class of wood preservative used (see SANS 10005)
 - The number of the charge in which the pole was treated
 - The group strength or maximum fibre stress in bending.
- Templates shall be used for drilling holes required to fix cross-arms, brackets, indicators, etc. to the poles. The pole excavation shall be done in accordance with the Detailed Design and approved drawings.

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3.1.2.4.2 Span Lengths

- The basic span length is specific to the conductor and environment in which the line will be situated and will be considered in the detailed design. Individual spans will normally be within $\pm 20\%$ of the chosen basic span.
- The maximum span lengths shall be calculated taking account of conductor clashing and steelwork strength limitations. Maximum span length is the lesser of the actual ground clearance span, electrical span, wind span and weight span. This is restricted by the strength of the poles and cross arms used and depends on the MV Mink conductors used.
- The average span length of every kilometre of line (not necessarily between section supports) shall not be greater than the basic span.
- Wind span values are based on pole strength and the soil foundations will be adequate in type 1 soils.
- If this is not the case and poor soil is suspected, individual calculation shall be done using the bearing pressures received from actual tests.

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3.1.2.4.3 Phasing

- Phasing on all pole top configurations shall be in accordance with Eskom drawing D-DT-0311 — “Phase configurations for standard pole top designs”.

3.1.2.4.4 Stays and Anchors

- Stays provide stability for line structures and shall impose as little crippling load as possible on the supporting poles.
- The standard MV stay assembly is 96 kN. This assembly is adequate for all stayed structures. The number of stays used for each structure may vary to suit the structure type, conductor size and line deviation angle. When 60° deviation is exceeded on an H-pole structure, bisector stays must be fitted to both uprights.
- Adequate staying shall be installed to maintain correct tension of the line and the verticality of every pole in the line.
- Stay wires shall be installed with approved preformed materials.
- The angle between the stay and the poles shall be between 30 and 45 degrees. The stay shall be made off on the pole, as near as practical to the point of resultant stress.
- Stay wires shall comply with SANS 182-5 and shall be manufactured from zinc-coated stranded steel wires.
- The number and standard diameter of wires shall be 7 /4.00mm or nearest complying with 450 kPa. The overall diameter shall be 12.19 mm (min.) in accordance with SANS 182-5.
- Stay rod length shall be in accordance with Eskom standard 240-75883148 Table 3
- All material used for the stay work shall be galvanised.
- Power installed stays may be used in suitable soils if the strength criterion is met, the most cost-effective stay assembly shall be used. This may be conventional, rock or percussion.
- Struts shall be fitted with anti-climbing devices.
- Stays shall be indicated on the final design drawings by means of the structure codes.
- Flying stays shall be installed in the positions indicated on the final design drawings and shall be indicated by the Eskom design codes. Anchor poles shall be as specified for the line structures and of sufficient length to ensure the required ground clearance.

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3.1.2.4.5 Cross Arms

- Cross arms may be constructed from wood or metal, as deemed appropriate by the designer.
- The distance between the cross arm and stay wires shall be at least 70 mm.
- After the erection of supports and providing guys, the cross-arms are to be mounted on the support with necessary clamps, bolts and nuts. The practice of fixing the cross arms before the pole erection should be followed.

3.1.2.4.6 Conductors

- Bare conductors shall be used for the Kendal MV overhead reticulation
- The overhead line shall be aluminium conductor steel reinforced (ACSR) Mink technology.
- Mink conductor properties are detailed in the table below:

3.1.2.4.7 Conductor Sags and Tensions

- The software program, PLS-CADD, shall be used to produce sag and tension tables for the 11 kV line.
- This software shall also analyse clearances and drafting functions for the design of the entire power line.
- Power Line Systems' PLS-CADD technology has been the industry standard for 30 years and has a proven technology to ensure the integrity of a utility's grid and infrastructure.

3.1.2.4.8 Electrical Clearances

- In positioning lines and equipment, fixing connections and setting of jumpers, the minimum clearances shall be in accordance with SANS 10280 .
- Where the clearance is likely to vary due to the flexibility of connections or the remoteness of fixed supports, the above-mentioned clearances shall be increased to suit the conditions pertaining, allowing for swing due to wind etc.

