



NATIONAL OCCUPATIONAL STANDARD FOR PROCESS ENGINEER

NOS.PE.01 FIRST EDITION

APPROVING AUTHORITY

This National Occupational Standard has been prepared and published under the authority of the Zambia Qualifications Authority Board on 7th May, 2021.

ZAMBIA QUALIFICATIONS AUTHORITY

The Zambia Qualifications Authority Act No. 13 of 2011 was enacted by the Government of the Republic of Zambia to ***“provide for the development and implementation of a national qualifications framework; establish the Zambia Qualifications Authority; provide measures to ensure that standards and registered qualifications are internationally comparable; and provide for matters connected with, or incidental to the foregoing”***. Among other functions, ZAQA is responsible for ***determining national standards for any occupation***, through various sector specific National Occupational Standards Development Teams (NOSDTs).

REVISION OF NATIONAL OCCUPATIONAL STANDARDS

National Occupational Standards shall be revised every after **5 years**, or whenever necessary, by the issue of either amendments or of revised editions. It is important that users of National Occupational Standards (NOS) should ascertain that they are in possession of the latest amendments or editions.

NOS DEVELOPMENT TEAM RESPONSIBLE

This National Occupational Standard was prepared by the Mining National Occupational Standards Development Team, upon which the following organisations were represented:

1. Alfred H. Knight
2. CNMC Luanshya Copper Mines
3. Copperbelt University
4. First Quantum Minerals Limited
5. Geological Survey Department (Ministry of Mines and Minerals Development)
6. Kansanshi Mining Plc
7. Kitwe Trades School
8. Mines Safety Department (Ministry of Mines and Minerals Development)
9. Ministry of Labour and Social Security
10. Northern Technical College
11. Sino-Zam College of Science and Technology
12. Solwezi Trades Training Institute
13. University of Zambia
14. Zambia Qualifications Authority

ACKNOWLEDGEMENT

The Zambia Qualifications Authority would like to acknowledge the invaluable support of the following stakeholders that participated in the development of this National Occupational Standard:

1. Eng. Victor Chongo (Alfred H. Knight)
2. Eng. Evaristo Mwenya (CNMC Luanshya Copper Mines)
3. Prof. Peter R.K. Chileshe (Copperbelt University)
4. Dr. Godwin Mooba Beene (First Quantum Minerals Limited – Country Office)
5. Eng. Mutumbi Ng'uni (Geological Survey Department/Ministry of Mines and Minerals Development)
6. Eng. Teza Kasengele (First Quantum Minerals Limited - Kansanshi Mining Plc)
7. Mrs. Chanda Bwalya Catherine (Kitwe Trade School)
8. Eng. Abiyudi Sakala (Mines Safety Department/Ministry of Mines and Minerals Development)
9. Eng. George Kashinka and Mr. Chansa Kapema (Ministry of Labour and Social Security)
10. Eng. Moses Chilekwa (Northern Technical College)
11. Capt. Eng. Dennis Kaonga (Sino-Zam College of Science and Technology)
12. Tech. Kelvin Chama (Solwezi Trades Training Institute)
13. Dr. Samuel F. Kangwa (University of Zambia)
14. Mr. Modest Hamalabbi (Zambia Qualifications Authority)
15. Mr. Fidelis Cheelo (Zambia Qualifications Authority)
16. Eng. James Mwewa (Zambia Qualifications Authority)
17. Miss. Womba Soneka (Zambia Qualifications Authority)

TABLE OF CONTENTS

FOREWORD.....	iv
JUSTIFICATION.....	iv
ACRONYMS AND ABBREVIATIONS.....	vi
GLOSSARY OF TERMS.....	vii
1. OVERVIEW	1
2. SCOPE	2
3. PERSONAL ATTRIBUTES (VALUES, ETHICS AND ATTITUDES).....	2
4. UNITS AND ELEMENTS.....	2
5. EQUIPMENT, TOOLS AND CONSUMABLE MATERIALS.....	26
6. DILEMMAS/CHALLENGES AND COMPLEXITIES FOR A JOB HOLDER	26
7. WORKING CONDITIONS/ENVIRONMENT	26
8. PARTIES INVOLVED/INTERACTING WITH THE JOB HOLDER OR TRAINEE..	27
9. PHYSICAL DEMANDS ON THE BODY	27
ANNEX A	28
ANNEX B	29

FOREWORD

The Zambia Qualifications Authority (ZAQA) is a statutory body under the Ministry of Higher Education established by ZAQA Act No. 13 of 2011 to “**provide for the development and implementation of a national qualifications framework; provide measures to ensure that standards and registered qualifications are internationally comparable; and provide for matters connected with, or incidental to the foregoing**”.

Among other functions, ZAQA is responsible for “**determining national standards for any occupation**”, through various sector specific National Occupational Standards Development Teams (NOSDTs) of experts composed of representation from appropriate authorities, government departments, industry, academia, regulators, consumer associations and non-governmental organisations, etc.

This National Occupational Standard (NOS) has been developed by the Mining National Occupational Standards Development Team in accordance with the procedures and guidelines of ZAQA. All users should ensure that they have the latest edition of this publication as National Occupational Standards are revised from time to time.

This NOS shall be used by, among others, industry, employers, quality assurance bodies, awarding and professional bodies and education and training institutions, as a benchmark to identify training needs, develop job profiles/descriptions, develop curricula and learning programmes, in various sectors where the occupation exists. In the Mining sector, demonstration of competence against this NOS may be required in order to run a business or practice a craft or profession.

JUSTIFICATION

A Process Engineer, also known as a Metallurgical Engineer plays an important role in design and implementation of the production plan, in a cost effective, efficient, safe and environmentally friendly manner.

Process Engineers are responsible for:

- Defining the workflows and associated unit operations and operating parameters throughout the production stream.
- Reviewing existing processes and procedures and give recommendation on the most effective and efficient methods to achieve the desired output or product.
- Undertaking research in order to remain up-to-date with new technology and recommending ways of integrating such technology into existing systems.
- Owning the process functionality of critical in-line instrumentation and measurements.
- Production & systems challenges and offer troubleshooting on solutions.
- Owning the process data; historical and current.
- Analysing technical issues using PI and other tools
- Reviewing process flow sheets and P&IDs in line with plant changes

- Offering solutions to plant operational problems

- Engaging with Original Equipment Manufacturer (OEMs)
- Picking plant issue symptoms early and configuring alerts from PI or other systems using different communication tools to operations and maintenance for warning detection
- Applying metal accounting technical skills
- Complying with Occupational Health, Safety and Environmental standard requirements for the production process.

This National Occupational Standard highlights core knowledge, skills, competences and personal attributes that a Process Engineer must possess to be successful in their jobs.

ACRONYMS AND ABBREVIATIONS

CS	Core Skill
ISO	International Organisation for Standardisation
NOS	National Occupational Standard
NOSDT	National Occupational Standards Development Team
OK	Organisational Knowledge
PC	Performance Criteria
PE	Process Engineer
PS	Professional Skill
RK	Regulatory Knowledge
RPL	Recognition of Prior Learning
TK	Technical Knowledge
ZAQA	Zambia Qualifications Authority
ZQF	Zambia Qualifications Framework

GLOSSARY OF TERMS

For the purposes of this NOS, the following terms and definitions shall apply:

Core Skills/Generic Skills: are a group of skills that are key to learning and working in today's world. These skills are typically needed in any work environment. In the context of the NOS, these include communication related skills that are applicable to most job roles.

