



**NATIONAL COMPETENCY STANDARDS  
FOR  
SOLAR POWER TECHNICIAN  
(NC2)**

**Department of Occupational Standards  
Ministry of Labour and Human Resources  
Thimphu, Bhutan.  
(May 2021)**



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## FOREWORD

The Department of Occupational Standards of the Ministry of Labour and Human Resources is pleased to present the National Competency Standards (NCSs) for Solar Power Technician. The standards represent the fruits of hard work and invaluable experiences gained by the department since its establishment in the latter half of 2003. The main aim of developing NCS is to set up a well-defined nationally recognized Vocational Qualification System that will help set a benchmark for the Technical Vocational Education and Training (TVET) System in our country aligned to international best practices.

NCS is one of the base pillars in the Bhutan Vocational Qualification Framework (BVQF) and is the first step in its implementation. The NCS are developed and revised to ensure that employees or vocational graduates possess and acquire the desired competencies required by industries and employers. In order to ensure this close match in supply and demand of competencies, NCS have been developed and revised in close consultation and partnership with industry experts and validated by the Technical Advisory Committees of the concerned economic sectors.

A vocational education and training system based on NCS shall ensure that delivered training is of a high quality and relevant to the needs of the labour market. As a result, future TVET graduates will be better equipped to meet the need and expectations of industries and employers. This positive impact on the employability of TVET graduates will enhance the reputation of vocational education and training and make it attractive to school leavers.

I gratefully acknowledge collaboration and the valuable contributions made by experts from industries during the consultation and validation processes of the standards. I look forward for continued engagement and participation of the industry and employers in the development of a quality assured demand driven TVET system and to build competent and productive national workforce that will contribute to the continued socio-economic progress of our country.

Director  
Department of Occupational Standards  
Ministry of Labour and Human Resources

## **ACKNOWLEDGEMENT**

**Development date** : 06/05/2021

**Date of Review** : 06/05/2023 (Max. 3 years)

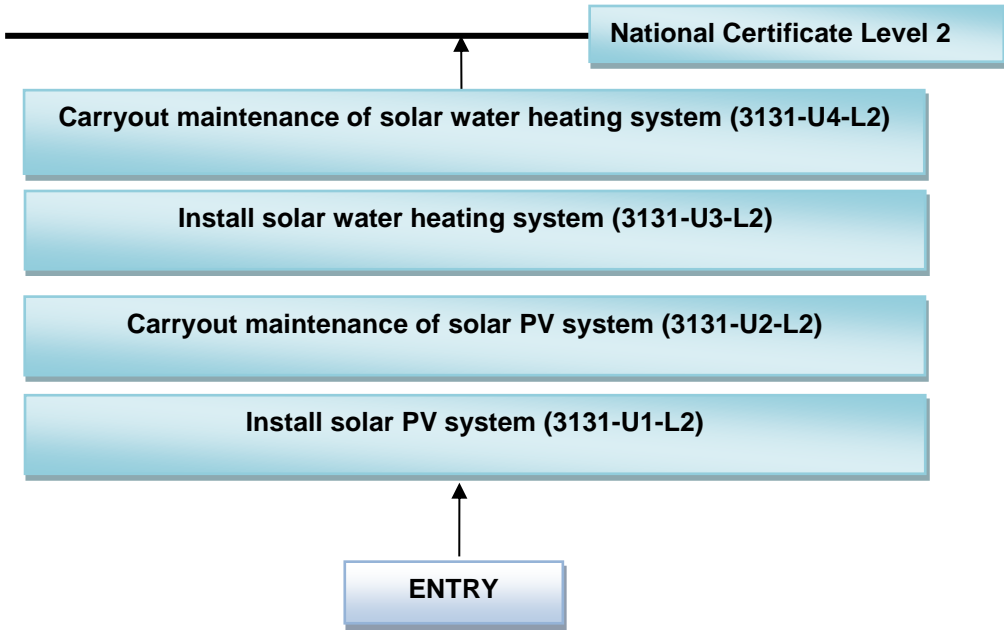
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### **Facilitators:**

