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SOLAR PHOTOVOLTAIC SAFETY 101

Cornell Cooperative Extension

www.energyresponsegroup.com

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A PASSION FOR SAFETY. PLAIN AND SIMPLE.

At Energy Safety Response Group (ESRG), we have over 350 years of combined experience in firefighting, hazmat operations, destructive renewable energy and safety testing, hazard and risk assessment, and fire investigation.

Leveraging our unique experience, ESRG plays a critical role in supporting utilities, developers, regulators, and emergency services through comprehensive risk assessments, failure investigations, and training programs. By combining technical expertise with field experience, ESRG delivers practical, data-driven solutions that enhance safety protocols, inform design and siting decisions, and support regulatory compliance across the rapidly evolving renewable energy landscape.

- SAFETY & PERMITTING CONSULTING
- LARGE-SCALE FIRE TESTING
- EMERGENCY RESPONSE

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World leaders in training, testing and response

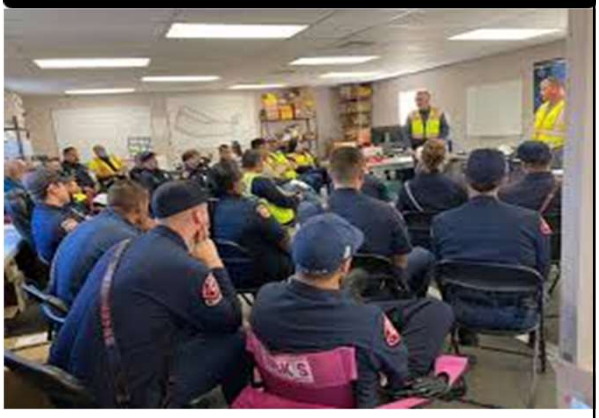
ESRG is comprised of **engineers**, former **AHJs**, investigators, and **active and retired firefighters** with experience in both rural and urban areas

Training

With the experience of over 300 medium and large-scale renewable energy tests, ESRG is an industry leader in the training of firefighters, SMEs, and code officials on risks related to ESS fires and overhaul

Testing

This experience also supports product development, permitting, hazard assessment, operational safety, and disposal— full lifecycle testing



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AGENDA

1. About Me
2. Introduction to Solar
3. Managing Solar Incident
4. Emergency Response Considerations
5. Site Requirements
6. Developers
7. AHJs
8. Conclusions and Recommendations
9. Time for Q&A

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ABOUT ME

Brian Scholl – Director of Emergency Response

Brian recently retired from the Phoenix Fire Department after a 23-year career. Brian's last position within the Phoenix Fire Department was as Deputy Fire Marshal over the Special Hazards Unit. This unit addressed any facility that posed a unique hazard to our firefighters, including renewable energy. He has collaborated with organizations such as NFPA, UL, Con Edison, FM Global, DOE, and NYSERDA, and represents the Arizona Fire Marshal's Association on multiple NFPA and ICC Committees, like NFPA 855, 420, and 30A, as well as ICC's Fire Code Action Committee. Lastly. Brian provides training to fire departments around the country, Canada, and Mexico, and is an instructor at the National Fire Academy.

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Participation

- Please ask questions
- Use the raise your hand feature or post your questions in the chat
- The more participation, the better

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Questions before we begin?

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Introduction to Solar Photovoltaic

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INTRODUCTION TO SOLAR PV

Description

- Solar energy is the energy we generate from sunlight. Through a process known as the photoelectric effect, we can convert energy from the sun's rays into electricity that can power our TVs, refrigerators, lights, and other appliances.
- Solar panels create electricity when sunlight hits a solar pane and electrons in the silicon begin to move, initiating a flow of direct current (DC) electricity.
- A solar farm is a large collection of photovoltaic (PV) solar panels that absorb energy from the sun, convert it into electricity, and send that electricity to power the grid for distribution or a BESS facility.

