NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

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PROPOSED OCCUPATIONAL STANDARDS

OCCUPATION: RENEWABLE ENERGY ENGINEER (HYDRO)

LEVEL: NTA 8

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ABBREVIATIONS

CAD	Computer-Aided Design
CASS	Topographic/Cadastral Mapping Software (Developed by South Digital Technology Co., Ltd.)
CBET	Competency Based Education and Training
HSE	Health, Safety, Environment
NACTVET	National Council for Technical and Vocational Education and Training
NOS	National Occupational Standards
OS	Occupational Standards
TET	Technical Education and Training
TVET	Technical and Vocational Education and Training

GLOSSARY OF TERMS

Circumstantial Knowledge:	Detailed knowledge, which allows the decision-making in regard to different circumstances and cross cutting issues.
Competence:	The ability to use knowledge, understanding, practical, and thinking skills to perform effectively to the workplace standards required in employment.
Competency:	A description of the ability one possesses when able to perform a given occupational task effectively and efficiently.
Competency-based Education:	An instructional programme that derives its content from validated tasks and bases assessment on the learner's performance.
Curriculum:	A description or composite of statements about "what is to be learned" by the trainee/student in a particular instructional programme; a product that states the "intended learning outcomes".
Educational/Training Programme:	The complete curriculum and instruction (what and how) that is designed to prepare a person for employment in a job or other particular performance situation.
Occupation:	A specific position requiring the performance of specific tasks – essentially the same tasks are performed by all employees having the same title. (Example: baker)
Occupational Area:	This is a broad grouping of related jobs. (Example: food service)
Occupational Competence:	The application of knowledge and skills that consistently meet the standards required by the work context.
Occupational Standards:	Specific requirements of competences people are expected to demonstrate in a particular occupational area, including knowledge and relevant attitudes. They also act as a performance tool of assessment of the prescribed outcomes.
Occupational/Job Analysis:	A process used to identify the tasks that are important to employees in any given occupation**.**
Performance Criteria:	Indicate expected end results or outcomes in the form of evaluative statements.
Skills:	The ability to perform occupational tasks with a high degree of proficiency within a given occupation. Skill is conceived of as a composite of three completely interdependent components: cognitive, affective, and psychomotor.

Standards:	A set of statements, which if proved true under working conditions, means that an individual is meeting an expected level and type of performance.
Task Analysis:	The process of analysing each task to determine the steps, circumstantial knowledge, attitudes, performance standards, tools and materials needed, as well as safety concerns required for the employees performing it.
Task:	A work activity that has a definite beginning and ending, is observable or measurable, and consists of two or more definite steps that leads to a product, service, or decision.
Underpinning Knowledge:	Crucial knowledge that an individual must acquire in order to demonstrate competences that are associated in performing a given task.
Verification Process:	The process of having experts review and confirm the importance of the task (competency) statements identified through occupational analysis. Other questions, such as the degree of task learning difficulty are also frequently asked. This process is also sometimes referred to as validation.

1.0. INTRODUCTION

Technical Education and Training (TET) is one of the most important education sub-sectors in Tanzania, responsible for developing a skilled workforce to support the country's industrialization economic agenda. Tanzania's *Development Vision 2025* intends to raise the country's economy to a middle-income status. This requires a skilled workforce that is aligned with the needs of the public and private sectors of the economy. The National Council for Technical Education has begun the job of drafting Occupational Standards that will eventually be adopted as National Occupational Standards for TET in order to ensure that it meets the needs of the labour market and the country's economic agenda.

National Occupational Standards (NOS) are performance criteria that are matched with labour market demands. Each National Occupation Standard describes functions, performance standards, and knowledge/understanding for one important function or task. They combine skills, knowledge, and attitudes to describe best practice. They are useful tools for establishing job roles, personnel recruiting, supervision, and appraisal, as well as TET standards. They're also helpful for benchmarking and harmonizing qualifications on a national and international level. Standards, in general, provide a solid framework for high-quality TET that is labour market-relevant, current, and consistent in delivery across all public and private institutions.

However, it must be noted that, Occupational Standards and Training standards/qualifications standards are different. Occupational standards are defined in terms of activities performed by a person in a selected occupation (e.g., an electrical engineer designs electrical wiring circuits, performs troubleshooting in electrical wiring, etc.) and they are usually defined by employers following procedures agreed upon by all stakeholders. Education and training standards are developed from the activities defined in occupational standards, and they include learning objectives to ensure that the necessary skills and knowledge are developed by a person to enable him or her to function at an agreed level in an occupation. Education and Training standards are used to define curricula in training institutions. It is however critical that there must be a direct link between the occupational standards and the training standards to respond to the demands of the labour market.

In TET delivery, Tanzania adopted the Competence Based Education and Training (CBET) approach. The CBET approach focuses on providing learners with the skills and knowledge required to meet the occupational standards. Occupational standards are thus the starting point for developing competency-based training (CBET) programmes. TET institutions will be required to benchmark their curricula with relevant occupational standards.

Occupational Standards are developed based on a given occupation's current and future demands.

As a result, they serve as a means of bridging the gap between the worlds of employment and technical education and training (TET).

The Renewable Energy Engineer (Hydro) has its own set of occupational standards. The document explains how the occupational standards were developed, as well as the scope, the occupational profile in the form of DACUM charts, and the Occupational Standards.

2.0. OCCUPATIONAL STANDARD DEVELOPMENT PROCESS

The Occupational standards development process began with an examination of major documents that guide Tanzanian skill development. The *10-year National Skills Development Strategy (2016-2026)* was one of the documents reviewed, and it outlined six (6) economic sectors that should be prioritized when developing skills development programmes.

These sectors include: Transport and Logistics, Tourism and Hospitality, Agribusiness, Construction, Energy and ICT. NACTE labour market reports were also used in the literature review to determine the skills demand in the Tanzanian labour market as a whole.

After the literature review, a workshop comprised of expert workers and educators with substantial knowledge and experience in the occupation conducted an occupational analysis utilizing the DACUM approach to produce the occupational profile. The analysis resulted in DACUM Charts, which are attached as **Appendix 1** to this document.

