



**NATIONAL COMPETENCY STANDARDS
FOR
HYDROPOWER MECHANICAL TECHNICIAN
(CERTIFICATE 3)**

HYDROPOWER SECTOR

**TECHNICAL & VOCATIONAL EDUCATION AND TRAINING QUALITY COUNCIL
BHUTAN QUALIFICATIONS AND PROFESSIONALS CERTIFICATION AUTHORITY
THIMPHU, BHUTAN
JULY 2025**

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FOREWORD

The TVET Quality Council, BQPCA, is pleased to present the National Competency Standards (NCS) for Hydropower Mechanical Technician, Certificate 3, developed in collaboration with industry experts and trainers. These standards establish a nationally recognized qualification aligned with international best practices, setting a benchmark for TVET qualifications in Bhutan.

The NCS ensures that trainees acquire the necessary skills, knowledge, and attitude required by industries. Developed through close consultation with experts, it enhances the relevance of training to labor market needs, equipping graduates to meet industry expectations and improving their employability. A strong and responsive TVET system will also make vocational education more attractive to youth.

The Council acknowledges the valuable contributions of industry experts and trainers in the development of these standards. We urge employers and training providers to continue their support in implementing the NCS, fostering a skilled and productive workforce that contributes to national socio-economic development. Moving forward, we look forward to enhanced industry engagement and collaborative efforts in building a quality-assured, demand-driven TVET system.

Director
BQPCA

ACKNOWLEDGEMENT

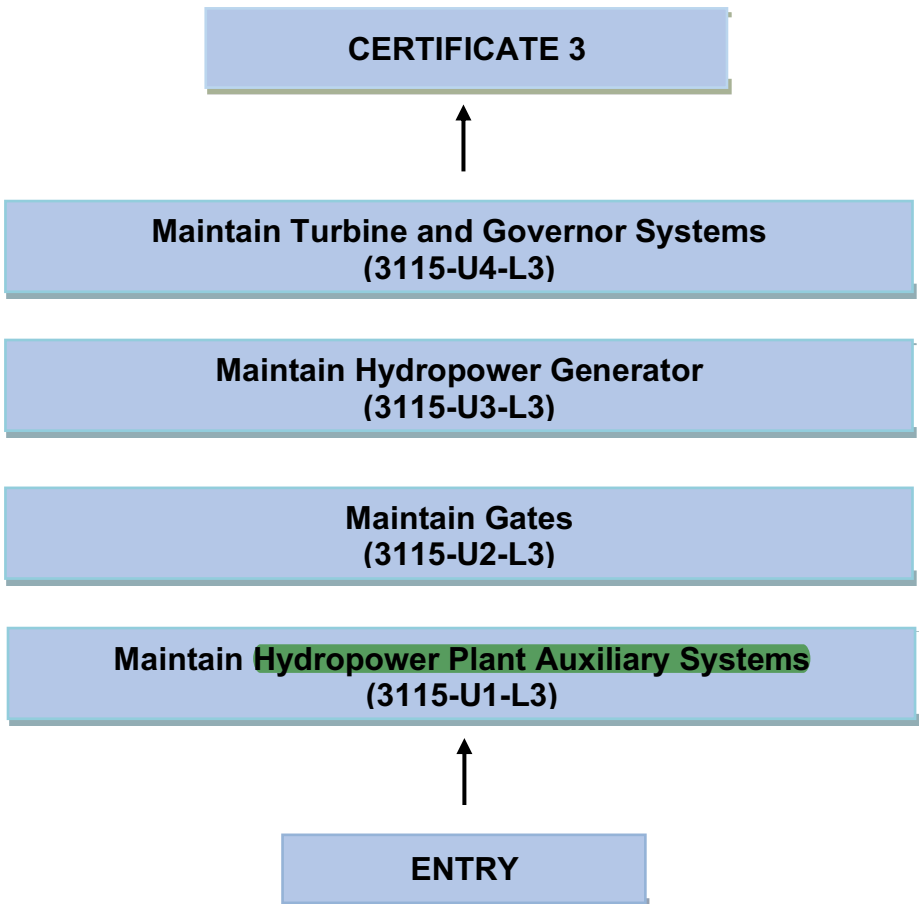
Date of Endorsement : 30 July 2025

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The TVET Quality Council, Bhutan Qualifications and Professionals Certification Authority would like to express our deepest appreciation to the following industry and subject matter experts who have participated in development of the National Competency Standards for Hydropower Mechanical Technician:

