

	WORK INSTRUCTION	KUSILE POWER STATION PROJECT
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Title: **TRENCH AND EXCAVATION
WORK INSTRUCTION**

Document Identifier: **240-131806419**

Alternative Reference
Number: **N/A**

Area of Applicability: **Eskom Holdings SOC Ltd**

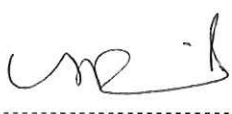
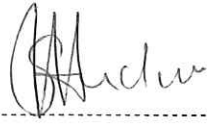
Functional Area: **Kusile Project**

Revision: **1**

Total Pages: **22**

Next Review Date: **October 2021**

Disclosure
Classification: **Controlled Disclosure**

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Date: <u>14/05/2018</u>	Date: <u>14/05/2018</u>	Date: <u>2018/05/22</u>	Date: <u>2018/05/25</u>

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**KUSILE POWER STATION
TRENCH AND EXCAVATION WORK
INSTRUCTION**

Unique Identifier: 240-131806419

Revision: 1

Page: 3 of 22

Table 3: Minimum Personal Protective Equipment required

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1. Introduction

This document is intended to ensure that operational activities are carried out in a safe and systematic manner. In order to ensure sustained performance of plant and equipment on a long-term basis, all parties involved in this action will carry out the instructions in the required time, only authorised or competent persons will carry out work and that materials and equipment used comply with legislation.

2. Supporting Clauses

2.1 Scope

This document describes the process by which all Excavation and Trenching on the Kusile Power Station Project shall be conducted.

2.1.1 Purpose

The purpose of this document is to ensure that:

- Activities are properly identified.
- The safety aspects of the work are properly identified.
- The relevant Personal Protective Equipment (PPE) is correctly identified.
- Records are identified, controlled, collated, filed, stored and maintained for a pre-determined period so that adherence to standard requirements can be demonstrated.
- Ensure compliance with applicable legislation whilst preventing injuries and property damage incidents.

2.1.2 Applicability

This document process applies to the excavating and backfilling of all trenches by hand and by excavator machines. This document shall apply to all Contractors and Sub Contractor work(s) associated with the Kusile Power Station Project.

2.1.3 Effective date

This document shall be effective from date of approval

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2.2 Normative/Informative References

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

- [1] 240-131819635 - Trench, Excavation, Earth Moving Permit
- [2] 240-131819659 – Access Certificate
- [3] 240-131819607 – Excavation and Trenching Permit Register

2.2.1 Normative

- [4] ISO 9000 Quality Management System - Fundamentals and Vocabulary
- [5] ISO 9001 Quality Management Systems – Requirements
- [6] ISO 14001 Environmental Management System
- [7] BS OHSAS 18001:2007 Occupational Health and Safety Management Systems
- [8] Occupational Health and Safety Act (85 of 1993) and associated Regulations

2.2.2 Informative

- [9] Task Specific Hazard Identification and Risk Assessment
- [10] Eskom Work Permits
- [11] Relevant inspection documentations

2.3 Definitions

2.3.1 Table 1- Document definitions

Definition	Description
Contractor Representative	This shall be a person who performs his normal duties in a supervisory capacity and who is fully trained, found competent and authorized as a representative in terms of the requirements for trench and excavation works;
Client Representative	Shall approves or reject trench and excavation works;
Excavation	Means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal;
Package Construction Manager	Construction Manager appointed to oversee Contractor works;
Protective system	Means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include

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Definition	Description
	support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection
Shoring (Shoring system)	means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave- ins
Underground Locator	means a method such as ultrasonic, infrared, or electromagnetic detection utilized to identify underground utilities prior to trench and excavation activity;

2.4 Abbreviations

Table 2: Abbreviations and Explanations

Abbreviation	Explanation
AFC	Approved For Constructions
KET	Kusile Execution Team
LV	Low Voltage
MV	Medium Voltage
PPE	Personal Protective Equipment
SPO	Smart plant operation
SHE	Safety, Health and Environmental

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2.5 Roles and Responsibilities

