Federal Democratic Republic of Ethiopia

OCCUPATIONAL STANDARD

POWER GENERATION INSTALLATION AND MAINTENANCE- MECHANICAL

NTQF Level IV

Ministry of Education

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Introduction

Ethiopia has embarked on a process of reforming its TVET-System. Within the policies and strategies of the Ethiopian Government, technology transformation – by using international standards and international best practices as the basis, and, adopting, adapting and verifying them in the Ethiopian context – is a pivotal element. TVET is given an important role with regard to technology transfer. The new paradigm in the outcome-based TVET system is the orientation at the current and anticipated future demand of the economy and the labor market.

The Ethiopia Occupational Standards (EOS) is the core element of the Ethiopian National TVET-Strategy and an important factor within the context of the National TVET-Qualification Framework (NTQF). They are national Ethiopian standards, which define the occupational requirements and expected outcome related to a specific occupation without taking TVET delivery into account.

This document details the mandatory format, sequencing, wording and layout for the Ethiopia Occupational Standard which comprised of Units of Competence.

A Unit of Competence describes a distinct work activity. It is documented in a standard format that comprises:

- Occupational title and NTQF level
- Unit title
- Unit code
- Unit descriptor
- Elements and Performance criteria
- Variables and Range statement
- Evidence guide

Together all the parts of a Unit of Competence guide the assessor in determining whether the candidate is competent.

The ensuing sections of this EOS document comprise a description of the occupation with all the key components of a Unit of Competence:

- chart with an overview of all Units of Competence for the respective level (Unit of Competence Chart) including the Unit Codes and the Unit Titles
- contents of each Unit of Competence (competence standard)
- occupational map providing the technical and vocational education and training (TVET) providers with information and important requirements to consider when designing training programs for this standards and for the individual, a career path

UNIT OF COMPETENCE CHART

Occupational Standard: Power Generation Installation and Maintenance- Mechanical

Occupational Code: EIS IMM

NTQF Level IV

EIS IMM4 01 0612 Monitor Compliance with OHS Policy and Procedures	EIS IMM4 02 0612 Install and Maintain Complex Mechanical Seals	EIS IMM4 03 0612 Maintain Complex Mechanical Valves
EIS IMM4 04 0612 Maintain Complex Mechanical Pumps	EIS IMM4 05 0612 Install and Maintain Steam Turbine	EIS IMM4 06 0612 Conduct Complex Leveling and Alignment
EIS IMM4 07 0612 Maintain Fluid Power Systems	EIS IMM4 08 0612 Install and Maintain Hydro Turbines	EIS IMM4 09 0612 Conduct Technical Inspection of Process Plant and Equipment
EIS IMM4 10 0612 Conduct Performance Testing on Process Plant and Equipment	EIS IMM4 11 0612 Diagnose and Repair Faults in Complex Refrigeration/Air Conditioning Equipment	EIS IMM4 12 0612 Diagnose and Repair Faults in Mechanical Equipment
EIS IMM4 13 0612 Install and Maintain Industrial Transmissions	EIS IMM4 14 0612 Perform Mechanical and Fabrication Drafting	EIS IMM4 15 0612 Conduct Condition Monitoring
EIS IMM4 16 0612 Coordinate First Response Team Operation	EIS IMM4 17 0612 Conduct Welding Inspection/Supervision	EIS IMM4 18 0612 Tune Process Plant and Equipment
EIS IMM4 19 0612 Monitor and Maintain Civil Assets	EIS IMM4 20 0612 Coordinate Permit to Work System	EIS IMM4 21 0612 Plan and Organize work
EIS IMM4 22 0612 Migrate to New Technology	EIS IMM4 23 0612 Establish Quality Standards	EIS IMM4 24 0612 Develop Teams and Individuals
EIS IMM4 25 0612 Utilize Specialized Communication Skills	EIS IMM4 26 0612 Manage and Maintain Small/Medium Business Operation	EIS IMM4 27 1012 Manage Continuous Improvement System

