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March 27, 2019

VIA ELECTRONIC MAIL
AND FIRST CLASS MAIL

Mr. James J. Murphy, Vice-Chairman
Connecticut Siting Council
Ten Franklin Square
New Britain, CT 06051

Re: Petition No. 1354 – Chatfield Solar Fund, LLC, petition for a declaratory ruling, pursuant to Connecticut General Statutes §4-176 and §16-50k, for the proposed construction, maintenance and operation of a 1.98-megawatt AC solar photovoltaic electric generating facility located in Killingworth, Connecticut

Dear Vice-Chairman Murphy:

As mentioned during the hearing on March 26, 2019, Chatfield Solar Fund is submitting Petitioner's Exhibit 15 which is an excerpt from a 2015 German study entitled "Assessing Fire Risks in Photovoltaic Systems and Developing Safety Concepts for Risk Minimization", which discusses certain photovoltaic system fire statistics in connection with Germany's 1.3 million solar installations. This study was translated by the U.S. Department of Energy in 2018. The original and fifteen (15) copies are enclosed.

I certify that a copy hereof has been furnished on this date via electronic mail and/or first class mail, postage prepaid, to all parties, intervenors and participants of record for this petition as of this date.

Please feel free to contact me with any questions concerning this submittal at (203) 772-7787.

Very truly yours,

Bruce L. McDermott

Enclosures

GUIDELINE

Assessing Fire Risks in Photovoltaic Systems and Developing Safety Concepts for Risk Minimization

Project Sponsor

Dr.-Ing. Klaus Prume, Project Sponsor Jülich
Dipl.-Ing. Jochen Viehweg, Project Sponsor Jülich

Affiliated Partners

TÜV Rheinland Energie und Umwelt GmbH
Fraunhofer-Institut für Solare Energiesysteme (ISE)

Project Partners

Berner Fachhochschule Technik und Informatik
Berufsfeuerwehr München
Currenta GmbH & Co. OHG
Deutsche Gesellschaft für Sonnenenergie e.V. Berlin
Energiebau Solarstromsysteme GmbH
TÜV Rheinland LGA Products GmbH

June 2018

(German original 2nd edition – July 2015)

Supported by:

Federal Ministry of Economics and Technology

by decision of the German Federal Parliament

TÜVRheinland® Precisely Right.

Fraunhofer ISE

Declaration

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Disclaimer

Denver, June 2018

Legal information

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Acknowledgments

The Project Team especially thanks project sponsor Jülich (PTJ) for support of the research project. The dedicated work by the responsible persons of the PTJ, Mr. Jochen Viehweg and Dr. Klaus Prume, enabled the comprehensive work on fire risks and fire safety in PV systems, with the summary of this work and findings being presented in the form of the present Guideline.

The Project Team is also grateful to the colleagues from the companies or institutions of the affiliated partners and to the representatives of the German solar energy industry for the expertise they provided through professional exchanges, as well as to the German Solar Energy Society (DGS) and the German Solar Industry Association for their multifarious activities in connection with the research project.

Heartfelt thanks are also due to our students, who acquired solid professional knowledge through their dedication and who supported our series of experiments with many good ideas and diligence during their practical semesters and work on their bachelor theses.

Personnel and professional support in particular from Munich Fire Department as well as personnel and equipment from the Cologne Professional Fire Department, the Cologne Volunteer Fire Department, the Porz-Langel Fire Brigade and the Siegburg section of the THW made possible the series of elaborate and realistic experiments. We expressly thank them again.

Special thanks are also due to the following companies for providing equipment and materials on loan: Clausen OHG – Treble-Light Special-Lighting, SETOLITE Lichttechnik GmbH, Schmidt-Strahl GmbH, Karl Meister GmbH, Hella Fahrzeugteile Austria GmbH, Dönges GmbH & Co. KG.

We also thank the participants in our online survey, whose information and detailed knowledge about past occurrences of fire damage involving PV systems gave us an overview of the incidents, including the affected components. In this regard we wish to single out the professional fire departments in Germany, who conducted a survey among their own ranks. We are also especially grateful to Mannheimer Versicherung, which significantly supported us with statistical data on their insurance cases related to PV systems.

Last but not least, we wish to express our heartfelt thanks to the participants in our three workshops in Cologne and Freiburg, whose professional interest, expertise and own experiences repeatedly gave us a fresh impetus and strengthened our resolve.

Willi Vaaßen, TÜV Rheinland and Heribert Schmidt, Fraunhofer ISE

and on behalf of the Project Team

3.3 Damage and fire event analysis of PV systems

3.3.1 Introduction

The project specifically researched cases of fire and overheating in PV systems in order to identify possible weak points and derive potential for improvement. Since the point was to find weak points, overheating and fire incidents were considered together, thus neglecting the influence of the surroundings of the damaged component on the level of damage.

The following sources of information were analyzed:

- Internet and media reports
- Operational reports from fire departments
- Assessor reports and statements
- Damage reports from Mannheimer Versicherung
- Internet-based survey

The recorded information was checked as to plausibility and if necessary followed up and evaluated. In many cases only incomplete details were available, so that only partially plausible estimates about the origin of damage were possible or the ultimate cause of fault could not be identified. If a damage appraisal was available, the conclusions from this report were adopted.

The analyses presented in the following reflect the status of January 2013. At this point in time, Germany had approximately 1.3 million PV systems with a total output of over 30 GWp. Individual fire incidents in 2013 entered into the analysis.

