IEC and European Inverter Standards

Christoph Panhuber

FRONIUS International GmbH

Europe and the US – two different philosophies

UL IEEE NEC

IEC CENELEC

The International Electrotechnical Commission

- Mission: to prepare and publish international standards for all electrical and electronic technololgies
- Theory:a component or system manufactured to IEC standards and manufactured in country A can be sold and used in countries B through to Z
- Currently 63 members and associate members, among which are: the USA, Canada, all European Union countries, China, Australia, Korea,

IEC is trying to establish unified standards

PV BOS and Installation Projects currently in progress:

- IEC 61727: Characteristics of the Utility Interface
- IEC 62109: Safety of Static Inverters
- IEC 62116: Testing procedure of Islanding Prevention Methods for Utility-Interactive Photovoltaic Inverters

Existing Standard

- IEC 60364-7-712: Electrical Installations of Buildings: Requirements for Special Installations or Locations – Solar Photovoltaic power supply systems

IEC 61727: Characteristics of the Utility Interface

- Scope: 10 kW or smaller PV systems connected to the low-voltage grid
- Main focus: Power quality parameters: Voltage and frequency range, flicker, DC injection, Harmonics and waveform distortion, Power factor
- Behaviour in case of over/under voltage and over/under frequency conditions
- No specific anti-islanding requirements in this document, reference is made to IEC 62116

IEC 62109: Safety of Static Inverters

- Standard is comparable to UL 1741
- Input is taken from UL 1741, IEC 60950, IEC 60103 and IEC 61010
- It deals with mechanical and electrical safety aspects
- Status: a CDV (committee draft for voting) shall be issued in the next weeks
- Could possibly have major impact on existing products – the reactions to the CDV will be very interesting

European Standards

- Standard for Micro-CHP Units
- Special case: Transformerless inverters
- The most important standard in Germany – the DIN VDE 0126

CENELEC TC 8X – Standard for Micro-CHP Units

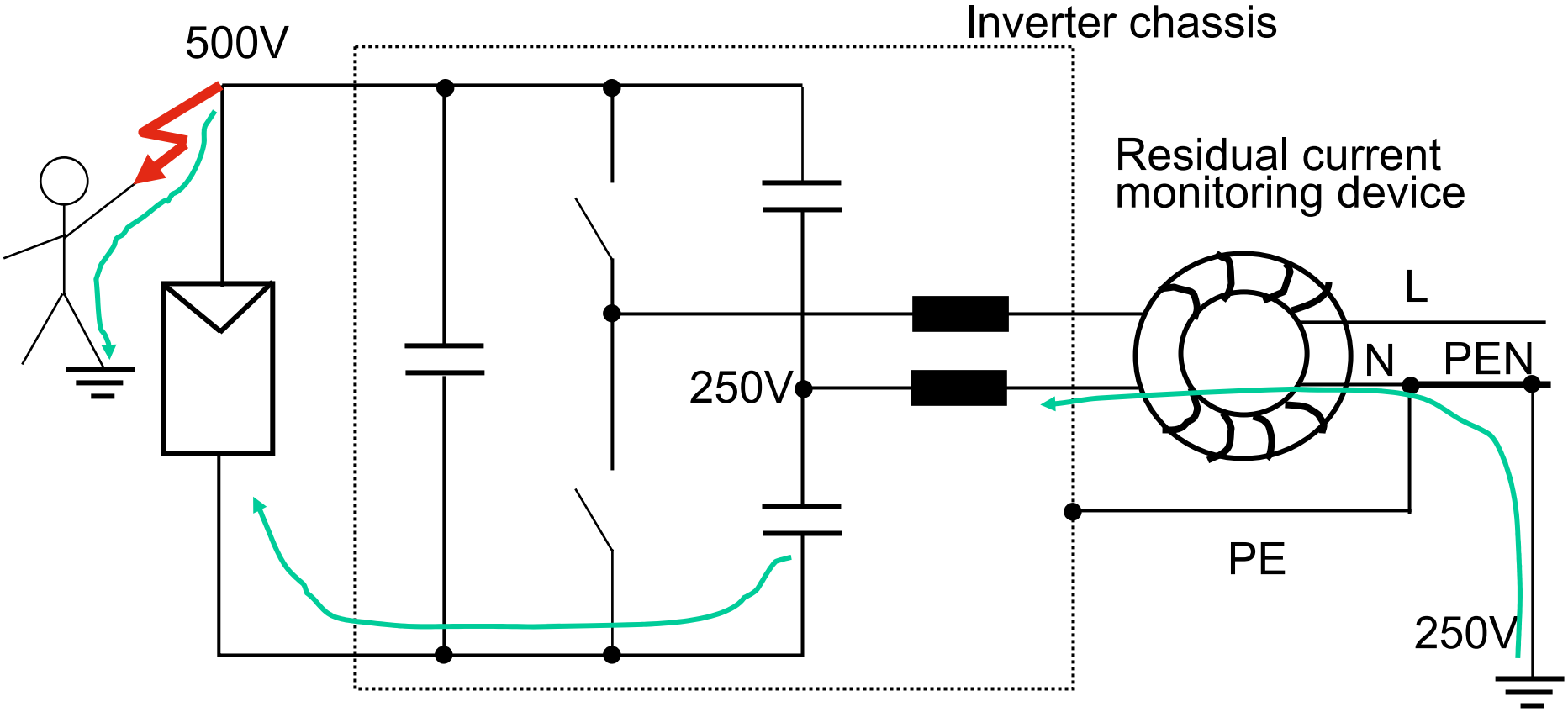
- Scope: Micro-CHP Units (e.g. Stirling-Engines, Fuel Cells) up to an electrical power of 16A per phase @230V
- Main focus: Power quality issues (Harmonics, Power factor, Flicker, EMC, DC injection)
- Safety issues (Behaviour at abnormal voltage / frequency conditions) - Country-specific shutdown conditions will be allowed
- No specific anti-islanding requirements at matched load – shutting down is required if a 25% imbalance between generation and load is detected