2.5.1 Contractor Site Personnel

Contractor Site Personnel shall be responsible for complying with:

- Section 14 of the Occupational Health and Safety Act 85 of 1993
- The requirements of this excavation and trenching work instruction

2.5.2 Contractor Site Manager (Construction Manager)

The Contractor Site Manager shall be responsible for:

- Complying with section 8 of the Occupational Health and Safety Act 85 of 1993
- Complying with section 13 of the Occupational Health and Safety Act 85 of 1993
- Ensuring that personnel performing tasks in accordance with this work instruction are competent to perform such tasks
- Ensuring that the personal protective equipment required performing the tasks described in this document is issued to the relevant employees.
- Ensuring that site records are properly stored and are easily retrievable

2.5.3 Contractor SHE Officer (Construction SHE Officer)

- The Contractor SHE Officer (Construction SHE Officer) shall be responsible for ensuring that:
- Equipment inspections are carried out as required and that equipment is safe to use.
- Tools and accessories are controlled and used in accordance with the work instruction.
- The Personal Protective Equipment required performing the tasks described in this work instruction.
- Work Instruction is issued to site employees.
- A Task Specific Hazard Identification and Risk Assessment is conducted with all employees involved prior to work commencing and re-conducted if the scope of the work changes.
- Site records are adequate to demonstrate compliance to the requirements of the document.
- Site records are properly stored and are easily retrievable

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2.5.4 Contractor Site Supervisor (Construction Supervisor)

The Contractor Site Supervisor shall be responsible for ensuring that:

- All employees comply with this work instruction.
- All employees are aware and understand the hazards attached to the work being carried out.
- A Task Specific Hazard Identification and Risk Assessment is conducted with all employees involved prior to work commencing and re-conducted if the scope of the work changes.
- Required control measures are identified and implemented.
- Discipline is enforced at the construction site at all times.
- All identified statutory requirements are met.
- Any other interests in terms of the Health and Safety with respect to the responsible area are met.
- Safety, Health, Environmental and housekeeping requirements are met while ensuring that personnel on site adhere to these requirements as well.

2.5.5 KET Project Construction Manager

- The appointed KET Package Construction Manager is responsible for ensuring that all required disciplines have reviewed and signed the Trench and Excavation Permit prior to work commencing by the Contractor
- Shall ensure that the Contractor is aware of all approvals, rejections and comments that are to be incorporated in to the Trench & Excavation Permit
- May delegate [recorded in writing] his responsibility to a suitable person that they have deemed to have the appropriate level of knowledge and experience to conduct duties relating to this document.
- Is responsible for ensuring that construction works only take place once a valid access permit is available, Other KET designated personnel reviewing the permit are not required to verify the validity of access permits.
- Site records are properly stored and are easily retrievable

2.6 Process for Monitoring

This document is subject to document control work instructions and will be updated when it is due for revision or when conditions dictate. The process of monitoring is through internal and external audits.

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2.7 Related/Supporting Documents

- Contractor Risk Assessment Register.
- Task Specific Hazard Identification and Risk Assessment Recording Sheet
- Contractor Hand tools inspection
- Contractor Daily excavation checklist
- Existing services, wayleaves and drawings
- Contractor drawing register
- The Kusile relevant latest SHE Specification

3. Document Content

- The document describes the process/method to be followed for the excavating and backfilling of all trenches by hand/manual safely and by excavating machines.

3.1 Safety

Table 3: Minimum Personal Protective Equipment required for this job at Kusile Power Station

Overall	Overall Pants	Overall Top	Dust coat	Apron	Hard hat	Gum boots	Safety shoes	Safety Glasses	Face shield	Welding helmet	Dust mask	Respirator	Ear protection	Safety belt (harness)	Gloves
	X	X			X		X	X							X

- Personal protective equipment (PPE) must be worn when work is carried out.
- A Task Specific Hazard Identification and Risk Assessment must be carried out.
- Ensure that the correct hand tools and testing equipment are available and are inspected.
- Ensure all required permits, access or possession certificates have been issued.
- Where permits have been issued, ensure that the necessary documents are in place
- Ensure that all existing services has been identified and recorded. The location and type is to be recorded in relevant document.