Experts involved in the development of NCS			
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PACKAGING OF QUALIFICATIONS



OVERVIEW OF THE NCS

Unit Title	Element of Competence
1. Maintain Hydropower Plant Auxiliary Systems	<ol style="list-style-type: none">1. Plan for Maintenance works2. Maintain Cooling system3. Maintain Air Compressor4. Maintain Cranes5. Maintain Diesel Generator6. Complete the Maintenance works
2. Maintain Gates	<ol style="list-style-type: none">1. Plan for Maintenance works2. Maintain gates3. Complete the Maintenance works
3. Maintain Hydropower Generator	<ol style="list-style-type: none">1. Plan for Maintenance works2. Service Generator3. Complete the Maintenance works
4. Maintain Turbine and Governor System	<ol style="list-style-type: none">1. Plan for Maintenance works2. Service Turbine Components3. Service Main Inlet valve4. Maintain Governor5. Complete the Maintenance works

UNIT TITLE	Maintain Hydropower Plant Auxiliary Systems
DESCRIPTOR	This unit covers the competencies required to plan and maintain hydropower plant auxiliary systems following standard procedure.
CODE	3115-U1-L3
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Plan for Maintenance works	<p>1.1 Select and use PPEs as per the job requirement following standard procedure.</p> <p>1.2 Select tools, equipment and materials.</p> <p>1.3 Assess and mitigate safety hazards.</p> <p>1.4 Plan maintenance sequence for efficiency.</p> <p>1.5 Refer auxiliary system specifications.</p>
2. Maintain Cooling System	<p>2.1 Inspect for leaks or blockages.</p> <p>2.2 Clean heat exchangers and cooling lines.</p> <p>2.3 Replace worn seals or damaged components.</p> <p>2.4 Maintain mechanical valves, flow meters for flow and pressure regulation.</p> <p>2.5 Maintain condition of pumps and motors</p> <p>2.6 Ensure system maintains optimal operating temperature.</p>

<p>3. Maintain Air Compressor</p>	<p>3.1 Inspect HP/LP compressor for leaks or mechanical faults.</p> <p>3.2 Clean and lubricate compressor components.</p> <p>3.3 Repair or replace faulty compressor parts.</p> <p>3.4 Test pressure output and system efficiency.</p> <p>3.5 Verify compressor meets safety and operational requirements.</p>
<p>4. Maintain Cranes</p>	<p>4.1 Inspect crane components for wears or damages</p> <p>4.2 Lubricate and check alignment of moving parts.</p> <p>4.3 Test crane controls and safety mechanisms.</p> <p>4.4 Repair or replace defective crane parts.</p> <p>4.5 Verify safe lifting capacity and operation.</p>
<p>5. Maintain Diesel Generator</p>	<p>5.1 Inspect generator components for faults.</p> <p>5.2 Repair or replace damaged generator parts.</p> <p>5.3 Check/Change engine oil and coolant as per the manufacturer's specification</p> <p>5.4 Assist in verifying the operational dry/on-load test</p>
<p>6. Complete the Maintenance works</p>	<p>6.1 Record all maintenance activities accurately.</p> <p>6.2 Confirm performance of auxiliary systems.</p> <p>6.3 Clear workspace of tools and materials.</p>

	<p>6.4 Dispose of waste as per safety and environmental standards.</p> <p>6.5 Prepare and submit maintenance reports to supervisors.</p>
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RANGE STATEMENT	
PPEs may include but not limited to:	
<ul style="list-style-type: none"> • Safety boot • Hand gloves • Ear Plug 	<ul style="list-style-type: none"> • Goggles • Work dress
Tools and Equipment may include but not limited to:	
<ul style="list-style-type: none"> • Hand tool set • Torque Wrench 	<ul style="list-style-type: none"> • Power tools
Materials may include but not limited to:	
<ul style="list-style-type: none"> • POL • Transmission oil 	<ul style="list-style-type: none"> • Spare parts •
Cranes may include but not limited to:	
<ul style="list-style-type: none"> • EOT 	<ul style="list-style-type: none"> • Gantry
Critical Aspects	

- Follow Safety at workplace
- Follow standard procedure for all the tasks
- Diagnosis of defects of the auxiliary system.