Function: is an activity necessary for achieving the key purpose of the sector, occupation, or area of work, which can be carried out by a person or a group of persons. Functions are identified through functional analysis and form the basis of NOS.

Job Title: defines a unique set of functions that together form a unique employment opportunity in an organisation.

Knowledge and Understanding: are statements which together specify the technical, generic, professional and organisational specific knowledge that an individual needs in order to perform to the required standard.

National Occupational Standards (NOS): are statements of the standards of performance individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding. They are precise descriptions of what an individual is expected to be able to do in his/her work role.

National Occupational Standards (NOS) Code: is a unique reference code that identifies a NOS.

National Occupational Standards Development Team (NOSDT): means an established group of national stakeholders/experts responsible for the development of National Occupational Standards within a specific economic sector or occupation.

Occupation: is a set of job roles, which perform similar/related set of functions in an industry.

Organisational Context: includes the way the organisation is structured and how it operates, including the extent of operative knowledge that managers have in their relevant areas of responsibility.

Performance Criteria: are statements that together specify the standard of performance required when carrying out a task.

Scope: is the set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on the quality of performance required.

Sector: is a conglomeration of different business operations having similar businesses and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.

Sub Sector: is derived from a further breakdown based on the characteristics and interests of its components.

Technical Knowledge: is the specific knowledge needed to accomplish specific designated responsibilities.

Unit Title: gives a clear overall statement about what the incumbent should be able to do.

1. OVERVIEW

This is an introductory section providing a brief summary and specific information or commentary about the content of the NOS and the targeted sector and occupation to help the user judge whether it is relevant to them.

NOS Code	NOS.PE.01
Occupation	Metallurgy
Job Title	Process Engineer
Job Description	The Process Engineer executes end to end technical activities of mineral/metal and petroleum extraction from its ore.
Job Purpose	This role is responsible for conducting end to end technical activities of extracting minerals/metals from their ores through the processes of Mineral processing, Hydrometallurgy and Pyrometallurgy.
ZQF Level	7
Sector	Mining
Sub Sector	Extractive Metallurgy
Other Economic Sector(s) in which the Occupation is Practiced	Manufacturing and Energy.
Other Similar Jobs and activities that can be performed by the Process Engineer	Chemical Engineering, Research and Development, Metallurgical Consultancy, Metallurgical Engineering, Plant Metallurgist, Metallurgical/ Technical Superintendent, Ore Processing Supervisor/ Foreman, etc.
Minimum Educational Job Entry Qualification(s)	Bachelor's Degree in Metallurgy, Mineral Processing or Chemical Engineering
Practicing License Requirements (if any)	Membership with the Engineering Institution of Zambia and Engineering Registration Board (EngRB) practicing license
Training/RPL (Suggested)	<ol style="list-style-type: none"> 1. Different processing techniques used in metallurgy. 2. Diploma in Metallurgy or Chemical Engineering with 10 years' work experience in metallurgical technical roles. 3. Use of ICTs (Internet, Computer Packages, Email, Computer Software and Hardware necessary for the job, etc.)
Minimum Job Entry Age	23
Prior Experience (Suggested)	2 years or more in mineral processing operations
Performance Criteria	As described in the Units under Section 4

2. SCOPE

This National Occupational Standard specifies the fundamental knowledge and understanding, skills and competences that Process Engineers must possess to be successful in their jobs.

3. PERSONAL ATTRIBUTES (VALUES, ETHICS AND ATTITUDES)

The Process Engineer needs to possess the following personal attributes:

- Effective leadership, interpersonal and motivational skills
- Strong drive and personal sense of ownership and accountability
- Ability to maintain self-discipline within a stressful environment
- Enthusiastic and pro-active in manner
- Sober minded and confidentiality
- Safety consciousness.

4. UNITS AND ELEMENTS

This National Occupational Standard is divided into 7 Units representing the tasks that a job holder should undertake in his/her day to day work. Each unit is further broken down into elements depicting the number of activities to be carried out for the successful execution of a particular task.

UNIT 1 [This Unit is about the Process Engineer demonstrating awareness of the Concentrator Process Plant and its operations].

Unit No.	01
Unit Title	Demonstrate awareness of the Concentrator Process Plant and its operations
Description	This Unit demonstrates the awareness of the Process Engineer for the Concentrator Process Plant, associated unit operations, final product (concentrate) and tailings.
Scope	This unit covers the following: <ul style="list-style-type: none"> • Crushing, conveying, screening and stockpiling • Milling and classification • Flotation • Dewatering • Tailings storage
Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria (PC)
Crushing, Conveying, Screening and Stockpiling	<p>To be competent, the individual must be able to:</p> <p>PC1. Carry out crushing operations and demonstrate awareness of crushing technical specifications in terms of:</p> <ul style="list-style-type: none"> - Type, size and capacity of crusher, - Crusher product size and distribution, - Crusher gap set measurements and adjustments, - Safety control systems/ devices and protocols, - Inspection and testing of crushing equipment, - Crushing control philosophy. <p>PC2. Perform conveying operations and demonstrate awareness of conveying technical specifications in terms of:</p> <ul style="list-style-type: none"> - Types of feeders and conveyors, - Capacity of feeders and conveyors, - Safety control systems/ devices and protocols. <p>PC3. Conduct screening operations and demonstrate awareness of screening technical specifications in terms of:</p> <ul style="list-style-type: none"> - Types and capacity of screens, - Product size distribution, - Aperture size and wear rates, - Screen open area, - Circulating Load. <p>PC4. Execute stockpiling operations and demonstrate awareness of stockpiling specifications in terms of:</p> <ul style="list-style-type: none"> - Type of storage and capacity, - Live storage capacity,
Milling and Classification	<p>PC5. Perform milling and classification operations and demonstrate awareness of milling and classification technical specifications in terms of:</p> <ul style="list-style-type: none"> - Type, size and capacity of the mill, - Feed and product size,