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3.2 Tools and Equipment

- Tools and equipment shall be suitable and maintained.
- Tools and equipment will be used in such a manner that does not damage the steel material or the protective coating.
- Any tools and equipment that could cause such damage shall be removed from the work site and replaced with acceptable tools and equipment.

3.3 Excavation Permit

- Before commencing excavation work an application for excavations must be submitted to the Client representatives.
- Trench and Excavation Permit Register (240-131819607) will be maintained at KET Document Control department consisting of allocated permit numbers.
- Excavation may only commence once permission is obtained from the Client and an access certificate and/or permit is issued were deem necessary.
- Contractor Competent Representative completes Trench & Excavation Permit and submits Permit (per document delivery contractual process) to the Package Construction Manager for review, acceptance and signatures. A site engineer's sketch/drawings of the proposed excavation shall be attached to the permit. The sketch/drawing should relate to the boundary of the excavation and the immediate vicinity.
- Note: If Contractor's proposed works are within another Contractor's area or area for which the Contractor doesn't have approved access, an Access Permit shall be obtained from the Primary Access Holder (the contractor currently holding access or KET) and form part of the Trench and Excavation Permit packet.
- The engineers sketch/drawing shall detail the excavation dimensions not just the dimensions of the structure or utility that will be constructed. The sketch will include any ramps and minimum service information relating to the excavation 5m beyond the top of the excavation. The sketch/drawing will also include transposed service, utility and other pertinent information from utility drawings. The dimensioned sketch/drawing will always include a plan view and if required may require section view(s).
- Contractor Construction Manager requests Permit Number from KET Document Control after all signatures have been obtained.
- KET Construction Manager Reviews that Contractor Representative has applicable permit with approved Construction (AFC) drawing(s) and/or "As-Built" drawing(s) for the area indicated on the respective Sketch or drawings.
- Contractor shall ensure that a trained and competent person who has received the KET buried service briefing shall perform a physical evidence survey and perform an underground locate for all identified utilities and installations identified on the applicable drawing(s) in the area indicated on the respective Permit. All underground installations within the excavation servitude (+ 5 meters), in addition to excavation boundary points, shall be marked on the ground as indicated on the below table 2 as follows:

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Table 4: Ground marking colour indication

COLOUR	DESCRIPTIONS
Blue	Drinking water
Orange	Telecommunications, alarm or signal lines, or conduit;
Pink	Temporary survey markings, unknown/unidentified facilities; White Proposed excavation limits (boundaries) and/or route;
Red	Electrical power line, cables, conduit, and lighting cables
Violet	Reclaim water, irrigation and slurry lines;
Yellow.	Natural gas, oil, steam, petroleum or other gas/flammable liquid; Green Sewers and drain lines;

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- If no installations are noted on the respective drawing, Contractor shall still continue with underground locate to ensure no other underground installations are present.
- Contractor Construction Manager reviews proposed trench and excavation controls for adequacy and ensures all required documentation are included with the Permit. Control measures may include, but not be limited to, the following: de-energization, hand digging, hydro-excavating, shoring, sloping, etc.
- Once reviewed and accepted, the Contractor Construction Manager submits the Permit to Field Engineering to review drawing validity and to review if underground installations have been appropriately identified on the applicable drawing(s). Field Engineering will accept permit by applying his/her signature.
- Once all reviews and signatures have been obtained the Package Construction Manager will indicate Final Acceptance by applying his/her signature.
- The Contractor Construction Manager submits the signed Trench & Excavation Permit to Document Control so it can be logged into the Trench and Excavation Register. Document Control shall make a copy for the Contractor and retain the Original. The Contractor Construction Manager can then return the accepted Permit (photocopy) to the Contractor Representative;
- Contractor performs proposed works for the timeframe identified on the approved Trench and Excavation Permit.

3.4 Method/Work Instruction

- Inspecting the Area for Existing Services

Note: Even if the Client issues a drawing to indicate existing services, under no circumstances are cable trenches to be excavated without the use of a cable locator instrument

3.5 Only persons who have been trained and certified may use a cable locator. Ensure the cable locator has a calibration certificate and the calibration date has not expired.

