SCE's Evolving Approach to BESS Safety

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Southern California Edison in 2020

• 134 years of service
• 50,000 square mile service territory
• 15 million residents
• 5 million customer accounts
• 24,000 MW system peak
• 40% energy from carbon-free sources

• More than 100,000 miles of distribution lines
• 1.4 million electric poles
• 725,000 transformers
• And energy storage...

• Search “Edison Pathway 2045” to see where the state is headed

Supporting California’s 2045 carbon neutrality goal
BESS on SCE’s Grid

- **Drivers**
  - California environmental direction
  - CPUC energy storage & microgrid decisions
  - Grid modernization & resiliency

- **Types of deployments**
  - Merchant-owned BESS
    - Energy Storage as a Service (“ESSaaS”)
    - Provide market services and distribution capital deferral
  - Customer-owned BESS
    - Behind-the-meter (BTM)
    - Commercial demand reduction, peak shaving
    - Residential backup power

- **SCE-owned demonstration and pilot BESS**
  - Enhance learning and understanding
  - Capital deferral
  - Distribution reliability
  - Preferred (renewable) resources penetration
  - Microgrids

- **SCE-owned production BESS**
  - Build one-off projects in production environment when special needs arise (e.g., third-party market inefficiencies/failure to meet certain needs)

- **SCE-owned BESS experience**
  - **Timeframe:** 1980s – present
  - **Applications:** Grid reliability, market operation
  - **Purposes:** Demonstrations, pilots, production operations
  - **Locations:** BTM (residential, commercial), IFM (12 kV, 66 kV)
  - **Power:** 4 kW – 20 MW
  - **Energy:** 10 kWh – 80 MWh
  - **Chemistries:** Pb, NaS, NaNiCl, li-ion (various)
  - **Battery manu.:** Exide, NGK, A123, LG Chem, Samsung, Panasonic, GE, Tesla
  - **Integrators:** Bechtel, S&C, A123, NEC, LG Chem, Princeton, GE, Tesla
  - **Partnerships:** EPRI, DOE, CPUC

1. Field deployments only (excludes lab-based systems). Includes decommissioned systems.
Nice mullet

Who wears suits to job sites anymore?

Nice gold buttons
Two broad categories to address BESS safety

1. Prevent a problem in the first place (offense)
2. Mitigate a problem when it appears (defense)
1. Prevent A Problem in the First Place

**Battery OEMs & Sys. Integrators**
- Cell/module design and manufacturing process
- Robust BMS that monitors voltage, current, temperature
- BMS, PCS, and other subsystems integrated through site-level controller

**SCE**
- Requirements and specifications around design features and behaviors, incl. industry standards
- Extensive lab testing at the cell, module, rack, and mini system levels
- System Acceptance Test (SAT) in the field (separate from and after system integrator’s commissioning process)

Traditionally, battery manufacturers, system integrators, and SCE very focused here
Case Study: Tehachapi Storage Project Lab Testing

- 8 MW, 32 MWh
- One of the first multi-MW + multi-MWh BESS to use li-ion batteries
- First generation stationary li-ion battery + BMS technology
- Tested cells, modules in lab
- Validated full hardware, software integration on lab “mini system” before operating full system in field
- 11 rounds, 9 months of testing, each with corresponding BMS software/firmware updates
- Enabled full system to safely and successfully complete acceptance testing in just two weeks
2. Mitigate a Problem When It Appears

**Traditional practices – usually present**
- Component isolation/system trip
- Cell/module/rack, PCS, system-level fusing/protection
- Smoke detection
- Gas-based fire suppression
- On-site audible and visible alarms
- Remote alarm and condition monitoring

**Traditional practices – sometimes present**
- Ground fault protection
- Interlocked/cross-zoned smoke, heat detectors
- Significant cell/module separation
- Anti-propagation modules

Traditionally, battery manufacturers and system integrators are active here as well, but as we’ve seen, there’s room for improvement.
Enter New (and Old) Codes and Standards

**But first, some things about CA**

- State adopts International Fire Code (IFC) as California Fire Code (CFC)
  - Instead of adopting NFPA 1
- Something like NFPA 855 has no effect unless and until incorporated into IFC, then adopted into CFC
  - Plus, 855 doesn’t have a scope
- State adopts National Electrical Code (NEC) as California Electrical Code (CEC)
  - Scope has utility exemption
- National Electrical Safety Code (NESC) not adopted in CA
  - State has its own utility codes: GO95 (OH) and GO128 (UG)

**2016 CFC July 2018 Supplement**

- Adopted 2018 IFC Section 1206 into CFC Section 608, applies to BESS
- No utility exemption
- Good requirements; might have prevented some of the significant industry events we’ve seen recently
- Array spacing? Not practical.
- Full-scale fire and fault condition testing
- Hazard mitigation analysis
- Could identify need for deflagration vents, gas detection + intrinsically safe ventilation, water-based suppression

**2018 IFC/2019 CFC**

- Effective in CA this year
- Section 1206 applies to BESS
- Scope has utility exemption

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So, what do you do when NFPA 1 and NESC aren’t adopted in your jurisdiction, 855 doesn’t have a scope, CFC and NEC provide exemptions, and internally, BESS are not yet “standardized” grid equipment?
Reference the Industry-consensus Codes, Anyway!

- Li-ion BESS technology maturing
- System integration still leaves something to be desired, but subsystems are becoming more off-the-shelf
- SCE no longer conducts extensive lab testing prior to deploying systems in field
- Do you rely on subsystem OEMs and integrators to provide robust BMS and safe systems?
  - Yes and no
- Rely on OEMs and integrators to tackle offense (prevent a problem in the first place through unique design)
- Rely on codes and standards to tackle defense (mitigate a problem when it happens)

**Current SCE Approach**

- Formed cross-company BESS safety working group (T&D + Generation)
- Performing third-party risk assessments of all operational BESS; comparing to current code (NFPA 855 and CFC 1206)
- Developing internal design and operation standards
- Participating in EPRI BESS Fire Prevention and Mitigation Supplemental Project, contributing four BESS sites
- In-flight projects started under “2018 CFC” are going through permitting process
- New projects under 2019 CFC will require code compliance, anyway
  - If AHJ can’t/won’t go through permitting process, integrator must still perform required testing and analysis, and hire qualified engineering consultant to review design against code
Thank you