1. Karma Loday, Specialist, SQD, DOS, MoLHR
2. Chogay Lhendup, Sr. Program Officer, SQD, DOS, MoLHR

## PACKAGING OF QUALIFICATIONS



## Overview of National Competency Standards

UNIT TITLE	ELEMENTS OF COMPETENCE
1. Install solar PV system	<ol style="list-style-type: none"><li>1. Prepare for installation of solar PV system</li><li>2. Perform installation of solar PV system</li><li>3. Perform installation of solar street lighting system</li></ol>
2. Carryout maintenance of solar PV system	<ol style="list-style-type: none"><li>1. Perform troubleshooting of solar PV system</li><li>2. Perform maintenance of solar PV system</li></ol>
3. Install solar water heating system	<ol style="list-style-type: none"><li>1. Prepare for installation of solar water heating system</li><li>2. Perform installation of water heating system</li></ol>
4. Carryout maintenance of solar water heating system	<ol style="list-style-type: none"><li>1. Perform troubleshooting of solar water heating system</li><li>2. Perform maintenance of solar water heating system</li></ol>

**UNIT TITLE** : Install solar PV system

**DESCRIPTOR** : This unit covers the competencies required to install solar PV system including both home and industry lighting, and street light system following safety at all times.

**CODE** : 3131-U1-L2

<b>ELEMENTS OF COMPETENCE</b>	<b>PERFORMANCE CRITERIA</b>
1. Prepare for installation of solar PV system	1.1 Select the site for installation of solar PV system following standard procedures 1.2 Select <b>tools and equipment</b> as per the job requirement following standard procedure 1.3 Select <b>solar PV components</b> as per the job requirement following standard procedures
2. Perform installation of solar PV system	2.1 Read and interpret drawings for installation following standard procedures 2.2 Install mounting structures following standard procedures 2.3 Install solar PV system components as per the standard procedures 2.4 Install solar PV system protection following standard procedures 2.5 Test and commission the solar PV installation following standard procedures
3. Perform installation of solar street lighting system	3.1 Read and interpret drawings for installation of solar street lighting system following standard procedures 3.2 Erect the pole following standard procedures 3.3 Install solar street lighting system components as per the standard procedures



	3.4 Test and commission the solar street lighting system installation following standard procedures
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<b>RANGE STATEMENT</b>	
<b>Tools and equipment may include but not limited to:</b>	
<ul style="list-style-type: none"> <li>• Plier</li> <li>• Screw driver set</li> <li>• Compass</li> </ul>	<ul style="list-style-type: none"> <li>• Multi-meter</li> <li>• Wrench</li> <li>• Spirit level</li> </ul>
<b>Personal protective equipment (PPE) may include but not limited to:</b>	
<ul style="list-style-type: none"> <li>• Hand gloves</li> <li>• Workshop dress</li> </ul>	<ul style="list-style-type: none"> <li>• Safety shoes</li> <li>• Safety goggles</li> </ul>
<b>Solar PV components may include but not limited to:</b>	
<ul style="list-style-type: none"> <li>• Modules</li> <li>• Inverter</li> <li>• Charge/discharge controller,</li> </ul>	<ul style="list-style-type: none"> <li>• Battery</li> <li>• Load</li> <li>• dis-connector</li> <li>• Wire</li> </ul>
<b>Solar street lighting system components may include but not limited to:</b>	
<ul style="list-style-type: none"> <li>• Modules</li> <li>• Battery</li> <li>• Controller</li> </ul>	<ul style="list-style-type: none"> <li>• Load</li> <li>• Wire</li> </ul>
<b>Critical Aspects:</b>	
<ul style="list-style-type: none"> <li>• Demonstration of occupational health and safety practices at workplace</li> <li>• Connection of PV modules and batteries following standard procedure</li> </ul>	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> <li>• Ethics and Integrity</li> <li>• OHS regulations</li> <li>• First Aid</li> <li>• Basic system sizing</li> <li>• Basic electricity</li> <li>• Basic IT</li> <li>• Working principle of solar PV system</li> <li>• Types of solar PV system</li> <li>• Types of PV module</li> <li>• Types of inverter/controller</li> <li>• Types of battery</li> </ul>	<ul style="list-style-type: none"> <li>• Team work</li> <li>• Communication</li> <li>• Negotiation</li> <li>• Time management</li> </ul>