	<ul style="list-style-type: none"> - Mill weight, critical speed and filling degree, - Grinding media type, charge levels and filling degree, - Grinding media costs and consumption monitoring, - Pump operations, types and capacities, - Power costs and consumption monitoring, - Liner/ lifter profiles and wear measurements, - Types and parts of cyclones, - Cyclone operating parameters (feed pressure; feed, overflow and underflow density), - Cyclone product size measurement.
Flotation	<p>PC6.Undertake flotation operations and demonstrate awareness of flotation technology in terms of:</p> <ul style="list-style-type: none"> - Ore type, grade and mineralogy, - Type and size of flotation units, - Flotation circuit configuration, - Flotation characteristics (feed size, pulp density, bubble formation and loading, pulp chemistry, - Operating parameters (pulp level controls, froth depth, aeration and pulling rates), - Reagent types and regime, make-up and dosage rates. - Agitation and conditioning, - Safety control systems/ devices and protocols, - Flotation control philosophy.
Dewatering	<p>PC7. Carry out dewatering operations and demonstrate awareness of dewatering technology in terms of:</p> <ul style="list-style-type: none"> - Thickener types, capacity and product (overflow and underflow) characteristics, - Thickener operating parameters (rake torque, rake position, overflow clarity, underflow density and bed pressure), - Type of flocculants and make up, - Filter type, capacity, throughput, filter media, filtrate and filter cake characteristics.
Tailings Storage	<p>PC8. Show an appreciation of tailings storage in terms of:</p> <ul style="list-style-type: none"> - Design and construction of the tailings storage facility, - Characteristics/ chemistry of the material to be stored, - Revegetation of the dam/ dump walls, - Monitoring of dam stability, - Minimum pollution to ground water and air, - Maximum reuse of process water.
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation and its processes)	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>OK1. Relevant standards, procedures and policies followed in the company,</p> <p>OK2. Context of the organisation as determined by external factors like legal, financial, social, regulatory and cultural as well as internal factors like internal structures, governance and resource capabilities,</p> <p>OK3.Organisational roles, responsibilities, accountabilities and authorities,</p>

	<p>OK4. Hazard identification and assessment of risks and opportunities, OK5. Management of change, OK6 Emergency preparedness and response, OK7 Performance evaluation, OK8. Management systems such as Occupational Health and Safety, Quality and Environmental Management Systems.</p>
B. Technical Knowledge	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>TK1. Ore mineralogy, processing methods and associated equipment, TK2. Types of reagents, reagent makeup and associated Safety Data Sheets, TK3. Metallurgical Research and Development works TK4. Engineering fundamentals (Mass Balance, Heat and Mass transfer, Energy Balance, Phase diagrams, Engineering drawing, etc.), TK5. Engineering design and principles, TK6. Mineral processing, TK7. Metallurgical test works TK8. Metallurgical software (such as Moly-cop tools, MetSMAR and METSIM), TK9. Process consumables, composition and characteristics (reagents, grinding media, liners, screen panels, etc.),</p>
C. Regulatory context (Knowledge of Mines Safety Rules and Regulations)	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>RK1. Mine safety rules and regulations RK2. Mines and Minerals Development Act, 2015 RK3. Environmental Management Act, 2011 RK4. Occupational Health and Safety Act, 2010 RK5. Factories Act Cap 441 RK6. Workers Compensation Act RK7. Employment Act Chapter 268 and any other relevant labour laws</p>
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	<p>The individual on the job must be able to:</p> <p>CS1. Produce Metallurgical Technical Reports referencing findings conclusions, and recommendations, CS2. Develop/ review Standard Operating Procedures, CS3. Write instructions for the successful implementation of process changes, CS4. Use conversational communication methods such as E-mails, CS5. Communicate effectively through writing.</p>
	Reading Skills
	<p>The individual on the job must be able to:</p> <p>CS6. Research, read and interpret technical data from manuals, books and any other relevant literature, CS7. Read and comprehend written information or communication.</p>

	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS8 Manage meetings and discussions. CS9 Provide feedback on technical works CS10. Give instructions to the team CS11. Listen attentively and comprehend information given by the speaker
B. Professional Skills	Plan and Organise
	The individual on the job must be able to: PS1. Plan, Organise, Lead and Control organisational activities. PS2. Use the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis in their functional area of responsibility
	Analytical Thinking
	The individual on the job must be able to: PS3. Solve problems quickly and effectively using a methodical step-by-step approach to thinking and break down complex problems into single and manageable components
	Judgment and Critical Thinking
	The individual on the job must be able to: PS4. Use common sense and make judgments in day to day activities PS5. Use reasoning skills to identify and resolve basic problems PS6. Use intuition to identify any potential problems which could arise during operations
	Desire to Learn and Take Initiatives
	The individual on the job must be able to: PS7. Demonstrate willingness to explore new ideas PS8. Demonstrate willingness to adopt new ideas to improve performance PS9. Take initiative when required
Problem Solving and Decision Making	
The individual on the job must be able to: PS10. Solve complex problems diligently within the agreed timelines PS11. Identify problems, apply appropriate problem solving techniques and be assertive in decision making PS12. Consult widely and identify possible remedies PS13. Escalate when required as per organisation escalation procedure and protocol	

UNIT 2 [This Unit is about demonstrating awareness of the Hydrometallurgical Process Plant and its operations].

Unit No.	02
Unit Title	Demonstrate awareness of the Hydrometallurgical Process Plant and its operations
Description	This unit is about demonstrating awareness of the Hydrometallurgical Process and associated unit operations, and final product (Cathode)
Scope	This unit covers the following: <ul style="list-style-type: none"> Leaching, Counter Current Decantation (CCD) Operation of the feeders, Clarification, Cooling Towers, Solvent Extraction and Electrowinning
Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria (PC)
Leaching, Counter Current, Decantation, Clarification, Cooling Towers, Solvent, Extraction, Electrowinning	<p>To be competent, the individual must be able to:</p> <p>PC1. Perform leaching operations and demonstrate awareness of leaching in terms of:</p> <ul style="list-style-type: none"> Type of Leaching Processes (Ambient/ High Temperature Atmospheric Leach, High Temperature and Pressure Leach, Heap Leach, Insitu Leach and Biological Leach). <p>PC2. Carry out Counter Current Decantation (CCD) operations and demonstrate awareness of Counter Current Decantation (CCD) process in terms of:</p> <ul style="list-style-type: none"> Thickener types, capacity and product (overflow and underflow) characteristics Thickener operating parameters (rake torque, rake position, underflow density, bed pressure and overflow clarity) Type of flocculants and their make up <p>PC3. Undertake clarification operations and demonstrate awareness of Clarification technology in terms of:</p> <ul style="list-style-type: none"> Clarifier type, capacity and product characteristics <p>PC4. Show an appreciation of the operation of cooling towers in terms of:</p> <ul style="list-style-type: none"> Cooling tower type and capacity Heat exchangers <p>PC5. Carry out Solvent Extraction operations and demonstrate awareness of Solvent Extraction technology in terms of:</p> <ul style="list-style-type: none"> Mixers Settlers Organic Compounds Phase Characteristics <p>PC6 Execute Electrowinning operations and demonstrate awareness of the Electrowinning process in terms of:</p> <ul style="list-style-type: none"> Electrowinning cells Current Converter <p>PC7. Execute Electro-refining operations and demonstrate awareness of the Electro-refining process in terms of:</p> <ul style="list-style-type: none"> Electro-refining activities e.g. copper anode preparation, tank house loading, cathode stripping and washing, slime handling, e.t.c.

Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Relevant standards, procedures and policies followed in the company OK2. Context of the organisation as determined by external factors like legal, financial, social, regulatory and cultural as well as internal factors like internal structures, governance and resource capabilities. OK3. Organisational roles, responsibilities, accountabilities, and authorities OK4. Hazard identification and assessment of risks and opportunities OK5. Management of Change OK6 Emergency preparedness and response OK7 Performance evaluation Management Systems such as Occupational Health and Safety, Quality and Environmental Management Systems.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Ore mineralogy, processing methods and associated equipment TK2. Types of Chemicals (Acids, bases and alkalis, depressants, salts) and their associated data sheets. TK3. Metallurgical Research and Development works TK4. Engineering fundamentals (Mass Balance, Heat and Mass Transfer, Energy Balance, Phase diagrams, Engineering drawing etc.) TK5. Engineering design and principles TK6. Process control principles and technology TK7. Principles of Simultaneous Liquid – Liquid separation. TK8. Electricity (Faraday’s Laws of electrolysis) TK9. Absorption and Adsorption principles TK10. Ion exchange principle TK11. Organic Chemistry TK12. Thermodynamics and fluid mechanics TK13. Ion Exchange TK14. Cementation TK15. Metallurgical Test Works TK16. Process consumables, composition and characteristics.
C. Regulatory context (Knowledge of Mines Safety Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Mine safety rules and regulations RK2. Mines and Minerals Development Act, 2015 RK3. Environmental Management Act, 2011 RK4. Occupational Health and Safety Act, 2010 RK5. Factories Act Cap 441 RK6. Workers Compensation Act RK7. Employment Act Chapter 268 and any other relevant labour laws
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	The individual on the job must be able to: CS1. Produce Metallurgical Technical Reports CS2. Develop / Review Standard Operating Procedures

	<p>CS3. Write instructions for the successful implementation of process changes</p> <p>CS4. Use conversational communication methods such as E-mails, CS5. Communicate effectively through writing.</p>
	<p>Reading Skills</p> <p>The individual on the job must be able to:</p> <p>CS6. Research, read and interpret technical data from manuals, books and any other literature</p> <p>CS7. Read and comprehend written information or communication.</p>
	<p>Oral Communication (Listening and Speaking skills)</p> <p>The individual on the job must be able to:</p> <p>CS8 Manage meetings and discussions.</p> <p>CS9 Provide feedback on technical works</p> <p>CS10. Give instructions to the team</p> <p>CS11. Listen attentively and comprehend information given by the speaker</p>
	<p>B. Professional Skills</p> <p>Plan and Organise</p> <p>The individual on the job must be able to:</p> <p>PS1. Plan, Organise, Lead and Control organisational activities.</p> <p>PS2. Use the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis in their functional area of responsibility.</p>
	<p>Analytical Thinking</p> <p>The individual on the job must be able to:</p> <p>PS3. Solve problems quickly and effectively using a methodical step-by-step approach to thinking and break down complex problems into single and manageable components.</p>
	<p>Judgment and Critical Thinking</p> <p>The individual on the job must be able to:</p> <p>PS4. Use common sense and make judgments in day to day activities</p> <p>PS5. Use reasoning skills to identify and resolve basic problems</p> <p>PS6. Use intuition to identify any potential problems which could arise during operations</p>
	<p>Desire to Learn and Take Initiatives</p> <p>The individual on the job must be able to:</p> <p>PS7. Demonstrate willingness to explore new ideas</p> <p>PS8. Demonstrate willingness to adopt new ideas to improve performance</p> <p>PS9. Take initiative when required.</p>
	<p>Problem Solving and Decision Making</p> <p>The individual on the job must be able to:</p> <p>PS10. Solve complex problems diligently within the agreed timelines.</p> <p>PS11. Identify problems, apply appropriate problem solving techniques and assertive in decision making</p> <p>PS12. Consult widely and identify possible remedies PS13. Escalate when required as per organisation escalation procedure and protocol</p>

UNIT 3 [This Unit is about demonstrating awareness of the smelting process and associated unit operations].

Unit No.	03
Unit Title	Demonstrate awareness of the smelting process and associated unit operations
Description	This Unit is about demonstrating awareness of the smelting process and associated unit operations, and final product (Anode)
Scope	This Unit covers the following: <ul style="list-style-type: none"> • Concentrate blending • Smelting • Converting • Anode casting • Acid production • Oxygen production
Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria (PC)
Concentrate blending	To be competent, the individual must be able to: PC1. Perform concentrate blending and reclamation activities and demonstrate awareness of. <ul style="list-style-type: none"> - Concentrate mineralogy - Quality of concentrates being blended (Copper, Iron, Sulphur, insoluble and moisture) - Determination of Matte grade - Quality of Silica and its effect of the liquidus temperature - Quality of Slag - Quality of Reverts - Control system for concentrate conveyance (Feeders and tripper car systems)
Smelting	PC2. Carry out smelting operations and demonstrate awareness of smelting technologies (e.g. Isa-Smelt) and types of furnaces (such as Blast furnace, Puddling furnace, Reverberatory furnace, Bessemer converter, Open hearth furnace, Electric Arc furnace, Electric Induction furnace, flash furnace, Reverberatory furnace, Blast furnace, Teniente and Noranda)
Converting and Anode Casting	PC3. Operate converters and demonstrate awareness of the converting process in terms of: <ul style="list-style-type: none"> - Converters (Horizontal converters of the Peirce-Smith type) - Reagents (Silica) for fluxing during slag blow - Cold dope addition during slag blow and copper blow PC4. Operate Anode Furnaces and demonstrate awareness of the processing and casting operations in terms of: <ul style="list-style-type: none"> - Anode copper oxidation process - Anode copper reduction process - Anode casting operation - Anode quality control

Acid Production	<p>PC5. Demonstrate knowledge of Acid Plant</p> <ul style="list-style-type: none"> - Gas Cleaning - Catalytic Converter - Drying and Adsorption - Acid Storage and Transfer - Catalysts used in Sulphur dioxide conversion - Process Water Treatment
Oxygen Production	<p>PC6. Show an appreciation of Oxygen Production (Cryogenic) Process in terms of:</p> <ul style="list-style-type: none"> - Air compression - Air Cleaning - Cooling Towers (Fractional distillation) - Oxygen Storage and Transfer
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation and its processes)	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>OK1. Relevant standards, procedures and policies followed in the company</p> <p>OK2. Context of the organisation as determined by external factors like legal, financial, social, regulatory and cultural as well as internal factors like internal structures, governance and resource capabilities.</p> <p>OK3. Organisational roles, responsibilities, accountabilities, and authorities</p> <p>OK4. Hazard identification and assessment of risks and opportunities</p> <p>OK5. Management of Change</p> <p>OK6 Emergency preparedness and response</p> <p>OK7 Performance evaluation</p> <p>Management Systems such as Occupational Health and Safety, Quality and Environmental Management Systems.</p>
B. Technical Knowledge	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>TK1. Concentrate conveying systems technical specifications in terms of:</p> <ul style="list-style-type: none"> - Types of feeders, conveyors and tripper cars - Capacity of feeders and conveyors - Safety Control Systems / devices and protocols <p>TK2. Determination of plant equipment availability, utilisation and efficiency</p> <p>TK3. Engineering fundamentals (such as Mass Balance, Heat and Mass Transfer, Energy Balance, Phase diagrams and Engineering drawing)</p> <p>TK4. Computer packages</p> <p>TK5. Plant portable measurement devices</p> <p>TK6. Determination of:</p> <ul style="list-style-type: none"> - Silica requirements for fluxing during slag blow - Cold dope requirements during copper blow - Air flow requirements for both Slag and Copper blow <p>TK7. Interpretation of Phase Diagrams</p> <p>TK8. Mass balance of the converting and Anode copper refining processes,</p>