- Ensure the cable locator is in working condition by using the self-test mechanism.
- With the cable locator, physically walk the length of the marked out route by gently moving the cable locator instrument the full breadth of the proposed cable trench from left to right.
- If the cable locator picks up existing service below ground the area shall be marked clearly with danger tape and recorded on the Existing Services Checklist.
- Location of identified existing services must be communicated to all employees and attendance registers must kept.

3.6 Cross Trenching

- Mark out the intended route for excavation.
- Refer to design drawings and check for existing services with the use of the cable locator instrument.

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- Check for metering pillars, street light poles, mini-substations, cable, water, sewage line or Telkom markers that may be visible above ground for indications of existing services.
- If existing services are found, mark a line with a fish line with danger tape perpendicular to the intended cable trench ± 1 to 2 meters on either side of the marked out cable route.
- With competent supervision and the utmost care dig until cable has been exposed.
- Once exposed, a box excavation must be opened around the existing service of 300mm deep and 300mm to either side of the service to ascertain if there are any further existing services in the area.
- If another service is discovered in the "box" the box excavation shall be repeated to ascertain if there are any further existing services in the area.
- Be observant for the possibility of existing services that may not yet have been identified while trenching.
- By repeating this process a number of times down the proposed cable route, a good indication of the existing cables or other services can be traced.
- The proposed cable route can now be rerouted to accommodate the exiting services.

Note: Further tests with the cable locator instrument should be continued where cross trenching has not taken place to insure that a cable has not been missed.

3.7 Trenching Excavations

- The appointed excavation Supervisor shall inspect the area and assess the soil type to determine what machinery or tools may be required. Results must be recorded.
- Should the Excavation Supervisor be in any doubt or is unsure of any obstacles he should seek assistance from the Site Manager immediately.
- Before the excavating can begin the Excavation Supervisor shall ensure that all workers fully understand that a cable or other services have been detected and extra care needs to be taken.
- The Excavation Supervisor shall ensure that all workers are using the correct hand tools for excavation work.
- In areas where cables or other services have been detected only pick-axe hoes with plastic handles shall be used. (See Diagram 1)
- The sharp end of the pick must be off (bush pick) as this will help prevent the hoe penetrating the cable or other services.
- Only the large flat end of the hoe must be used to move soil. (See Diagram 2)
- The worker must not drive the hoe forcefully into the ground from shoulder height but rather from waist height. See diagram 3 below

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Diagram 1: Pick-axe hoes with plastic handles

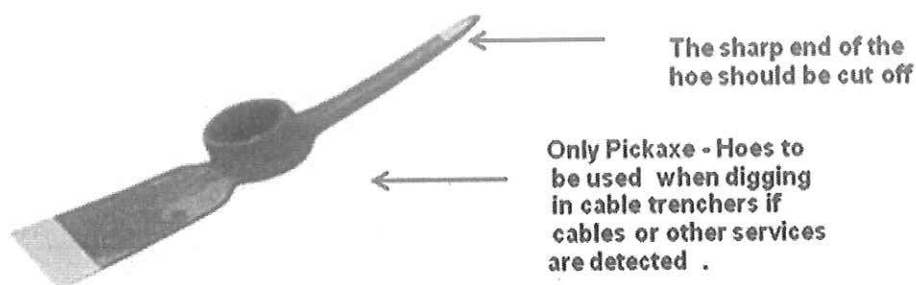


Diagram 2: Large flat end of the hoe.