The occupational standards were then developed. Experts in Occupational Analysis and the Development of Occupational Standards facilitated the workshop. Interviews, online surveys, and a stakeholder forum were used to validate the Occupational Standards. Engineers, supervisory technicians on the job, and experienced Renewable Energy Engineers (Hydro) were key informants in the survey to discover occupational trends. This information was used to gain insight from the workplaces regarding trends and changes in the profession, including how well graduates are prepared for working in the occupation. A total of 8 online surveys were completed by experts from the labour market across the country. Apart from the surveys aiding in defining the scope for the occupational analysis, they also served to engage a wide cross-section of experts in the occupation. Apart from this, the stakeholders' forum was attended by 20 participants from different parts of the country representing various companies.

3.0. THE SCOPE AND OVERVIEW OF THE OCCUPATION STANDARDS FOR RENEWABLE ENERGY ENGINEERS (HYDRO)

These standards cover a broad range of duties and tasks that can be performed by a Renewable Energy Engineer (Hydro). However, the occupational standards are not meant to replace individual job descriptions. Instead, they are to be used for guidance in defining skill levels and knowledge for the technician in specific settings or positions. The Renewable Energy Engineer (Hydro) may

perform tasks in a number of key areas of the occupational standards, but not necessarily in all areas. For example, in large operations, other individuals may be employed or designated to perform specific tasks.

The Renewable Energy Engineer (Hydro) shall complete the operation, maintenance, management and design of small and medium-sized hydropower stations in coordination and cooperation with other engineers. On the site of the hydropower station, the Renewable Energy Engineer (Hydro) may guide and organize technicians to analyse the causes of typical faults of generator set and deal with them; coordinate and manage the organization, safety and production technology of the plants in the hydropower station, and complete the design and engineering drawings of the six parts of the small and medium-sized hydropower station, including the water intake structure, water diversion structure, pressure pipeline, surge chamber, plant area, and vertical powerhouse. Generally, a Renewable Energy Engineer (Hydro) performs the following responsibilities:

a. Typical faults and treatment of generator set equipment in hydropower stations

b. Hydropower station management

c. Design of small and medium-sized hydropower stations

d. Operation management of hydraulic structures

e. Operation management of metal structures

f. Operation management of electromechanical equipment

g. Operation management of auxiliary equipment

h. Operation management of management equipment

i. Optimization of operation management

j. Typical faults and treatment of generator set equipment in hydropower stations

k. Hydropower station management

l. Design of small and medium-sized hydropower stations

The Occupational Standards have been clustered into NTA qualification levels, i.e. NTA level 7 and 8.

4.0. VALIDITY PERIOD

Due to the rapid development of technology, the validity period of occupational standards is 3-5 years. The review will proceed in the same manner as the one before it, with new occupational standards being developed based on current trends of the labour market.

5.0. OCCUPATIONAL STANDARDS

5.1 OCCUPATIONAL STANDARDS FOR RENEWABLE ENERGY ENGINEER (HYDRO) - NTA 8

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	TYPICAL FAULTS AND TREATMENT OF GENERATOR SET EQUIPMENT IN HYDROPOWER STATIONS	**DUTY NO.**	**801**
TASK TITLE	TYPICAL FAULTS AND HANDLING OF HYDRAULIC TURBINES	**TASK NO.**	**8011**
PERFORMANCE CRITERIA	The person performing this task must be able to handle the generator accidents in accordance with the technical specifications for hydropower station operation and maintenance, as well as the operation and maintenance regulations for hydro generator sets. They must quickly identify the causes of hydraulic turbine accidents and carry out maintenance and recovery.		
RANGE STATEMENT	The task can be performed in the power house of hydropower stations under the supervision of water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. Safety protection equipment and emergency tools; 2. Hydraulic turbine parts.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Monitor the operating parameters of the hydraulic turbine, and inspect and maintain the overcurrent components, guide vane transmission mechanism, main shaft sealing device, runner and main shaft; 2. Handle the fault of the shear pin on the guide vane; 3. Handle abnormal spindle sealing water pressure; 4. Reduce the raised water level of the hydraulic turbine head cover; 5. Handle the problem of reduced oil level in turbine guide bearings; 6. Reduce the deterioration of lubricating oil and abnormally high oil level of turbine guide bearings; 7. Handle problems such as interruption of cooling water or decrease in water pressure in the oil cooler; 8. Handle the increased temperature of the guide bearing; 9. Handle faults where the vibrating	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Judge the occurrence of accidents based on the instrument readings of the hydraulic turbine and equipment faults, and quickly conduct preliminary treatment to limit the development of the accident; 1.2 Remove common faults of hydraulic turbines. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Key points and principles for maintaining hydraulic turbines; 2.2 Principles for handling hydraulic turbine faults and accidents; 2.3 Principles for handling faults of hydraulic turbines; 2.4 Management system of work safety in hydropower station. **3.0 Theories** The person performing this task must be able to explain the following:

and swing of the hydraulic turbine exceed the specified values; 10. Analyse and handle the causes of generator set overspeed accidents; 11. Analyse and handle the causes of abnormal vibration of the generator set; 12. Analyse and handle the causes of lifting and water hammer; 13. Clean the tools, equipment and workplaces; 14. Standardize the storage of operating tools and equipment.	3.1 Theory of calculating the suction height and installation elevation of hydraulic turbine; 3.2 Calculation of pressure regulation guarantee for hydraulic turbines; 3.3 Causes of common failures and accidents of hydraulic turbine; 3.4 Analyse the cause of the accident and make corresponding measures. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Report writing skills; 4.3 Safety operation skills; 4.4 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The common faults and accidents of hydraulic turbines are handled according to relevant operation and maintenance technical requirements and operation and maintenance regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Waste disposal; 3. "Two-ticket and Three Systems" in hydropower station; 4. Safety operation regulations for hydropower stations.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	TYPICAL FAULTS AND TREATMENT OF GENERATOR SET EQUIPMENT IN HYDROPOWER STATIONS	**DUTY NO.**	**801**
TASK TITLE	COMMON FAULT ANALYSIS AND HANDLING OF GENERATORS	**TASK NO.**	**8012**
PERFORMANCE CRITERIA	The person performing this task must be able to handle the generator accidents in accordance with the technical specifications for hydropower station operation and maintenance, as well as the operation and maintenance regulations for hydro generator sets. They must quickly identify the causes of hydro generator accidents and carry out maintenance and recovery.		
RANGE STATEMENT	The task can be performed in the power house of hydropower station in collaboration and cooperation with water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. Safety protection equipment and emergency tools; 2. Components and parts of generators.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Monitor the power generation (temperature, oil level, vibration, insulation, current extraction device, cooler, braking system); 2. Handle the generator's failure to generate electricity; 3. Stabilize the generator voltage; 4. Handle abnormal voltage of the phase compound excitation generators; 5. Handle voltage faults of thyristor excitation generators; 6. Handle three-phase voltage imbalance fault of generators; 7. Reduce excessive generator temperature; 8. Handle the noise of the generator during operation; 9. Ensure that the temperature of the generator bearings is appropriate; 10. Reduce excessive vibration of the generators; 11. Handle unstable and oscillating voltage; 12. Handle loaded generators that require too much excitation current;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Judge the occurrence of accidents based on the instrument readings of the generator and equipment faults, and quickly conduct preliminary treatment to limit the development of the accident; 1.2 Remove common faults of generators. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Key points and principles for maintaining generators; 2.2 Principles for handling generator faults and accidents; 2.3 Causes of common failures and accidents of generator; 2.4 Management system of work safety in hydropower station. **3.0 Theories** The person performing this task must be able to explain the following:

