Board Discussion Item

Topic: BUS FIRE RISK WITH OUR BUSES ON ORDER
Context: Neighboring district electric bus fire (NMC battery); district buses use LFP batteries

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1. Background and Purpose

A neighboring school district recently experienced a fire involving an electric bus equipped with a Nickel Manganese Cobalt (NMC) lithium-ion battery. This incident has raised understandable concerns regarding the safety of the electric buses our district has already purchased and is awaiting delivery.

The purpose of this item is to brief the Board on:

- The root causes of electric bus battery fires
- The key safety differences between NMC and Lithium Iron Phosphate (LFP) battery chemistry
- Why the batteries in our ordered buses present a lower fire risk relative to the incident in the neighboring district
- Ongoing best practices and mitigation measures used by manufacturers and districts

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2. Why Electric Bus Fires Occur (High-Level Overview)

Electric bus fires—while rare—are typically associated with thermal runaway, a chain reaction inside lithium-ion batteries caused by one or more of the following factors:

- Manufacturing defects or internal cell failures
- Physical damage (e.g., collision, vibration fatigue)
- Overcharging or charging system failures
- Electrical connection or wiring faults
- External heat exposure

When thermal runaway occurs, batteries can release heat, flammable gases, and in some cases flame. Importantly, the underlying battery chemistry significantly influences how

likely this is to happen and how severe it becomes. [sunlithenergy.com], [electrichy...nology.com]

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3. Key Difference: NMC vs. LFP Battery Chemistry

A. NMC Batteries (Neighboring District)

Nickel Manganese Cobalt (NMC) batteries are commonly used in long-range electric vehicles because of their higher energy density. However, that benefit comes with trade-offs:

- Lower thermal runaway threshold:
  Thermal runaway can begin at approximately 150–210°C
- More rapid and intense fire behavior once ignited
- Greater gas release and flame intensity
- Higher reliance on complex battery management systems (BMS) and cooling controls

Research and testing consistently show that NMC batteries are more prone to thermal runaway under abuse conditions compared to LFP chemistry. [sunlithenergy.com], [electrichy...nology.com]

B. LFP Batteries (Our District)

Our district's electric buses are equipped with Lithium Iron Phosphate (LFP) batteries, a chemistry increasingly favored for public transit and school transportation.

Key safety characteristics include:

- Much higher thermal runaway threshold:
  Typically 270–300°C, providing a far greater margin before failure
- Slower heat propagation between cells
- Lower peak combustion temperatures
- Reduced likelihood of violent flame or explosion
- No cobalt or nickel, which reduces toxic byproducts

Because LFP batteries are more chemically stable, they are widely regarded as the safest lithium-ion option for large fleet and public-use vehicles, including school buses. [sunlithenergy.com], [eureka.patsnap.com]

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4. Comparative Safety Summary (Board-Level)

Safety Characteristic	NMC Battery	LFP Battery
Thermal Runaway Onset	~150–210°C	~270–300°C
Fire Severity	Higher	Lower
Heat Release Rate	Faster & more intense	Slower & less intense
Toxic Smoke Risk	Higher (nickel/cobalt)	Lower
Industry Use	Long-range EVs	School buses, transit fleets
Overall Safety Margin	Moderate	High

(Source synthesis from multiple peer-reviewed and industry safety studies) [sunlithenergy.com], [electrichy...nology.com], [eureka.patsnap.com]

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5. Additional Safety Layers in Modern Electric Buses

Beyond chemistry, electric school buses—including ours—incorporate multiple redundant safety systems, such as:

- Advanced Battery Management Systems (BMS) that monitor temperature, voltage, and current in real time
- Automatic shutdown and isolation of battery packs when abnormal conditions are detected
- Reinforced battery enclosures designed to contain thermal events
- Manufacturer-specified charging protocols and temperature controls
- Fire detection and mitigation strategies recognized by transit authorities

Industry reviews show that, despite occasional high-profile incidents, electric buses experience fewer fires per mile traveled than diesel buses overall. [mdpi.com], [eschoolbus...lliance.ca]

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6. Key Takeaways for the Board

- The fire in the neighboring district involved an NMC battery, which has different and higher inherent fire risk characteristics than the LFP batteries in our fleet.
- LFP battery chemistry is widely recognized as more thermally stable and safer, particularly for school and transit applications.
- Our district's buses align with industry best practices for public-use electric vehicles.
- Electric bus fires remain statistically rare, and LFP-equipped fleets show lower severity outcomes when incidents do occur.