



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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COURSE INFORMATION



OPERATOR TRAINING FOR SOLAR ROOFTOP SYSTEMS



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Alternative Energy Promotion Centre (AEPC)

Tahachal, Post Box No.: 14364, Kathmandu, Nepal

Tel: +977-1-4498013/4498014

Email: info@aepec.gov.np

Web: www.aepec.gov.np

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Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Promotion of Solar Technologies for Economic Development (POSTED)

NTNC Complex, Khumaltar, Lalitpur, Nepal

P.O. Box 1457, Kathmandu, Nepal

Tel: +977 1 5555 289, 5538 129

Email: posted@giz.de

Developed by

Integration Umwelt & Energie GmbH, Germany

Authors: Bikash Uprety, Kabir Chitrakar, Rohini Khyen

Review: Chuman Babu Shrestha, Felix Nitz

Layout: Rohini Khyen

Cover design: Far-Out Media Design (Nigeria), Felix Nitz

Project head: Felix Nitz

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1. COURSE INFORMATION

This course imparts essential knowledge and skills for operating and maintaining solar rooftops, focusing on operators with limited technical knowledge. It equips participants with the skills required to manage operations, perform basic troubleshooting, and effectively carry out maintenance tasks.

Title	Operator Training for Solar Rooftop Systems
Duration	17 hours (3 days)
Language	The training language is Nepali, the Handouts are in Nepali. However, the Course Information for the instructor (this document) is in English.
Class size	Recommended: 15 participants – Maximum size: 20 participants
Target group	<ul style="list-style-type: none"> ▪ Personnel responsible for the operation and maintenance of SRT systems, preferably electricians, technicians and individuals with basic technical skills. ▪ Electricians of companies planning to deploy SRT systems.
Enrolment criteria	<ul style="list-style-type: none"> ▪ Minimum school education of 8th grade ▪ Bright and motivated individuals
Training objectives	<p>Upon completion of the training, the participants will possess the skills to:</p> <ul style="list-style-type: none"> ▪ Perform scheduled and routine maintenance tasks, and prompt repairs when necessary to uphold optimal system functionality. ▪ Effectively operated SRT systems ensuring optimal performance. ▪ Monitor and record system performance accurately. ▪ Liaise with pertinent entities should issues arise beyond operator's capacity to resolve and manage.
Training methodology	<ul style="list-style-type: none"> ▪ Practical, hands-on training on-site an SRT system. Participants have direct access to observe and interact with components and technology. ▪ Learner-centric, incorporating project-based problem solving and learning through case studies focusing on prevalent and resolvable issues encountered in the operation of SRT. ▪ Collaborative learning environment fostering knowledge exchange and networking among participants. ▪ Develop communication skills and relationships that can facilitate future assistance and support in addressing system challenges.
Training material	<ol style="list-style-type: none"> 1) Handouts for this training available as separate document in Nepali language 2) Course Information for the instructor (this document) in English language
Equipment required	Access to a solar rooftop system for conducting the training, conveniently situated near a hotel where participants reside during the training period.
Certification	The training provider will award a course participation certificate to those participants who have completed the training. For completion, the participant must have full attendance.

Course Structure

Expected Learning Outcomes		Duration in Minutes	Theory	Practice
Opening				
	Opening, ice breaking	60	---	---
1. Components of Solar Rooftop Systems				
	<ul style="list-style-type: none"> Identify all components of the system. Describe the function of all components of a solar rooftop system. 	30	---	90
2. Inspection of Solar Panel and DC Distribution Box				
	<ul style="list-style-type: none"> Interpret specifications provided in the solar panels. Measure the output voltage and current of panels as well as MCB/MCCB using a multimeter. Conduct routine inspections of the DCDB. Execute routine checks of MCCB/MCB and SPD. Perform cleaning of panels and DCDB. 	---	---	120
3. Inspection and Maintenance of Batteries				
	<ul style="list-style-type: none"> Identify the different types of batteries and explain their characteristics. Measure the voltage and current of the battery. Measure specific gravity as a parameter for battery health assessment. Inspect visually to identify potential issues. Clean battery terminals for maintaining the system in operation. 	---	---	120
4. Inspection and Troubleshooting of Inverters				
	<ul style="list-style-type: none"> Explain the on-grid and off-grid inverters. Measure the input and output electrical parameters of the inverter. Identify common issues encountered with inverters such as low battery, overload/short circuit and temperature-related problems. Detect and resolve insulation faults within inverter systems. Perform routine cleaning on inverters. 	30	---	90
5. Inspection and Maintenance of AC Distribution Box				
	<ul style="list-style-type: none"> Explain the purpose, components and functions of the ACDB in the SRT system. Test and verify the functionality of MCB/MCCB, ELCB and RCB/RCCB. Measure the electrical parameters and assess the connected load. Perform cleaning of the ACDB. 	---	---	60

