

Testing a Method for De-energizing Solar Panels for Firefighting

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The Problem

- 365,000 house fires in 2012
- Many homes have solar panels
 - tripping/slipping
 - additional weight
 - battery hazards
 - melted/vaporized materials
 - **electrical shock**



source: www.ktvu.com

Possible Solutions

- ◉ Disengage cutoff switch at the panel if accessible/present
- ◉ Cover the panels with
 - tarp
 - proprietary spray



source: www.securedsolar.com

Firefighting Foam

○ Benefits

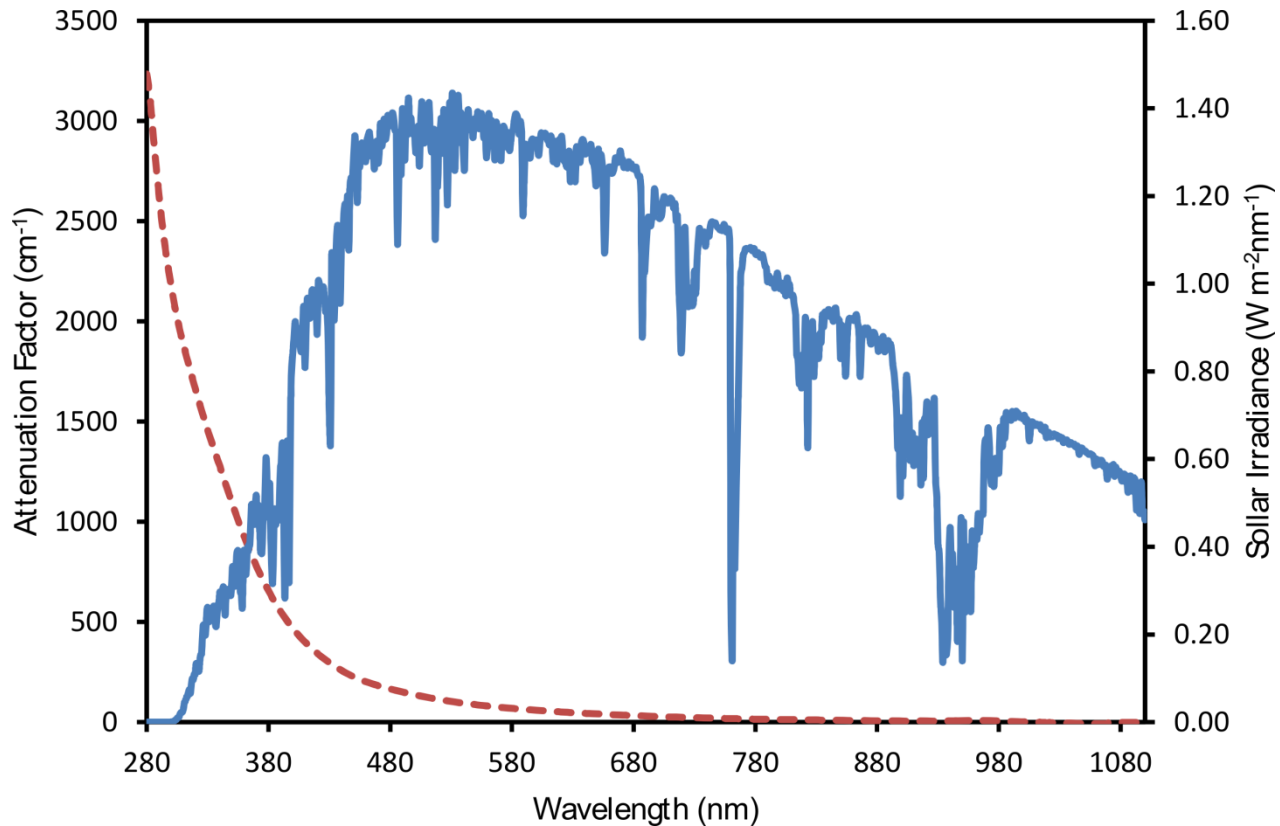
- already accessible
- easy to apply
- easy to remove
- environmentally friendly