Occupational Standard: Power Generation Installation and Maintenance- Mechanical Level IV	
Unit Title	**Monitor Compliance with OHS Policy and Procedures**
Unit Code	**EIS IMM4 01 0612**
Unit Descriptor	This unit deals with the skills and knowledge required to implement and monitor the organization's Occupational Health and Safety (OHS) policies, procedures and programs in the relevant work area to achieve and maintain Occupational Health and Safety standards. This unit describes generic occupational health and safety competencies applicable for employees with supervisory responsibilities to be exhibited in the work area of responsibility. It involves application of relevant Occupational Health and Safety legislation and codes of practice, including duties and responsibilities of all parties under the general duty of care. It requires the ability to implement and comply with workplace procedures in hazard identification and risk control, observation of others safe practices during work operations and conduct of participative arrangements for maintaining health and safety in the workplace.

Elements	Performance Criteria
1. Provide information to the work group about Occupational Health and Safety and the organization's policies, procedures and programs	1.1 Relevant provisions of Occupational Health and Safety legislation and codes of practice are accurately and clearly explained to the work group 1.2 Information on the organization's Occupational Health and Safety policies, procedures and programs is provided in a readily accessible manner and is accurately and clearly explained to the work group 1.3 Information about identified hazards and the outcome of risk assessment and risk control procedures is regularly provided and is accurately and clearly explained to the work group 1.4 Where appropriate, the teams and individuals roles and responsibilities within the team are identified, and, where required, assist in the provision of on-the-job training
2. Implement and monitor participative arrangements for the management of OHS	2.1 Organizational procedures for consultation over Occupational Health and Safety issues are implemented and monitored to ensure that all members of the work group have the opportunity to contribute 2.2 Issues raised through consultation are dealt with and resolved promptly, or referred to the appropriate personnel for resolution in accordance with workplace procedures for issue resolution

	2.3 The outcomes of consultation over Occupational Health and Safety issues are made known to the work group promptly
3. Implement and monitor the organization's procedures for identifying hazards and assessing risks	3.1 Existing and potential hazards in the work area are identified and reported so that risk assessment and risk control procedures can be applied
4. Implement and monitor the organization's procedures for controlling risks	4.1 Work procedures to control risks are implemented and adherence to them by the work group is monitored in accordance with workplace procedures 4.2 Existing risk control measures are monitored and results reported regularly in accordance with workplace procedures 4.3 Inadequacies in existing risk control measures are identified in accordance with the hierarchy of control and reported to designated personnel 4.4 Inadequacies in resource allocation for implementation of risk control measures are identified and reported to designated personnel
5. Implement the organization's procedures for dealing with hazardous events	5.1 Workplace procedures for dealing with hazardous events are implemented whenever necessary to ensure that prompt control action is taken 5.2 ***Hazardous events*** are investigated to identify their cause in accordance with investigation procedures 5.3 Control measures to prevent recurrence, and minimize risks of hazardous events, are implemented, based on the hierarchy of control if within scope of responsibilities and competencies, or alternatively referred to designated personnel for implementation
6. Implement and monitor the organization's procedures for providing Occupational Health and Safety training	6.1 Occupational Health and Safety training needs are identified accurately, specifying gaps between Occupational Health and Safety competencies required and those held by work group members 6.2 Arrangements are made for fulfilling identified Occupational Health and Safety training needs in both on and off-the-job training programs in consultation with relevant parties
7. Implement and monitor the organization's	7.1 Occupational Health and Safety records for work area are accurately and legibly completed in accordance with workplace requirements for Occupational Health and

procedure for maintaining Occupational Health and Safety records	Safety records and legal requirements for the maintenance of records of occupational injury and disease 7.2 Aggregate information from the area's Occupational Health and Safety records is used to identify hazards and monitor risk control procedures within work area according to organizational procedures and within scope of responsibilities and competencies

Variable	**Range**
Hazardous events	May include but not limited to: • Include accidents, fires and emergencies such as chemical spills or bomb scare. • Procedures for dealing with emergency include evacuation, chemical containment and first aid procedures