	<p>TK9. Determination of furnace refractory life using Thermal imaging camera TK10. Controlling Anode quality TK11. Metallurgical accounting TK12. The autothermal limit of the plant TK13. Determination of:</p> <ul style="list-style-type: none"> - Sulphuric acid concentration for the Drying Tower and Absorption Tower using equipment such as Titration Ultrasonic Equipment - Sulphur Dioxide concentration in the gas stream using Reich Test or Orsat Gas Analyser - Sulphur Balance <p>TK14. Elemental properties (Periodic Table) and compounds such as Oxygen, Nitrogen and Carbon Dioxide TK15. Advanced Process Control TK16. Mechanical, Instrumentation and Software Engineering TK17. Thermal Dynamics and Fluid Mechanics TK18. Safety Control Systems/ devices and protocols</p>
<p>C. Regulatory context (Knowledge of Mines Safety Rules and Regulations)</p>	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>RK1. Mine safety rules and regulations RK2. Mines and Minerals Development Act, 2015 RK3. Environmental Management Act, 2011 RK4. Occupational Health and Safety Act, 2010 RK5. Factories Act Cap 441 RK6. Workers Compensation Act RK7. Employment Act Chapter 268 and any other relevant labour laws</p>
<p>Skills (S)</p>	
<p>A. Core Skills/ Generic Skills</p>	<p>Writing Skills</p>
	<p>The individual on the job must be able to:</p> <p>CS1. Produce Metallurgical Technical Reports CS2. Develop / Review Standard Operating Procedures CS3. Write instructions for the successful implementation of process changes CS4. Use conversational communication methods such as E-mails, CS5. Communicate effectively through writing</p>
	<p>Reading Skills</p>
	<p>The individual on the job must be able to:</p> <p>CS6. Research, read and interpret technical data from manuals, books and any other literature CS7. Read and comprehend written information or communication.</p>
<p>Oral Communication (Listening and Speaking skills)</p>	
<p>The individual on the job must be able to:</p> <p>CS8. Manage meetings and discussions. CS9. Provide feedback on technical works CS10. Give instructions to the team CS11. Listen attentively and comprehend information given by the speaker</p>	

B. Professional Skills	Plan and Organise
	The individual on the job must be able to: PS1. Plan, Organise, Lead and Control organisational activities. PS2. Use the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis in their functional area of responsibility.
	Analytical Thinking
	The individual on the job must be able to: PS3. Solve problems quickly and effectively using a methodical step-by-step approach to thinking and break down complex problems into single and manageable components.
	Judgment and Critical Thinking
	The individual on the job must be able to: PS4. Use common sense and make judgments in day to day activities PS5. Use reasoning skills to identify and resolve basic problems PS6. Use intuition to identify any potential problems which could arise during operations
	Desire to Learn and Take Initiatives
The individual on the job must be able to: PS7. Demonstrate willingness to explore new ideas PS8. Demonstrate willingness to adopt new ideas to improve performance PS9. Take initiative when required.	
Problem Solving and Decision Making	
The individual on the job must be able to: PS10. Solve complex problems diligently within the agreed timelines. PS11. Identify problems, apply appropriate problem solving techniques and assertive in decision making PS12. Consult widely and identify possible remedies PS13. Escalate when required as per organisation escalation procedure and protocol	

UNIT 4 [This Unit is about demonstrating awareness of the Electrorefining Process Plant and its operations].

Unit No.	04
Unit Title	Demonstrate awareness of the Electrorefining Process Plant and its operations
Description	This unit is about demonstrating awareness of the Electrorefining Process and associated unit operations, and final product (Cathode)
Scope	This unit covers the following: Anode Preparation, Tank Loading, Electrolyte Circulation, Deposition Inspection, Electrolyte filtration and Slimes Handling, Cathode Stripping, Anode Scrap Handling, Electrolyte Purification, Cathode Despatch, Metallurgical Accounting
Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria (PC)
Anode Preparation, Tank Loading, Electrolyte Circulation, Deposition Inspection, Electrolyte filtration and Slimes Handling, Cathode Stripping, Anode Scrap Handling, Electrolyte Purification, Cathode Despatch, Metallurgical Accounting	<p>To be competent, the individual must be able to:</p> <p>PC1. Perform anode preparation operations and demonstrate awareness of anode preparation in terms of:</p> <ul style="list-style-type: none"> Physical parameters and characteristics of anodes suitable for loading in electrolytic cells. Chemical composition of anodes suitable for loading in electrolytic cells. <p>PC2. Carry out tank loading operations and demonstrate awareness of tank loading process in terms of:</p> <ul style="list-style-type: none"> Cell dressing Cell furniture integrity Electrode (Anode and Cathode) loading and alignment <p>For smooth cathode deposition.</p> <p>PC3. Carry out electrolyte circulation activities and demonstrate awareness of electrolyte circulation activities in terms of:</p> <ul style="list-style-type: none"> Electrolyte temperature Flowrate control Electrolyte composition Reagent preparation and addition (thiourea, glue, salt, acid, water, flocculants) Current control <p>PC4. Carry out deposition inspection operations and demonstrate awareness of the same in terms of:</p> <ul style="list-style-type: none"> Shorts detection Shorts correction Cell voltage correction <p>To ensure uniform current distribution and achieve high current efficiency</p> <p>PC5. Carry out Electrolyte filtration and Slimes Handling activities and demonstrate awareness of Electrolyte filtration and Slimes Handling in terms of:</p> <ul style="list-style-type: none"> Settling tanks operations Filters Settling cones Filter presses Rotary vacuum driers

	<p>In order to remove suspended solids from the electrolyte to below 20ppm for smooth cathode deposition</p> <p>PC6. Carry out Cathode Stripping activities and demonstrate awareness of Cathode Stripping in terms of:</p> <ul style="list-style-type: none"> • Cathode stripping machine or cathode pulling <p>PC7. Carry out Anode Scrap Handling activities and demonstrate awareness of Anode Scrap Handling in terms of:</p> <ul style="list-style-type: none"> • Anode Scrap Washing machine operation to remove slimes from the scraps • Stacking of anode scrap in readiness for despatch to smelter <p>PC8. Carry out Electrolyte Purification operations and demonstrate awareness of Electrolyte Purification in terms of:</p> <ul style="list-style-type: none"> • Liberator operations • Acid Purification Unit <p>In order to remove excess dissolved impurities in the electrolyte</p> <p>PC9. Carry out Cathode Despatch activities and demonstrate awareness of Cathode Despatch in terms of:</p> <ul style="list-style-type: none"> • Generation of loading permits • Sorting, bundling and weighing of cathodes • Loading and clearing of trucks <p>PC10. Carry out Metallurgical Accounting activities and demonstrate awareness of Metallurgical Accounting in terms of:</p> <ul style="list-style-type: none"> • Pre-Process balance (Check-in, Check-out) • Work in Progress (Physical Verification of Book Stock) • Precious Metal Process Stock • Post Process balance (Cathode Balance, Scrap Despatches) • Daily Metallurgical Reporting • Monthly Balances • Third Quarter and Year End Metallurgical Audits • Production Planning
Knowledge and Understanding (K)	
<p>D. Organisational Context (Knowledge of the company/ organisation and its processes)</p>	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>OK1. Relevant standards, procedures and policies followed in the company</p> <p>OK2. Context of the organisation as determined by external factors like legal, financial, social, regulatory and cultural as well as internal factors like internal structures, governance and resource capabilities.</p> <p>OK3. Organisational roles, responsibilities, accountabilities, and authorities</p> <p>OK4. Hazard identification and assessment of risks and opportunities</p> <p>OK5. Management of Change</p> <p>OK6 Emergency preparedness and response</p> <p>OK7 Performance evaluation</p> <p>OK8 Management Systems such as Occupational Health and Safety, Quality and Environmental Management Systems.</p>
<p>E. Technical Knowledge</p>	<p>The individual on the job must demonstrate knowledge and understanding of:</p>

