



**Asia-Pacific  
Economic Cooperation**

# Rooftop Solar PV System Designers and Installers

## Training Curriculum

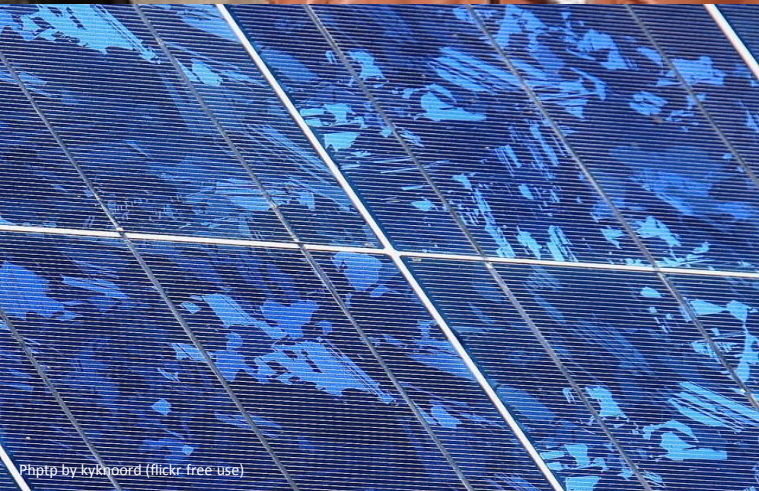
APEC Secretariat

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# SYSTEM TROUBLESHOOTING

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*Training of PV Designer and Installer*



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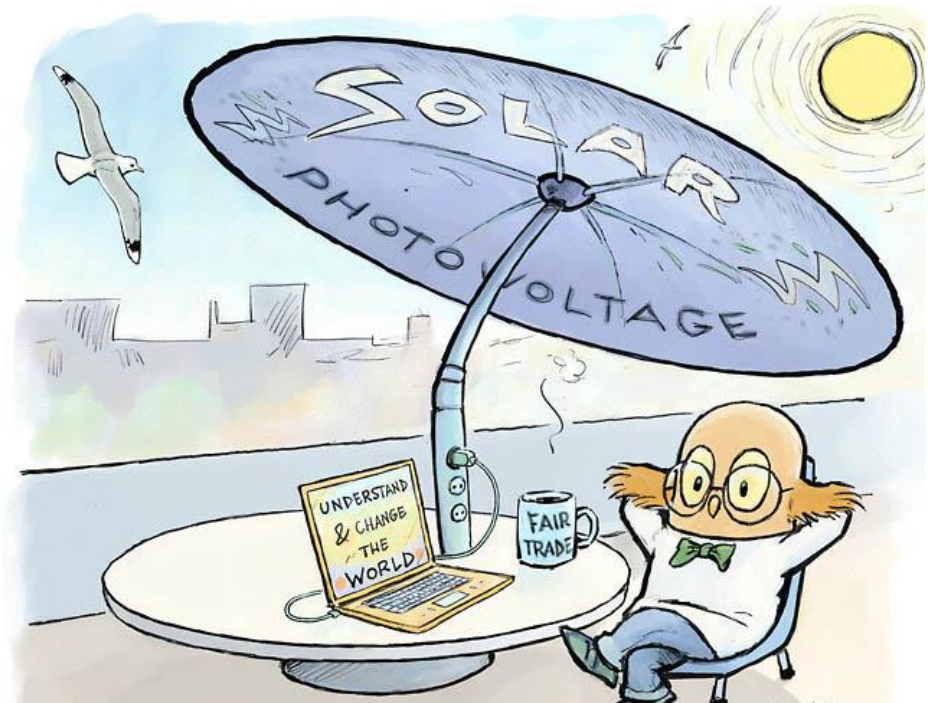
**International Copper  
Association**  
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# Contents

- A. Safety first
- B. Identify the problem
- C. Troubleshooting PV system



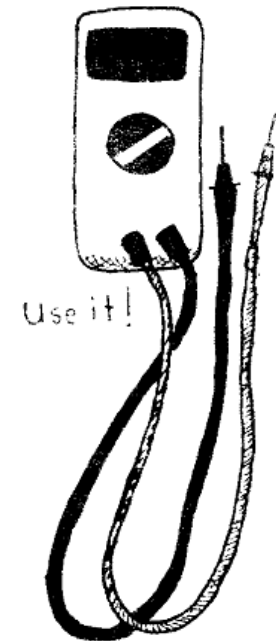
# A. Safety first

- Good work habits and a clean work area
- Proper equipment and its use
- Awareness of hazard and how to avoid them



