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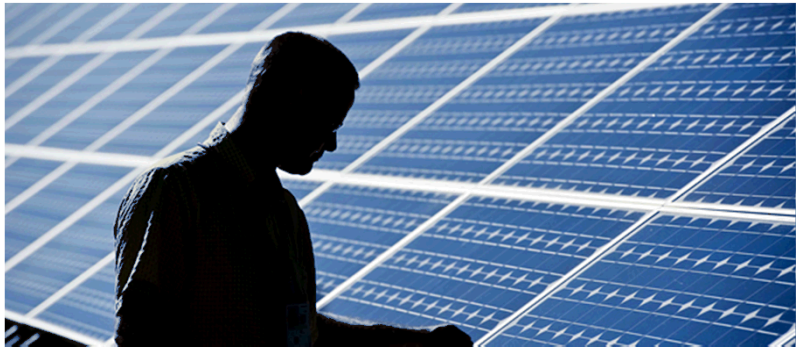
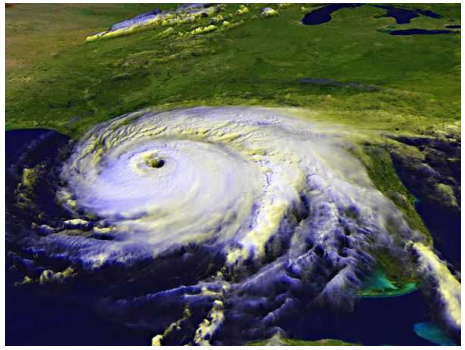


The Application of Standards to Energy Storage System Testing and Validation

David M. Rose

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U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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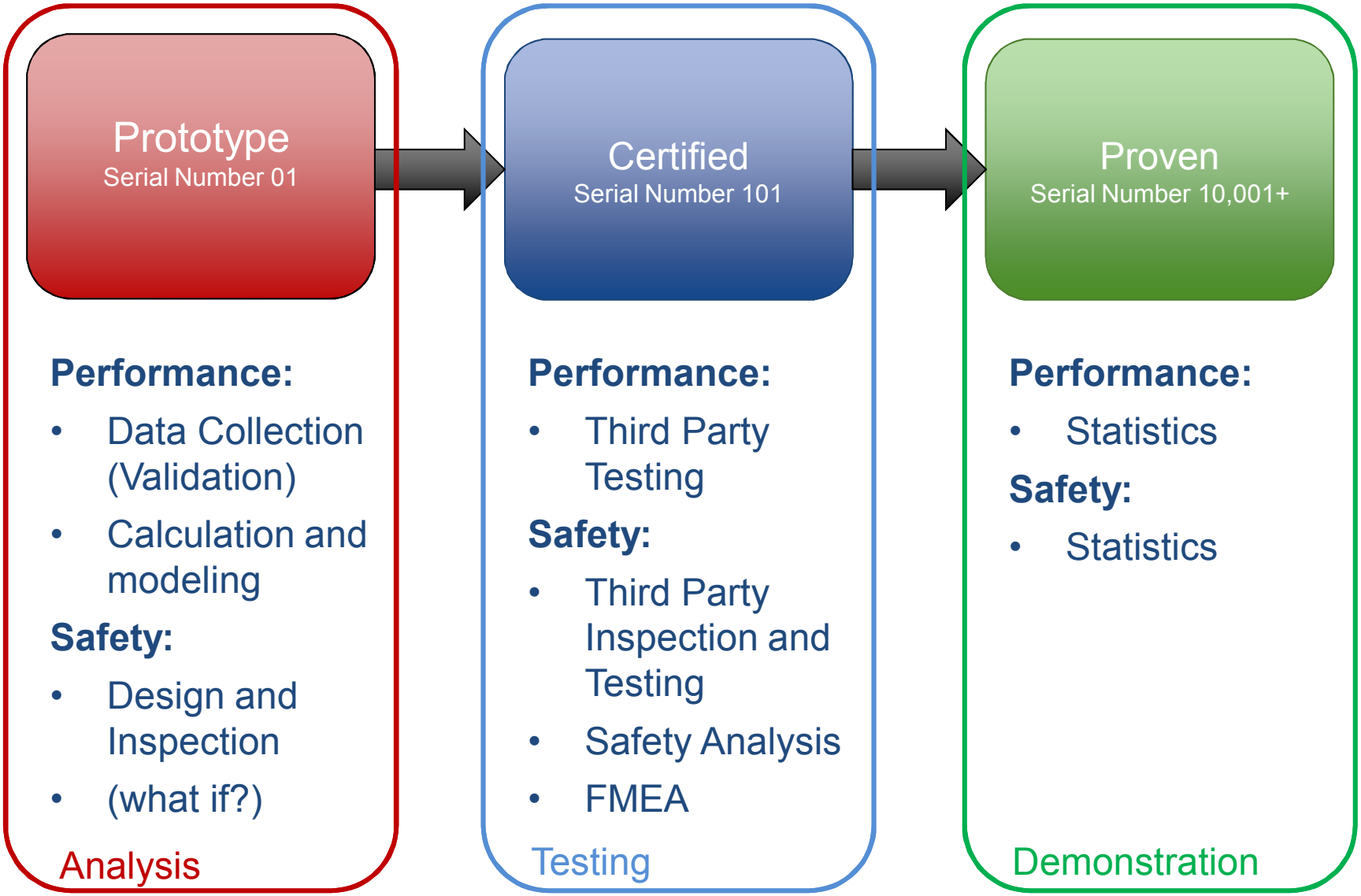
Stages of Development