	<p>TK1. Ore mineralogy, processing methods and associated equipment</p> <p>TK2. Types of Chemicals (Acids, bases, alkalis, salts, thiourea, glue, water, flocculants) and their associated data sheets.</p> <p>TK3. Metallurgical Research and Development works</p> <p>TK4. Engineering fundamentals (Mass Balance, Heat and Mass Transfer, Energy Balance, Phase diagrams, Engineering drawing, Metallurgical Accounting, etc.)</p> <p>TK5. Engineering design and principles</p> <p>TK6. Process control principles and technology</p> <p>TK7. Principles of Solid – Liquid separation.</p> <p>TK8. Electricity (Faraday’s Laws of electrolysis)</p> <p>TK9. Absorption and Adsorption principles</p> <p>TK10. Ion exchange principle</p> <p>TK11. Organic Chemistry</p> <p>TK12. Thermodynamics and fluid mechanics</p> <p>TK13. Metallurgical Test Works</p> <p>TK14. Cementation</p> <p>TK15. Process consumables, composition and characteristics.</p>
<p>F. Regulatory context (Knowledge of Mines Safety Rules and Regulations)</p>	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>RK1. Mine safety rules and regulations</p> <p>RK2. Mines and Minerals Development Act, 2015</p> <p>RK3. Environmental Management Act, 2011</p> <p>RK4. Occupational Health and Safety Act, 2010</p> <p>RK5. Factories Act Cap 441</p> <p>RK6. Workers Compensation Act</p> <p>RK7. Employment Act Chapter 268 and any other relevant labour laws</p>
<p>Skills (S)</p>	
<p>C. Core Skills/ Generic Skills</p>	<p>Writing Skills</p>
	<p>The individual on the job must be able to:</p> <p>CS1. Produce Metallurgical Technical Reports</p> <p>CS2. Develop / Review Standard Operating Procedures</p> <p>CS3. Write instructions for the successful implementation of process changes</p> <p>CS4. Use conversational communication methods such as E-mails,</p> <p>CS5. Communicate effectively through writing.</p>
	<p>Reading Skills</p>
	<p>The individual on the job must be able to:</p> <p>CS6. Research, read and interpret technical data from manuals, books and any other literature</p> <p>CS7. Read and comprehend written information or communication.</p>
<p>Oral Communication (Listening and Speaking skills)</p>	
<p>The individual on the job must be able to:</p> <p>CS8. Manage meetings and discussions.</p> <p>CS9. Provide feedback on technical works</p> <p>CS10. Give instructions to the team</p> <p>CS11. Listen attentively and comprehend information given by the Speaker</p>	

D. Professional Skills	Plan and Organise
	The individual on the job must be able to: PS1. Plan, Organise, Lead and Control organisational activities. PS2. Use the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis in their functional area of responsibility.
	Analytical Thinking
	The individual on the job must be able to: PS3. Solve problems quickly and effectively using a methodical step-by-step approach to thinking and break down complex problems into single and manageable components.
	Judgment and Critical Thinking
	The individual on the job must be able to: PS4. Use common sense and make judgments in day to day activities PS5. Use reasoning skills to identify and resolve basic problems PS6. Use intuition to identify any potential problems which could arise during operations
	Desire to Learn and Take Initiatives
The individual on the job must be able to: PS7. Demonstrate willingness to explore new ideas PS8. Demonstrate willingness to adopt new ideas to improve performance PS9. Take initiative when required.	
Problem Solving and Decision Making	
The individual on the job must be able to: PS10. Solve complex problems diligently within the agreed timeliness. PS11. Identify problems, apply appropriate problem solving techniques and assertive in decision making PS12. Consult widely and identify possible remedies PS13. Escalate when required as per organisation escalation procedure and protocol	

UNIT 5 This Unit is about demonstrating awareness of auxiliary services, equipment and consumables required to sustain metallurgical processes].

Unit No.	05
Unit Title	Demonstrate awareness of auxiliary services, equipment and consumables required to sustain metallurgical processes
Description	This Unit is about demonstrating awareness of auxiliary services, equipment and consumables required to sustain metallurgical processes
Scope	This Unit covers the following: <ul style="list-style-type: none"> • Compressed air and Blower air • Process Water • Treated Water • Mobile Equipment • Consumables
Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria (PC)
Compressed air and blower air	To be competent, the individual must be able to: PC1. Show an appreciation of the operation of air compressors and blowers as well as the associated technology in terms of: <ul style="list-style-type: none"> - High Pressure – Low Volume - Low Pressure – High Volume PC2. Demonstrate understanding of compressor and blower technical specifications PC3. Demonstrate understanding of the control philosophy for compressor and blower operations
Process and Treated water	To be competent, the individual must be able to: PC4. Identify the sources of water fit for metallurgical processes PC5. Demonstrate awareness of water treatment processes PC6 Exhibit knowledge of use of various classes of water (such as process water, raw water, gland water, potable water and demineralised water)
Mobile Equipment	To be competent, the individual must be able to: PC7. Demonstrate awareness of the application of various mobile equipment used in a mineral processing plant such as: <ul style="list-style-type: none"> - Front End Loader - Forklift - Bobcat - Mobile Crane - Backhoe Loader - Articulated Dump Truck - Rigid Dump Truck
Consumables	To be competent, the individual must be able to: PC8. Show an appreciation of different kinds of consumables used in mineral processing plants such as: <ul style="list-style-type: none"> - Reagents - Fuels - Grinding media - Chemicals - Catalysts