13. Deal with the problem that the generator starts normally, but the switch trips when connecting the external circuit; 14. Handle the fault that the magnetic field rheostat is burnt red; 15. Handle faults of large sparks on the electric brush; 16. Clean the tools, equipment and workplaces; 17. Standardize the storage of operating tools and equipment.	3.1 Theory of measurement methods for insulation resistance and absorption ratio of hydro generators; 3.2 Drying methods and technologies for hydro generators; 3.3 Principles for handling faults of hydraulic turbines; 3.4 Analyse the cause of the accident and make corresponding measures. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Report writing skills; 4.3 Safety operation skills; 4.4 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The common faults and accidents of generators are handled according to relevant operation and maintenance technical requirements and operation and maintenance regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Safety operation regulations for hydropower stations; 3. "Two-ticket and Three Systems" in hydropower station.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	TYPICAL FAULTS AND TREATMENT OF GENERATOR SET EQUIPMENT IN HYDROPOWER STATIONS	**DUTY NO.**	**801**
TASK TITLE	TYPICAL FAULTS AND HANDLING OF MICROPROCESSOR-BASED SPEED CONTROLLER	**TASK NO.**	**8013**
PERFORMANCE CRITERIA	The person performing this task must be able to handle accidents of microprocessor-based speed controller in accordance with the acceptance regulations for the testing of hydraulic turbine speed regulators and oil pressure devices, and the testing guidelines for the adjustment of hydraulic turbine electro-hydraulic regulating system and devices, and quickly identify the causes of microprocessor-based speed controller accidents and carry out maintenance and recovery.		
RANGE STATEMENT	The task can be performed in the power house of hydropower station in collaboration and cooperation with water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. Safety protection equipment and emergency tools; 2. Parts of the microprocessor-based speed controller.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Adjust, operate, and maintain microprocessor-based speed controllers; 2. Handle the problem of inability to start the machine after power on due to electrical failure; 3. Handle the problem that the guide vanes are fully closed after manual startup and grid connection and switching to automatic mode; 4. Handle the problem that the speed controller does not respond to the fault after the startup command is issued; 5. Handle the problem of generator set frequency stability value less than 50Hz after startup; 6. Handle the problem of excessive oscillation of the automatic no-load frequency of the generator set; 7. Handle the problem of load	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Judge the occurrence of accidents based on the instrument readings of the microprocessor-based speed controller and equipment faults, and quickly conduct preliminary treatment to limit the development of the accident; 1.2 Eliminate common faults in microprocessor-based speed controllers. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Key points and guidelines for maintaining microprocessor-based speed controllers; 2.2 Principles for handling accidents of microprocessor-based speed controllers; 2.3 Principles for handling faults of microprocessor-based speed controllers; 2.4 Principles for regulating and controlling the microprocessor-based speed controller system; 2.5 Management system of work safety in hydropower

shedding during the generator set's operation with load; 8. Handle the problem of servomotor twitching during the generator set's operation with load; 9. Handle the problem of sudden load reduction to zero and stable operation during the generator set's operation with load; 10. Handle the problem that the speed controller cannot shut down urgently during the generator set's operation with load; 11. Handle abnormal phenomena during load rejection and shutdown processes.	station. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Causes of common faults and accident of microprocessor-based speed controllers; 3.2 Analysis of the methods for handling microprocessor-based speed controller accidents. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Report writing skills; 4.3 Safety operation skills; 4.4 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Common faults and accidents of microprocessor-based speed controllers are handled according to relevant technical requirements and regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Safety operation regulations for hydropower stations; 3. "Two-ticket and Three Systems" in hydropower station.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	TYPICAL FAULTS AND TREATMENT OF GENERATOR SET EQUIPMENT IN HYDROPOWER STATIONS	**DUTY NO.**	**801**
TASK TITLE	TYPICAL FAULTS AND HANDLING OF EXCITATION DEVICES	**TASK NO.**	**8014**
PERFORMANCE CRITERIA	The person performing this task must be able to take corresponding measures based on common faults of the excitation devices, master the basic requirements for handling accidents of the excitation devices, and quickly search for causes and repair and restore the excitation devices based on the accidents.		
RANGE STATEMENT	The task can be performed in the power house of hydropower station in collaboration and cooperation with water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. Safety protection equipment and emergency tools; 2. Parts of the excitation devices.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Operate and maintain microprocessor-based excitation devices; 2. Handle the problem of excitation failure; 3. Handle the problem of excitation TV disconnection; 4. Handle the faults of over excitation and low excitation limits; 5. Handle the problem of pulse disappearance; 6. Handle the faults of overcurrent and DC power failure; 7. Handle the faults of over excitation protection; 8. Handle the problem of quick-acting fusing in the power cabinet; 9. Handle the problem of the generator being unable to lift voltage when starting up; 10. Handle the problem of generator voltage below rated voltage after startup and voltage buildup.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Judge the occurrence of accidents based on the instrument readings of the excitation device and equipment faults, and quickly conduct preliminary treatment to limit the development of the accident; 1.2 Explain how to repair common faults in the excitation devices. **2.0 Principles** 2.1 Maintenance points and guidelines for excitation devices; 2.2 Principles for handling excitation device accidents; 2.3 Working principles of three-phase bridge-type thyristor rectifier circuit; 2.4 Principles of self-excited generator excitation; 2.5 Principles for handling excitation device faults. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Common fault causes of excitation devices; 3.2 Analyse the methods for handling excitation device accidents.

