



Government of Nepal  
Ministry of Energy, Water Resources and Irrigation  
Alternative Energy Promotion Centre (AEPC)  
Making Renewable Energy Mainstream Supply in Nepal

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für Internationale  
Zusammenarbeit (GIZ) GmbH

## COURSE INFORMATION



# SOLAR ELECTRIC TECHNICIAN LEVEL 2

As per the curriculum of **CTEVT**, supplemented to meet  
the National Occupational Skill Standard (**NOSS**) 2023  
of National Skill Testing Board (**NSTB**)



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# 1. COURSE INFORMATION

This training imparts knowledge and skills to equip learners with the technical skills and knowledge necessary to install, operate, maintain, and troubleshoot solar photovoltaic systems. In terms of scope, this course covers on-grid and off-grid systems up to 10 kW<sub>p</sub> both in single and 3-phase configurations in common applications that include:

- Solar streetlights
- Solar water pumps (SWP)
- Solar rooftop (SRT) systems, and
- Solar mini-grids (SMG).

This course aims to address the growing demand for skilled solar technicians in the country, supporting Nepal's commitment to expanding its renewable energy sector in achieving the sustainable development goals.

<b>Title</b>	<b>Solar Electric Technician (Level 2) – As per NOSS 2023</b>
<b>Duration</b>	260 hrs. (approx. 43 days)
<b>Language</b>	The content of this training material is in Nepali, with exception of Lesson Plans intended for the instructor only and selected materials not available in Nepali.
<b>Class size</b>	Recommended: 16 participants – Maximum size: 20 participants
<b>Target group</b>	<ul style="list-style-type: none"> <li>▪ Pre-diploma graduates in electrical and electronics engineering.</li> <li>▪ Solar Technicians with L1 certificate.</li> <li>▪ Interested individuals with grade eight pass.</li> </ul>
<b>Enrolment criteria</b>	<ul style="list-style-type: none"> <li>▪ Bright and motivated individuals of at least 16 years of age.</li> <li>▪ Physical and mental fitness.</li> </ul>
<b>Training objectives</b>	<p>Upon completion of the training, participants will possess the skills to:</p> <ul style="list-style-type: none"> <li>▪ Operate the relevant tools/materials/equipment of solar PV systems.</li> <li>▪ Install/assemble solar PV systems, including solar panels, inverters, charge controllers, batteries, water pumps and related components, ensuring adherence to industry standards and safety protocols.</li> <li>▪ Commission, diagnose, troubleshoot, and resolve issues in solar energy systems, ensuring continuous and efficient operation.</li> <li>▪ Perform routine maintenance and repair of solar PV and its components.</li> </ul>
<b>Training methodology</b>	<p>The training will combine theory instruction with hands-on practicals with diverse and engaging methods such as:</p> <ul style="list-style-type: none"> <li>▪ Lectures and interactive sessions in the classroom.</li> <li>▪ Hands-on practice with solar panels, inverters, batteries, and system components to install, assemble and test solar energy systems.</li> <li>▪ Site visits to operational solar installations to observe and learn from.</li> </ul> <p>Additionally, the training provider endeavours to facilitate access to On-the-Job Training with industry partners to gain experience in the world of work.</p>

## Tools and equipment required

- A solar water pumping system (SWP),
- A 3-phase solar rooftop (SRT) system on site,
- Access to a solar mini-grid (SMG) system site for visits, and
- An in-house workshop with tools specified below.