	<ul style="list-style-type: none"> - Resins - Filter media - Depressants <p>PC9. Show an appreciation of the physical and chemical composition and properties, including mixing ratios for different kinds of consumables used in mineral processing plants</p>
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation and its processes)	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <ul style="list-style-type: none"> OK1. relevant standards, policies and procedures followed in the company OK2. Organisational roles, responsibilities, accountabilities, and authorities
B. Technical Knowledge	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <ul style="list-style-type: none"> TK1. Thermodynamics and fluid mechanics TK2. Pressure Control Systems TK3. Sources of water for use in mineral processing plants TK4. Water Treatment Processes (Filtration, Sedimentation, Chemical, Ultrasonic and Sludge Treatment) TK5. Types of Machines used in mineral processing plants TK6. Organic and Inorganic Chemistry TK7. Theories and principles of Physics TK8. Advanced Mathematics
C. Regulatory context (Knowledge of Mines Safety Rules and Regulations)	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <ul style="list-style-type: none"> RK1. Mine safety rules and regulations RK2. Mines and Minerals Development Act, 2015 RK3. Environmental Management Act, 2011 RK4. Occupational Health and Safety Act, 2010 RK5. Factories Act Cap 441 RK6. Workers Compensation Act RK7. Employment Act Chapter 268 and any other relevant labour laws
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	<p>The individual on the job must be able to:</p> <ul style="list-style-type: none"> CS1. Produce Technical Reports CS2. Develop/ Review Standard Operating Procedures CS3. Write instructions for the successful implementation of process changes CS4. Use conversational communication methods such as E-mails, CS5. Communicate effectively through writing.
	Reading Skills
	<p>The individual on the job must be able to:</p> <ul style="list-style-type: none"> CS6. Research, read and interpret technical data from manuals, books and any other literature CS7. Read and comprehend written information or communication.

	<p>Oral Communication (Listening and Speaking skills)</p> <p>The individual on the job must be able to:</p> <p>CS8 Manage meetings and discussions. CS9 Provide feedback on technical works CS10. Give instructions to the team CS11. Listen attentively and comprehend information given by the speaker</p>
<p>B. Professional Skills</p>	<p>Plan and Organise</p>
	<p>The individual on the job must be able to:</p> <p>PS1. Plan, Organise, Lead and Control organisational activities. PS2. Use the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis in their functional area of responsibility.</p>
	<p>Analytical Thinking</p>
	<p>The individual on the job must be able to:</p> <p>PS3. Solve problems quickly and effectively using a methodical step-by-step approach to thinking and break down complex problems into single and manageable components.</p>
	<p>Judgment and Critical Thinking</p>
	<p>The individual on the job must be able to:</p> <p>PS4. Use common sense and make judgments in day to day activities PS5. Use reasoning skills to identify and resolve basic problems PS6. Use intuition to identify any potential problems which could arise during operations</p>
	<p>Desire to Learn and Take Initiatives</p>
	<p>The individual on the job must be able to:</p> <p>PS7. Demonstrate willingness to explore new ideas PS8. Demonstrate willingness to adopt new ideas to improve performance PS9. Take initiative when required.</p>
<p>Problem Solving and Decision Making</p>	
<p>The individual on the job must be able to:</p> <p>PS10. Solve complex problems diligently within the agreed timelines. PS11. Identify problems, apply appropriate problem solving techniques and assertive in decision making PS12. Consult widely and identify possible remedies PS13. Escalate when required as per organisation escalation procedure and protocol</p>	

UNIT 6 [This unit is about maintaining health and safety measures critical in mines].

Unit No.	06
Unit Title	Maintain health and safety
Description	This unit is about maintaining health and safety in the mining industry
Scope	This unit covers the following: <ul style="list-style-type: none"> • Maintain health and safety measures critical in mines
Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria (PC)
Maintain health and safety in the mining Industry	To be competent, the individual must be able to: PC1. Comply with occupational health and safety regulations adopted by the employer PC2. Adhere to mining operation procedures with respect to materials handling and accidents PC3. Follow the correct safety steps in case of accidents or major failure PC4. Comply with safety regulations and procedures in case of fire hazards PC5. Conversant with emergency preparedness procedures PC6. Work responsibly and as safely and carefully as possible so as not to put the health and safety of self or others at risk, including members of the public PC7. Perform storage and transportation of hazardous materials compliant with safety guidelines prescribed by Mines Safety Department PC8. Demonstrate knowledge of Personal Protective Equipment PC9. Adhere to manufacturer’s instructions for care and safe operation of the equipment
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Relevant standards, policies and procedures followed in the company OK2. Context of the organisation as determined by external factors like legal, financial, social, regulatory and cultural as well as internal factors like internal structures, governance and resource capabilities. OK3. Organisational roles, responsibilities, accountabilities, and authorities OK4. Hazard identification and assessment of risks and opportunities OK5. Management of Change OK6. Emergency preparedness and response OK7. Performance evaluation OK8. Management Systems such as Occupational Health and Safety, Quality and Environmental Management Systems.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Health and Safety Management Systems

	<p>TK2. Health and Safety Management Standards such as ISO 45001:2018</p> <p>TK3. Accident/ Incident investigation skills</p> <p>TK4. Safety Statistics</p> <p>TK5. Hazard Identification and Risk Assessment</p>
C. Regulatory context (Knowledge of Mines Safety Rules and Regulations)	<p>The individual on the job must demonstrate knowledge and understanding of:</p> <p>RK1. Mine safety rules and regulations</p> <p>RK2. Mines and Minerals Development Act, 2015</p> <p>RK3. Environmental Management Act, 2011</p> <p>RK4. Occupational Health and Safety Act, 2010</p> <p>RK5. Factories Act Cap 441</p> <p>RK6. Workers Compensation Act</p> <p>RK7. Employment Act Chapter 268 and any other relevant labour laws</p>
Skills (S)	
A. Core Skills/ Generic Skills	Reading Skills
	<p>The individual on the job must be able to:</p> <p>CS1. Research, read and interpret Safety information from manuals, books and any other literature</p> <p>CS2. Read and comprehend written information or communication.</p>
	Writing Skills
	<p>The individual on the job must be able to:</p> <p>CS3. Produce Safety Reports</p> <p>CS4. Develop/ Review Risk Assessments</p> <p>CS5. Write instructions for the successful implementation of Safety in a workplace</p> <p>CS6. Use conversational communication methods such as E-mails,</p> <p>CS7. Communicate effectively through writing.</p>
	Oral Communication (Listening and Speaking skills)
	<p>The individual on the job must be able to:</p> <p>CS8. Manage meetings and discussions.</p> <p>CS9. Provide feedback on Safety Performance</p> <p>CS10. Give instructions to the team</p> <p>CS11. Listen attentively and comprehend information given by the speaker</p>
B. Professional Skills	Plan and Organise
	<p>The individual on the job must be able to:</p> <p>PS1. Plan, Organise, Lead and Control organisational activities.</p> <p>PS2. Use the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis in their functional area of responsibility.</p>
	Judgment and Critical Thinking
	<p>The individual on the job must be able to:</p> <p>PS3. Use common sense and make judgments in day to day activities</p> <p>PS4. Use reasoning skills to identify and resolve basic problems</p> <p>PS5. Use intuition to identify any potential problems which could arise</p>

	Desire to Learn and Take Initiatives
	The individual on the job must be able to: PS6. Demonstrate willingness to explore new ideas PS7. Demonstrate willingness to adopt new ideas to improve performance PS8. Take initiative when required.
	Problem Solving and Decision Making
	The individual on the job must be able to: PS9. Solve complex problems diligently within the agreed timelines. PS10. Identify problems, apply appropriate problem solving techniques and assertive in decision making PS11. Consult widely and identify possible remedies PS12. Escalate when required as per organisation escalation procedure and protocol

UNIT 7 [This Unit is about applying leadership and supervisory skills].