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge in: • Evidence of understanding of hierarchy of control (the preferred order of risk control measures for most to least preferred, i.e. elimination, engineering controls, administrative controls and personal protective equipment) is required. • Evidence of understanding of the significance of other management systems and procedures for Occupational Health and Safety is required. • Evidence of knowledge of literacy levels and communication skills of work group members and consequent suitable communication techniques is required. • Dealing with an unplanned event by drawing on essential knowledge and skills to provide appropriate solutions incorporated in the holistic assessment
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Relevant Occupational Health and Safety regulations • Relevant statutory legislation • Relevant enterprise/site safety procedures including identification of hazards and controlling of risks • Enterprise/site emergency procedures and techniques • Environmental legislation • Plant status • Participative arrangements including safety committees • Provision of occupational health and safety instruction to others • Maintenance of occupational health and safety records
Underpinning Skills	Demonstrates skills to: • Apply relevant occupational health and safety regulations • Apply relevant statutory legislation

	• Apply relevant enterprise/site safety procedures • Apply enterprise /site emergency procedures and techniques • Apply enterprise recording procedures • Locate and/or identify relevant plant and equipment • Identify plant status • Communicate effectively.
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

Occupational Standard: Power Generation Installation and Maintenance- Mechanical Level IV	
Unit Title	**Install and Maintain Complex Mechanical Seals**
Unit Code	**EIS IMM4 02 0612**
Unit Descriptor	This unit deals with the skills and knowledge required to undertake all work associated with the installation and maintenance of complex mechanical seals and which may involve fault finding, diagnosis and repairs.

Elements	Performance Criteria
1. Plan and prepare for the work	1.1 Work requirements are identified from request/work orders or equivalent and clarified/confirmed with appropriate parties or by site inspection 1.2 Occupational Health and Safety standards, statutory requirements, relevant Ethiopian standards, codes of practice, manufacturers‟ specifications, environmental requirements and enterprise procedures are identified, applied and monitored throughout the work procedure 1.3 Resources required to satisfy the work plan are identified, obtained and inspected for compliance with the job specifications 1.4 Relevant plans, drawings and texts are selected and interpreted in accordance with the work plan 1.5 Correct size, type and quantity of materials/components are determined, obtained and inspected for compliance with the job specifications 1.6 Work is planned in detail including sequencing and prioritizing and considerations made, where appropriate, for the maintenance of plant security and capacity in accordance with system/site requirements 1.7 Coordination requirements, including requests for isolations where appropriate, are resolved with others involved, affected or required by the work 1.8 Potential hazards are identified and prevention and/or control measures are selected in accordance with the work plan and site procedures 1.9 Work area is prepared in accordance with work requirements and site procedures 1.10 Where appropriate, the teams and individuals roles and responsibilities within the team are identified and, where required, assist in the provision of on-the-job training
2. Remove seals for maintenance	2.1 Required ***isolations*** are confirmed where appropriate, in accordance with site requirements

	2.2 ***Seals*** are identified in accordance with the work plan 2.3 Seals are removed in a manner which will assist in replacement in accordance with the work plan 2.4 Seals are inspected for abnormalities in accordance with the work plan
3. Maintain complex seals	3.1 ***Maintenance*** is performed in accordance with manufacturers specifications and site procedures 3.2 Seal assemblies are dismantled using appropriate engineering principles and technical procedures in accordance with the job plan and site requirements 3.3 Component parts are clearly marked and sketches produced as required for identification in accordance with the job plan and site requirements 3.4 Component wear and clearances are determined using precise measuring techniques and appropriate test equipment in accordance with manufacturer specifications and site requirements 3.5 Components found to be faulty are repaired, replaced and/or adjusted to conform with manufacturer specifications and site requirements 3.6 New components are inspected for compliance to required specifications and prepared for re***assembly*** according to manufacturer specifications /site requirements 3.7 Component parts are refitted to seal assemblies according to manufacturer specifications /site requirements 3.8 Modifications/alterations are undertaken in accordance with site requirements
4. Replace/install complex seals	4.1 ***Site*** is prepared for seal replacement in accordance with the work plan 4.2 Seals are replaced in accordance with the work plan and manufacturer specifications 4.3 All fastenings are torque in accordance with manufacturer specifications and site requirements 4.4 Machinery/plant is test run, monitored and adjusted as required in accordance with manufacturer specifications and site requirements
5. Complete the work	5.1 Work is completed and appropriate personnel notified in accordance with site/enterprise requirements 5.2 Work area is cleared of waste, cleaned, restored and secured in accordance with site/enterprise procedures