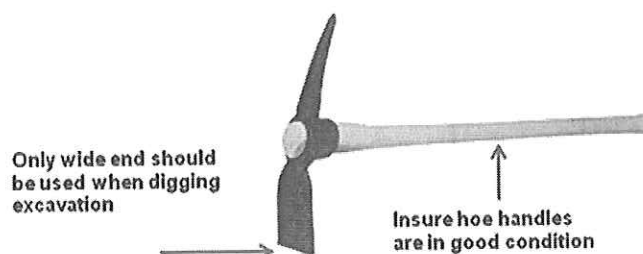
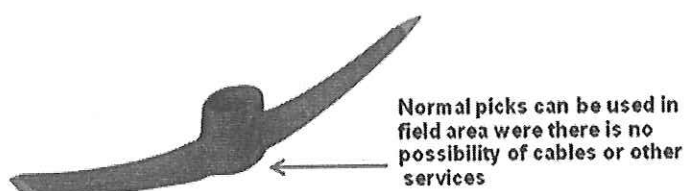


Diagram 3: Typical example of a hoe.



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- The Excavation Supervisor shall supervise the worker through the entire process until the cable or other service has been exposed.
- If the cable trench has to be deeper than the exposed cable, continued supervision shall be maintained until full depth has been reached.

Note: It is often that, "Where there is one cable there are more". Never assume there are no more cables.

- All excavated material should be placed at least 500mm from the edge of the trench.
- Ensure adequate shoring where there is a possibility of the sides of the excavation can collapse.
- The bottom of the excavation should be smoothly levelled horizontally. (See Diagram 4)
- The sides of the excavation should be smoothly levelled vertically. (See Diagram 5)

Diagram 4: Excavation bottom levelling

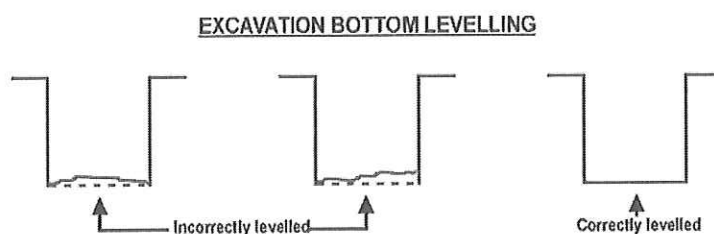
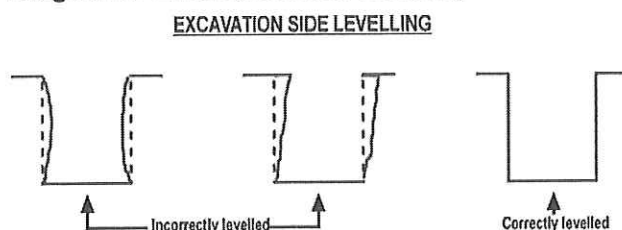


Diagram 5: Excavation side levelling



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3.8 Trench Specification

- LV Cable Trench Specification
- The Cable trench specifications shall be according to the Client Supplied Specification Sheet for the type of cable being laid.
- When trenching in soil free of stones, rocks, etc. cable may be laid directly into 500-600mm deep trench.
- A sieve of 12mm mesh size may be used to sift soil.
- Blanket soil must be compacted with hand compacting tools only.

3.9 Barricading Excavations

Note: Barricading in areas where a hazard exists which could threaten the safety and health of employees entering an area and surrounding members of the public shall be accomplished as follows:

- Obtain appropriate barricading net and signs for barricading the area.
- Barricade signs shall include information as follows:
 - Date of when the barricade is in effect.
 - The employee responsible for barricading the area.
 - The Supervisor.
 - The Contractor's Project Manager.
 - The contractor's company and phone number.
- Required personal protective equipment should be identified by the use of signs at the entrance of the barricaded area.
- Post sufficient danger and company logo signs on all sides of the barricaded area.

3.10 Erecting Barricading

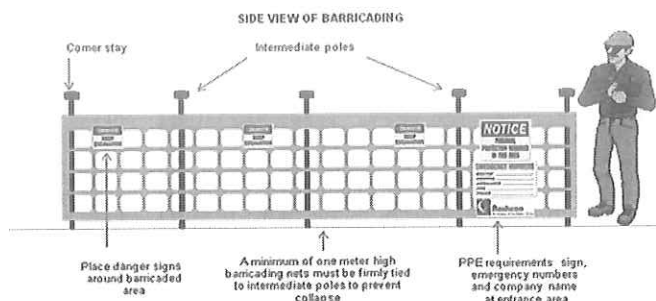
- Hammer in wooden or steel poles securely no less than three meters from each other along and around the open excavation.
- The barricading should cover the entire area of work.
- Attach the barricading to the poles by means of binding wire or cable ties.
- Ensure the barricading is firm, neat and tidy after attaching to the poles.

