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PV Safety, Arcing & Fusing

Arcs – What do we do?

www.ceem.unsw.edu.au

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Consider the Fire Risk

Type of system	Secondary risk	Fire risk assessment
BIPV- facade	Domestic fire	high
BIPV- roof	Domestic fire	high
Elevated flat roof	Fire risk only in individual cases	low
Elevated sloping roof		low
Open air site	Risk of large-scale fire in single cases	low

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Many systems are building integrated

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What can we do?

- Quality control & proper design
  - Carefully rated equipment for dc use.
  - Protection rated for current limited applications.
- Standards for Array installation
- Arc Detector?
- Testing and inspection?

Related issues:

- Array design (voltage, strings, etc)
- String fusing
- Connectors
- Cables
- Earthing
- Installation practice

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Standards for Array installation

- Where we are with respect to the rest of the world
  - AS5033
    - New project **IEC 62548**
      - **Installation and Safety Requirements for Photovoltaic (PV) Generators**
  - USA – NEC
  - Europe IEC 60364-7-712
    - **ELECTRICAL INSTALLATIONS OF BUILDINGS -**
    - **Part 7 : Requirements for special installations or locations -**
    - **Section 712 : Photovoltaic power supply systems**

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NEC - USA

- Requires PV conductors remain outside a building until they reach a readily accessible disconnect at the point of first penetration. OR
- Conductors from the PV array may be run inside the building before reaching the first readily accessible disconnect if installed in metallic raceways. Non-metallic raceways (PVC) not allowed because:
  - No physical protection, fire containment or ground-fault detection afforded by metallic raceways.

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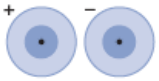
UK Guide (Not a Standard)

a. Single conductor cable – both insulated and sheathed



b. Single conductor cable in suitable conduit/trunking

c. Steel wire Armoured SWA (usually suitable only for main DC cable)

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Inherently safe installations

- What areas can be addressed using these techniques?
  - Cable protection where appropriate
  - Segregation of + and – (Conflicting requirements)
    - Conduits
    - Junction boxes
- Requirements for facades?
- Requirements for integrated systems?
- Fire barriers?

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Arc Fault Detectors

- 2008 NEC requires AC Arc Detector/Interrupter to protect:
  - Bedroom
  - dining rooms,
  - living rooms, and
  - other habitable areas.

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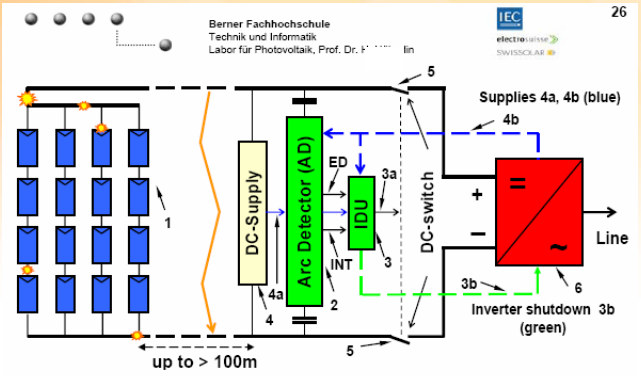
DC Arc Detector



- **Simple dual resonant filter and AM style detection circuit followed by intelligent detection unit.**
- **Need to have RF quiet inverter.**
- **Can integrate arc detection into inverter for significant cost reduction.**

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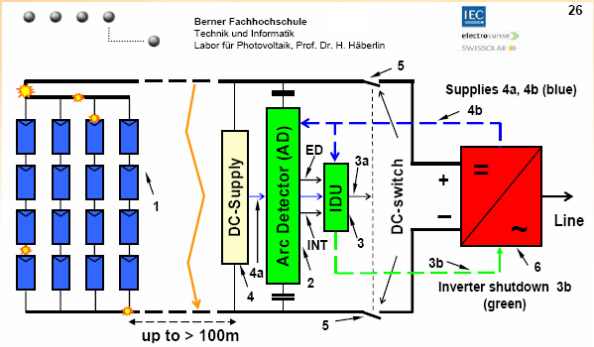
DC Arc Detector



- **The know-how, and extended reports about all former tests are available at Haeberlin's PV laboratory Burgdorf, Switzerland.**
- **Needs more development and field trials.**

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Arc Detection - (Haeberlin)

- In the coming years hundreds of thousands of PV plants with many 10 millions of external and many billions of internal contacts will be operational.
- After many years even with the highest quality standards during production and installation some of them will go defective and end up in dangerous DC arcs.
- If in the future from time to time fires would occur owing to such arcs in PV plants on buildings.
- If the general public and political decision makers become alarmed, not only the manufacturer of the defective device and the installer, but the PV community as a whole could face major problems**.**

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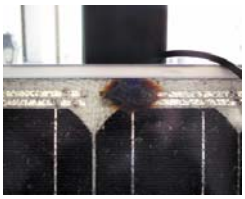
Other Measures

Testing / inspection






Visual inspection:

- Obvious failures
- Brown spots / scorching
- Inspection of rear & front

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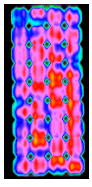
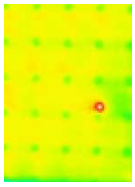
Other Measures

Testing / inspection

IR test

Hotspots should be obvious

Connect module to power supply to simulate operating conditions?

Arcing in PV DC-Arrays

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Other Measures

Testing / inspection

IV Curve irregularities?

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Other Measures

Remedial works

Remove, inspect & test

Install fire barrier ?

Arcing in PV DC-Arrays

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Many of our publications are available at:
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Discussion Items

- Module Standards
- Array Safety
  - Wiring practices
  - Arc Detector
- Fuses

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JOBS

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Standards