**UNIT TITLE** : Carryout maintenance of solar PV system

**DESCRIPTOR** : This unit covers the competencies required to maintain solar PV system following safety at all times

**CODE** : 3131-U2-L2

<b>ELEMENTS OF COMPETENCE</b>	<b>PERFORMANCE CRITERIA</b>
1. Perform troubleshooting of solar PV system	1.1 Select and use <b>tools and equipment</b> as per the job requirement 1.2 Conduct visual inspection to identify the <b>faults</b> as per the job requirement 1.3 Detect <b>faults</b> using multi-meter as per the standard procedures
2. Perform maintenance work of solar PV system	2.1 Replace faulty components following standard procedures 2.2 Replace faulty protective devices as per the standard procedures 2.3 Service solar PV system components as per the job requirement 2.4 Test the system following standard procedures

<b>RANGE STATEMENT</b>	
<b>Tools and equipment may include but not limited to:</b>	
<ul style="list-style-type: none"><li>• Multi meter</li><li>• Screw driver set</li></ul>	<ul style="list-style-type: none"><li>• Plier</li><li>• Hydro meter</li></ul>
<b>Personal protective equipment (PPE) may include but not limited to:</b>	
<ul style="list-style-type: none"><li>• Hand gloves</li><li>• Workshop dress</li></ul>	<ul style="list-style-type: none"><li>• Safety shoes</li><li>• Safety goggles</li></ul>
<b>Visual faults may include but not limited to:</b>	
<ul style="list-style-type: none"><li>• Damages</li><li>• Burnt</li></ul>	<ul style="list-style-type: none"><li>• Alignment</li><li>• Shading</li></ul>

• Disconnections	• Battery electrolyte level
<b>Faults may include but not limited to:</b>	
• Continuity	• Voltage and current
<b>Critical Aspects:</b>	
<ul style="list-style-type: none"> <li>• Demonstration of occupational health and safety practices at workplace</li> <li>• Diagnose the faults as per the job requirement</li> </ul>	

<b>UNDERPINNING KNOWLEDGE</b>	<b>UNDERPINNING SKILLS</b>
<ul style="list-style-type: none"> <li>• Ethics and Integrity</li> <li>• OHS regulations</li> <li>• First Aid</li> <li>• Maintenance schedule</li> <li>• Component's specification</li> </ul>	<ul style="list-style-type: none"> <li>• Team work</li> <li>• Communication</li> <li>• Negotiation</li> <li>• Time management</li> </ul>

**UNIT TITLE** : Install solar water heating system

**DESCRIPTOR** : This unit covers the competencies required to install solar heating system following safety at all times.

**CODE** : 3131-U3-L2

<b>ELEMENTS OF COMPETENCE</b>	<b>PERFORMANCE CRITERIA</b>
1. Prepare for installation of solar water heating system	1.1 Select the site for installation of solar water heating system following standard procedures 1.2 Select <b>tools and equipment</b> as per the job requirement following standard procedure 1.3 Select <b>solar water heating components</b> as per the job requirement following standard procedures
2. Perform installation of solar water heating system	2.1 Read and interpret drawings for installation following standard procedures 2.2 Install mounting structures following standard procedures 2.3 Install solar water heating system components as per the standard procedures 2.4 Test and commission the solar water heating system installation following standard procedures

<b>RANGE STATEMENT</b>	
<b>Tools and equipment may include but not limited to:</b>	
<ul style="list-style-type: none"><li>• Wrench</li><li>• Screw driver</li><li>• Spirit level</li></ul>	<ul style="list-style-type: none"><li>• Drilling machine</li><li>• Pipe vice</li></ul>
<b>Personal protective equipment (PPE) may include but not limited to:</b>	
<ul style="list-style-type: none"><li>• Hand gloves</li><li>• Workshop dress</li></ul>	<ul style="list-style-type: none"><li>• Safety shoes</li><li>• Safety goggles</li></ul>
<b>Solar water heating components may include but not limited to:</b>	