○ Drawbacks

- must be continually applied due to runoff
- only 99.6% blocking

Firefighting Foam



$$I(\lambda, L) = I_0 e^{-\alpha(\lambda)L}$$

Experimental Design

- Monitor power output of array
 - AC/DC current and voltage meters
 - inverter is grid connected



- Monitor cloud cover
 - calibrated power meter
- Apply foam
 - local volunteer firefighters
- Record results

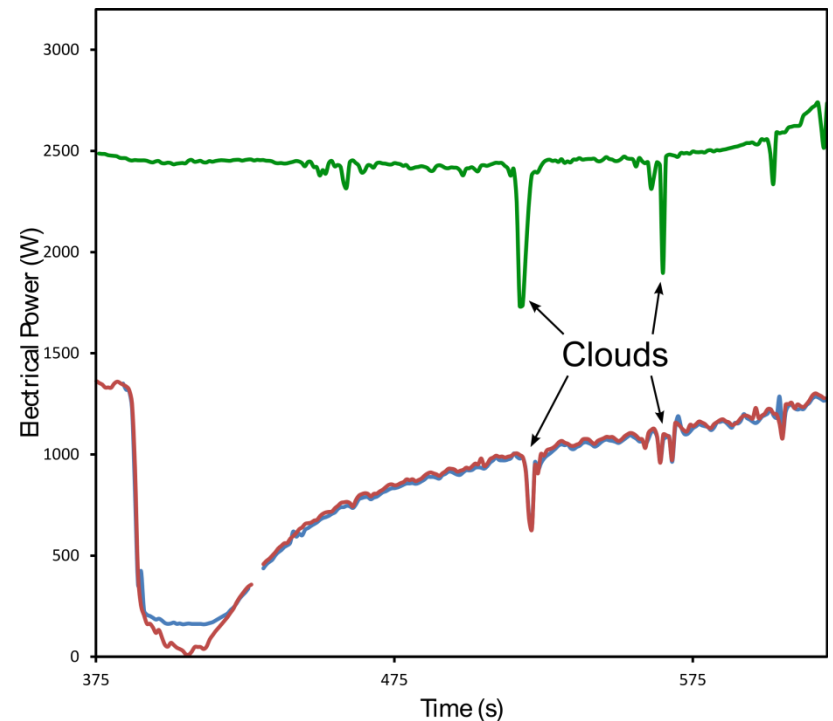
Data Collection



<https://www.youtube.com/watch?v=xi-2VL9YJcY>

Results

- ◉ Foam applied at $t = 388$ s
 - thin layer already present
- ◉ DC power
- ◉ AC power
- ◉ Control measurement for cloud cover



Results

- 3.2 kW array at 210 VDC
 - sixteen 200 W panels
 - two parallel strings of 8
- Inverter efficiency 0.92
- Aer-O-Foam XL-3
 - protein hydrolysate (fish)



- Max power: 2.75 kW
- Steady-state thin layer power: 1.48 kW (40 s)
- Min power: 12 W, 60 mA
- Reduction: 99.6%

Future Work

Goal: 10 mA or below

- Other foaming agents for
 - optimal absorption/reflection
 - coagulation to reduce runoff (36° tilt on site)
- Additives to foam
 - focus on non-toxic, eco-friendly
- Test with DC load and no inverter
- Micro-inverters

References and Contact

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- NREL's Strategic Energy Analysis Center, Renewable Energy Data Book, National Renewable Energy Laboratory, NR-6113, 2012. Retrieved 5/26/2014 from <http://www.nrel.gov/docs/fy14osti/60197.pdf>
- Grant, C., Fire Fighter Safety and Emergency Response for Solar Power Systems, AFG Funded Study (2010).
- Bayliss, K., Johnson, D. and Stamm, D., 11-Alarm Fire Guts Dietz & Watson Warehouse, NBC10.com (2013), Retrieved 5/27/2014 from <http://www.nbcphiladelphia.com/news/local/2-Alarm-Fire-Rips-Through-Dietz--Watson-Building-222001371.html>
- National Foam, Material Safety Data Sheet for Aer-O-Foam XL-3, MS120 (2010).
- Developed by Subcommittee, Standard Tables for Reference Solar Spectral Irradiances: Direct Normal and Hemispherical on 37° Tilted Surface, ASTM G173-03 (2012).