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • Occupational Health and Safety regulations • Basic first Aid • Working principle of auxiliary system integration. • Safety standards for electrical and mechanical maintenance. • Diagnostic, testing, and repair techniques for auxiliary systems. • Documentation, • Environmental regulations 	<ul style="list-style-type: none"> • Team Work • Communication • Problem Solving • Interpersonal Relationship • Time Management • Innovation

UNIT TITLE	Maintain Gates
DESCRIPTOR	This unit contains competencies required to plan and maintain gates following standard procedure.
CODE	3115-U2-L3
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Plan for Maintenance works	<p>1.1 Identify tools, equipment and materials for maintenance</p> <p>1.2 Conduct safety risk assessments (Tool-Box-Talk) and obtain permits</p> <p>1.3 Refer dam components (Spillway Gate, Intake Gates, SFT Gates, TRC Machines), technical specifications</p> <p>1.4 Plan maintenance tasks for minimal downtime</p> <p>1.5 Coordinate with water control teams and power house.</p>
2. Maintain Gates	<p>2.1 Inspect gates for structural integrity and alignment</p> <p>2.2 Clean and lubricate gate and its hoisting mechanisms</p> <p>2.3 Repair or replace damaged gate components</p> <p>2.4 Functionality test of gate movement and sealing effectiveness</p>

3. Complete the Maintenance works	3.1 Document all maintenance activities and results 3.2 Verify gate operational performance 3.3 Clear work area of tools and debris 3.4 Dispose of waste per environmental guidelines 3.5 Report maintenance outcomes to supervisors.
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RANGE STATEMENT	
PPEs may include but not limited to:	
<ul style="list-style-type: none"> • Safety boot • Hand gloves • Ear Plug 	<ul style="list-style-type: none"> • Goggles • Work dress
Tools and Equipment may include but not limited to:	
<ul style="list-style-type: none"> • Hand tool set • Grinding machine 	<ul style="list-style-type: none"> • Power tools
Materials may include but not limited to:	
<ul style="list-style-type: none"> • Seals 	<ul style="list-style-type: none"> • Spare parts

Critical Aspects

- Follow Safety at workplace
- Follow standard procedure for all the tasks
- Sealing effectiveness of gate

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none">• Ethics and Integrity• Occupational Health and Safety regulations• Basic first Aid• Hydraulic and mechanical principles of gates.• Water flow control and structural integrity concepts.• Safety standards for high-pressure systems and water management.• Maintenance planning, repair, and testing techniques.• Environmental compliance	<ul style="list-style-type: none">• Team Work• Communication• Problem Solving• Interpersonal Relationship• Time Management• Innovation

UNIT TITLE	Maintain Hydropower Generator
DESCRIPTOR	This unit contains competencies required to plan and maintain hydropower generator
CODE	3115-U3-L3
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Plan for Maintenance works	<p>1.1 Select and use PPEs as per the job requirement following standard procedure.</p> <p>1.2 Select and use tools, equipment and materials.</p> <p>1.3 Conduct safety risk assessments (Tool-Box-Talk) and obtain permits.</p> <p>1.4 Plan maintenance sequence for efficiency.</p> <p>1.5 Refer generator specifications.</p> <p>1.6 Ensure availability of backup systems if required.</p>
2. Service Generator	<p>2.1 Inspect generator components for mechanical faults</p> <p>2.2 Repair or replace damaged generator parts.</p> <p>2.3 Maintain generator mechanical components</p>
3. Complete the Maintenance works	<p>3.1 Record all maintenance and test activities accurately.</p>

	<p>3.2 Assist in confirming performance of generator components.</p> <p>3.3 Clear workspace of tools and materials.</p> <p>3.4 Dispose of waste per safety and environmental standards.</p> <p>3.5 Prepare and submit maintenance reports to supervisors.</p>
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RANGE STATEMENT	
PPEs may include but not limited to:	
<ul style="list-style-type: none"> • Safety boot • Hand gloves 	<ul style="list-style-type: none"> • Goggles • Work dress
Tools and Equipment may include but not limited to:	
<ul style="list-style-type: none"> • Hand tool set • Torque Wrench 	<ul style="list-style-type: none"> • Power tools
Materials may include but not limited to:	
<ul style="list-style-type: none"> • Lube Oil • Grease 	<ul style="list-style-type: none"> • Spare parts •
Mechanical faults may include but not limited to:	
<ul style="list-style-type: none"> • Wear and tear 	<ul style="list-style-type: none"> • Damaged bearing