	4.0 Essential Skills 4.1 Communication skills; 4.2 Report writing skills; 4.3 Safety operation skills; 4.4 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The common faults and accidents of excitation devices are handled according to relevant operation and maintenance technical requirements and operation and maintenance regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Safety operation regulations for hydropower stations; 3. "Two-ticket and Three Systems" in hydropower station.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	TYPICAL FAULTS AND TREATMENT OF GENERATOR SET EQUIPMENT IN HYDROPOWER STATIONS	**DUTY NO.**	**801**
TASK TITLE	FAULTS AND HANDLING OF GENERATOR SET AUXILIARY EQUIPMENT	**TASK NO.**	**8015**
PERFORMANCE CRITERIA	The person performing this task must be able to conduct a scientific and comprehensive evaluation on the operating conditions of the oil, gas, and water systems of the hydropower station, take corresponding measures for common faults, and quickly identify the causes of auxiliary equipment accidents for maintenance and recovery in accordance with the operating regulations of the hydropower station.		
RANGE STATEMENT	The task can be performed in the power house of hydropower station in collaboration and cooperation with water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. Safety protection equipment and emergency tools; 2. Parts of auxiliary equipment.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Comply with the operating procedures and fault handling principles of the auxiliary equipment; 2. Handle abnormal oil level faults in hydro generator bearings; 3. Handle oil splashing faults in the bearings of hydro generators; 4. Handle abnormal oil level faults of pressure oil devices; 5. Handle abnormal vibration or sound faults during the operation of the air compressor; 6. Handle abnormal temperature rise during the operation of the air compressor; 7. Handle faults of air compressor with long pumping time; 8. Handle the temperature rise of the cooled equipment; 9. Handle cooling water interruption.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Repair common faults in auxiliary equipment. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for handling auxiliary equipment faults and accidents; 2.2 Operating procedures for auxiliary equipment. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Causes of common faults and accident of auxiliary equipment; 3.2 Causes of abnormal oil level faults in hydro generator bearings; 3.3 Causes of oil splashing faults in the bearings of hydro generators; 3.4 Causes of abnormal oil level faults of pressure oil devices;

	3.5 Causes of abnormal vibration or sound faults during the operation of the air compressor; 3.6 Causes of abnormal temperature rise during the operation of the air compressor; 3.7 Causes of load shedding during the generator set's operation with load; 3.8 Causes of faults of air compressor with long pumping time; 3.9 Causes of the temperature rise of the cooled equipment; 3.10 Causes of cooling water interruption. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Learning skills; 4.3 Management skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The common faults and accidents of auxiliary equipment are handled according to relevant operation and maintenance technical requirements and operation and maintenance regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	TYPICAL FAULTS AND TREATMENT OF GENERATOR SET EQUIPMENT IN HYDROPOWER STATIONS	**DUTY NO.**	**801**
TASK TITLE	ABNORMAL OPERATION AND ACCIDENT HANDLING OF TRANSFORMERS	**TASK NO.**	**8016**
PERFORMANCE CRITERIA	The person performing this task must be able to take corresponding measures based on common faults in transformers, and quickly identify the causes for maintenance and recovery according to the basic requirements of transformer accident handling and the situation of transformer accidents.		
RANGE STATEMENT	The task can be performed in the power house of hydropower station in collaboration and cooperation with water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. Safety protection equipment and emergency tools; 2. Parts of the transformer.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Comply with the operating procedures and fault handling principles of the transformers; 2. Handle the main insulation and interturn insulation faults of the winding; 3. Handle insulation faults at the leads; 4. Handle insulation faults in iron cores; 5. Handle flashover and explosion faults at the sleeves; 6. Handle sub switch faults; 7. Handle abnormal oil temperature of transformers; 8. Handle abnormal oil level of transformers; 9. Handle transformer fire faults; 10. Handle faults after differential protection action.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Repair common faults in transformers; 1.2 Handle abnormal oil of transformers; **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Transformer operation regulations and fault handling principles; 2.2 Operation principles of transformers. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Common causes of transformer accidents; 3.2 Causes of the main insulation and interturn insulation faults of the winding; 3.3 Causes of insulating faults at the leads; 3.4 Causes of flashover and explosion faults at the sleeves; 3.5 The cause of the sub switch faults; 3.6 Causes of abnormal oil temperature of transformers.

	3.7 Causes of abnormal oil level of transformers. 3.8 Causes of the transformer's catching fire; 3.9 Causes of faults after differential protection action. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Learning skills; 4.3 Management skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The common faults and accidents of transformers are handled according to relevant operation and maintenance technical requirements and operation and maintenance regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	TYPICAL FAULTS AND TREATMENT OF GENERATOR SET EQUIPMENT IN HYDROPOWER STATIONS	**DUTY NO.**	**801**
TASK TITLE	ANALYSIS AND HANDLING OF COMMON FAULTS IN THE POWER SYSTEM OF THE PLANTS	**TASK NO.**	**8017**
PERFORMANCE CRITERIA	The person performing this task must be able to take corresponding measures based on common faults in power system of the plants, and quickly identify the causes for maintenance and recovery according to the basic accident handling requirements of power system of the plants and the situation of transformer accidents.		
RANGE STATEMENT	The task can be performed in the power house of hydropower station in collaboration and cooperation with water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. Safety protection equipment and emergency tools; 2. Parts of the power system of the plants.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Abide by the principles of handling faults and accidents of the power system of the plants; 2. Handle the fault of unsuccessful standby auto-switching of 400V busbar; 3. Handle phase loss of air compressor power supply.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Remove common faults in the power system of the plants; 1.2 Determine whether the automatic switching of the 400V busbar is successful. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of handling faults and accidents of the power system of the plants. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Methods for handling the faults and accidents of the power system of the plants; 3.2 Causes of phase loss of air compressor power supply. 3.3 Causes of common faults and accidents in the power system of the plants. **4.0 Essential Skills**