	5.3 Plant, ***tools and equipment*** are maintained and stored in accordance with site/enterprise procedures 5.4 ***Work completion details*** are finalized in accordance with site/enterprise procedures

Variable	**Range**
Complex/ specialized seals	May include but not limited to: • Generator hydrogen seals, double acting mechanical seals, floating seals and turbine labyrinth glands.
Test equipment	May include but not limited to: • Feeler gauge, dial gauge, bearing blue, micrometers, flexi gauge, leads and go/no-go gauges. • Details of maintenance may be clarified by diagnosis and work place inspection.
Tools and equipment	May include but not limited to: • micrometers, vernier, dial test indicators, slip gauges, hand tools, customized mandrels, digital height gauges, internal micrometers, oxyacetylene gear, depth gauges, air grinders, jigs and fixtures, customized spanners, electronic internal micrometers, appropriate lifting devices, heated oil bath and induction heaters.
Maintenance	May include but not limited to: • Repair, inspection, modification, overhaul, lubrication, servicing and test running.
Work completion details	May include but not limited to: • Plant/maintenance records, job cards, check sheets, on device labeling updates and reporting/documenting equipment defects.
Work site environment	May include but not limited to: • Affected by nearby plant or processes, e.g. chemical, heat, dust, noise, gas and oil.
Isolations	May refer to: • electrical/mechanical or other associated processes

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge in: • Occupational Health and Safety legislation, statutory legislation, enterprise/site safety procedures and enterprise/site emergency procedures • Preparation and planning of work • Removal techniques maintenance techniques and procedures • Installation techniques and procedures • Completion of work procedures • Dealing with an unplanned event by drawing on essential knowledge and skills to provide appropriate solutions

Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Occupational Health and Safety • Complex mechanical seals • Precision measuring equipment • Seals and gaskets (types and materials) • Bearings (anti-friction and plain) • Quality assurance/quality control • Specialized tools and jigs • Leveling and aligning principles • Rigging and lifting techniques • Relevant materials and components • Technical drawings and data • Data recording techniques • Hand and portable power tools • Diagnostic and testing techniques • Relevant plant and systems • Isolation procedures • Heating techniques • Communication principle
Underpinning Skills	Demonstrates skills to: • Apply Occupational Health and Safety standards • Identify and use measuring equipment • Apply sealing principles • Manufacture and install seals and gaskets • Install bearings (anti-friction and plain) • Use technical drawings and data • Identify and select materials and components • Use hand and portable power tools • Apply diagnostic and testing techniques • Apply dismantling and reassembling techniques • Apply installation and maintenance procedures • Apply data analysis techniques • Recognize worn/damaged components • Communicate effectively
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

Occupational Standard: Power Generation Installation and Maintenance- Mechanical Level IV	
Unit Title	**Maintain Complex Mechanical Valves**
Unit Code	**EIS IMM4 03 0612**
Unit Descriptor	This unit deals with the skills and knowledge required to undertake the fault finding, diagnosis, repair and/or overhaul of complex mechanical valves, but excluding associated servo or actuating units.

Elements	Performance Criteria
1. Plan and prepare for work	1.1 Work requirements are identified from request/work orders or equivalent and clarified/confirmed with appropriate parties or by site inspection 1.2 Occupational Health and Safety standards, statutory requirements, relevant Ethiopian standards, codes of practice, manufacturer specifications , environmental requirements and enterprise procedures are identified, applied and monitored throughout the work procedure 1.3 Resources required to satisfy the work plan are identified, obtained and inspected for compliance with the job specifications 1.4 Relevant plans, drawings and texts are selected and interpreted in accordance with the work plan 1.5 Correct size, type and quantity of materials/components are determined, obtained and inspected for compliance with the job specifications 1.6 Work is planned in detail including sequencing and prioritizing and considerations made, where appropriate, for the maintenance of plant security and capacity in accordance with system/site requirements 1.7 Coordination requirements, including requests for isolations where appropriate, are resolved with others involved, affected or required by the work 1.8 Potential hazards are identified and prevention and/or control measures are selected in accordance with the work plan and site procedures 1.9 Work area is prepared in accordance with work requirements and site procedures 1.10 Where appropriate, the teams and individuals roles and responsibilities within the team are identified and, where required, assist in the provision of the on-the-job training
2. Remove valves for	2.1 Required isolations are confirmed where appropriate, in accordance with site requirements