<ul style="list-style-type: none"> • Lubricant contamination 	<ul style="list-style-type: none"> • Misalignment
<i>Generator mechanical components</i>	
<ul style="list-style-type: none"> • Guide Bearings, • HP Lubrication system 	<ul style="list-style-type: none"> • Coolers • Brake Jack System
<i>Critical Aspects</i>	
<ul style="list-style-type: none"> • Follow Safety at workplace • Follow standard procedure for all the tasks • Diagnosis of defects in Hydropower Generator and its components 	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • OHS regulations • Basic first Aid • Generator operation • Basic electrical systems and auxiliary system integration • Safety standards for electrical and mechanical maintenance • Diagnostic, testing, and repair techniques for generators components • Environmental regulations 	<ul style="list-style-type: none"> • Team Work • Communication • Problem Solving • Interpersonal Relationship • Time Management • Innovation

UNIT TITLE	Maintain Turbine and Governor System
DESCRIPTOR	This unit contain competencies required to plan and maintain turbine and governor system following standard procedure.
CODE	3115-U4-L3
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Plan for Maintenance works	<p>1.1 Select and use PPEs as per the job requirement.</p> <p>1.2 Identify and gather required tools and materials.</p> <p>1.3 Conduct safety risk assessments (Tool-Box-Talk) and obtain permits.</p> <p>1.4 Develop a detailed maintenance schedule.</p> <p>1.5 Refer technical manuals and specifications.</p> <p>1.6 Coordinate with team to ensure resource availability.</p>
2. Service Turbine components	<p>2.1 Inspect turbine components for wear, corrosion, erosion, leakages or damages.</p> <p>2.2 Clean and lubricate moving parts to reduce friction.</p> <p>2.3 Repair or replace faulty components per manufacturers specification.</p> <p>2.4 Assist in Conducting alignment and balancing checks.</p>

	2.5 Assist in testing turbine operation to confirm performance.
3. Service Main Inlet Valve	<p>3.1 Inspect valve and its components for corrosion, wear, leaks, or damages.</p> <p>3.2 Clean and lubricate valve components.</p> <p>3.3 Repair or replace faulty valve parts.</p> <p>3.4 Test valve and it's components for smooth turbine operation and isolation.</p>
4. Maintain Governor	<p>4.1 Assist in verifying governor mechanical set points for precise control.</p> <p>4.2 Inspect governor hydraulic components for wear, leaks or damages.</p> <p>4.3 Repair or replace defective parts as needed.</p> <p>4.4 Assist in verifying functionality of the system.</p>
5. Complete the Maintenance works	<p>5.1 Document maintenance activities in detail.</p> <p>5.2 Monitor turbine and governor functionality post-service.</p> <p>5.3 Clear work area of debris and tools.</p> <p>5.4 Dispose of waste per environmental regulations.</p> <p>5.5 Report any unresolved issues to supervisors.</p>

RANGE STATEMENT	
PPEs may include but not limited to:	
<ul style="list-style-type: none"> • Safety boot • Hand gloves • Ear Plug 	<ul style="list-style-type: none"> • Goggles • Work dress •
Tools and Equipment may include but not limited to:	
<ul style="list-style-type: none"> • Hand tool set • Torque Wrench 	<ul style="list-style-type: none"> • Power tools
Turbine Components may include but not limited to:	
<ul style="list-style-type: none"> • Runner (Pelton, Francis, Kaplan) • Distributer/Scroll casing • Deflector mechanism • Turbine Guide Bearing assembly 	<ul style="list-style-type: none"> • Guide Vanes • Nozzle Injector • Butterfly valve • Shaft
<ul style="list-style-type: none"> • Materials may include but not limited to: 	
<ul style="list-style-type: none"> • Lube Oil • Grease 	<ul style="list-style-type: none"> • Spare Parts
Critical Aspects	
<ul style="list-style-type: none"> • Follow Safety at workplace • Follow standard procedure for all the tasks • Diagnosis of defects in Turbine and Governing System 	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • Occupational Health and Safety regulations • Basic first Aid • Principles of turbine operation, fluid dynamics, and governor systems. • Technical manual interpretation and maintenance planning. • Diagnostic and calibration techniques for turbines and governors. • Record-keeping, reporting, and • Environmental compliance and waste disposal standards. 	<ul style="list-style-type: none"> • Team Work • Communication • Problem Solving • Interpersonal Relationship • Time Management • Innovation

ANNEXURE

National Competency Standards (NCS)

The National Competency Standards specify the skill, knowledge and attitudes applied to a particular occupation. Standards also specify the standards or criteria of performance of a competent worker and the various contexts in which work may take place. Standards provide explicit advice to assessors regarding the skill and knowledge to be demonstrated by candidates seeking formal recognition either following training or through work experience.