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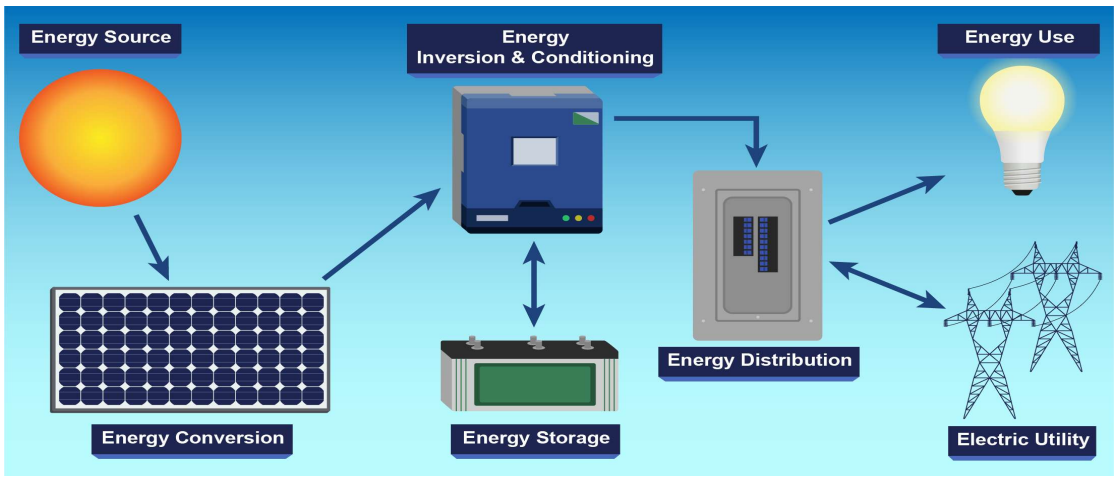
INTRODUCTION TO SOLAR PV



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INTRODUCTION TO SOLAR PV

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INTRODUCTION TO SOLAR PV

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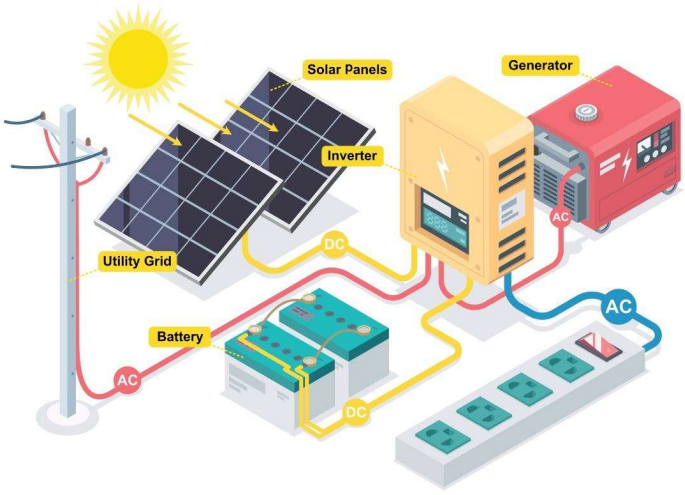
INTRODUCTION TO SOLAR PV

Solar panels create direct current (DC) electricity, we use alternating current (AC) electricity

Inverters are devices that convert direct current (DC) electricity to alternating current (AC) electricity, which the electrical grid uses.



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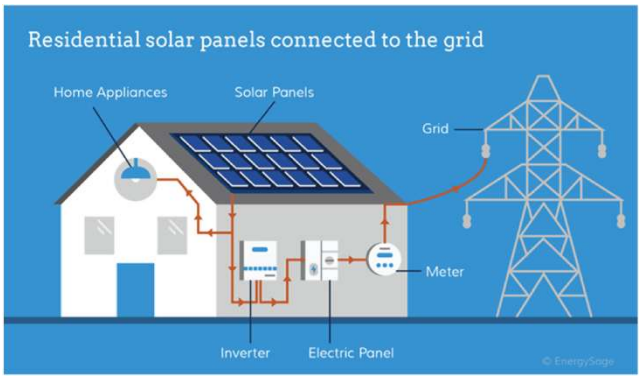

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INTRODUCTION TO SOLAR PV

Solar panels are primarily made of silicon (for photovoltaic cells), glass, metal (often aluminum), and plastic.