<i>Expected Learning Outcomes</i>	<i>Duration in Minutes</i>	<i>Theory</i>	<i>Practice</i>
6. Inspection and Operational Check of Automatic Transfer Switch			
<ul style="list-style-type: none"> Explain the function of automatic transfer switches (ATS). Identify the common problems in ATS. Perform basic troubleshooting to address ATS issues. Report identified problems for further evaluation and resolution by qualified personnel or company representative. 	30	60	
7. Inspection and Maintenance of Protection Devices			
<ul style="list-style-type: none"> Identify protection devices of SRT systems. Verify and rectify connection issues or damages in the protection devices. Measure earth resistance and apply appropriate measures to reduce it if it exceeds the desired range. 	30	60	
8. Inspection of Time-of-Day Meter			
<ul style="list-style-type: none"> Explain the function of the time-of-day (TOD) meter and the different tariffs associated with the connection. Verify the connection issues or damages in the TOD meter. Fill out the log sheet with incoming and outgoing units of TOD meter. 	30	30	
9. Operator Roles and Responsibilities			
<ul style="list-style-type: none"> Practice the roles and responsibilities of operators within the system, ensuring effective management and maintenance. 	---	60	
10. Regular Performance Checks			
<ul style="list-style-type: none"> Fill out the log sheet with relevant data and information. Conduct periodic performance checks according to the schedule outlined in the log sheet. 	30	60	
Evaluation and Closing			
Post training evaluation, closing and certificate distribution.	30	---	
Total in minutes		270	750
Total in hours		4.5	12.5

2. LEARNING ACTIVITIES

<i>Trainer Activities</i>	<i>Learner Activities</i>	<i>Teaching Aids</i>	<i>Time (hours)</i>
Opening			
The opening session will be graced by the esteemed presence of the head of department from the enterprise, hospital or school where the system is deployed, alongside training facilitators. The training objectives and methods are highlighted.			0.5
Ice-breaking			
<ul style="list-style-type: none"> ▪ Set training ground rules. ▪ Introduction of the participants followed by guided questions. <ul style="list-style-type: none"> ○ How long have you worked as an operator? ○ What skills and qualities do you believe are crucial for a successful operator? ○ What are the key factors ensuring long-term sustainability of SRT systems? 	<ul style="list-style-type: none"> ▪ Individual introductions: <ul style="list-style-type: none"> ○ Name, address, and installed capacity of the system. ○ Individual expresses their comprehension in response to the guided questions. ▪ Share expectations from the training. 	Meta cards and markers	0.5
1. Components of Solar Rooftop Systems			
<ul style="list-style-type: none"> ▪ Explain the function and role of system components. ▪ Lead a guided tour of the installed SRT system to introduce the components and layouts. 	<ul style="list-style-type: none"> ▪ Observe and take notes of the installed system during tour. ▪ Participate in discussion and share observations about the system components. 	Meta cards and markers	2
2. Inspection of Solar Panels and DC Distribution Box (DCDB)			
<ul style="list-style-type: none"> ▪ Illustrative talk on solar panels showing real panels. ▪ Emphasize the significance of safety protocols. ▪ Explain the purpose of the DCDB. ▪ Demonstrate voltage and current measurement on panels. ▪ Divide participants into 3 groups. Assign each to review the panel datasheet and measure current and voltage of panels and DCDB. ▪ Guide learners to measure the voltage and current. 	<ul style="list-style-type: none"> ▪ Listen to the information shared by the trainers. ▪ Work in a group for the given assignment. ▪ Ask the trainers for the information and steps that are unclear. 	Solar panels, mobile phone, Allen/hex keys, screwdriver set, blower, notebook and pen	2

<i>Trainer Activities</i>	<i>Learner Activities</i>	<i>Teaching Aids</i>	<i>Time (hours)</i>
<ul style="list-style-type: none"> ▪ Demonstrate how to conduct routine inspections of the DCDB. ▪ Demonstrate cleaning of panels and DCDB. ▪ Assign groups to clean the panels and DCDB the next day morning. 	<ul style="list-style-type: none"> ▪ Clean the panels and DCDB, the next morning as assigned to the group. Training re-commences after that. 	Mop, cloth, brush and clean water	
3. Inspection and Maintenance of Batteries			
<ul style="list-style-type: none"> ▪ Give an illustrative talk on batteries and their characteristics. ▪ Demonstrate measuring voltage and current on the batteries. ▪ Give an illustrative talk on specific gravity and its significance in assessing battery health. ▪ Demonstrate the process of measuring specific gravity. ▪ Perform visual inspection for common battery issues. ▪ Demonstrate the proper method for cleaning battery terminals, emphasizing the importance of maintenance for functioning. ▪ Assign groups to clean batteries and apply petroleum jelly on terminals. 	<ul style="list-style-type: none"> ▪ Measure output current and voltage as assigned. ▪ Check the specific gravity of battery cells to determine the battery's health. ▪ Work in groups to clean the battery terminals and apply petroleum jelly as assigned in the group. 	Wrenches, multimeter, hydrometer, brush, hot water, soft cloth, petroleum jelly, notebook and pen	2
4. Inspection and Troubleshooting of Inverters			
<ul style="list-style-type: none"> ▪ Give an illustrative talk on the purpose and function of on-grid and off-grid inverters. ▪ Demonstrate measuring input and output parameters of the inverter. ▪ Assign groups to measure the electrical parameters of the inverter. ▪ Discuss common issues encountered with inverters, such as low battery, overload/short circuit, and temperature-related problems. ▪ Guide participants in detecting and resolving insulation faults of the inverter. ▪ Demonstrate how to perform routine cleaning on inverters. Divide participants into groups to perform cleaning as demonstrated. 	<ul style="list-style-type: none"> ▪ Work in groups as assigned to conduct the following: <ul style="list-style-type: none"> ○ Measure the electrical parameters of the inverter. ○ Verify the connection of the inverter and identify if it is connected or disconnected. ▪ Perform cleaning of inverters as demonstrated by trainers. 	Camera, screwdriver set, blower, multimeter, flip chart, marker, notebook and pen	2