CENELEC TC 8X – Standard for Micro-CHP Units

The FIT & INFORM concept

- Type-tested equipment may be installed, connected and commissioned by licensed electrical fitters without involvement of the utility (the concept of an electrical inspector is unknown in most EU countries anyway)
- Within 30 days documentation about the installation process, the equipment used and a commissioning protocol has to be sent to the utility / the network operator
- Install first – inform the utility later!

Transformerless Inverters



Note: All potentials indicated relative to negative DC!

Important consequences

With transformerless inverters

- There is the possibility of a dangerous DC fault current – personal safety is not assured
- This requires a DC sensitive Residual Current Monitoring Unit (RCMU) – common RCDs are only sensitive to AC fault currents
- These DC fault currents MUST NOT be mixed up with DC current injection!
- DC current injection is not a fault current, but a small asymmetry between the positive and negative half-wave of the current fed into the grid

The DIN VDE 0126 – revision of the most important German safety Standard

The standard defines the requirements for an automatic AC disconnect interface – it eliminates the need for a lockable, externally accessible AC disconnect.

It defines:

- Redundancy and one-fault tolerance requirements
- Anti-Islanding requirements
- DC current injection requirements
- For transformerless inverters: Requirements for a RCMU (residual current monitoring unit) which has to be sensitive for both AC and DC currents)