Purpose of National Competency Standards

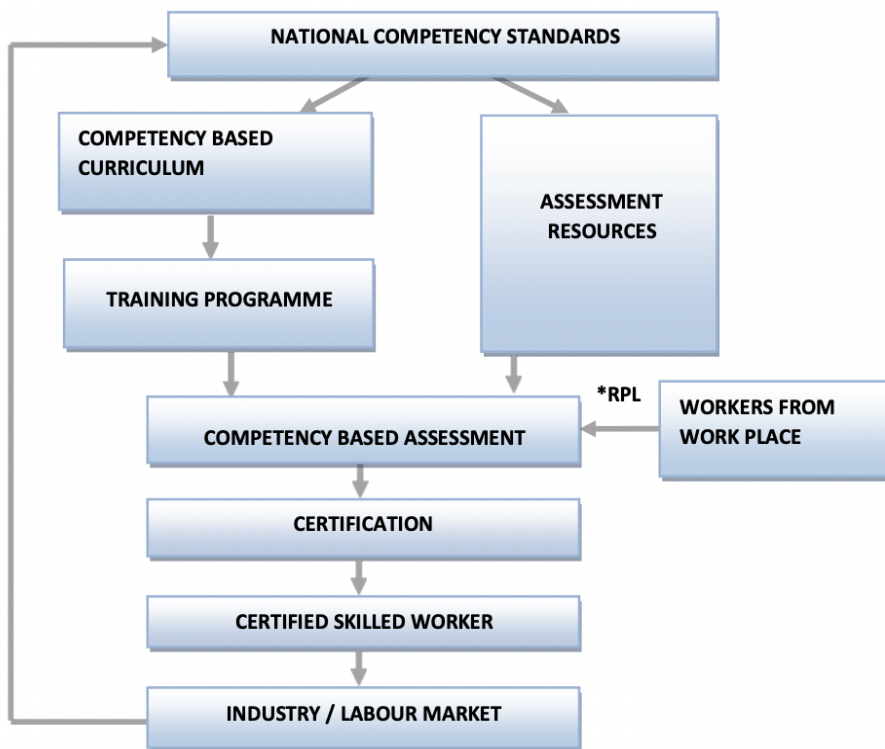
National Competency Standards serve a number of purposes including:

- Providing advice to curriculum developers about the competencies to be included in the curriculum.
- Providing specifications to assessment resource developers about the competencies within an occupation to be demonstrated by candidates.
- Providing advice to industry/employers about job functions, which in turn can be used for the development of job descriptions, performance appraisal systems and work flow analysis.

Bhutan Qualifications Framework (BQF)

Bhutan Qualifications Framework is an integrated national framework that outlines all types of qualification in Bhutan. As an established and nationally accepted instrument, the BQF has been benchmarked against international practices in terms of standards. The BQF aims to recognize all forms of learning systems, including formal, non-formal, and informal learning. It acknowledges technological advancements and recognizes contemporary modes of delivery. It covers a broad range of education systems including the TVET education.

Implementation of TVET Qualifications



* RPL = Recognition of Prior Learning

TVET Qualifications Levels

TVET Qualifications have seven levels as per the BQF as follows:

Bhutan Qualifications Framework 2023

Table 2: Qualification Types and Levels Based on Education Sector.

BQF Level	Community Education	School Education	TVET	Higher Education	Monastic Education
8				Doctoral Degree	<i>Khewang</i> མཁས་དབང་།
7			Master's Degree Postgraduate Diploma Postgraduate Certificate	Master's Degree Postgraduate Diploma Postgraduate Certificate	<i>Tsugla Gongma</i> གཞུག་ལག་གོང་མ།
6			Applied Degree	Bachelor's Degree Bachelor's Degree (Honours) Graduate Diploma Graduate Certificate	<i>Tsugla Wogma</i> གཞུག་ལག་འོག་མ།
5			Advanced Diploma	Advanced Diploma	
4			Diploma	Diploma	
3		Bhutan Higher Secondary Education Certificate	Certificate 3		<i>Dringrim Gongma</i> འབྲིང་རིམ་གོང་མ།
2		Bhutan Certificate for Secondary Education	Certificate 2		<i>Dringrim Barma</i> འབྲིང་རིམ་བར་མ།
1	ALC		Certificate 1		

Level Descriptors

The TVET Qualification levels are set based on the level descriptors, as defined in the BQF. The detail of the qualification level descriptor is as follow:

Level	<i>Knowledge</i>	<i>Skills</i>	<i>Values</i>	<i>Application</i>
	<i>Knowledge that is:</i>	<i>Demonstrate skills that involve:</i>	<i>Demonstrate values that involve:</i>	<i>Applied in contexts that involve:</i>
4	Broad theoretical, technical and operational	<p>Selecting and applying a range of standard processes relevant to varied and sometimes unpredictable tasks</p> <p>Selecting and applying a range of solutions involving formulation of solutions to resolve complex issues</p> <p>Demonstrating a high level of proficiency in English and Dzongkha</p>	<p>Strong level of awareness of self and others; and an appreciation of belief system, role of social norms, and the importance of relationship building</p> <p>Application of ethical norms and legal rules in decision-making; and comprehending the correlation between values and behavior</p> <p>Commitment to own profession and quality of work</p>	<p>Stable tasks with predictable changes</p> <p>Broad guidance with some self-direction that requires sound judgement</p> <p>Taking some responsibility for planning and coordination with others</p>
3	Theoretical with some technical and operational processes	<p>Applying a range of standard processes to known but varied tasks</p> <p>Selecting and applying a range of solutions to familiar</p>	<p>Sound level of self-awareness and beliefs; and ability to apply social norms and</p>	<p>Stable tasks with some aspects of change</p> <p>General guidance and supervision that require</p>

		<p>and unfamiliar problems</p> <p>Communicating effectively and clearly, both oral and written, in both English and Dzongkha</p>	<p>build relationships</p> <p>Application of a set of ethical norms</p> <p>Commitment to own field of interest and apply self-management of learning and performance</p>	<p>discretion and judgement</p> <p>Adapting to own behaviour to work with others</p>
2	Basic, factual and conceptual	<p>Applying standard processes relevant to carry out known tasks</p> <p>Applying a set of known solutions to solve simple and straightforward issues</p> <p>Using simple and direct exchange of information on familiar and routine matters</p> <p>Developing basic proficiency in Dzongkha and English</p>	<p>Some level of self-awareness and beliefs, and appreciation of social norms; and significance of relationships</p> <p>Awareness of ethical norms, and openness to different activities</p> <p>Developing own knowledge and skills</p>	<p>Structured and stable tasks</p> <p>General support and Supervision that require some discretion and judgement</p> <p>Collaboration with others to achieve goals</p>
1	Foundational, every day and general	<p>Applying operational literacy, numeracy skills required to carry out simple tasks</p> <p>Applying simple solutions to solve simple and straightforward everyday issues</p>	<p>Basic awareness of self, beliefs, and social norms; and understand the significance of relationships</p> <p>Basic awareness of</p>	<p>Highly structured tasks with close support and supervision</p> <p>Minimal Discretion and judgement</p>

		Communicating using everyday expressions and simple phrases in Dzongkha and English	fundamental ethical norms, basic civil rights, and responsibilities Willingness to understand tasks and motivated to implement them successfully	Readiness to work together and share knowledge with others
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CODING USED FOR NATIONAL COMPETENCY STANDARDS

The coding and classification system developed in Bhutan is logical, easy to use, and also aligned with international best practices. The Bhutanese coding and classification system is based on the International Standard Classification of Occupations, 2008 (ISCO-08) developed by the International Labour Organisation (ILO). The coding of the National competency standards forms the basis of the identification code for the Technical & Vocational Education and Training Management Information System (TVET – MIS) both in terms of economic sector identification and that of the individual standard.

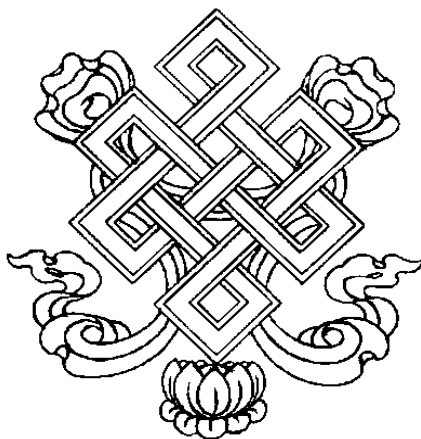
Coding the individual national competency standards

Coding the individual skills standard has a multiple purpose:

- to identify the level,
- to identify to which module the standard belongs,
- to identify in which order the standard is clustered within that module.

A job can include a number of competencies described in the national competency standards.

However, in order to follow a logical order, only national competency standards related to each other and following a logical sequence in terms of training delivery, from the simple to the complex, are clustered into a module. Some standards are so complex that they need to stand alone.



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