# Proper equipment

- Know the system before start to work on it
- Keep test equipment in top operating condition
- Wear appropriate clothing
- Always measure the conductivity from exposed metal frames and junction boxes to ground
- Measure voltage from all conductors (on the PV output circuit) to ground
- Measure the operating voltage and current

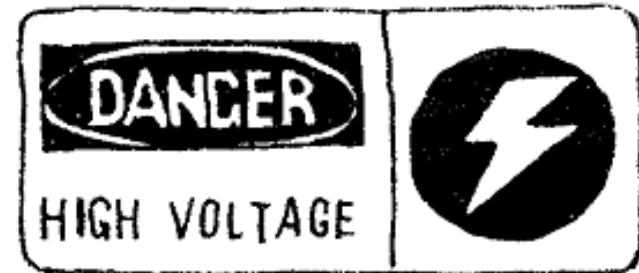




# Awareness of hazard

- Non-Electrical hazards

- Exposure
- Insects, snakes, other Vermin
- Cuts and bumps
- Falls, sprains, strains
- Burns -- thermal
- Burns -- acid



- Electrical hazards

- Anytime a PV array contains more than two modules, a shock hazard should be presumed to exist
- Never disconnect a wire before have checked the voltage and current
- Don't trust switches to operate perfectly



# Awareness of hazard

- Battery hazards

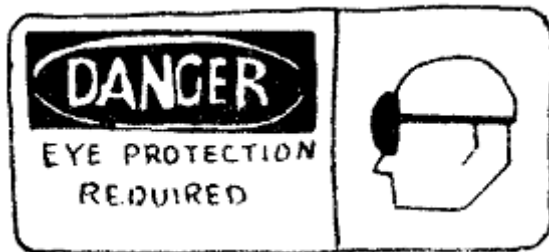
- Electrical burn
- Acid burns
- Gas explosion or fire



*Anytime you work with  
batteries....*

- AC power hazards

- This equipment will have high voltage at both input and output when it is operating and enough current will be present to kill



*Live electrical  
equipment.*



# Shutdown Procedure

- Follow the supplied instructions
- Remember DC voltage equipment are not to be disconnected or connected under load
- Common shutdown procedure:
  - Disconnect the solar input circuit to the AC distribution box at the utility connection
  - If present, disconnect the inverter AC output
  - If present, disconnect the PV array input/DC isolator at the inverter
  - Disconnect the PV array circuit at the DC disconnect
  - Pull out all the string fuses

NOTE: start up procedure is commonly the reverse. Always follow the supplied instructions for startup and shutdown procedures





# B. Identify the problem

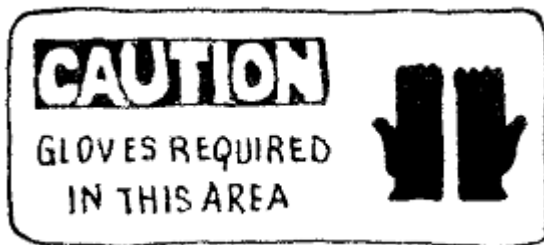
- The fault correction method depends upon the type of fault and the type of PV system.
- Customers should be asked when and how the fault came to their attention.
- Circuit diagrams and technical description of the system are very helpful.
- Troubleshooting guide aims to present the actions should be taken in order to ensure the proper performance of a PV system.



# C. Troubleshooting PV system

- Troubleshooting PV system usually means :
  - a load does not operate properly or not at all
  - the inverter does not operate properly or not at all
  - the array has low or no voltage or current