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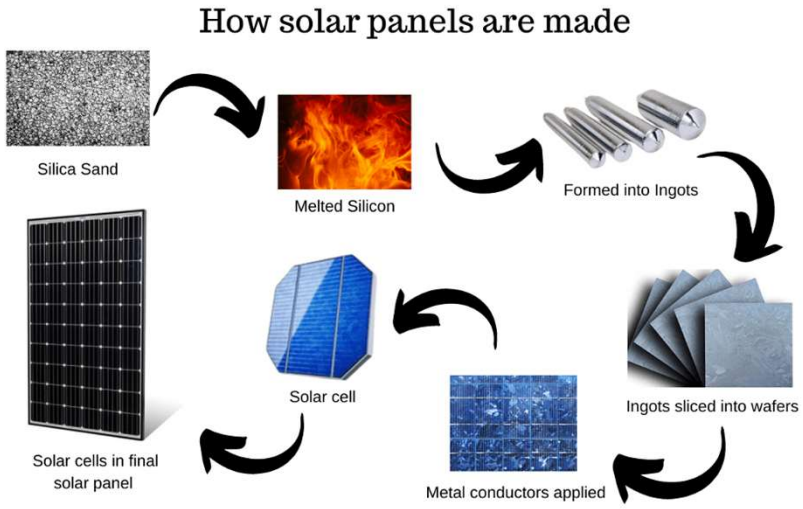
INTRODUCTION TO SOLAR PV



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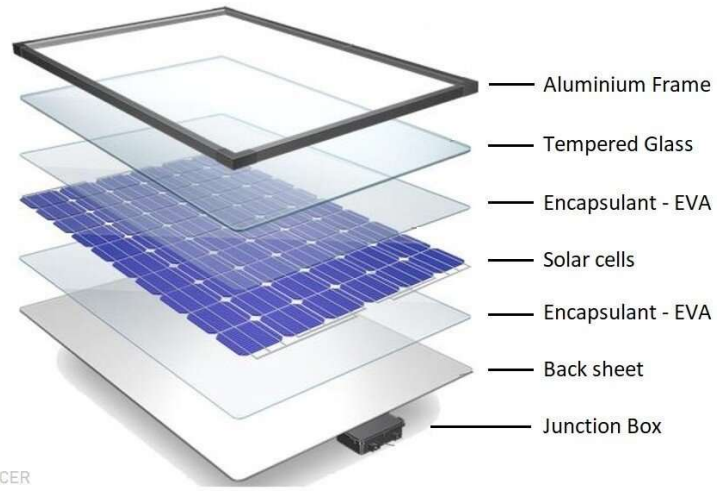
INTRODUCTION TO SOLAR PV



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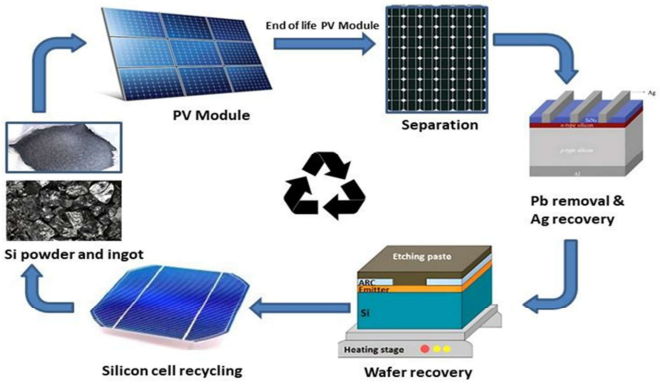
INTRODUCTION TO SOLAR PV

A significant portion, approximately 80% to 95%, of a solar panel's components are recyclable. While the exact percentage can vary depending on the panel type and recycling process, materials like glass, aluminum, copper, and silicon are commonly recovered and repurposed



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Managing Solar Incidents

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MANAGING SOLAR INCIDENTS

Electrical Shock

Description

- Startle reaction – involuntary muscle contraction (2 mA DC)
- Lock on Effect – 30 mA DC
- Cardiac Arrythmia – 80 mA DC
- Most commercial solar panels produce 350 and 400 watts (350,000 to 400,000 mA)

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MANAGING SOLAR INCIDENTS

Electrical Burns

Description

- When an electrical current passes through the body, it is converted to heat, causing damage to skin, tissue, and major organs

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MANAGING SOLAR INCIDENTS

Turnouts

Description

- Gloves only provide limited electrical protection when **dry**
- Boots provide **limited** protection when wet or damaged

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Emergency Response

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EMERGENCY RESPONSE

Description

- Similar to responding to an electrical substation failure
- If possible, stage and wait for Subject Matter Expert (SME)
- Allow the affected panel to consume itself
- Protect exposures

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EMERGENCY RESPONSE

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EMERGENCY RESPONSE

Solar Panel Fire

Should I spray water on a solar panel?