maintenance	2.2 ***Valve*** is disconnected in accordance with the work plan 2.3 Valve is removed in a manner which will assist in replacement in accordance with the work plan. 2.4 Valve is inspected for abnormalities in accordance with the work plan.
3. Perform valve maintenance	3.1 ***Maintenance*** is performed in accordance with manufacturer specifications and the work plan 3.2 Valve is dismantled, clearly marked for identification and relevant sketches drawn in accordance with the work plan 3.3 Components are correlated in preparation for re-***assembly*** in accordance with manufacturer's drawings/manuals 3.4 New components are inspected to ensure compliance with manufacturer specifications 3.5 Dimensional inspection is performed with ***precision measuring devices*** to ensure compliance with manufacturer specifications and site requirements 3.6 Components are reassembled for testing in accordance with manufacturer specifications and site requirements 3.7 Modifications/alterations are undertaken in accordance with manufacturer specifications and site requirements 3.8 Components are leveled, aligned, coupled and connected in accordance with manufacturer specifications and site requirements. 3.9 Valves are pressure tested, monitored and adjusted if required in accordance with manufacturer specifications and the work plan
4. Replace/install valves	4.1 ***Site*** is prepared for valve replacement in accordance with the work plan 4.2 Valve is replaced in accordance with the work plan and manufacturer specifications 4.3 Valve is connected in accordance with the work plan and manufacturer specifications 4.4 Final job inspection is completed and any permits relinquished in accordance with the work plan
5. Complete the work	5.1 Work is completed and appropriate personnel notified in accordance with site/enterprise requirements 5.2 ***Work area*** is cleared of waste, cleaned, restored and secured in accordance with site/enterprise procedures 5.3 Plant, tools and equipment are maintained and stored in accordance with site/enterprise procedures 5.4 ***Work completion details*** are finalized in accordance with site/enterprise procedures

Variable	Range
Complex valves	May include but not limited to: • Double seated pressure and flow control valves, boiler safety valves, and valves whose actuators are an integral part of the valve and so must be part of any maintenance to the valve.
Precision measuring devices	May include but not limited to: • Inside/outside micrometers, vernier, engineer's rule, dial gauges, depth gauges and feeler gauges.
Testing	May include but not limited to: • Pressure testing (hydraulic and vacuum), blue check and non-destructive testing.
Valve may control solutions	May include but not limited to: • gases solids and fluids and chemicals such as caustic soda, chlorine, ammonia, sulphuric acid, sodium hypochlorite, hydrazine, diethylamine, citric acid, hydrofluoric acid, ammonium molydate, trisodium phosphate, hydrogen, nitrogen, carbon dioxide, water, fly-ash, slurry, compressed air, brine, oil, steam (superheated and saturated), hydrogen, propane and carbon dioxide.
Details of maintenance	May include but not limited to: • clarified by diagnosis and workplace inspection
Maintenance	May include but not limited to: • Repair, inspection, modification, overhaul, lubrication, servicing, test running, sealing, machining, identifying and replacing defective components and valve packing.
Valve drives	May include but not limited to: • electrical, mechanical, pneumatic, hydraulic or manual
Work completion details	May include but not limited to: • Plant and maintenance records, job cards, check sheets, on device labeling updates and reporting and/or documenting equipment defects.
Work site environment	May be affected by but not limited to: • Nearby plant or processes, e.g. chemical, heat, dust, noise, gas and oil, Isolations can refer to electrical/mechanical or other associated processes.