Credit: Dan Cass, GCube (NaatBatt 2014)



Energy Storage Test Pad and Energy Storage Analysis Laboratory

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Providing reliable, independent, third party testing and verification of advanced energy technologies for cell to MW systems

- Testing capabilities for supercapacitors, primary and secondary storage from cells to MW systems.
- Testing programs are designed to evaluate and validate battery performance.

Testing capabilities include:

Cell Testing

- 60 cell and battery testing channels:
  - 72 V 1000 A Bitrode (2 Channels)
  - 60 V 200 A Arbin (2 Channels)
  - 36 V 100 A Bitrode (3 Channels)
  - 36 V 25 A Bitrode (5 Channels)
  - 2 V 10 A Arbin (48 Channels)

72 V 1000 A Bitrode (2 Parallel Channels)

System Testing

- Scalable from 5 KW to 1 MW, 480 VAC, 3 phase.
- 1 MW/1 MVAR loadbank for either parallel microgrid, or sires UPS operations
- Subcycle metering in feeder breakers for system identification and transient analysis.
- Can test for both power and energy applications

Energy Storage Test Pad (ESTP) (April 2010)

Standard Performance

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- **IEEE 1679-2010** Recommended Practice for the Characterization and Evaluation of Emerging Energy Storage Technologies in Stationary Applications
  - Energy rating
  - Power rating
  - Cycling capability
  - Energy efficiency
  - Self-discharge characteristics
  - Storage life and Calendar life
- **DOE Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems**
  - Pre-standard to be used by future standards bodies
  - Standardized duty cycles for peek shaving and frequency regulation services.

Standard Safety

"Safety is a system property, not a component property." Nancy Leveson, April 2000

- **IEEE 1679-2010**
  - Safety design approach
  - Safety compliance tests
    - DOT, IATA, IMO, ASTM, UL, CSA, IEEE, ISO, IEC
  - Marking
  - Safety conditions
  - Abuse tolerance
  - Fault tolerance
- **IEEE 1187**
  - Valve Regulated Lead Acid (VRLA) Specific
  - Good place to start for any technology

Recommendations

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1. Put together a packet of the standards your system complies with. Include the relevant testing data and certification letters.
    1. Normally a list of 2-5 system level standards
2. Put together a packet of the standards your sub-systems and components comply with. Include everything from the wires, to the metal siding
    1. Keep this in a series of spreadsheets and folders to stay organized
    2. 50 – 2,000 lines depending on the complexity of the system
3. If you find anything that doesn't have a standard or it complies with the wrong standard, replace it in your design if possible. (Also watch out for counterfeit electrical parts).
4. Take these packets with you to testing organizations and costumers
    1. This cuts past the "Trust" question
5. Get your systems tested
    1. If you are working on a prototype, get a third party analysis
    2. If you are working on a product, get certified
6. Don't rely only on standards to dictate system safety

The NEC has been learning from electrical accidents since 1897.

How long has your energy storage technology been around?

Contact

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“For me, I am driven by two main philosophies: know more today about the world than I knew yesterday and lessen the suffering of others. You'd be surprised how far that gets you.”

— Neil deGrasse Tyson