Safety First with Kentucky’s Largest Lithium-Ion Battery

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LG&E and KU Own and Operate Kentucky’s largest solar farm and largest lithium-ion battery.
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Top 20 Action Items Disclaimer

• We are not lithium-ion battery or fire safety experts.

• We are not endorsing any action, product, or provider.

• Safety is our top priority, and we did the best we could to take quick action to ensure our system was safe.

• This presentation explains what we did, for better or worse, and is not necessarily what anyone else should do.

• Top 20 action items are not in their exact order of sequence.
# 1: Stopped battery operation pending investigation and site audit after fires in Arizona
# 2: Danger Signs make clear that this is a lithium-ion battery, provides contact information, and warns “Stay Back 75 ft. Allow to burn.” Cost: $500, 24-Hours
# 2: Danger Signs make clear that this is a lithium-ion battery, provides contact information, and warns “Stay Back 75 ft. Allow to burn.” Cost: $400, 24-Hours
# 3: Establish clear safety perimeter and keep gates closed.
# 4: Realtime Alarm Monitoring & Notification

My iPhone on a Sunday Morning 😊
# 5: Installed Emergency Stops Outside at the entrance to the site. Tested many times.
# 6: Installed Emergency Stops in nearby plant control room with dedicated fiberoptic & 24/7 staffing.
# 7: Developed Emergency Response Plan and communicated it to staff and first-responders.
# 8: **Temperature Alarms** and Limiting Battery Operation by Module & Container Temperature

<table>
<thead>
<tr>
<th>2019-10-21 11:05:59</th>
<th>Rate: 76 kW</th>
<th>SOC: 14%</th>
<th>Mode: Other</th>
<th>Ambient 21°C</th>
</tr>
</thead>
</table>

**Container 1**
- 21°C

**Container 2**
- 17°C
# 9: Temperature Alarms and Limiting Battery Operation by Module & Container Temperature

- Normal battery operations when container temperatures are between 17° and 22°C and module temperatures are between 17° and 27°C.
- 75% Derate when Instantaneous Maximum Module Temperature is greater than or equal to 28°C
- Emergency stop when max module temperatures are greater than or equal to: 30°C
- Emergency stop when battery container temperature are greater than or equal to 25°C.
# 10: Limited State of Charge to 10% to 90%. Operators are now unable to fully-charge, or discharge battery.
# 11: Manufacturer Inspection by LG Chem and Firmware Update
# 12: Safety Audit by Warner ESS and Benson Fire
# 13: First-Responder Safety Training led by Warner ESS & Benson Fire Technologies

E.W. Brown operators in the training building
# 13: First-Responder Safety Training led by Warner ESS & Benson Fire Technologies
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# 14: Installed Li-on Tamer Off-Gas Detection
# 15: Site Camera Installation and Monitoring
Other Actions Taken

# 16: Cross-Trained Engineering Staff. Went from 1 battery operator to 6 operators.

# 17: Tested/Re-Certified Fire Alarms and FM200 Fire Suppression System.

# 18: Vegetation Management around battery site

# 19: Removed flammable boxes and equipment stored in battery containers.

# 20: Enabled man-door sensor to emergency stop operations if a human entered the battery container.