- Allow panel fire to burn itself out and protect unaffected panels
- If the plastic on the panel is on fire, water can be applied to the panel
- Research shows water can be sprayed on the panel
  - A safe distance of 20 ft for straight bore nozzles
  - A safe distance of 5 ft for fog pattern
  - 10-deg angle for adjustable nozzles
  - Follow Standard Operating Procedures (SOPs)

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EMERGENCY RESPONSE

Solar Panel Fire (cont'd)

- Plain water is effective in putting out a solar panel fire
- **DO NOT USE FOAM**
- Most experts say not to spray water on a solar panel that is actively arcing or sparking

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EMERGENCY RESPONSE

Can't we just turn off the solar panels?

- No, they are always creating electricity
- Electricity still produced at night:
  - Moonlight
  - Artificial light (ambient light, fire, lights from fire apparatus)

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EMERGENCY RESPONSE

SCBA

Don't breathe in smoke from any fire – all smoke is bad!

- Firefighters should always wear proper SCBA

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EMERGENCY RESPONSE

SCBA cont.

- Newer solar panels do not produce the same toxic smoke as earlier generations of panels, many do not have "forever" chemicals (GenX or PFAS substances)
- Older PV cells can produce the following when burning:
  - Cadmium telluride – carcinogenic
  - Gallium arsenide – highly toxic and carcinogenic
  - Phosphorous – lethal dose 50 mg

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EMERGENCY RESPONSE

SCBA cont.

- Cadmium Telluride – also found in semiconductors and pocket calculators and cameras
- Gallium Arsenide – also found in smartphones, Bluetooth earphones, and LEDs
- Phosphorous – also found in Fire Retardants, matches, lithium ion batteries

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EMERGENCY RESPONSE

Fire Extinguishers

- Portable fire extinguishers rated for electrical fires (Class C)
- Not recommended, as effective use of the extinguisher would require unsafe proximity to the hazard

Fire Extinguisher Types

Extinguisher		Type of Fire					
Colour	Type	Solids (wood, paper, cloth, etc)	Flammable Liquids	Flammable Gasses	Electrical Equipment	Cooking Oils & Fats	Special Notes
	Water	✓ Yes	✗ No	✗ No	✗ No	✗ No	Dangerous if used on 'liquid fires' or live electricity.
	Foam	✓ Yes	✓ Yes	✗ No	✗ No	✓ Yes	Not practical for home use.
	Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes	✗ No	Safe use up to 1000v.
	Carbon Dioxide (CO2)	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes	Safe on high and low voltages.

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EMERGENCY RESPONSE

Inverter Fires

Description

- Disconnect power to inverter
- If unable to disconnect, use extreme caution

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EMERGENCY RESPONSE

Exposure Fires

Description

- Protect nearby exposures from the grass, brush, or outside fire

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EMERGENCY RESPONSE

Overhaul

Description

- Don’t cut or pull apart the panels
- If you completely cover a panel, it will stop producing electricity.
- You can cover the panel with tarps, but use caution when using plastic after a fire
- Do you have the correct type and size of tarp or fire blanket?
- Turn the scene over to the SME

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EMERGENCY RESPONSE

Overhaul

Some products claim you can spray them on PV Panels to “turn off” the panels.

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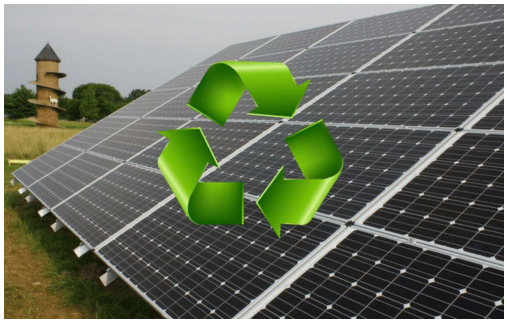
EMERGENCY RESPONSE

Closing Out the Call

Description

- Turn the scene over to the SME
- SMEs will remove any damaged panels
- Damaged panels sent to approved recycling facility
- More than 85% of a solar panel is made of recyclable materials such as aluminum and glass



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EMERGENCY RESPONSE

Additional Hazards

Description

- Overhead high voltage lines
- Substation / switchyard
- Transformers
- Battery Energy Storage System (BESS)
- O&M building

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EMERGENCY RESPONSE

, SME Coordination

Coordination with System Owner / SME:

