



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 MINI-GRIDS



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1. COURSE INFORMATION

This course imparts knowledge and skills for the operation and maintenance for solar mini-grids (SMG) with focus on operators with limited technical knowledge. The training empowers participants with the skills necessary to manage operation, conduct basic troubleshooting, and perform maintenance tasks.

Title	Operator Training for Solar Mini-Grids
Duration	18 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"> Operators responsible for the operation and maintenance of SMG systems. Local technicians and individuals with basic technical skills keen to learn about the operation and maintenance of SMG 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"> Execute scheduled and routine maintenance tasks, and prompt repairs when necessary to uphold optimal system functionality. Upkeep of the distribution networks and effective management of the connected load in the system. 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 of an SMG 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 SMG. 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"> Handouts for this training available as separate document in Nepali language Course Information for the instructor (this document) in English language
Equipment required	Access to a solar mini-grid 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

<i>Expected Learning Outcomes</i>	<i>Duration in Minutes</i>	<i>Theory</i>	<i>Practice</i>
Opening			
Opening, ice breaking	60	---	---
1. Components of Solar Mini-Grid Systems			
<ul style="list-style-type: none"> Identify all components of the system. Describe the function of all components of a solar mini-grid 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 different types of inverters used in SMG in Nepal and their features. 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 SMG system. Test and verify the functionality of MCB/MCCB, ELCB and RCB/RCCB. Measure the electrical parameters and assess the connected load. Conduct cleaning of the ACDB. 	---	60	

Expected Learning Outcomes		Duration in Minutes		Theory	Practice
6. Inspection and Preventive Maintenance of Distribution System					
	<ul style="list-style-type: none">Identify the various aspects of the distribution network, including its components and functions.Conduct visual inspections to identify potential issues such as sagging, inclination, loose connections, insulator breakdown, stay-set loosening and vegetation interference on the distribution network.Explain safety protocols for managing right-of-way and vegetation near power lines.Gain skills to measure loads, to change MCBs, to take meter reading, and to make service connections in the low-voltage distribution network.	30		180	
7. Inspection and Maintenance of Protection Devices					
	<ul style="list-style-type: none">Identify protection devices of the system.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. 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.Use communication apps (such as Team Viewer, WhatsApp, or Viber) to facilitate effective communication with the installer company or relevant stakeholders.	---		60	
9. 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	240		840
		Total in hours	4		14

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 ward chairperson from the local government where the system is deployed, alongside training facilitators. Training objectives and methods will be 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 mini-grid operator? What are the key factors for ensuring long-term sustainability of SMG projects? 	<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 Mini-Grid Systems			
<ul style="list-style-type: none"> Explain the function and role of system components. Lead a guided tour of the installed SMG system to introduce the components and layouts. 	<ul style="list-style-type: none"> Observe and take notes of the installed system during the 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"> Give an 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 and assign each to review the panel datasheet and measure current and voltage of the 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 to check 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 different inverters categories used in SMG systems in Nepal and their characteristics. ▪ Demonstrate to measuring electrical 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 inverter insulation faults. ▪ Demonstrate routine cleaning on inverters. Divide participants into groups to perform cleaning. 	<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"> ▪ Illustrative talk on the function and application of ACDB including the components used in it. ▪ Demonstrate the functionality test of MCBs, MCCBs, ELCBs and RCBs/RCCBs. ▪ Demonstrate to measure the electrical parameters and assess the connected load. ▪ Conduct cleaning of the ACDB. ▪ Assign groups to perform a functionality test of the 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 keys, screwdriver set, blower, and soft cloth	1
6. Inspection and Preventive Maintenance of Distribution System			
<ul style="list-style-type: none"> ▪ Illustrative talk on the different components used in the low-voltage distribution network. ▪ Assign groups to conduct a visual inspection to identify potential issues such as sagging, inclination, loose connections, insulator breakdown, stay-set loosening and vegetation interference on the distribution network. ▪ Explain safety protocols for managing right-of-way and vegetation near power lines. ▪ Teach skills to measure loads, change MCBs, take meter readings, and make service connections in the low-voltage distribution network. 	<ul style="list-style-type: none"> ▪ Conduct a visual inspection in groups of the low voltage distribution network and identify potential issues such as sagging, inclination, loose connections, insulator breakdown, stay-set loosening and vegetation interference on the distribution network. ▪ Share insights and learning based on the visual inspection in the team. 	Notebook, pen, ladder, cutting tools, screwdriver sets, wrenches, and safety belt	3.5

<i>Trainer Activities</i>	<i>Learner Activities</i>	<i>Teaching Aids</i>	<i>Time (hours)</i>
7. Inspection and Maintenance of Protection Devices			
<ul style="list-style-type: none"> ▪ Give an illustrative talk on the various equipment used for protecting SMG 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 groups. 	Flip chart, marker, notebook, pen, Allen/hex keys, screwdriver sets, earth tester	1.5
8. 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 installer company representatives or relevant authorities in case problems arise 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 are currently undertaking. ▪ 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
9. 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