Unit No.	07
Unit Title	Application of leadership and supervisory skills
Description	This Unit is about demonstrating competency in leadership and supervision of subordinates
Scope	This Unit covers the following: <ul style="list-style-type: none"> • Delegation of duties and responsibilities, supervision, training and development, and team building
Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria (PC)
Delegation of duties and responsibilities, supervision, training and development, and team building	To be competent, the individual must be able to: <ul style="list-style-type: none"> PC1. Demonstrate ability to delegate duties and responsibilities to subordinates as part of training and development PC2. Create synergies within the team by promoting team spirit PC3. Identify training and development opportunities for subordinates PC4. Effectively supervise subordinates PC5. Develop Key Performance Indicators for subordinates which are clear and achievable PC6. Review performance of subordinates against Key Performance Indicators PC7. Provide constructive performance feedback to the subordinates PC8. Recommend competent and high potential subordinates for promotion
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: <ul style="list-style-type: none"> OK1. Relevant standards, policies and procedures followed in the company OK2. Organisational roles, responsibilities, accountabilities, and authorities OK3. Organisational strategic goals and objectives
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: <ul style="list-style-type: none"> TK1. Planning, organising, directing and controlling TK2. Problem solving and decision making TK2. Conflict management TK3. Importance and need for effective communication
C. Regulatory context	The individual on the job must demonstrate knowledge and understanding of: <ul style="list-style-type: none"> RK1. Mine safety rules and regulations RK2. Mines and Minerals Development Act, 2015 RK3. Environmental Management Act, 2011 RK4. Occupational Health and Safety Act, 2010 RK5. Factories Act Cap 441 RK6. Workers Compensation Act RK7. Employment Act Chapter 268 and any other relevant labour laws

Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	The individual on the job must be able to: CS1. Issue instructions, recommendations and commendations in writing CS2. Conduct performance assessments and develop performance reports
	Reading Skills
	The individual on the job must be able to: CS3. Read and understand leadership courses
B. Professional Skills	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS4. Manage meetings and discussions. CS5. Provide feedback on Strength Weaknesses, Opportunities and Threats for the team CS6. Give instructions to the team CS7. Listen attentively and comprehend information given by the speaker
	Plan and Organise
	The individual on the job must be able to: PS1. Plan, Organise, Lead and Control organisational activities. PS2. Use the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis in their functional area of responsibility.
B. Professional Skills	Analytical Thinking
	The individual on the job must be able to: PS3. Solve problems quickly and effectively using a methodical step-by-step approach to thinking and break down complex problems into single and manageable components.
	Judgment and Critical Thinking
	The individual on the job must be able to: PS4. Use common sense and make judgments in day to day activities PS5. Use reasoning skills to identify and resolve basic problems PS6. Use intuition to identify any potential problems which could arise during operations
	Desire to Learn and Take Initiatives
	The individual on the job must be able to: PS7. Demonstrate willingness to explore new ideas PS8. Demonstrate willingness to adopt new ideas to improve performance PS9. Take initiative when required
	Problem Solving and Decision Making
The individual on the job must be able to: PS10. Solve complex problems diligently within the agreed timelines PS11. Identify problems, apply appropriate problem solving techniques and assertive in decision making PS12. Consult widely and identify possible remedies PS13. Escalate when required as per organisation escalation procedure and protocol	

5. EQUIPMENT, TOOLS AND CONSUMABLE MATERIALS

These include, but not limited to: ore source, personal protective equipment, laboratory measuring and testing equipment/vessels/tools, ore crushing and grinding machinery/equipment, chemicals/reagents, mineral/metal recovery and processing equipment and vessels, lighting accessories e.g. lamp/torch, toolkits, first aid kit, stretcher, medical kit, safety warning and general information signs, climbing ladders, safety tools and equipment such as fire extinguishers and barricades, copies of mine safety rules and regulations, company's safety policy/procedure, company's standard operating procedures, incident/accident reporting templates, etc.

6. DILEMMAS/CHALLENGES AND COMPLEXITIES FOR A JOB HOLDER

Dilemmas associated with the job of Process Engineer include: working in dangerous areas, confined areas, operating hazardous machinery/equipment and handling harmful chemicals, lifting/pulling/pushing relatively heavy materials, long working hours, exposure to mining biological hazards, pressure from supervisors and colleagues, pressure from government regulators, working in extreme weather such as hot and cold conditions, working in noisy, wet and dusty environments, etc.

6.1 Alternative Choices (Solutions) to Dilemmas and Complexities

Solutions to dilemmas include: wearing protective clothing and ensuring their availability and use by other employees, exercising regularly to maintain physical fitness, participating in workplace safety sensitisation and awareness meetings/training sessions, adhering to company's safety and standard operating procedures at all times, consulting extensively within and outside one's department/team on electrical safety issues, etc.

7. WORKING CONDITIONS/ENVIRONMENT

Working conditions include: underground mines or on the surface, confined spaces, cold, hot and wet conditions, climbing heights, standing/sitting for long hours, lifting materials, handling chemicals/reagents, working in day or night shifts, areas that are noisy and dusty, areas with limited lighting and ventilation, etc.

8. PARTIES INVOLVED/INTERACTING WITH THE JOB HOLDER OR TRAINEE

8.1 Internal/Within the Organisation

Supervisors, trainers, safety team, other colleagues, etc.

8.2 External/Outside the Organisation

Government regulators, trainers, suppliers of equipment/tools/consumables, fellow Process Engineers from other companies, labour unions/occupational health and safety associations, etc.

9. PHYSICAL DEMANDS ON THE BODY

- Physique to sustain strenuous conditions;
- Be able to walk and stand for long periods of time;
- Bend, stretch, twist, or reach out;
- Be able to lift relatively heavy materials, tools and equipment;
- Be able to use fingers, hands and feet with ease to complete the assigned task (dexterity);
- Etc.

ANNEX A

Criteria for Assessments based on this NOS

A.1 Guidelines for Assessment

A.1.1 Criteria for assessment for curricula and learning programmes based on this NOS will be created by curricula and programmes developers. Each Performance Criteria (PC) will be assigned marks proportional to its importance in the NOS. Curricula and programmes developers will also lay down proportion of marks for theory and practical skills for each performance criteria, giving more weight to practical skills.

There shall be allocated the 'Total Mark', which will be the sum of all marks in each Unit, distributed across the number of PCs in that particular Unit. The 'out of' mark will be the mark allocated to each PC, which will be shared between theory and skills practical assessments.

A.1.2 Individual awarding/assessment bodies or institutions and other users of the NOS will create unique question papers for the theory part and evaluations for skill practical part for their respective candidates.

ANNEX B NOS Version Control

This Annex gives details necessary for the tracking of the NOS versions based on the number of revisions.

NOS Code	NOS.PE.01		
ZQF Level	7	Version Number	01
Sector	Mining	Date of Approval	7 th May, 2021
Sub Sector	Mineral Processing	Date of Last Review	N/A
Occupation	Metallurgy	Date of Next Review	May 2026