	4.1 Communication skills; 4.2 Learning skills; 4.3 Management skills; 4.4 Equipment operation skills; 4.5 Teamwork skills; 4.6 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The common faults and accidents of power system of the plants are handled according to relevant operation and maintenance technical requirements and operation and maintenance regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	TYPICAL FAULTS AND TREATMENT OF GENERATOR SET EQUIPMENT IN HYDROPOWER STATIONS	**DUTY NO.**	**801**
TASK TITLE	TYPICAL FAULTS AND HANDLING OF DC SYSTEM	**TASK NO.**	**8018**
PERFORMANCE CRITERIA	The person performing this task must be able to take corresponding measures based on common faults of the DC systems, master the basic requirements for handling accidents of the DC systems, and quickly search for causes and repair and restore based on the accidents of transformers.		
RANGE STATEMENT	The task can be performed in the power house of hydropower station in collaboration and cooperation with water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. Safety protection equipment and emergency tools; 2. Parts of the DC system.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Abide by the principles of handling faults and accidents of the DC system; 2. Handle deformation of battery casing; 3. Handle battery faults; 4. Handle communication interruption in the charging module; 5. Handle communication interruption in DC system module; 6. Handle low or high voltage faults of DC busbars; 7. Grounding faults of DC system	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Repair common faults in the DC system. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for handling faults and accidents of the DC system; 2.2 Working principles of the battery. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Methods for handling the faults and accidents of the DC system; 3.2 Causes of deformation of battery casing; 3.3 Causes of battery faults; 3.4 Causes of communication interruption in the charging module; 3.5 Causes of communication interruption in DC system module; 3.6 Causes of low or high voltage faults of DC busbars; 3.7 Causes of grounding faults of DC system

	4.0 Essential Skills 4.1 Communication skills; 4.2 Learning skills; 4.3 Management skills; 4.4 Equipment operation skills; 4.5 Teamwork skills; 4.6 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The common faults and accidents of the DC system are handled according to relevant operation and maintenance technical requirements and operation and maintenance regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	HYDROPOWER STATION MANAGEMENT	**DUTY NO.**	802
TASK TITLE	ORGANIZATION MANAGEMENT	**TASK NO.**	8021
PERFORMANCE CRITERIA	The person performing this task must be able to establish a sound, capable, and efficient management organization based on the actual situation of the power station, determine post settings, employee allocation, and post responsibilities, assign positions and personnel and adopt dual responsibilities for one position, and strictly implement to ensure normal operation.		
RANGE STATEMENT	The task can be performed in the hydropower station or, if necessary, in a dedicated safety management department under the supervision of full-time or part-time safety officers. The tools and equipment to be used include: 1. Computer and its operating system; 2. Statistical analysis software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Use relevant national laws, regulations, and procedures, as well as knowledge in the installation, operation, overhaul, production, and management of hydropower stations; 2. Monitor and inspect operational equipment, detect faults or anomalies, and have skills in emergency rescue; 3. Strictly implement the "Two-ticket and Three Systems", carefully fill out operation tickets, and collect, organize, and manage equipment technical files and materials; 4. Organize the preparation of various records, reports, audits, summaries, analyses, and other daily work related to this duty, and archive and classify them.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Operate and overhaul the generator set equipment and conduct statistical analysis of accidents or faults; 1.2 Archive and classify technical files related to design, construction, installation, debugging, trial operation records, inspection records, etc. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principle of switching operation 2.2 Principles for installation, operation, overhaul, and safety supervision of hydropower stations; 2.3 Principles for archiving and classifying equipment files and various production technical data. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 The theories of "Two-ticket and Three Systems" and switching operation; 3.2 The theory of responsibility system of determining responsibilities, organization, and staffing.

	4.0 Essential Skills 4.1 Communication skills; 4.2 Learning skills; 4.3 Management skills; 4.4 Office software operation skills; 4.5 Teamwork skills; 4.6 Report writing skills. **5.0 Math Skills** 5.1 Skills in probability theory and mathematical statistics.
DESCRIPTION OF THE END PRODUCT / SERVICE	A sound system for the organization and management of small and medium-sized hydropower stations is established, job positions, personnel allocation, and job responsibilities are determined and strictly implemented to ensure normal operation.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	HYDROPOWER STATION MANAGEMENT	**DUTY NO.**	802
TASK TITLE	SAFETY MANAGEMENT	**TASK NO.**	8022
PERFORMANCE CRITERIA	The person performing this task must adhere to the policy of "safety first, prevention first", formulate work safety goals based on the actual situation of the power station, establish work safety systems, materialize work safety responsibilities, and do a good job in safety management from aspects such as operation safety management, occupational health management, hazard management, and risk point management.		
RANGE STATEMENT	The task can be performed under the supervision of full-time or part-time safety inspectors and safety officers. A sound safety management system for organizations, personnel and funds, and regular maintenance and overhaul system for equipment and facilities should be established in accordance with the standardized management requirements for work safety in small hydropower station, to ensure the realization of the work safety goals in the hydropower station. The tools and equipment to be used include: 1. Computer and its operating system; 2. Statistical analysis software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Use relevant national laws, regulations, and procedures, as well as knowledge in the installation, operation, overhaul, production, and management of hydropower stations; 2. Based on the content of operation safety management, master the usage of safety protection facilities, firefighting facilities and equipment of hydropower stations, strictly abide by the operating procedures, strictly implement the "Two-ticket and Three Systems", and eliminate the "three violations"; 3. Identify hazards in production accidents, identify and evaluate risk points, handle typical accidents and faults, timely, accurately, and completely report to the safety production department, and prepare	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Conduct "Two-ticket and Three Systems"; 1.2 Identify and evaluate the risk points of production equipment, facilities, and workplaces of pressure lifting stations, pressure pipelines, and dams; 1.3 Conduct typical hazard identification and handle accidents and faults. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of "Two-ticket and Three Systems" and switching operation; 2.2 Principles of risk identification; 2.3 Principles for the operation, overhaul, and accident handling of hydropower station equipment. **3.0 Theories** The person performing this task must be able to explain the following:

emergency plans or on-site disposal plans and measures; 4. Establish and improve an emergency response plan system for flood, typhoon, geological disasters, serious fires, etc., organize at least one emergency response drill per year and connect it with the emergency response plan formulated by the local government.	3.1 The theories of "Two-ticket and Three Systems" and switching operation; 3.2 Risk identification and evaluation theories; 3.3 Maintenance, accident handling, and emergency rescue theory for production equipment, facilities, and workplaces such as booster stations, pressure pipelines, and dams. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Learning skills; 4.3 Management skills; 4.4 Office software operation skills; 4.5 Teamwork skills; 4.6 Report writing skills. **5.0 Math Skills** 5.1 Skills in probability theory and mathematical statistics.
DESCRIPTION OF THE END PRODUCT / SERVICE	Safety management of hydropower stations is well done, the safety production organizations are established and improved, the safety production system is established, and safety production responsibilities are implemented.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal; 5. Analysis methods of LEC operation risks.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	HYDROPOWER STATION MANAGEMENT	**DUTY NO.**	802
TASK TITLE	PRODUCTION AND OPERATION MANAGEMENT	**TASK NO.**	8023
PERFORMANCE CRITERIA	The person performing this task must be able to strictly follow relevant national regulations and laws in terms of hydropower station operation management, overhaul management, equipment and facility management, technical file management, etc., and carry out training and assessment work for newly built small and medium-sized hydropower stations to strengthen employees' professional skills and safety consciousness.		
RANGE STATEMENT	The task can be performed by special personnel from the aspects of operation management, overhaul management, equipment and facilities management, and technical file management according to the actual situation of the hydropower station, by organizing and carrying out various forms of cultural activities, training and the assessment work, and by establishing and improving the technical assessment and operation inspection systems. The tools and equipment to be used include: 1. The computer and its operating system; 2. Statistical analysis software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Use relevant national laws, regulations and rules to master the knowledge of management of hydropower station operation, overhaul, equipment and facilities and technical files; 2. Implement the operating procedures and the electric safety work procedures, and hang or post the main operation procedures and technical charts in the relevant workplaces; 3. Conduct regular inspection, maintenance, test and scrapping management of hydraulic structures, metal structures, electromechanical equipment and other equipment and facilities; 4. Implement special personnel to be responsible for archive management, including archiving, storage, borrowing and confidentiality, and	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Conduct "Two-ticket and Three Systems"; 1.2 Operate the gate for opening and closing; 1.3 Conduct inspection, maintenance, test and scrapping management of hydraulic structures, metal structures, electromechanical equipment and other equipment and facilities; 1.4 Classify, write and keep all kinds of technical files. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of "Two-ticket and Three Systems" and switching operation; 2.2 Principles for the operation management of gate opening and closing; 2.3 Principles for the operation, overhaul, and accident handling of hydropower station equipment.

adopt the methods of annual archiving and classified storage to establish and implement technical file management systems; 5. Conduct regular training for new employees, including underpinning knowledge of hydropower station operation, various skill operations, accident handling procedures and methods, and production processes, and only after the assessment meets the standards can they take up their posts.	**3.0 Theories** The person performing this task must be able to explain the following: 3.1 Theories of "Two-ticket and Three Systems" and switching operation; 3.2 Theories for the operation management of gate opening and closing; 3.3 Theories for the operation, overhaul, and accident handling of hydropower station equipment. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Learning skills; 4.3 Management skills; 4.4 Software operation skills; 4.5 Teamwork skills; 4.6 Report writing skills. **5.0 Math Skills** 5.1 Skills in probability theory and mathematical statistics.
DESCRIPTION OF THE END PRODUCT / SERVICE	Technical assessment and operation inspection of hydropower stations are done well, the archiving and classified management of technical files are carried out, the professional training and assessment are conducted, the management and training are strengthened, the work safety behaviors are specified, and the work safety is standardized.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal; 5. Anticorrosion treatment methods for metal structures.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	DESIGN OF SMALL AND MEDIUM-SIZED HYDROPOWER STATIONS	**DUTY NO.**	803
TASK TITLE	LAYOUT DESIGN OF INTAKE STRUCTURES	**TASK NO.**	8031
PERFORMANCE CRITERIA	The person performing this task must be able to prepare design schemes according to the requirements of relevant design specifications for hydropower station structures, in combination with the overall layout scheme of the water conservancy project, the topographic and geological data within the scope of the intake, the building grade, and hydrological and meteorological conditions, taking into account the economy and safety situations, and in accordance with the technical requirements, so as to achieve a good design effect of intake structures.		
RANGE STATEMENT	The task can be performed in the design room under the supervision of renewable energy engineers (hydro). The tools and equipment to be used include: 1. The computer and its operating system; 2. Graphics software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Analyse the applicable conditions of different types of water intakes for hydropower stations; 2. Draw up the outline and size of the submerged intake; 3. Arrange and design the main equipment of submerged and open intakes; 4. Design the location and elevation of the intake; 5. Write the design report of intake structure layout.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Choose the type of hydropower station intakes; 1.2 Arrange the main equipment of hydropower station intakes; 1.3 Confirm the location and elevation of the hydropower station intakes. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of choosing hydropower station intake types; 2.2 Principles of arranging the main equipment of submerged intakes; 2.3 Principles of arranging the main equipment of open intakes; 2.4 Principles of designing the location and elevation of the intake. **3.0 Theories** The person performing this task must be able to explain

	the following: 3.1 Principles of choosing hydropower station intake types; 3.2 Principles of arranging the main equipment of hydropower station intakes. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Learning skills; 4.3 Teamwork skills; 4.4 Skills of CAD drawing reading and engineering drawing; 4.5 Report writing skills; 4.6 Intake elevation design skills. **5.0 Math Skills** 5.1 Numerical analysis and calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The intakes are designed according to the construction requirements of the intake project and in combination with the general layout scheme of the water conservancy project, and the topographic and geological data within the scope of the intake.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Analysis of topographic and geological data; 2. Common measures for preventing ice, sand, and pollution; 3. Occupational health and safety; 4. Regulations and detailed rules of the local government; 5. Static electricity protection; 6. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	DESIGN OF SMALL AND MEDIUM-SIZED HYDROPOWER STATIONS	**DUTY NO.**	803
TASK TITLE	LAYOUT DESIGN OF INTAKE STRUCTURES	**TASK NO.**	8032
PERFORMANCE CRITERIA	The person performing this task must be able to prepare design schemes according to the requirements of relevant design specifications for hydropower station structures, in combination with the development mode, use requirements, topographic and geological conditions and types of water retaining structures of the hydropower station, as well as the overall layout and construction conditions of the hub, considering technical and economic conditions, and in accordance with the requirements of technical specifications, so as to achieve a good design effect of intake structures.		
RANGE STATEMENT	The task can be performed in the design room under the supervision of renewable energy engineers (hydro). The tools and equipment to be used include: 1. The computer and its operating system; 2. Graphics software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Design and arrange the water diversion channel of the hydropower station; 2. Select the economic section of the diversion tunnel of the hydropower station; 3. Design and arrange the main equipment of the forebay of the hydropower station; 4. Write the layout design report of the diversion structure of the hydropower station.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Choose the types, routes, section forms and slope protection types of water diversion channels of the hydropower station; 1.2 Choose the type, economic sections and routes of diversion tunnels of the hydropower station; 1.3 Carry out the location selection and layout design of the forebay of the hydropower station. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of choosing the routes and section forms of water diversion channels of the hydropower station; 2.2 Principles of choosing the route of diversion tunnels; 2.3 Principles of choosing the forebay location. **3.0 Theories** The person performing this task must be able to