ALWAYS follow the manufacturer's troubleshooting procedure recommendation



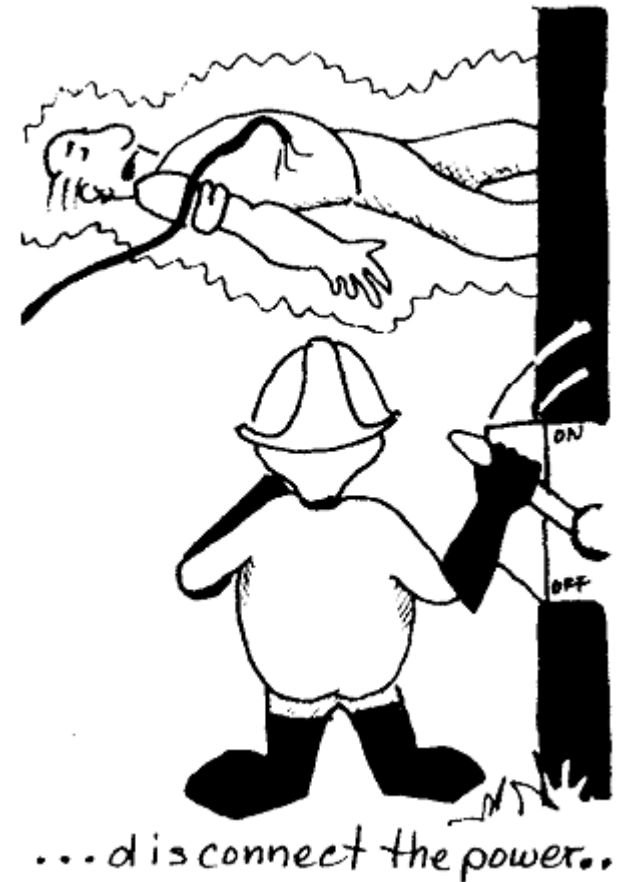
# Load problem

- Check all switches
- Check the proper voltage is present by multimeter
- Check the fuses and circuit breakers
- Check the broken wires and any loose connections
- Check system voltage and load connection
- Check for any ground faults



# Inverter problem

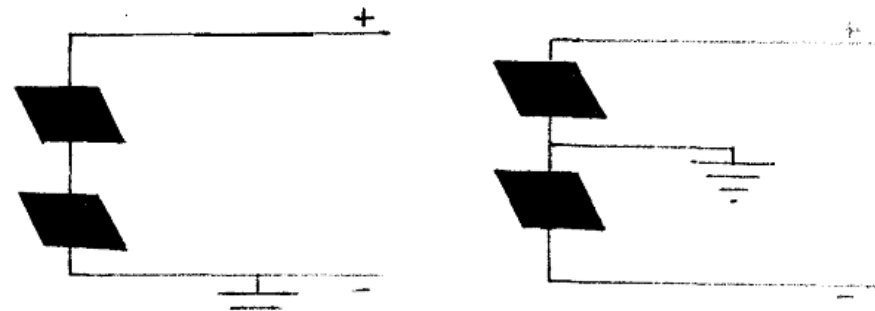
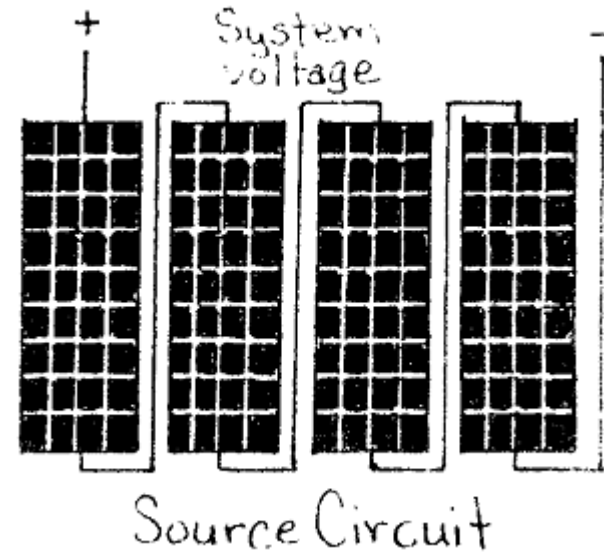
- Check for and repair any ground faults
- Check array of inverter
- Test the inverter operating data (LED or error code by remote software or laptop)
- Check the AC and DC side at the inverter
- Check the DC cable and the DC main disconnect/isolator switch



# Array problem



- Check the inverter input voltage and current from array
- Check all switches, fuses, and circuit breakers
- Check broken wires and loose or dirty connections in the inverter
- Visually check the array for obvious damage to the module and wiring
- Check the combiner box
- Check for the wrong wiring connection
- Check the shading source
- Check the dirty module



# Ground and short-circuit faults



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- Ground and short-circuit faults can be detected by following the troubleshooting procedure, but the PV strings should first be separated and measured individually.
- First switch off the inverter, if present the switch off the DC switch
- One module per string should be completely darkened by covering it from sunlight
- Now, the string can be separated without the danger of arcing and measurement can begin



*Don't become part  
of the grounding  
circuit.*





# Troubleshooting Procedures

- Go through each major component
- Check polarity (positive/negative in DC circuits and line/neutral/ground in AC circuits)
- Check voltages at every device's input and output starting with the system completely off
- Start checking the voltages at the DC side (starting with the solar modules, strings and arrays)

Review the attached troubleshooting procedure document





# Asia-Pacific Economic Cooperation

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