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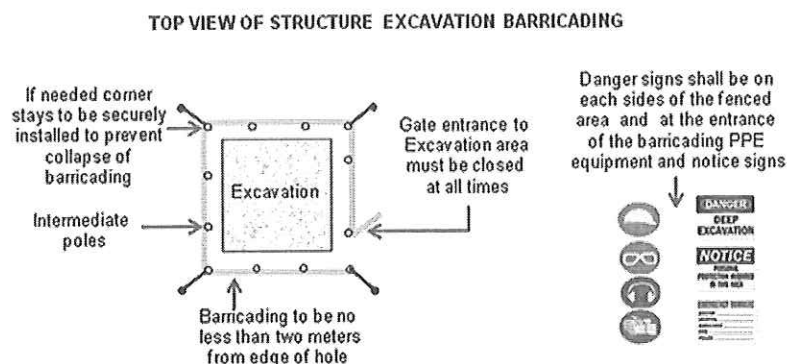
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Diagram 6: Side view of barricading



- There may be more than one entrance to the excavation site provided the entrances are manned by a Watchman to prevent unauthorized persons entering.
- The barricading shall be supported in a manner that will allow them to be seen by motorist and provide a stable support not easily pushed over by wind, livestock or traffic.
- If needed, corner stays may be installed to reinforce stability.
- There shall be 360 degree coverage with the barricade net and barricade signs shall be posted on all sides and at all normal entrances to the area.

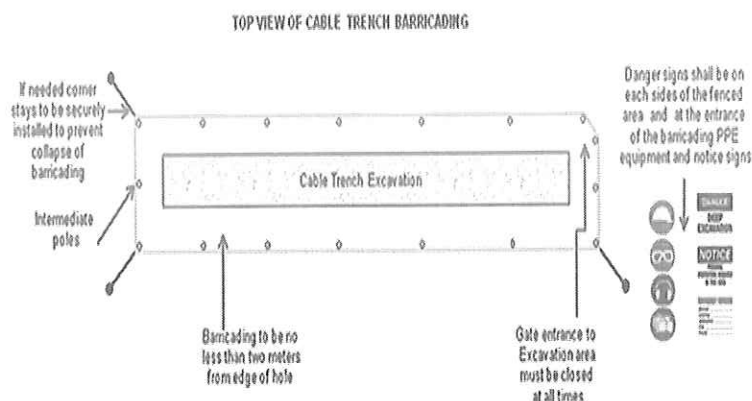
Diagram 7: Top view of structure excavation barricading



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- Barricade only the minimum area necessary to protect safety and health of employees and member public. If the barricade interferes with regular pedestrian, vehicles or livestock, a Watchman/Flagman shall coordinate an alternate thoroughfare.
- The competent person shall inspect the excavation as follows:



- Every day before work.
- After every rainstorm.
- As needed, for evidence of possible cave-ins.
- After each day's work before leaving site.

Note: Records shall be kept of all inspections

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On the left is an example of deficient Protection and site-security at an excavation site Contractor failed to maintain protective fencing/barricade systems around the entire site.

- After work has been completed and the hazard no longer exists, all barricade fencing and signs shall be removed.

3.11 Backfilling and Compacting

- Prior to backfilling any damaged earth shall be reinstated and integrity verified
- Ensure all workers have left the trench before backfilling starts.
- Ensure all tools and equipment has been removed.
- Install blanket soil to cover cables as specified.
- Backfill with suitable soil, free from rock etc., in layers of less than 150mm and compact as per client specifications
- Install danger tape and or protection slabs as specified.
- Install cable route markers and indicate on the As-Built Record.
- Housekeeping
- The excavation area shall be cleaned of all equipment and material and returned to the construction camp.
- Clean area of any litter around the barricaded area.
- The work area shall be levelled completed with top soil.