	explain the following: 3.1 Principles of choosing the types, routes, section forms and slope protection types of water diversion channels of the hydropower station; 3.2 Principles of choosing hydropower station intake types; 3.3 Principles of arranging the main equipment of hydropower station forebays. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Learning skills; 4.3 Teamwork skills; 4.4 Report writing skills; 4.5 Skills of reading and making drawings. **5.0 Math Skills** 5.1 Numerical analysis and calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The design of water diversion structure is carried out according to the construction requirements of the water diversion structure project, in combination with the overall layout and construction conditions of the hub, and the technical and economic conditions.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	DESIGN OF SMALL AND MEDIUM-SIZED HYDROPOWER STATIONS	**DUTY NO.**	803
TASK TITLE	LAYOUT DESIGN OF PRESSURE PIPELINES	**TASK NO.**	8033
PERFORMANCE CRITERIA	The person performing this task must be able to prepare design schemes according to the requirements of relevant design specifications for hydropower station structures, in combination with the requirements of overall layout of hubs, topography and geology, construction, manufacture, transportation and installation, taking into account economy and safety situations, and according to the technical requirements, so as to achieve good design effect of pressure pipeline layout.		
RANGE STATEMENT	The task can be performed in the design room under the supervision of renewable energy engineers (hydro). The tools and equipment to be used include: 1. The computer and its operating system; 2. Graphics software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Choose the structure type of pressure pipes; 2. Choose the route and layout of pressure pipes; 3. Carry out hydraulic calculation of pressure pipes and determine the economic diameter and wall thickness; 4. Determine the supporting structure of water diversion pipes; 5. Write the layout design report of the pressure pipeline.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Carry out hydraulic calculation of pressure pipes； 1.2 Determine the dynamic economic pipe diameter of pressure pipes according to the minimum annual cost method; 1.3 Calculate pipe wall thickness. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of choosing the structure type of pressure pipes; 2.2 Principles of choosing the route and layout of pressure pipes; 2.3 Principles of arranging the supporting structure of water diversion pipes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Principles of choosing the structure type and layout of pressure pipes;

	3.2 Principles of choosing the structure, valves, accessories and laying methods of water diversion pipes; 3.3 Principles of choosing the laying methods of water diversion pipes; 3.4 Principles of choosing the layout of commonly-used branch pipes; 3.5 Principles of choosing the laying methods and types of reinforced concretes. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Learning skills; 4.3 Teamwork skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Numerical analysis and calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The layout of pressure pipes is designed according to the construction requirements of the pressure pipe project, and in combination with the general layout scheme, topography, geological data and other conditions of the water conservancy project.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	DESIGN OF SMALL AND MEDIUM-SIZED HYDROPOWER STATIONS	**DUTY NO.**	803
TASK TITLE	CALCULATION OF WATER HAMMER AND REGULATION GUARANTEE	**TASK NO.**	8034
PERFORMANCE CRITERIA	The person performing this task must be able to calculate the water hammer pressure and the regulation guarantee according to the requirements of the relevant design specifications of hydropower stations, and the calculation results must meet the requirements of the specifications and should be used to guide the final design of hydropower stations and the setting of the regulation system.		
RANGE STATEMENT	The task can be performed in the design room under the supervision of renewable energy engineers (hydro). The tools and equipment to be used include: 1. The computer and its operating system; 2. Graphics software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Carry out water hammer calculation of simple pipes; 2. Carry out water hammer calculation of complex pipes; 3. Calculate the regulation guarantee; 4. Write the design report of calculating the water hammer and regulation guarantee.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Derive the calculation methods for direct and indirect water hammer of hydropower stations based on the chain equation; 1.2 Derive the calculation methods of the rotational speed change rate of the generator set; 1.3 Draw the water hammer pressure distribution in a simple pipe. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Four states of water hammer wave occurrence; 2.2 Standards for regulation guarantee calculation. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Principles of regulation guarantee calculation; 3.2 Principles for taking measures to improve the regulation guarantee of generator sets. **4.0 Essential Skills**

	4.1 Communication skills; 4.2 Learning skills; 4.3 Teamwork skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Numerical analysis and calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Calculation results of regulation guarantee are conformed to the requirements of the corresponding design specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Static electricity protection; 4. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	DESIGN OF SMALL AND MEDIUM-SIZED HYDROPOWER STATIONS	**DUTY NO.**	803
TASK TITLE	LAYOUT DESIGN OF SURGE CHAMBER	**TASK NO.**	8035
PERFORMANCE CRITERIA	The person performing this task must be able to prepare design schemes in accordance with the requirements of the relevant design specifications for hydropower station structures, in combination with engineering topographic and hydrological conditions, taking into account economy and safety situations, and in accordance with the technical requirements, so as to achieve a good design effect of surge chamber layout.		
RANGE STATEMENT	The task can be performed under the supervision of water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. The computer and its operating system; 2. Graphics software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Choose the type of the surge chamber; 2. Select the location of the surge chamber; 3. Calculate the minimum section of the surge chamber; 4. Write surge chamber layout design reports.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Determine the surge chamber location; 1.2 Choose the type of the surge chamber; 1.3 Calculate the minimum section of the surge chamber. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Theories of setting conditions of the surge chamber; 2.2 Principles of basic requirements of the surge chamber; 2.3 Theories of choosing the surge chamber type; 2.4 Principles of designing the surge chamber layout. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Basic setting conditions of the surge chamber; 3.2 Principles of determining the minimum section of the surge chamber. **4.0 Essential Skills**