The DIN VDE 0126 – revision of the most important German safety Standard

Changes in this version

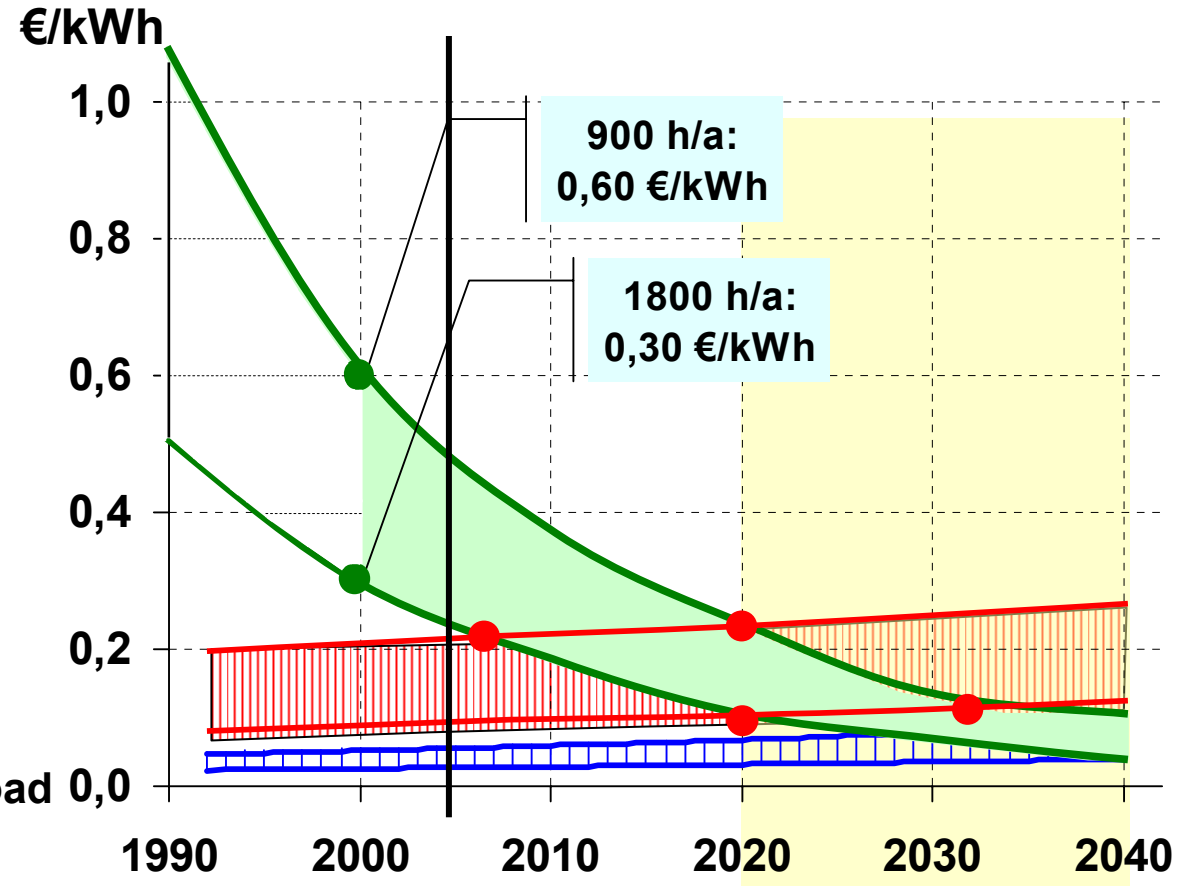
- Anti-Islanding requirements: a type-test similar to the anti-islanding test in UL 1741 has been added to the impedance measurement test
- The RCMU test is defined much better than before

Consequences:

- More options to achieve the required technical performance related to anti-islanding
- Well-defined requirements for transformerless inverters

When will PV be competitive?

Cost of Electricity



Source: RWE Energie AG und RWE SCHOTT Solar GmbH

There is a necessity to drive down the costs of PV without sacrificing safety

- In Germany installation costs for a grid-connected system are in the range of 4.200 to 5.000 € / kWp installed
- System prices in the US are in the order of 6.500 to 9.000 US$ / kWp installed
- Module prices are even cheaper in the USA than in Europe
- Inverter prices tend to be about equal

Why is there such a difference in system costs?

The answer: Installation

Germany / Austria: No externally accessible AC disconnects required

DC disconnects in the form of Multi-contact plugs

No conduits, but simple plastic raceways for cabling

Conclusions

- Standards are absolutely necessary to define clear rules
- It is desirable to have globally accepted standards to reduce costs
- The IEC is the forum to create these standards; Europe and the USA are actively involved in drafting IEC standards
- There is a difference in implementation strategies between Europe and the US