<ul style="list-style-type: none"> <li>• Collector</li> <li>• Hot water tank</li> <li>• Controller</li> </ul>	<ul style="list-style-type: none"> <li>• Pump station</li> <li>• Cold water storage tank</li> <li>• Pipes and fittings</li> </ul>
<b>Critical Aspects:</b>	
<ul style="list-style-type: none"> <li>• Demonstration of occupational health and safety practices at workplace</li> <li>• Perform pipeline connections without leakage following standard procedures</li> </ul>	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> <li>• Ethics and Integrity</li> <li>• OHS regulations</li> <li>• First Aid</li> <li>• Basic system sizing</li> <li>• Basic plumbing works</li> <li>• Basic electrical wiring</li> <li>• Working principle of solar water heating system</li> <li>• Types of solar water heating system</li> <li>• Types of collector</li> <li>• Types of hot water storage tank</li> </ul>	<ul style="list-style-type: none"> <li>• Team work</li> <li>• Communication</li> <li>• Negotiation</li> <li>• Time management</li> </ul>

**UNIT TITLE** : Carryout maintenance of solar water heating system

**DESCRIPTOR :** This unit covers the competencies required to maintain solar water heating system following safety at all times.

**CODE :** 3131-U4-L2

ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Perform troubleshooting of solar water heating system	1.1 Select and use <b>tools and equipment</b> as per the job requirement 1.2 Conduct visual inspection to identify the <b>faults</b> as per the job requirement 1.3 Detect <b>faults</b> using multi-meter as per the standard procedures
2. Perform maintenance of solar water heating system	2.1 Replace faulty components following standard procedures 2.2 Service solar water heating system components as per the job requirement 2.3 Test the system following standard procedures

RANGE STATEMENT	
<b>Tools and equipment may include but not limited to:</b>	
<ul style="list-style-type: none"> <li>• Multi meter</li> <li>• Screw driver set</li> </ul>	<ul style="list-style-type: none"> <li>• Plier</li> <li>• Wrench</li> </ul>
<b>Personal protective equipment (PPE) may include but not limited to:</b>	
<ul style="list-style-type: none"> <li>• Hand gloves</li> <li>• Workshop dress</li> </ul>	<ul style="list-style-type: none"> <li>• Safety shoes</li> <li>• Safety goggles</li> </ul>
<b>Visual faults may include but not limited to:</b>	
<ul style="list-style-type: none"> <li>• Leakage</li> <li>• Breakage</li> <li>• Blockage</li> </ul>	<ul style="list-style-type: none"> <li>• Shading</li> <li>• Pressure drop</li> </ul>
<b>Faults may include but not limited to:</b>	
<ul style="list-style-type: none"> <li>• Continuity</li> </ul>	<ul style="list-style-type: none"> <li>• Voltage</li> </ul>
<b>Critical Aspects:</b>	

- Demonstration of occupational health and safety practices at workplace
- Diagnose the faults as per the job requirement

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> <li>• Ethics and Integrity</li> <li>• OHS regulations</li> <li>• First Aid</li> <li>• Maintenance schedule</li> <li>• Component's specification</li> </ul>	<ul style="list-style-type: none"> <li>• Team work</li> <li>• Communication</li> <li>• Negotiation</li> <li>• Time management</li> </ul>

## ANNEXURE

### A. 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**

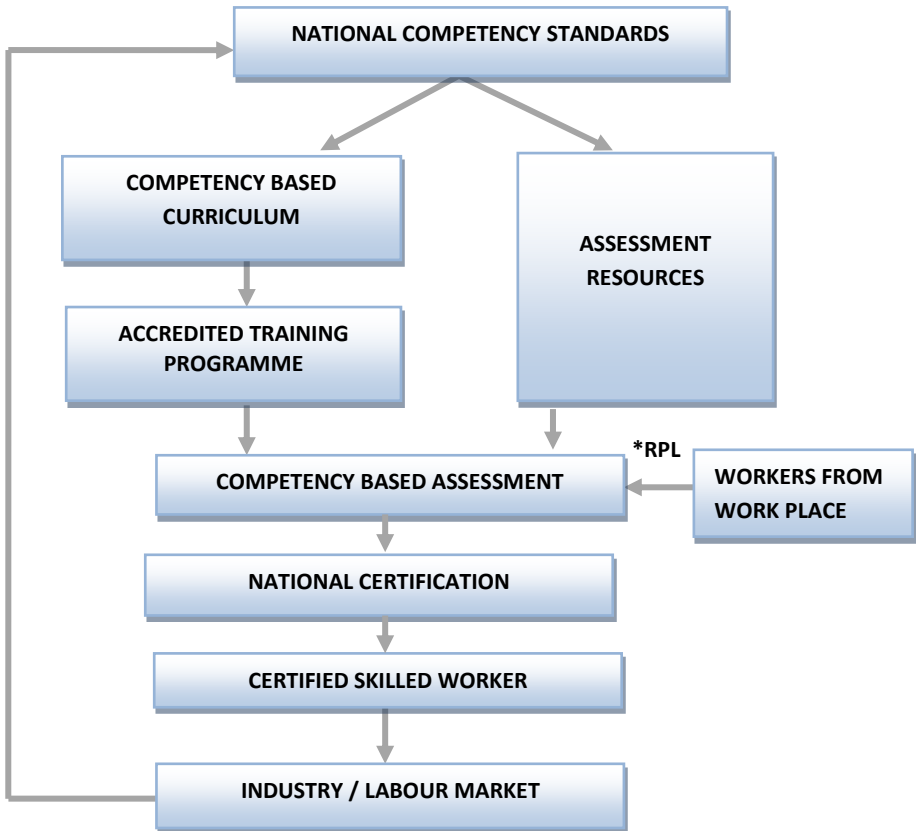
National Competency Standards serve a number of purposes including:

