PV Inverter Reliability

Integrator Perspective on Reliability

Quantity

Topics

Inverter Reliability – Integrators Perspective

- Reliability vs. Availability – Challenges
- Individual component and inverters – Impacts
- Non-technical items – how they can affect reliability

Reliability vs. Availability

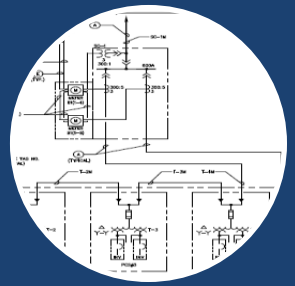
Reliability vs. Availability

Availability counts – not a 1:1 relationship with inverter reliability

- Gray area between failure and lower performance
- Combination of individual component reliability and system design
- Downtime matters
- Measurement (visibility)

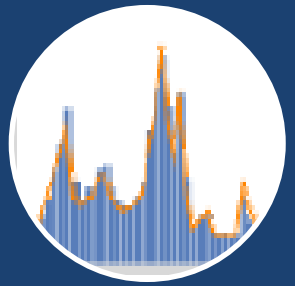
Reliability vs. Availability

Performance & Components



System Design

MTTR



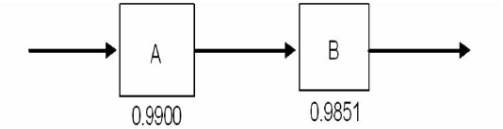
Irradiance

AVAILABILITY

Reliability vs. Availability

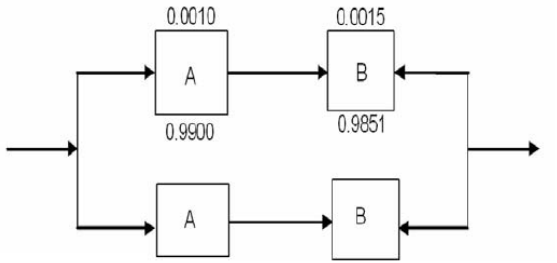
Evaluation is Difficult

- Series Connection

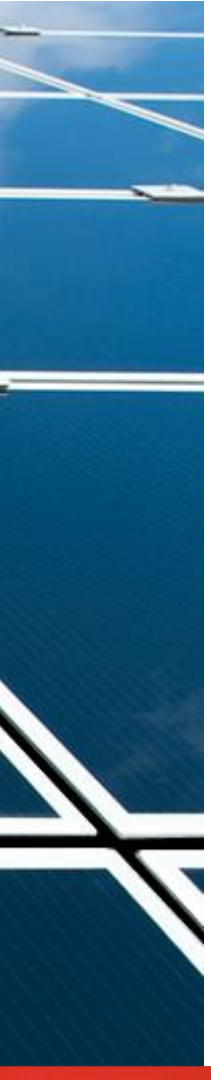


Weakest Link

- Redundancy



Multiple paths but not equal

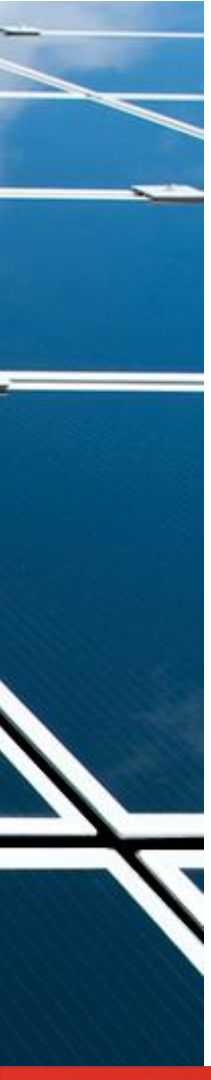


Reliability vs. Availability

Distributed nature of the system combined with the variability of the fuel source makes understanding the impact of reliability of components difficult!