<i>Trainer Activities</i>	<i>Learner Activities</i>	<i>Teaching Aids</i>	<i>Time (hours)</i>
5. Inspection and Maintenance of AC Distribution Box (ACDB)			
<ul style="list-style-type: none"> ▪ Give an illustrative talk on the function and application of ACDB including the components in it. ▪ Demonstrate the functionality test of MCBs, MCCBs, ELCBs and RCBs/RCCBs. ▪ Demonstrate measuring the electrical parameters and assess the connected load. ▪ Conduct cleaning of the ACDB. ▪ Assign groups to perform functionality tests of circuit protection devices, measure electrical parameters and clean the ACDB. 	<ul style="list-style-type: none"> ▪ Assemble into groups to conduct continuity checks on the circuit protection devices. ▪ Collaborate in groups to measure the electrical parameters of the connected load and present the monitored data among all the groups. ▪ Perform the cleaning of the ACDB as assigned. 	Allen/hex key, screwdriver set, blower, and soft cloth	1
6. Inspection and Operational Check of Automatic Transfer Switch (ATS)			
<ul style="list-style-type: none"> ▪ Give an illustrative talk on the purpose and operation of ATS in SRT systems. ▪ Highlight and discuss the typical issues that occur with ATS. ▪ Demonstrate basic troubleshooting techniques to address the common problems. 	<ul style="list-style-type: none"> ▪ Identify common problems that occur with ATS. ▪ Perform basic troubleshoot methods to resolve common issues. ▪ Identify problems and challenges that fall outside the operator's area of responsibility to address. 	Mobile phone, multimeter, notebook and pen	1.5
7. Inspection and Maintenance of Protection Devices			
<ul style="list-style-type: none"> ▪ Give an illustrative talk on the various equipment used for protecting SRT systems. ▪ Describe the process of identifying and rectifying connection problems, emphasizing safety protocols and best practices. ▪ Provide instruction to measure earth resistance and divide into groups to measure the earth resistance. 	<ul style="list-style-type: none"> ▪ Examine actual protection devices for any connection issues or damages. ▪ Measure earth resistance in group. 	Flip chart, marker, notebook, Pen, Allen/hex keys, screwdriver sets, earth tester	1.5

<i>Trainer Activities</i>	<i>Learner Activities</i>	<i>Teaching Aids</i>	<i>Time (hours)</i>
8. Inspection of Time-of-Day (TOD) Meter			
<ul style="list-style-type: none"> ▪ Explain the function of TOD meter and the various tariffs associated with the connection. ▪ Demonstrate how to identify and verify any connection issues or damages of the meter. ▪ Explain the instructions to view the meter units and record units. 	<ul style="list-style-type: none"> ▪ Learn about the purpose of TOD meter, including the different tariffs associated with its usages. ▪ Assemble into groups to identify and verify any connection issues or damages in the TPD meter. ▪ Perform filling out the log sheet with incoming and outgoing units recorded in the TOD meter. 	Log sheet, notebook and pen	1
9. Operator Roles and Responsibilities			
<ul style="list-style-type: none"> ▪ Inform participants of their responsibilities in operating and maintaining the system. ▪ Demonstrate the use of communication apps (such as Team Viewer, WhatsApp, or Viber) to contact company representatives or relevant authorities in case of problem arises beyond their responsibility or if they are unable to troubleshoot. 	<ul style="list-style-type: none"> ▪ Discuss in groups the current roles and responsibilities that the operators have. ▪ Be familiar with roles and use techniques to seek assistance from concerned authorities if system issues go beyond their responsibility. ▪ Use communication apps to communicate with company representatives or relevant authorities. 	Handouts, notebook and pen	1
10. Regular Performance Checks			
<ul style="list-style-type: none"> ▪ Provide instructions on how to fill out the log sheet with relevant data. ▪ Discuss the significance of adhering to the schedule to ensure proper function of the system over time. 	<ul style="list-style-type: none"> ▪ Fill out the log sheet under the guidance of a trainer. 	Log sheet, notebook and pen	1.5
Evaluation and Closing			
<ul style="list-style-type: none"> ▪ Explain the evaluation and distribute the forms. Collect the filled forms. ▪ Distribute the certificates. 	<ul style="list-style-type: none"> ▪ Participants complete the evaluation form. ▪ Participants are awarded a certificate. 	Evaluation forms, certificates	0.5