- Providing advice to curriculum developers about the competencies to be included in 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.

## B. Bhutan Vocational Qualifications Framework (BVQF)

Bhutan Vocational Qualifications Framework is an agreed system of Assessing, Certifying and Monitoring nationally recognized qualifications for all learning in the TVET sector against national competency standards, in training institutions, in the workplace, in schools or anywhere where learning takes place.

### Components of the Bhutan Vocational Qualifications Framework (BVQF)



\* RPL = Recognition of Prior Learning

## BVQF Levels

The Bhutan Vocational Qualifications Framework has three levels classified based on the competency of the skilled workers. The three levels are:

- National Certificate Level 3 (NC III)
- National Certificate Level 2 (NC II)
- National Certificate Level 1 (NC I)

## BVQF Level Descriptors

The qualification levels are decided based on level descriptors. The detail of the qualification level descriptor is as follows:

### National Certificate Level 1

Carry out processes that:	Learning demand:	Responsibilities which are applied:
<ul style="list-style-type: none"><li>• Are narrow in range.</li><li>• Are established and familiar.</li><li>• Offer a clear choice of routine responses.</li><li>• Involve some prioritizing of tasks from known solutions.</li></ul>	<ul style="list-style-type: none"><li>• Basic operational knowledge and skill.</li><li>• Utilization of basic available information.</li><li>• Known solutions to familiar problems.</li><li>• Little generation of new ideas.</li></ul>	<ul style="list-style-type: none"><li>• In directed activity.</li><li>• Under general supervision and quality control.</li><li>• With some responsibility for quantity and quality.</li><li>• With no responsibility for guiding others.</li></ul>

## National Certificate Level 2

Carry out processes that:	Learning demand:	Responsibilities which are applied:
<ul style="list-style-type: none"> <li>• Require a range of well-developed skills.</li> <li>• Offer a significant choice of procedures requiring prioritization.</li> <li>• Are employed within a range of familiar context.</li> </ul>	<ul style="list-style-type: none"> <li>• Some relevant theoretical knowledge.</li> <li>• Interpretation of available information.</li> <li>• Discretion and judgments.</li> <li>• A range of known responses to familiar problems</li> </ul>	<ul style="list-style-type: none"> <li>• In directed activity with some autonomy.</li> <li>• Under general supervision and quality checking.</li> <li>• With significant responsibility for the quantity and quality of output.</li> <li>• With some possible responsibility for the output of others.</li> </ul>

## National Certificate Level 3

Carry out processes that:	Learning demand:	Responsibilities which are applied:
<ul style="list-style-type: none"> <li>• Requires a wide range of technical or scholastic skills.</li> <li>• Offer a considerable choice of procedures requiring prioritization to achieve optimum outcomes.</li> <li>• Are employed in a variety of familiar and unfamiliar contexts.</li> </ul>	<ul style="list-style-type: none"> <li>• A broad knowledge base which incorporates some theoretical concepts.</li> <li>• Analytical interpretation of information.</li> <li>• Informed judgment.</li> <li>• A range of sometimes innovative responses to concrete but often unfamiliar problems.</li> </ul>	<ul style="list-style-type: none"> <li>• In self-directed activity.</li> <li>• Under broad guidance and evaluation.</li> <li>• With complete responsibility for quantity and quality of output.</li> <li>• With possible responsibility for the output of others.</li> </ul>

## **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 practises. 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).