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge in: • Knowledge and application of relevant sections of Occupational Health and Safety legislation, statutory legislation, enterprise/site safety procedures and enterprise/site emergency procedures • Preparation and planning of work removal techniques • Maintenance techniques and procedures • Installation techniques and procedures • Completion of work procedures

	• Dealing with an unplanned event by drawing on essential knowledge and skills to provide appropriate solutions
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Valve operating and seating arrangements • Hydraulic and pneumatic principles • Measuring equipment • Glands, seals and gaskets • Bearings • Occupational Health and Safety standards • Quality assurance/quality control • Specialized tools and jigs • Leveling and aligning • Rigging and lifting equipment • Valve materials and components • Technical drawings and data • Data recording techniques • Hand and portable power tools • Diagnostic and testing techniques • Protective coatings • Plant and systems • Blow down duration and valve lift • Communication principles
Underpinning Skills	Demonstrates skills to: • Identify and use precision measuring equipment • Manufacture and install seals and gaskets • Apply dismantling and assembly techniques • Select, manufacture and use specialized tools and jigs • Level and align • Use technical drawings and data • Identify and select materials and components • Use hand and portable power tools • Apply diagnostic and testing techniques and rectify faults • Apply protective coatings • Interpret and apply valve operational techniques • Apply Occupational Health and Safety procedures • Recognize worn/damaged components • Apply effective maintenance procedures • Apply data analysis techniques and tools • Communicate effectively
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

Occupational Standard: Power Generation Installation and Maintenance- Mechanical Level IV	
Unit Title	**Maintain Complex Mechanical Pumps**
Unit Code	**EIS IMM4 04 0612**
Unit Descriptor	This unit deals with the skills and knowledge required to undertake the installation and maintenance of multi-stage centrifugal pumps, axial flow compressors, fans and blowers.

Elements	Performance Criteria
1. Plan and prepare for the work	1.1 Work requirements are identified from request/work orders or equivalent and clarified/confirmed with appropriate parties or by site inspection 1.2 Occupational Health and Safety standards, statutory requirements, relevant Ethiopian standards, codes of practice, manufacturer specifications , environmental requirements and enterprise procedures are identified, applied and monitored throughout the work procedure 1.3 Resources required to satisfy the work plan are identified, obtained and inspected for compliance with the job specifications 1.4 Relevant plans, drawings and texts are selected and interpreted in accordance with the work plan 1.5 Correct size, type and quantity of ***materials***/components are determined, obtained and inspected for compliance with the job specifications 1.6 Work is planned in detail including sequencing and prioritizing and considerations made, where appropriate, for the maintenance of plant security and capacity in accordance with system/site requirements 1.7 Co-ordination requirements, including requests for isolations where appropriate, are resolved with others involved, affected or required by the work 1.8 Potential hazards are identified and prevention and/or control measures are selected in accordance with the work plan and site procedures 1.9 Work area is prepared in accordance with work requirements and site procedures 1.1 Where appropriate, the teams and individuals roles and responsibilities within the team are identified and, where required, assist in the provision of on-the-job training
2. Remove pumps for maintenance	2.1 Required ***isolations*** are confirmed, where appropriate, in accordance with site requirements 2.2 ***Pump*** is disconnected in accordance with the work plan

	2.3 Pump is removed in a manner which will assist in replacement in accordance with the work plan 2.4 Pump is inspected for abnormalities in accordance with the work plan
3. Maintain pumps	3.1 ***Maintenance*** is performed in accordance with manufacturer specifications and site procedures 3.2 Pump is dismantled for maintenance in accordance with manufacturer specifications and site procedures 3.3 Sketches are made, data noted and components marked for identification and/or re-***assembly*** in accordance with job requirements and site procedures 3.4 New components are obtained and inspected for compliance with manufacturer specifications 3.5 Dimensional inspection is performed with precision measuring devices to ensure compliance with specifications and results recorded in accordance with job requirements and site procedures 3.6 Pump is reassembled applying appropriate principles and techniques in accordance with manufacturer specifications and site requirements 3.7 Modifications/alterations are undertaken in accordance with site requirements
4. Replace/install pumps	4.1 Site is prepared for pump replacement in accordance with the work plan 4.2 Pump is replaced in accordance with the work plan and manufacturer specifications 4.3 Pump is leveled, aligned, coupled and connected in accordance with the work plan 4.4 All fastening are torque in accordance with manufacturer specifications and site requirements 4.5 Machinery/plant and pump are test run, monitored and adjusted as required in accordance with manufacturer specifications and site requirements
5. Complete the work	5.1 Work is completed and appropriate personnel notified in accordance with site/enterprise requirements 5.2 ***Work area*** is cleared of waste, cleaned, restored and secured in accordance with site/enterprise procedures 5.3 ***Plant, tools*** and ***equipment*** are maintained and stored in accordance with site/enterprise procedures 5.4 ***Work completion details*** are finalized in accordance with site/enterprise procedures