3.1.2.4.9 Stringing of Conductors

- The works include spreading of conductors without any damage and stringing with proper tension without any kinks/ damage.
- The ground and line clearances at road crossings, along roads and other crossings shall be as per the design.
- Transportation of cable drums shall be such that the conductor does not get damaged. The drum shall be mounted on a cable drum support. The direction of rotation of the drum shall be according to the mark on the drum so that the conductor can be drawn correctly. While drawing the conductor, it shall not rub against any surface causing damage. The conductor shall be passed over poles on rubberized or aluminium snatch blocks (pulleys) mounted on the poles for this purpose.
- The conductor shall be pulled through come-along clamps to string the conductor between the tension locations.

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- Conductor splices shall not crack or otherwise be susceptible to damage in the stringing operation. The Contractor shall use only such equipment / methods during conductor stringing which ensures complete compliance in this regard. All the joints including mid span joints on the conductor shall be of the compression type, in accordance with the recommendations of the manufacturer and Eskom requirements.
- All joints shall be such that their current-carrying capacity exceeds that of the conductors that are being joined. Tension joints shall have a breaking strength of at least 95 % of that of the conductor.
- The maximum working tension may be exceeded only during the construction stages when the conductors are to be "over-tensioned" to $1.05 \times \text{MWT}$ for a period of not less than 8 hours, nor longer than 24 hours, after which the tension is to be reduced to a figure not to exceed the stated maximum working tension of the conductor concerned.
- Care shall be taken that the conductors do not touch and rub against the ground or objects, which could scratch or damage the strands.
- The sequence of running out shall be from the top to bottom i.e. the top conductor shall be run out first, followed in succession by the side conductors. Unbalanced loads on poles shall be avoided as far as possible.
- The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations. The final conductor surface shall be clean, smooth and free from projections, sharp points, cuts, abrasions, etc. The Contractor shall be entirely responsible for any damage to the poles during stringing.
- The conductor shall be checked constantly as it is unwound from the Conductor drum for any broken, damage or loose strand. If any major defect is noticed, then the defective portion must be removed and a mid-span joint provided.

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3.1.2.4.10 Joints and Connections

All joints and connections shall be the compression type and shall comply with the requirements of Eskom standard 240-75883110.

No joints shall be placed in crossing spans.

There shall not be any mid-span joint over a road crossing.

Joints shall, as far as possible, be made in the middle third of a span. No joint shall be placed within 20 m of a structure.

3.1.2.4.11 Insulators

- SANS 60815 shall be used as the guide for the selection of phase insulators.
- Insulators, together with their fittings, shall comply with SANS 60305, SANS 60383 and IEC 61109 and shall offer a high resistance to damage.
- The strength of the insulator shall be such that at the maximum working load of 4 kN for line post insulators and 40 kN for strain insulators shall be afforded.
- Pin insulators shall be used on all poles, while strain insulators shall be used on all angle and dead- end pole
- Intermediate pole conductor binding shall be carried out by means of wrap lock ties.
- Tension fittings shall be the preformed wire type, specially designed for the ACSR conductor used
- (Mink) together with suitable fittings for securing the tension insulators.
- Adequate bearing area between fittings shall be provided and "point" or "line" contacts shall be avoided. All split pins for securing the attachment of fittings of insulator sets shall be of stainless-steel type material and shall be backed by washers. D-shackles between insulator and eye shall be installed at all strain positions in accordance with SANS 10280.
- The cycloaliphatic long rod or porcelain insulators shall be puncture proof and of the type as specified in the detailed design. The insulator shed material shall have a high resistance to tracking by surface leakage currents and operate normally under adverse weather conditions. All insulators shall conform to the standards referenced in Section 3 of this document.
- Strain insulators of the twisted clevis tongue type are required for strain and terminal poles. The insulators shall be cycloaliphatic resin or high-grade porcelain material as specified in the detailed design.
- Strain insulators shall be complete with galvanized clevis pin (SANS 121) complete with washers and stainless-steel split pins (304 stainless steel), for preformed dead end.
- Strain insulators shall be installed and connected to cross-arms and A-frames, with D-shackles, clevis thimble and preformed dead end for conductor as per design specifications

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- Prior to fixing, all insulators shall be cleaned in a manner that shall not spoil, injure or scratch the surface of the insulator, but in no case shall any oil be used for this purpose. A torque wrench shall be used for fixing various line materials and components, such as the suspension clamp for conductors, whenever recommended by the manufacturer.