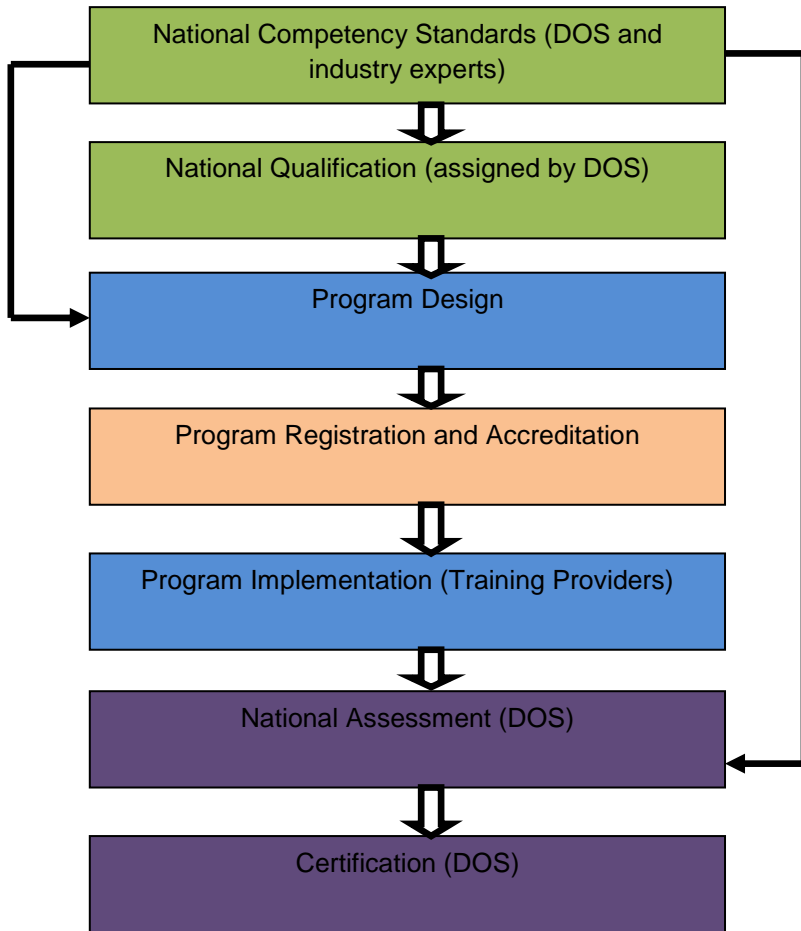
The coding of the national competency standards forms the basis of the identification code for the Vocational Education and Training Management Information System (VET – MIS) both in terms of economic sector identification and that of the individual standard.

Coding the individual units of competency standard is to identify the level in qualification packages to which it belongs.

While packaging, in order to follow a logical order, only 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 qualification packages.

The ILO assigns the code 3131 to the occupation Solar Plant Operator. Therefore, in the Bhutan context, the occupation solar power technician has been assigned the code 3131 in the National Coding System. The first unit is assigned the code U1, the first Unit of Competency Standard clustered into the first qualification is designated the code 3131-U1. Levels are assigned the code L and follow a logical progression from the National Certificate Level 1 (NC I) to the National Certificate Level 3 (NC 3). Therefore the National Certificate Level 2 is assigned the code L2. The complete unit code will be 3131-U1-L2.

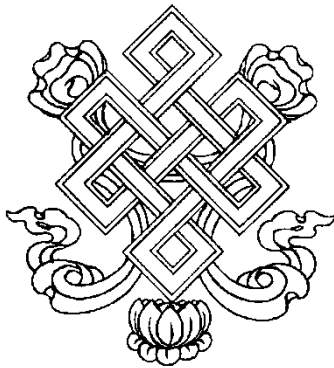
## Implementation and Operational Procedures for National Competency Standards



### Key:

MoLHR – Ministry of Labour and Human Resources

DOS – Department of Occupational Standards



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