Variable	Range
Materials	May include but not limited to: • Liquid nitrogen.
Isolations	May include but not limited to: • can refer to electrical/mechanical or other associated processes
Complex pumps	May include but not limited to: • Multistage boiler feed pumps and circulation pumps, gas turbine compressors, multistage hydrogen compressors.
Pump drives	May include but not limited to: • electrical, internal combustion, hydraulic, pneumatic or steam
Details of maintenance	May include but not limited to: • Be clarified by diagnosis and workplace inspection.
Maintenance	May include but not limited to: • Repair, inspection, modification, lubrication, servicing, test running, identifying and replacing defective components.
Tools	May include but not limited to: • Micrometers, verniers, dial test indicators, slip gauges, hand tools, hydraulic spanners, customized mandrels, digital height gauges, internal micrometers, depth gauges, air grinders, jigs and fixtures, customized spanners, thermal blankets, induction heaters, thermal crayons, digital thermometers, oxyacetylene gear and appropriate lifting devices.
Plant and equipment	May include but not limited to: • Include jigs for dismantling and oxyacetylene heating equipment.
Work site environment may	May include but not limited to: • Be affected by nearby plant or processes e.g. chemical, heat, dust, noise and oil.
Work completion details	May include but not limited to: • Plant and maintenance records, job cards, check sheets, on device labeling updates and reporting and/or documenting equipment defects.

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge in: • The knowledge and application of relevant sections of: Occupational Health and Safety legislation Statutory legislation Enterprise/site safety procedures Enterprise/site emergency procedures • Preparation and planning of work • Removal techniques • Maintenance techniques and procedures

	• Installation techniques and procedures • Completion of work procedures • Dealing with an unplanned event by drawing on essential knowledge and skills to provide appropriate solutions
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Pumps and compressors • Precision measuring equipment • Seals and gaskets • Bearings (anti-friction) • White metal and tilting pad bearings • Occupational Health and Safety standards • Quality assurance/quality control • Specialized tools and jigs • Advanced balancing, leveling and alignment techniques • Rigging and lifting equipment • Materials and components of pumps • Fluid dynamics • Torque techniques • Technical drawings and data • Data recording techniques • Hand and portable power tools • Diagnostic and testing techniques • Protective coatings • Heating techniques • Defined tolerances and fits • Isolation procedures • Insulation materials • Complex/multistage pumps, compressors • Communication principles
Underpinning Skills	Demonstrates skills to: • Identify and use precision measuring equipment • Manufacture and install seals and gaskets • Apply fluid dynamics principles • Install bearings (anti-friction and plain) • Use specialized tools and jigs • Apply advanced level and alignment techniques • Use technical drawings and data • Identify and select materials and components • Apply data analysis techniques • Identify and apply correct torque techniques • Use hand and portable hand tools • Apply diagnostic and testing techniques • Use heat application equipment • Apply dismantling and reassembling techniques • Work to defined tolerances • Apply Occupational Health and Safety procedures • Recognize worn/damaged components

	• Apply effective maintenance procedures • Install white metal and tilting pad bearings • Communicate effectively.
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

Occupational Standard: Power Generation Installation and Maintenance- Mechanical Level IV	
Unit Title	**Install and Maintain Steam Turbine**
Unit Code	**EIS IMM4 05 0612**
Unit Descriptor	This unit deals with the skills and knowledge required to install HP, IP, LP, and SFPT, cylinders, rotors and steam units.