3.1.2.4.12 Insulation Levels and BIL

Insulation levels for the overhead line shall be as per SANS 10280

The requirements for surge arrestors, BIL and bonding shall be considered in accordance with Eskom standard 240-75883906.

Lightning strike activity in the Kendal area shall be considered. Isochronic graphs are somewhat generalised, and it is possible to find a relatively high lightning incidence pocket with in a low rated area. For this design the number of lightning ground flashes per km² per year in accordance with the CSIR is 7.5 /km² (Witbank is the closest listed town to Kendal Power Station)

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3.1.2.4.13 Drop out Fuse Cut-outs

Switching points shall be provided and should preferably be fuse(fast blown) links.

Fuse selection criteria shall be carried out in accordance with Eskom Standard 240-75883906.

3.1.2.4.14 Surge Arrestors

Surge arrestors shall be installed if deemed a requirement from the line Detailed Design.

3.1.2.4.15 Line Routing

The overhead line will follow the most optimal and safest route in terms of clearances and ground profile.

A high-resolution drone scan has been carried out on the entire overhead line route to obtain optimal routing, pole positioning and line placement. Drones provide the ultimate platform to survey small or large areas by utilising stable aerial platforms over a site with ultra-sharp, high-definition camera systems. Accuracies of sub 1 cm are easily achievable.

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3.1.2.5 Plant coding and labelling

All numbering and labelling shall comply with the standards listed in section 3.1.1.

3.1.2.6 Testing and commissioning

The Contractor compiles and submits testing and commissioning procedures, for acceptance prior to any installation work starting.

Upon the successful completion of commissioning activities, the Contractor compiles and submits a commissioning report for acceptance. This report shall describe the commissioning results and, as a minimum, refer to the relevant commissioning procedure as well as any defects found and how they were rectified.

The Contractor provides all Equipment, tools and software required for testing and commissioning.

3.2 Documentation Requirements

All documents supplied by the Contractor are subject to the Employer's acceptance.

The language of all documentation is English.

All documentation is controlled and managed in accordance with Document and Records Management Procedure (32-6).

The creation, issuing and control of all Engineering Drawings are in accordance to the latest revision of the Engineering Drawing Standard 240-86973501.

As a minimum, the Contractor submits three hard copies and an electronic copy of all drawings to the Employer.

The Contractor submits electronic drawings in Micro Station (DGN) format, and scanned drawings in PDF format. No drawings submitted in TIFF, AUTOCAD or any other electronic format are accepted.

Drawings issued to the Employer are not "Right Protected" or encrypted.

3.3 Quality Control Plan

The Contractor compiles and submits a quality control package that includes the final scope of work, quality control plans, safety files, work execution procedures, etc. to Electrical Engineering and Electrical Technical support for acceptance prior to the commencement of the works. Refer to Kendal Quality Management Manual *1017374.

3.4 Competence

The Contractor shall comply with all the scope of work requirements. The competence of the Contractor will be evaluated during the technical evaluation by the Kendal Electrical Engineering and Maintenance team.

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3.5 Equipment Requirements

The Contactor shall supply all Equipment required to fully, and successfully, meet the requirements stated in this document.

3.6 Safety

Refer to the SHEQ Policy statement 32-727 and the OHAS 18001.

3.7 Environment

Refer to the SHEQ Policy statement 32-727 and ISO 14001.

3.8 Risk Management

Risk assessment shall comply with the following documents:

- Kendal Quality Management Manual *1017374
- Kendal Integrated Risk Management Procedure *1017401

3.9 Production Preservation Requirement

Refer to the Kendal Quality Management Manual *1017374, section 7.4.4 and 7.5.5

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4. Acceptance

This document has been seen and accepted by:

Name and Surname	Designation
Refilwe Mosadi	Project Leader
Thabani Sithole	Project Manager
Jack Matsi	Electrical Maintenance Supervisor

5. Revisions

Date	Rev.	Compiler	Remarks
July 2022	1	M.Tose	First draft.