- In many cases, the fire department is first on scene
- Critical that System Owner / SME is immediately available 24/7 remotely, and is able to arrive on-site in a timely manner to support fire department operations
- Incident Command System (ICS)
- Remediation
- Training

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EMERGENCY RESPONSE

Emergency Response Plan and Fire Department Training

Emergency Response Plan (ERP):

- Site-specific ERP including site / solar information, emergency contacts, hazards associated with solar panels, procedures for safe response
- Physical copy should be maintained in weatherproof lockbox outside of fenceline


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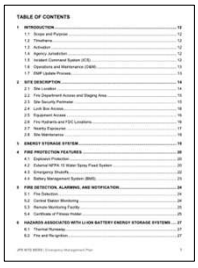
Battery Energy Storage System (BESS)

EMERGENCY MANAGEMENT PLAN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EMERGENCY RESPONSE

Emergency Response Plan and Fire Department Training

Fire Department and SME Training:

- Critical for safe response to incidents; recommend in-person training with all responding companies
- Information on solar technology, associated firefighting strategies, general hazards, and emergency response procedures
- Fire Department coordination with the site Subject Matter Expert (SME) is important
- Annual refresher training recommended
- Walkthroughs, tabletop exercises, and drills are helpful

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Site Requirements

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Site Requirements

Fire Department Access

Address

What do you want the gates to be called?

Gate 1?

West Gate?

Broadway Road Gate?

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Site Requirements

Fire Department Access

Fire Department Access, Staging:

- Adequate access and staging for fire department vehicles; paved roadways recommended
- Fire Code allows for alternate surface fire apparatus roads
- Fire department should **NOT ENTER FENCELINE** unless there is a clear threat to life safety
- Recommend signage and lockbox with ERP on exterior of project fenceline near each entrance

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Site Requirements

Fire Department Access

Signage

Proper emergency signage is required.

AHJ's have input on what they say and where they are located.

Have the main address and emergency contact information

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Site Requirements

Vegetation Control

Vegetation control on solar farms is crucial for maintaining efficiency and safety, and its code required.

Effective strategies include:

- planting low-growth species
- using mechanical methods like mowing and grazing
- strategically employing herbicides.

A comprehensive approach that combines these methods is generally recommended for optimal results

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Site Requirements

Vegetation Control

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Site Requirements

Wildlife Corridors and Fencing

- Incorporating corridors within solar farms to allow for the safe passage of animals.
- The codes require you to secure your site, but there are wildlife-friendly options
- Permeable Fencing: Using fencing that allows smaller animals to pass through while still deterring larger animals
- Installing wildlife-friendly fencing is economical as it costs roughly the same as a chain-link fence and holds up just as well structurally.

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Site Requirements

Wildlife Fencing

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Developers and AHJs

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Developers

Early and often communication

Build trust

Public engagements / Open Houses

Be prepared to answer the hard questions

Real News vs Fake News

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AHJs

Plans shall be submitted to both the building code official and the fire code official

Building - Structural, Electrical

Fire - Access, signage,

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AHJs

Codes and Standards are somewhat limited on solar farms

Rely on your electrical inspectors

Reach out to SMEs

Don’t be afraid to require a 3rd party to assist you

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Conclusion and Recommendations

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Conclusion

Proper installation

Training

Creating Partnerships

Be open to the public

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Conclusion

Ongoing Maintenance

Ongoing Training

Ongoing Dialogue

Become a member of the community

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QUESTIONS?

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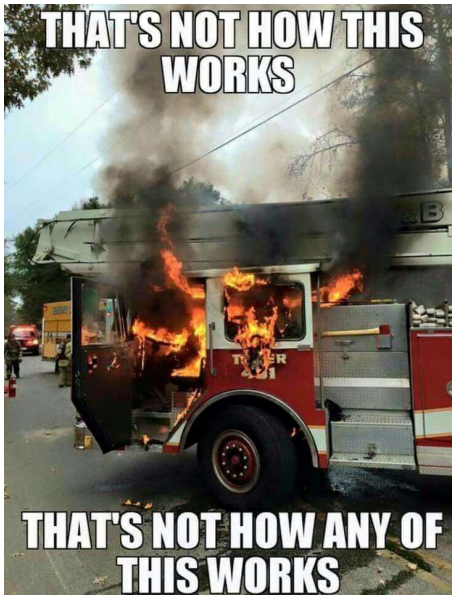

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