Individual Components and Inverters

Individual Component Impacts on Inverters



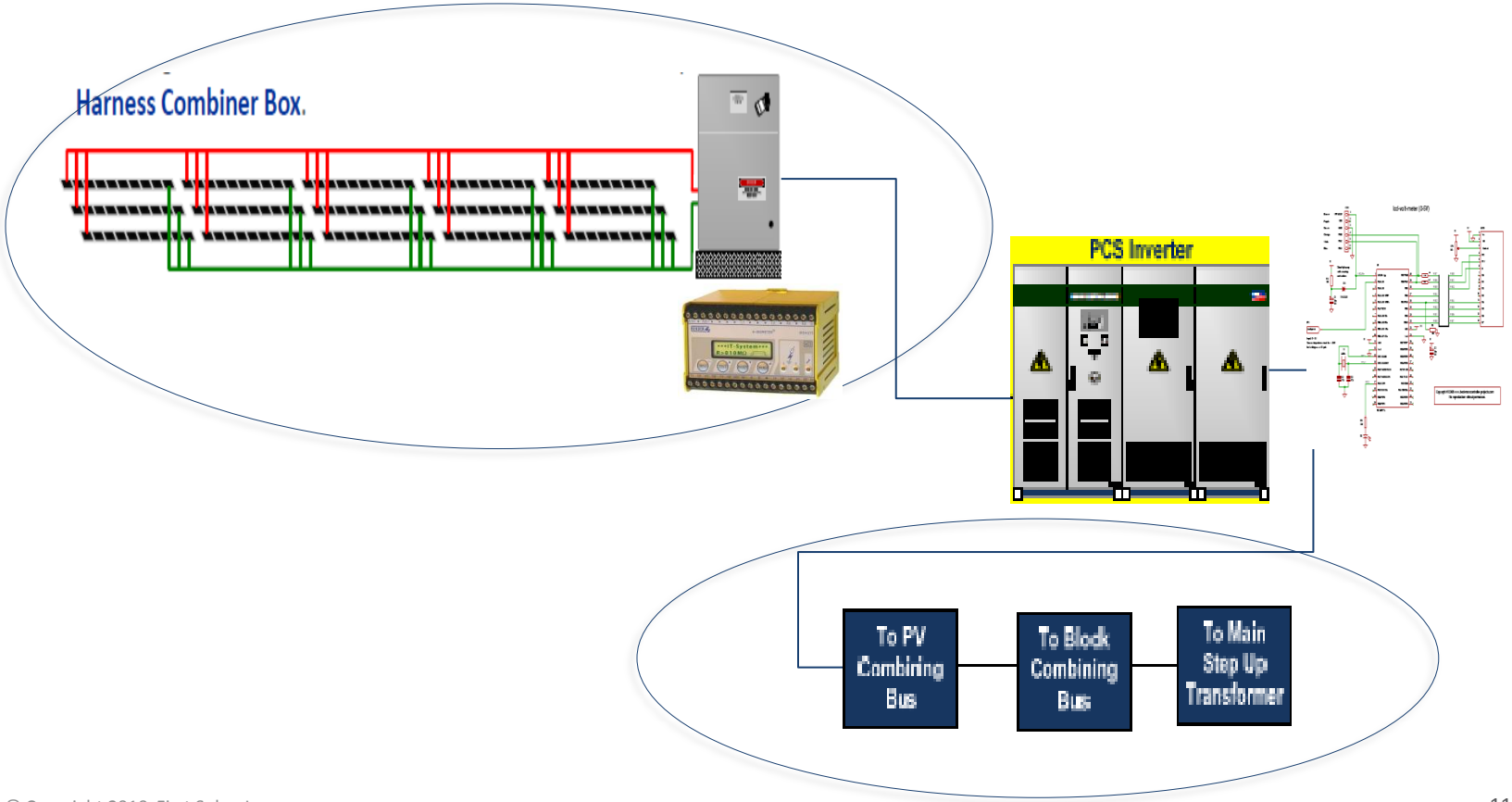
AC

- Grid and system stability
- External protection & control
- Advanced grid requirements