Elements	Performance Criteria
1. Plan and prepare for the work	1.1 Work requirements are identified from request/work orders or equivalent and clarified/confirmed with appropriate parties or by site inspection 1.2 Occupational Health and Safety standards, statutory requirements, relevant Ethiopian standards, codes of practice, manufacturer specifications , environmental requirements and enterprise procedures are identified, applied and monitored throughout the work procedure 1.3 Resources required to satisfy the work plan are identified, obtained and inspected for compliance with the job specifications 1.4 Relevant plans, drawings and texts are selected and interpreted in accordance with the work plan 1.5 Correct size, type and quantity of materials/components are determined, obtained and inspected for compliance with the job specifications 1.6 Work is planned in detail including sequencing and prioritizing and considerations made, where appropriate, for the maintenance of plant security and capacity in accordance with system/site requirements 1.7 Co-ordination requirements, including requests for isolations where appropriate, are resolved with others involved, affected or required by the work 1.8 Potential hazards are identified and prevention and/or control measures are selected in accordance with the work plan and site procedures 1.9 Work area is prepared in accordance with work requirements and site procedures 1.10 Where appropriate, the teams and individuals roles and responsibilities within the team are identified and, where required, assist in the provision of on-the-job training
2. Disassemble turbine	2.1 Required ***isolations*** are confirmed where appropriate in accordance with enterprise/site procedures 2.2 Turbine is disassembled in accordance with manufacturer specifications and work requirements

	2.3 Turbine components are removed in appropriate priority in accordance with manufacturer's specification and work requirements 2.4 Disassembly is carried out in a manner that will facilitate assembly in accordance with the work plan 2.5 ***Components*** are measured and clearances taken to determine conformity to manufacturer's limits, and to ensure assembly is in accordance with manufacturer specifications 2.6 Measurements and clearances are recorded in accordance with manufacturer specifications and work requirements.
3. Inspect turbine components	3.1 Components are cleaned and inspected in accordance with the work plan 3.2 Faults are identified and recorded in accordance with the work plan 3.3 New components are inspected for compliance to manufacturer specifications and work requirements 3.4 Components are prepared for ***assembly*** in accordance with the work plan
4. Repair turbine/ components	4.1 Repairs are carried out in accordance with the work plan 4.2 Repairs are tested and results analyzed to ensure conformance to specifications and in accordance with the work plan 4.3 Data from testing is recorded in accordance with the work plan and enterprise/site procedures
5. Reassemble turbine	5.1 Site is prepared for re-assembly of turbine in accordance with the work plan and site procedures 5.2 Components are refitted in accordance with the work plan and manufacturers specifications 5.3 Turbine is assembled in accordance with the work plan and manufacturer specifications 5.4 Turbine is test run and operating characteristics are monitored to ensure compliance with manufacturer specifications and enterprise requirements
6. Complete the work	6.1 Work is completed and appropriate personnel notified in accordance with site/enterprise requirements 6.2 ***Work area*** is cleared of waste, cleaned, restored and secured in accordance with site/enterprise procedures 6.3 Plant, tools and ***equipment*** are maintained and stored in accordance with site/enterprise procedures 6.4 ***Work completion details*** are finalized in accordance with site/enterprise procedures

Variable	Range
Isolations	can refer to : • electrical/mechanical or other associated processes
Assembly	May entail : • complex/advanced leveling and aligning procedures
Components	May include but not limited to: • White metal bearings, tilting pad bearings, lubrication system components, governor system components, cooling systems components, transmissions and couplings.
Test equipment	May include but not limited to: • optical fiber scope, gas analyzers, pressure recorders and vibration monitors
Work site environment	May be affected : • by nearby plant or processes, e.g. chemical, heat, dust, noise, gas and oil
Work completion details	May include but not limited to: • Plant and maintenance records, job cards, check sheets, on device labeling updates and reporting and/or documenting equipment defects.

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge in: • The knowledge and application of relevant sections of: Occupational Health and Safety legislation Statutory legislation Enterprise/site safety procedures Enterprise/site emergency procedures • Preparation and planning of work • Disassembly techniques • Inspection and fault diagnosis techniques and procedures • Repair and maintenance techniques and procedures • Re-assembly techniques • Completion of work procedures • Dealing with an unplanned event by drawing on essential knowledge and skills to provide appropriate solutions
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Occupational Health and Safety standards • Related plant and equipment • Hand and portable power tools • Precision measuring equipment • Rigging and lifting equipment • Specialized tools and jigs • Advanced leveling and aligning techniques • Technical drawings and data • Diagnostic and testing techniques • Gaskets and seals • Bearings (white metal and pad tilting)