Tool requirements for a class of 20 learners	Quantity	Approx. unit cost (NPR)	Approx. cost (NPR)
<b>Basic tools</b>			
Screwdriver set	10	1,200	12,000
Wrenches and spanners set	10	4,550	45,500
Pliers (needle-nose, cutting) (10 x 2)	20	250	5,000
Wire strippers and cutters	10	500	5,000
Hammer and mallet- 1 each	10	1,300	13,000
Measuring tape	10	400	4,000
Utility knife	10	300	3,000
Spirit level	10	800	8,000
Notepad and pen	20	250	5,000
Mobile phone with camera	Participants can use their own		
Adjustable wrench (12")	10	800	8,000
Pipe wrench (24")	10	2,000	20,000
3.8 metre telescopic ladder	2	12,500	25,000
<b>Electrical tools</b>			
Drill machine and drill bits	4	21,250	85,000
Multimetre	10	1,500	15,000
Clamp meter ( $\geq 1000\text{VDC}$ )	5	7,000	35,000
Earth tester	1	18,500	18,500
Soldering iron and solder	5	1,100	5,500
Crimping tool and crimp connectors	5	1,500	7,500
<b>Specialized tools</b>			
GPS device (for site surveying and positioning)	1	45,000	45,000
Inclinometer (to measure roof angle and panel tilt)	5	1,200	6,000
Compass (for proper panel orientation)	5	1,200	6,000
Thermal camera (to check for hot spots and faulty connections)	1	50,000	50,000
<b>Safety equipment</b>			
Insulated gloves	20	500	10,000
Safety glasses	20	500	10,000
Hard hat	20	600	12,000
Safety harness (for working at heights)	20	3,000	60,000
First aid kit	1	5,000	5,000
<b>Total in NPR, approximate as of time of publishing</b>			<b>524,000</b>

## Certification

- ① The **training provider** will award a participants who completed the training with at least 90% of attendance a certificate of participation.
- ② Additionally, participants with 3 years of work experience acquired prior or subsequent to the course are eligible to apply for a skills test leading to a Level 2 certificate "Solar Electric Technician" at the **National Skill Testing Board (NSTB)**.

## Course Structure

Expected Learning Outcomes	Duration in Hours <sup>1</sup>	Theory	Practice
Opening		1	0
Opening, ice breaking.			
<b>1. Introduction to solar electric systems</b>	<b>12</b>	<b>0</b>	
<ul style="list-style-type: none"> <li>Introduction of solar energy and photovoltaics.</li> </ul>	1		
<ul style="list-style-type: none"> <li>Introduce solar radiation and related parameters (watt peak, irradiance, insolation, peak sun hour).</li> </ul>	1.5		
<ul style="list-style-type: none"> <li>Discuss variations in solar radiation due to season and time of the day.</li> </ul>	1		
<ul style="list-style-type: none"> <li>Describe how solar radiation is measured.</li> </ul>	1		
<ul style="list-style-type: none"> <li>Discuss components of solar PV systems, and their types.</li> </ul>	2		
<ul style="list-style-type: none"> <li>Discuss applications of solar PV systems: Solar streetlights, solar water pumps (SWP), solar rooftop (SRT) systems, solar mini-grids (SMG), grid-connected and off-grid systems, hybrid systems.</li> </ul>	2		
<ul style="list-style-type: none"> <li>Explain the specifications of solar modules, charge controllers, inverters, batteries, water pump, pump controller, mounting structures, and balance of system (BOS).</li> </ul>	2		
<ul style="list-style-type: none"> <li>List electric protection equipment and explain their uses.</li> </ul>	1.5		
<b>2. Occupational health and safety</b>	<b>4</b>		<b>10</b>
<ul style="list-style-type: none"> <li>Apply personal safety.</li> </ul>		► 1.5 ◀	
<ul style="list-style-type: none"> <li>Apply workplace safety.</li> </ul>		► 2.5 ◀	
<ul style="list-style-type: none"> <li>Identify, use, clean and maintain tools and equipment used in solar PV systems.</li> </ul>		► 5.5 ◀	
<ul style="list-style-type: none"> <li>Apply basic First Aid.</li> </ul>		► 4.5 ◀	
<b>3. Measurement of electrical and solar parameters</b>	<b>8</b>		<b>16</b>
<ul style="list-style-type: none"> <li>Measure resistance.</li> </ul>		► 2 ◀	
<ul style="list-style-type: none"> <li>Measure voltage.</li> </ul>		► 2.5 ◀	
<ul style="list-style-type: none"> <li>Measure current.</li> </ul>		► 2.5 ◀	
<ul style="list-style-type: none"> <li>Measure power.</li> </ul>		► 2.5 ◀	
<ul style="list-style-type: none"> <li>Connect circuits in series and parallel.</li> </ul>		► 3 ◀	
<ul style="list-style-type: none"> <li>Test diodes.</li> </ul>		► 2 ◀	
<ul style="list-style-type: none"> <li>Perform continuity test.</li> </ul>		► 2 ◀	
<ul style="list-style-type: none"> <li>Measure earth resistance.</li> </ul>		► 2.5 ◀	
<ul style="list-style-type: none"> <li>Determine solar radiation with online data.</li> </ul>		► 2 ◀	
<ul style="list-style-type: none"> <li>Identify, differentiate, and comprehend single phase and 3-phase systems.</li> </ul>		► 3 ◀	