	4.1 Communication skills; 4.2 Learning skills; 4.3 Teamwork skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Numerical analysis and calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The surge chambers of the hydropower station are designed according to relevant design specifications for hydropower stations, and in combination with engineering topographic conditions and hydrological conditions.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	DESIGN OF SMALL AND MEDIUM-SIZED HYDROPOWER STATIONS	**DUTY NO.**	803
TASK TITLE	PLANT LAYOUT DESIGN	**TASK NO.**	8036
PERFORMANCE CRITERIA	The person performing this task must be able to prepare design schemes in accordance with the requirements of the relevant design specifications for hydropower station structures, in combination with engineering topographic and hydrological conditions, taking into account economy and safety situations, and in accordance with the technical requirements, so as to achieve a good design effect of hydropower plants.		
RANGE STATEMENT	The task can be performed under the supervision of water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. The computer and its operating system; 2. Graphics software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Design the layout of the main plants of the hydropower station; 2. Design the layout of the auxiliary plants of the hydropower station; 3. Design the layout of the main transformers; 4. Design the layout of switching stations; 5. Carry out the layout of the tailrace, traffic lines and design of flood control and drainage in the plant area; 6. Write the plant layout reports.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Design the main and auxiliary plants in the plant area; 1.2 Arrange the main transformer and switching stations in the plant area; 1.3 Design the layout of the tailrace, traffic lines and the flood control and drainage in the plant area. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of main and auxiliary plant layout; 2.2 Principles of main transformers design; 2.3 Principles of switching station design; 2.4 Principles of designing the layout of the tailrace, traffic lines and the flood control and drainage in the plant area; 2.5 Plant layout rules. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Principles of choosing plant types; 3.2 Principles for the layout of each composition of the plant area.

	4.0 Essential Skills 4.1 Communication skills; 4.2 Learning skills; 4.3 Teamwork skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Numerical analysis and calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The plant area layout of the hydropower station is designed according to relevant design specifications for hydropower stations, and in combination with engineering topographic conditions and hydrological conditions.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Waste disposal.

OCCUPATION	RENEWABLE ENERGY ENGINEER (HYDRO)	**OCCUPATION CODE**	
DUTY TITLE	DESIGN OF SMALL AND MEDIUM-SIZED HYDROPOWER STATIONS	**DUTY NO.**	803
TASK TITLE	LAYOUT DESIGN OF VERTICAL PLANT	**TASK NO.**	8037
PERFORMANCE CRITERIA	The person performing this task must be able to prepare design schemes in accordance with the requirements of the relevant design specifications for hydropower station structures, in combination with engineering topographic and hydrological conditions, taking into account economy and safety situations, and in accordance with the technical requirements, so as to achieve a standard-compliant design effect of vertical plant structures in the hydropower station.		
RANGE STATEMENT	The task can be performed under the supervision of water conservancy and hydropower engineering engineers. The tools and equipment to be used include: 1. The computer and its operating system; 2. Graphics software.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Design the layout of intake and outlet equipment in the plant; 2. Design the layout of plant auxiliary equipment; 3. Calculate the main plant size; 4. Design and arrange the generator layer and the hydraulic turbine layer; 5. Write the design report of hydropower station plants.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Design the plant equipment; 1.2 Calculate the main plant size; 1.3 Design the generator layer and the hydraulic turbine layer; 1.4 Write plant design reports. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of the layout of intake and outlet equipment in the plant; 2.2 Principles of plant auxiliary equipment design; 2.3 Principles of generator layers design of the main plant; 2.4 Principles of hydraulic turbine layers design of the main plant. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Principles of the main equipment layout of hydraulic

	turbine layers; 3.2 Principles of the main equipment layout of generator layers. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Learning skills; 4.3 Teamwork skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Numerical analysis and calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The plant layout of the hydropower station is designed according to construction requirements and specifications for hydropower stations and, and in combination with engineering topographic conditions and hydrological conditions.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Regulations and detailed rules of the local government; 3. Waste disposal.

TABLE 1: DACUM CHARTS FOR RENEWABLE ENERGY ENGINEER (HYDRO) - NTA 8

DUTIES	TASKS	ENABLERS
1. Typical faults and treatment of generator set equipment in hydropower stations	1.1 Typical faults and handling of hydraulic turbines. 1.2 Common fault analysis and handling of generators. 1.3 Typical Faults and Handling of Microprocessor-based Speed Controller. 1.4 Typical faults and handling of excitation devices. 1.5 Faults and handling of generator set auxiliary equipment. 1.6 Abnormal operation and accident handling of transformers. 1.7 Analysis and handling of common faults in the power system of the plants. 1.8 Typical faults and handling of DC system.	**General skills** · Communication skills · Writing skills · Management skills · Teamwork skills · Office software operation skills · Entrepreneurial skills **Knowledge skills** · Software operation skills · Report writing skills · Skills of reading and making drawings · Accident handling and analysis skills **Tools and equipment** · The computer and its operating system · Safety protection equipment and emergency tools · Hydraulic turbine parts · Components and parts of generators · Microprocessor-based speed controller parts · Excitation device parts · Parts of auxiliary equipment · Parts of the transformer · Parts of the power system of the plants · DC system parts · CAD drawing software **Materials** · Office software · Printers and calculators · Drawings and documents · Corresponding specifications · Operation technical requirements and standards

DUTIES	TASKS	ENABLERS
		Requirements for employees · Teamwork spirit · Scientific spirit and rigor · Honesty and collaboration · Safety consciousness · Time consciousness · Responsibility consciousness · Innovative consciousness
2. Hydropower station management	2.1 Organization management. 2.2 Safety management. 2.3 Production and operation management.	**General skills** · Communication skills · Writing skills · Management skills · Teamwork skills · Office software operation skills · Entrepreneurial skills **Knowledge skills** · Software operation skills · Report writing skills · Skills of reading and making drawings · Safety production and operation skills **Tools and equipment** · The computer and its operating system · Software running **Materials** · Office software · Printers and calculators · Drawings and documents · Operation specification manual **Requirements for employees** · Teamwork spirit · Scientific spirit and rigor · Honesty and collaboration · Safety consciousness · Time consciousness · Responsibility consciousness · Innovative consciousness
3 Design of	3.1 Layout design of intake	**General skills**

DUTIES	TASKS	ENABLERS
small and medium-sized hydropower stations	structures. 3.2 Layout design of intake structures. 3.3 Layout design of pressure pipelines. 3.4 Calculation of water hammer and regulation guarantee. 3.5 Layout design of surge chamber. 3.6 Plant layout design. 3.7 Layout design of vertical plant.	· Communication skills · Writing skills · Management skills · Teamwork skills · Office software operation skills · Entrepreneurial skills **Knowledge skills** · Software operation skills · Drawing and reading skills · Report writing skills · Skills of reading and making drawings · Safety production and operation skills **Tools and equipment** · The computer and its operating system · CAD drawing software **Materials** · Office software · Printers and calculators · Drawings and documents · Corresponding specifications **Requirements for employees** · Teamwork spirit · Hard working · Scientific spirit and rigor · Honesty and collaboration · Safety consciousness · Time consciousness · Responsibility consciousness · Innovative consciousness