DC

- Modules and wiring
- Combiner boxes
- Ground fault protection

Individual Component Impacts on Inverters



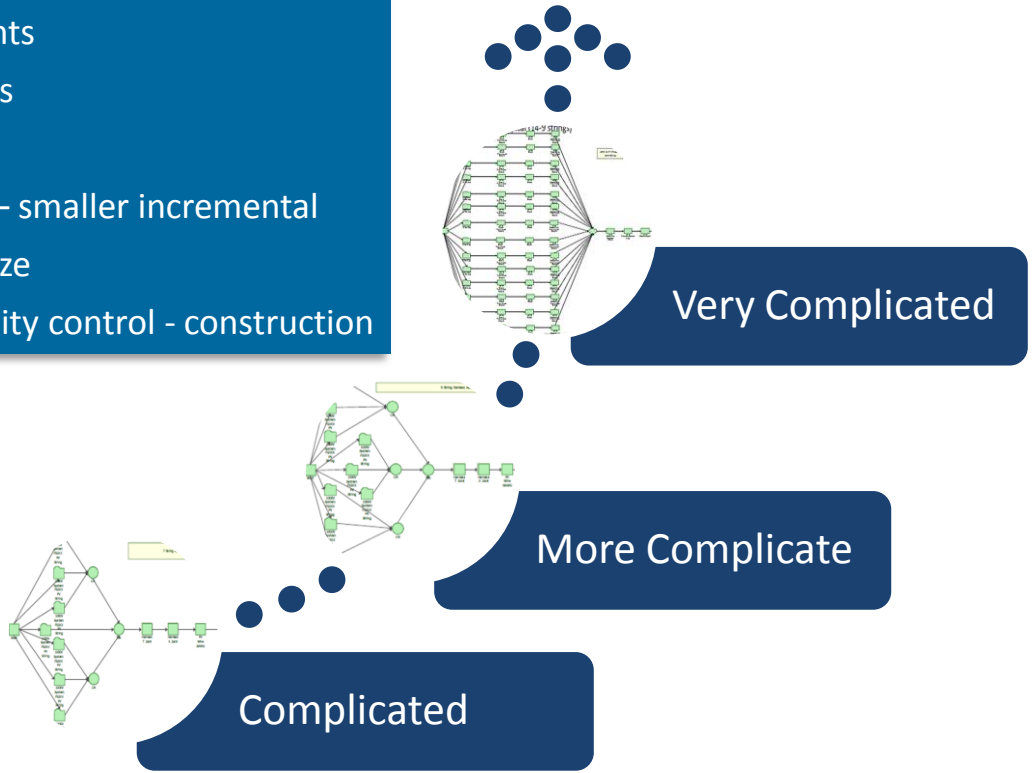
Individual Component Impacts on Inverters

AC – bigger impact

- Less components
- More standards

DC – Complicated – smaller incremental

- Difficult to analyze
- Challenging quality control - construction



Non Technical Impacts on Reliability

Non Technical Impacts on Reliability

- Standards and specifications
  - Measurable characteristics
  - Clearly identified performance characteristics
  - Well defined engineering specifications
- Operational logistics
  - Safety
  - Warranty commercial terms
  - Proximity of resources
  - Site access
- Vendor relationships and quality
  - Lines of communication
  - Tracking processes

Non Technical Impacts on Reliability

- Testing – Commissioning - Startup
  - Mfgr. testing
  - Factory Testing
  - Established startup procedures

First Solar Locations

Global Headquarters	Tempe, Arizona, USA
Europe	Berlin, Germany Brussels, Belgium Madrid, Spain Mainz, Germany Paris, France
Asia/Pacific	Beijing, China Sydney, Australia
North America	Bridgewater, New Jersey, USA Irvine, California, USA Oakland, California, USA New York, New York, USA San Francisco, California, USA Sarnia, Ontario, Canada
Manufacturing	Frankfurt (Oder), Germany Kulim, Malaysia Perrysburg, Ohio, USA