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- The designated smoking area shall be checked for cigarette buds and removed. All plantations should be re-planted again.
- The excavation barricading nets can now be removed from the excavation area.
- A check for any oil or hydraulic fluid leaks around the working area shall be conducted and if located removed immediately with the use of the oil spill recovery kit.
- All surfaces must be re-instated to their original condition and requirements on completion of work.

3.12 Trench & Excavation Permit Extension

- In the event that works cannot be completed within the agreed upon time frame as indicated on the Trench and Excavation Permit, the following process shall be adhered to:
- Contractor Representative shall notify Package Construction Manager that approved works will not be complete within allocated timeframe on Original Excavation Permit. Maximum timeframe on first submittal shall not be longer than 30 Calendar days from approval date. Afterward a 4 week permit extension may be granted. Further extensions to the permit may be issued subject to the package managers (not delegate) approval
- Contractor Representative shall provide updated Access Certificate (240-131819659) for applicable work area. Contractor Representative shall provide Package Construction Manager Assurance that applicable permit controls are still in effect and are adequate.
- Package Construction Manager shall communicate Permit Extension and obtain the required signature of permit.
- Once accepted, the permit shall be signed and the new date granted. The Trench and Excavation Permit Register (240-131819607) shall be up-dated.

3.13 Trench & Excavation Documentation

- After all signatures have been obtained on the Trench and Excavation Permit, the Permit shall be logged into the Trench and Excavation Permit Register (240-131819607) by the Document Control Department.
- Trench and Excavation Permit(240-131819607) and all submitted attachments, shall be scanned and retained by Document Control and a copy given to the KET Package Construction Manager to give to the Contractor.
- Trench and Excavation Permit Start Date and End Date shall be logged into the Permit Register by Document Control. This timeframe shall be negotiated between the Contractor Representative and the KET Package Construction Manager and shall be strictly adhered to. Caution shall be observed to ensure Trench and Excavation Permits are only active for the time needed to perform such works (typically less than one week);
- Open Trench and Excavation Permits shall be stored in a the Open Permits binder (2-ring) that is maintained by the KET Document Control Department;

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- Closed Trench and Excavation Permits shall be signed off as closed by the Contractor Representative and sent to KET Document Control.
- KET Document Control Department shall update the Trench and Excavation Permit Register to indicate that the Permit is closed.
- A copy of the approved Trench and Excavation Permit shall be maintained by the Operator conducting the works at all times, until referenced Permit is closed as indicated by the permit end date.

3.14 Energized Works

- All works shall be planned to avoid performing excavation works in the vicinity of energized installations. Identified installations shall be de-energized whenever feasible to support such works prior to commencement of works. Utility outages shall be coordinated via the Kusile Commissioning Department at least one week in advance to support proposed works. However, should it be determined that the proposed works must be performed within 3 meters of energized installations; the following minimum requirements shall be adhered to:
- Contractor shall complete all steps listed in Trench & Excavation Guidelines of stipulated within this document.
- Contractor shall identify all control measures in the Trench & Excavation Risk Assessment for proposed works and submit to the Engineer for review, in addition to, the Trench & Excavation Permit.
- Contractor shall identify safe work measures to safely expose energized underground installation(s) (e.g. pothole with insulated tools) at intervals agreed upon with the Engineer.
- Contractor shall expose energized installation as agreed upon with Engineer.

4. Acceptance

This document has been seen and accepted by the Kusile Power Station Project management

Name	Designation
Miranda Moahlodi	SHE Manager
Tumiso Railo	Engineering Manager
Mushayi Mudzielwana	Environmental Manager
Judith Gumede	Commissioning Manager
Makwena Makgwane	Document Control Manager

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5. Revisions

Date	Rev.	Compiler	Remarks
December 2017	1	JR SIBIYA	Change entire document for compliances and additional site specific requirement or technical information. New document number.

6. Development Team

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

- Richie Sibiya
- Jacques Prinsloo
- Cilliers Claasen

7. Acknowledgements

I would like to acknowledge the Kusile site Managers and change co-ordinators for their constant support to the continuous improvement of the change management process.

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