<sup>1</sup> For each session the learning hours have been allocated for Theory and for Practice. However, in the breakup per subtopic the time recommended covers both Theory and Practice together as denoted by the arrows ( ► 1.5 ◀ ).

<i>Expected Learning Outcomes</i>	<i>Duration in Hours<sup>1</sup></i>	<i>Theory</i>	<i>Practice</i>
<b>4. Site selection for solar PV systems</b>	<b>9</b>	<b>9</b>	<b>33</b>
<ul style="list-style-type: none"> <li>Discuss factors for site assessment including roof orientation, ground condition, shading, optimum direction, air circulation, and wiring requirements, etc. for different types of systems.</li> <li>Use forms to assess the site condition to select suitable location for PV array, inverter, battery bank, water pump, pump controller and balance of system (BoS) for different types of systems.</li> <li>Prepare and plan the installation site by consulting the mounting structure drawings and adhering to the specifications and manuals for inverters, battery banks, water pumps, pump controllers, and BoS, considering the drawings (engineering, single line, etc.) and site conditions.</li> <li>Finalize the cable route plan and power evacuation location.</li> </ul>		<ul style="list-style-type: none"> <li>8</li> <li>13</li> <li>17</li> <li>4</li> </ul>	
<b>5. Installation and assembly</b>	<b>17</b>	<b>17</b>	<b>72</b>
<ul style="list-style-type: none"> <li>Finalize all preparations to initiate the installation at selected site for different types of solar PV systems.</li> <li>Prepare tools and accessories to install as per the installation manual.</li> <li>Prepare, assemble, and install mounting structures (e.g. rails, clamps, brackets etc.) for ground mount, pole mount and roof mount systems.</li> <li>Refer to and comprehend the installation manuals of inverter, charge controllers, water pumps, pump controller, batteries and balance of system (BoS) to prepare for installation.</li> <li>Plan and perform cable routing, wiring and conduiting of cables as per safety standard for DC and AC single and three phase wiring including the power evacuation to the MDB or designated termination point.</li> <li>Connect solar PV modules, batteries, charge controller, inverter, water pumps, pump controller, switchgear, earthing system and protection device up to 10 kW<sub>p</sub> for single and three phases by referring to the single line diagram (SLD) and wiring drawings, technical manuals and defined standard procedures.</li> <li>Conduct 3-phase wiring and load distribution.</li> <li>Perform site clearance.</li> </ul>		<ul style="list-style-type: none"> <li>6</li> <li>6</li> <li>18</li> <li>6</li> <li>18</li> <li>24</li> <li>6</li> <li>5</li> </ul>	
<b>6. Testing and commissioning</b>	<b>7</b>	<b>7</b>	<b>29</b>
<ul style="list-style-type: none"> <li>Perform testing and commissioning of installed system components by using standard templates, technical manuals, and defined standard procedures.</li> <li>Check the integrity of wiring (single phase and 3-phase).</li> <li>Check PV modules, mounting structures, batteries, charge controller, inverter, water pump, pump controller, fuses, etc. for functioning.</li> <li>Check the connection of components including earthing and protection devices.</li> <li>Check the net metering function, anti-islanding function and installed metering system to meet the regulatory and technical requirements.</li> </ul>		<ul style="list-style-type: none"> <li>18</li> <li>4</li> <li>6</li> <li>4</li> <li>4</li> </ul>	