The following incidents of damage from overheating or fire involving PV systems in Germany were researched or reported:

- approximately 430 cases of fire or overheating in PV systems,
- about 220 cases thereof with external causes of fire
- about 210 cases with the cause of fire lying in the PV system

While far from recording all incidents, the analysis is probably the most comprehensive published compilation to date.

In 2013 and 2014, a series of further fire events was found whose causes and effects correspond to the statistics of section 3.3.2, so that a representative data stock may be assumed.

Two known fire cases 2013 and 2014 illustrate the point:

1. Fire incident in Walldorf: fire in a photovoltaic system on a warehouse roof

Foto: PR Video

Figure 3-8: Incinerated PV modules on a flat roof, substructure here with plastic trays(!)

In June 2014 PV modules in the system in question caught fire on a flat roof owing to a technical defect, resulting in property damage amounting to several thousand euros. Firefighters were able to promptly extinguish the fire, without it spreading to the building. As can be seen on the photo, the elevation was provided by plastic trays. These plastic trays are generally *normally flammable* (class E as per EN13501-.1). When selecting installation materials, especially for roof-mounted systems, attention must be given to the significant **potential for ignition and propagation of fire** if plastic is to be used.

2. Fire incident on Norderney: In August 2013, a fire started here in a workshop with adjoining vehicle depot. The fire spread rapidly, the roof structure and entire PV system collapsed, and the damage amounted to several million euros.

Figure 3-9: After a fire in a workshop with warehouse and depot (photo: Norderney Fire Department)

These examples demonstrate the scenarios basically to be distinguished among fire incidents at buildings with PV installations: on the one hand, the origin of the fire lying in the PV system itself, and on the other hand the “collateral fire” at a PV system caused by an external source (in this case, a building fire).

3.3.2 Statistical damage analyses

The approximately 210 damage incidents with causes lying inside the PV system were further analyzed. Table 3-1 breaks down these cases according to level of damage. Figure 3-10 explains these figures.

Table 3-1: Extent of damage in approx. 210 cases

Component damaged	59
PV system damaged	75
Building damaged	67
Building burned down	12

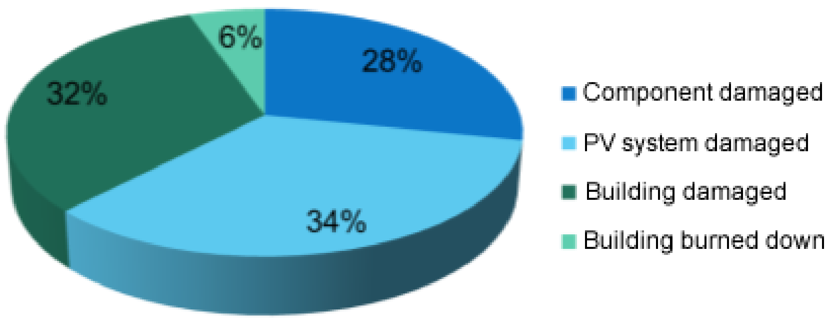

Figure 3-10: Overview of damage levels in the examined cases

These cases were further analyzed, depending on the available information. Despite uncertainties about the exact development of the damage in individual cases, the totality of the cases allows some robust conclusions to be drawn. The following aspects are of interest:

- Cause of fault
- Component causing the fire
- Age of system
- Type of system
- Severity of damage, impact on surroundings

The following presents these results in the form of analytical graphs.

A general observation reveals that the destructive force of an electric arc greatly increases if a serial arc develops into a parallel arc, as in the case of the electric arc from a string reaching a bundle of string lines. The Lorentz force gives the parallel electric arc the tendency to move away from the PV modules and thereby shift the fire hazard in the direction of the inverter.

3.3.2.1 Influence of the system type on damage frequency

The following graph shows how often the different types of system suffer damage.

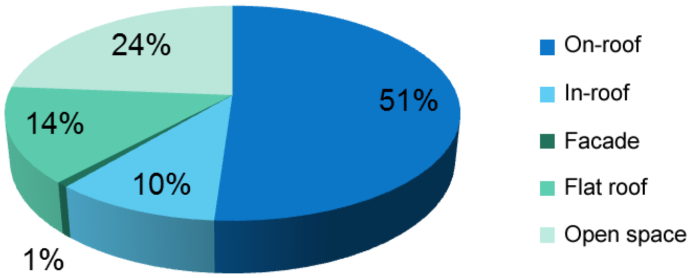

Figure 3-11: Breakdown of damage according to system type (based on 139 incidents of damage)

The ascertained distribution roughly corresponds to the market shares estimated by the German Solar Industry Association (BSW), with around 70% capacity on buildings and about 30% in open space. Less than one percent of the capacity has the form of building-integrated (in-roof) systems. Systems with building-integrated modules make up around 10% of the damage statistics, however.

Among all cases with building damage, building-integrated systems are more prominent. Figure 3-12 shows the distribution of cases where a building was damaged or destroyed and where information on the PV generator mounting type was available.

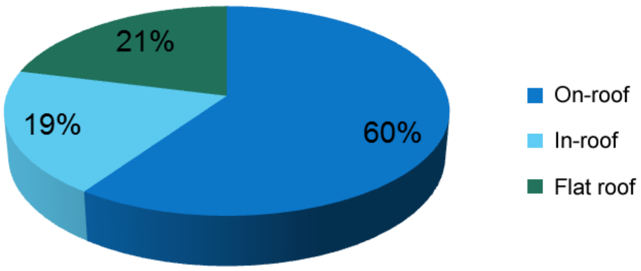

Figure 3-12: Damage distribution in cases with damage to buildings. “In-roof” also includes facade-integrated systems (based on 57 damage incidents).