6. Development Team

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

- M Tose

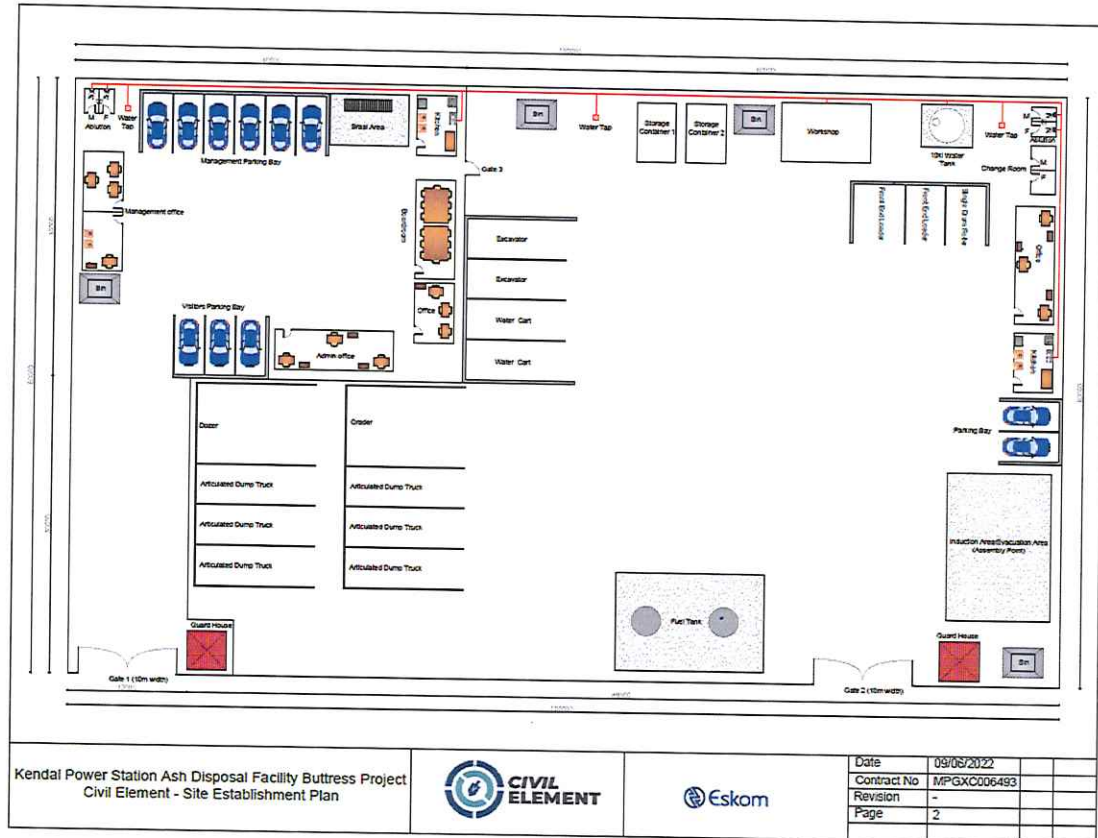
7. Acknowledgements

None.

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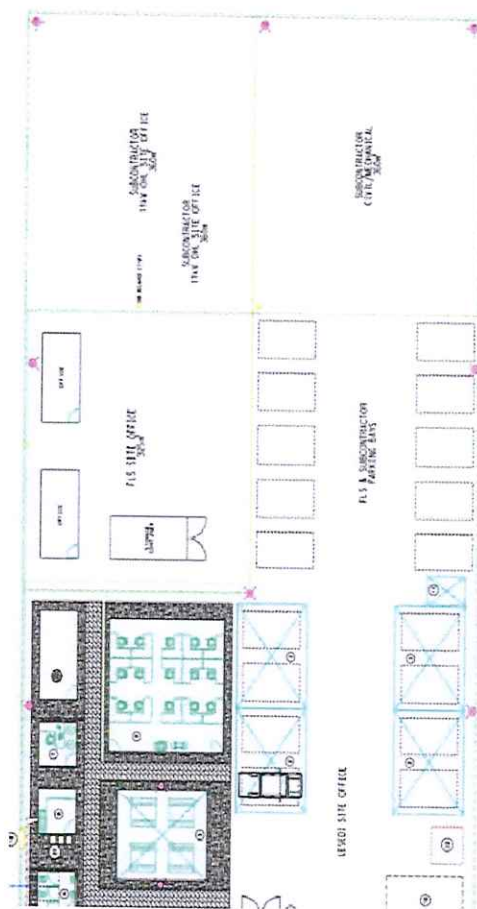
Appendix A: Civil Element Park home with required current of 110A



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Appendix B : Lesedi Park home with required current of 289A



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