<i>Expected Learning Outcomes</i>	<i>Duration in Hours<sup>1</sup></i>	<i>Theory</i>	<i>Practice</i>
<b>7. Maintenance and troubleshooting</b>	<b>5</b>	<b>5</b>	<b>29</b>
<ul style="list-style-type: none"> <li>▪ Maintain solar modules and mounting structures using the templates and guidelines.</li> <li>▪ Maintain and troubleshoot different types of systems and their components including but not limited to the following components using the technical manual:               <ul style="list-style-type: none"> <li>○ PV modules</li> <li>○ Mounting structure</li> <li>○ Battery bank</li> <li>○ Charge controller</li> <li>○ On-grid/off-grid inverter</li> <li>○ Pump controller</li> <li>○ Water pump</li> <li>○ Fuses, earthing, lightning arrestors and other protective devices</li> <li>○ Switchgear</li> <li>○ Cables and wiring</li> </ul> </li> <li>▪ Repair and maintain single phase and 3-phase wiring systems.</li> </ul>		▶ 4 ◀  ▶ 26 ◀          ▶ 4 ◀	
<b>8. Professional development</b>	<b>5</b>	<b>5</b>	<b>1</b>
<ul style="list-style-type: none"> <li>▪ Follow professional standards, technical standards, rules, guidelines, and practice ethical conduct.</li> <li>▪ Write an application/request letter.</li> <li>▪ Communicate with stakeholders.</li> </ul>			
<b>Closing</b>	<b>2</b>	<b>2</b>	<b>0</b>
Feedback, evaluation, closing and certificate distribution.			
<b>Total in hours</b>		<b>70</b>	<b>190</b>

## Training Materials

As set of training materials is available *in softcopy* for this course. This chapter helps navigating the materials which are organized in a folder as shown below.

### Training material folder structure

- 📁 **1. Course Information**
  - Course information (English)
  - NSTB 2023 - Solar Electric Technician NOSS L2 (English)
- 📁 **2. Training Manual**
  - Solar Electric Technician – Level 2 (Nepali)
- 📁 **3. Training Sessions**
  - 📁 1. Introduction to solar electric systems
  - 📁 2. Occupational health and safety
  - 📁 3. Measurement of electrical and solar parameters
  - 📁 4. Site selection for solar PV systems
  - 📁 5. Installation and assembly
  - 📁 6. Testing and commissioning
  - 📁 7. Maintenance and troubleshooting
    - 📁 1. Lesson plan
    - 📁 2. Media
    - 📁 3. Handouts
    - 📁 4. Assignments
  - 📁 8. Professional development

### Legend

#### 1. Course Information

**This document** – Contains information about the training course such as the objectives, scope, duration, target group and training methodology. It also lists out the main topics of the training and the expected learning outcomes apart from the required time for theory and practicals.

The folder also includes the **National Occupational Skill Standard, 2023** of National Skill Testing Board (NSTB). It defines the scope and performance standard for the Solar Electric Technician (L2). This is essential for instructors but also useful for learners keen to apply for the NSTB skills test.

#### 2. Training Manual

The principal resource book for this training published by CTEVT.

#### 3. Training Sessions

Contains one sub-folder for each of the sessions. Each session folder includes some or all of the following sub-folders:

1. **Lesson Plans:** Each session has its own lesson plan.
2. **Media:** Supporting materials referenced such as presentations and visual aids.
3. **Handouts:** Materials for use by participants during the training.
4. **Assignments:** Assignments to be given to learners during the training.





