WattTower™

- Goals
  - Demand charge reduction
  - Small footprint and high seismic
  - Low to medium volume production
  - Certify to UL 1973 and UL 1974

- Use Cases
  - Price arbitrage
  - Demand charge reduction
  - PV smoothing/load shifting

- Design Features
  - Parallel modules for reduced BMS cost
  - Non-serviceable concept
    - SNT fully replaces tower with new
  - Side mountable inverter and switchgear

How do we know a battery is safe?

- Understand failure modes
  - Lithium plating
  - Dendrite formation
  - SEI overgrowth
  - Gas formation
  - Corrosion
  - BMS fault
  - Inverter fault

- Understand failure modes mechanisms
  - High voltage
  - Low voltage
  - High temperature
  - Low temperature
  - High charge/discharge current
  - Environmental controls
  - Hardware/software failure

Levels of Safety

- Safety is critical
- Protect grid and ESS
  - Battery system self-protects
  - Inverter system self-protects
  - System Software layer protect
  - Managing Software layers notify

Grid Fault (Low Voltage) Emulated in Testbed – Inverter Safety shuts down in 3 cycles (based on ORNL config)
Life Cycle Management of Advanced Batteries

Non-Technical Observations

Albuquerque, March 2019

Dirk.spiers@spiersnt.com
Half Full
Safety is Many Things

- Support
- Core Collection
- Disposal
- Secure Supply of Materials
Many Kinds of Batteries

- Chemistries
- Quality
- Price
- Objective

Batteries are not all the Same
Automotive: Not your typical battery
Automotive: Not Your Typical Battery

Samsung’s Massive Galaxy Note 7 Recall Brings Battery-Maker Into Focus
• Battery 5R (Life Cycle Management)
  o Remanufacture
  o Refurbish
    o (extending economic life)
• Logistics & Storage
• Repurposing (Second Life)
  • Energy Storage Systems (ESS): Grade, Bin, Design, Manufacturing
• Recycle 2020
  • Cathode to Cathode
SNT: Cradle to Cradle, Closed Loop

- RePurpose
- C2C Recycling
- Core Recovery
- Reverse Logistics
- Refurb / Reman
- PreCycling
- Manufacturing

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A Funnel of returned Battery Packs

- USA & Europe
- Handling 2000+ packs a month
- (Test) Data of over 14,000 returned Battery Packs
- Every detail is tracked: location, vin, error code, SOH, SOC, Resistance, torque,….
- 4TB of data, growing every day
- Provenance is Important
Stuff fails

- Sensors
- Bus Bars
- Electronics
- Seals
- Electrochemical (degradation)
- Accidents
Automotive ≠ Consumer

- Need for different regulations
- IFC
- Testing & Certifications
- Shipping
Horses for Courses
• Shippers starting to drop Li-ion shipments

• Consumer batteries are threatening rest of the industry

• Regulations are useless if you have unscrupulous players
• Are we making it too difficult?
• Are they out of reach for smaller companies?
• Is it too expensive?
• Do we scare companies away?

Safety needs to be accessible
Unintended Consequences?

• What about Second Life?
• UL 1974: Will it help, will it kill?
• Can we afford to let go of all these Batteries?
• Extending Economic Life is important

Need to see the bigger picture
Second Life

• Only difference with First Life is retained capacity

• It is proven, it works

• Grading and Provenance are very important

• For the rest it is the same:

  • Engineering, Architecture, Understanding Usage profile, FMEA’s, Control Plans, Communications, Markings, Thermal Loads
• Are we hiding behind them?

• Hypocrisy of the (Insurance) Industry…..

Practical Safety is as Important as Adherence to Regulations
Typical event time line
Core Recovery is Vital
Our Goal (Dream)

A Closed Loop System though an integrated Business Model

Keep Batteries under control before accidents happen
In Closing

- Thanks to the Industry and National Labs
- Safety means many different things
- Different Packs need different approaches
- Need for a streamlined wholistic approach
- Safety needs to be accessible to everyone
- But is is good to be paranoid