



CAMPUS FIRE SAFETY CODE TALK

Campus Fire Safety e-NewZone

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Energy Storage Systems and Fire Safety

For those of you who are unfamiliar, energy storage systems (ESS) are devices that can store energy for use as electrical energy at a later time. They are used in residential, commercial and utility applications listed below. These storage systems are important because they provide resiliency and reliability to our aging electrical grid system.

The most popular form of ESS are batteries and in particular rechargeable lithium ion batteries. Other types of ESS include the following:

1. Flywheels
2. Pumped Hydro
3. Ultra Capacitors
4. Compressed Air
5. Thermal Storage (molten salts)

But I will concentrate on batteries for this article. Lithium Ion batteries are commonplace in today's consumer electronics, usually found in your laptops, phones and even electric and hybrid vehicles. They are used in such a variety of applications because of their high energy density.

What do we use Energy Storage Systems for?

One huge application of Energy Storage Systems is to supplement renewable energy such as solar panels or wind turbines. The use of ESS allows any excess unused power generated to be stored for later use. This is important because it means you can use electricity from renewable power generation methods any time and not just when the



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sun it out or when the wind is blowing. Estimates have shown that residential solar systems will regularly include energy storage in the future.

When looking at what drives most industries forward one word comes to mind, money, and ESS is no different. A big driver of recent ESS installations is the cost saving benefit. For those of you who are unaware, electric companies vary their rates throughout the day based on demand. ESS allows a user to shift where their electricity comes from by drawing power from the system during the higher cost daytime hours then recharging during the lower cost nighttime hours. This way you are always paying the lower rate for electricity.

One last application is using ESS for Backup Power, which is a power supply used to provide alternating current power to a load for some period of time in the event of a power failure. This is often used in hospitals, data centers and homes

ESS Hazards

So that was a little background as to what ESS are and how they are used but along with this great technology comes some unique hazards.

1. *Thermal Runaway.* Thermal Runaway is a term used to describe the rapid and uncontrolled release of heat energy from a battery cell. Thermal runaway occurs when a battery creates more heat than it can dissipate which can result in a battery fire or explosion. Due to the configuration of batteries thermal runaway can often spread to adjacent cells, batteries and materials, causing fire to spread rapidly. Also, these ESS are often incased in many layers of protection and the visible signs of thermal runaway can be hidden in its early stages.
2. *Stranded Energy.* Something that is particularly tricky about Energy Storage Systems is that they often do not dissipate all of their energy when they are involved in a fire. This can be dangerous for the first responders who are navigating a fire scene. Once the fire is out that doesn't mean the shock hazard is gone.
3. *Re-ignition.* ESSs has an uncanny ability to reignite after the fire is thought to be extinguished. This is because of the stranded energy not dissipating in a



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fire, it can be cooled and the fire thought to be extinguished but if it doesn't completely stop thermal runaway then the temperature will continue to increase and can reignite hours or even days later.

4. *Off-Gassing*. While involved in a fire, battery energy storage systems often let off different flammable and toxic gasses. These are dangerous while both fighting the fire and while cleaning up afterwards. Different ventilation techniques must be considered when installing these systems.
5. *Toxic Runoff*. Along with toxic gasses, while a first responder is putting out the fire the water can create a toxic runoff that can effect surrounding areas. This is still a challenging problem to solve with no clear answer.
6. *Lack of Information*. There are a limited number of publicly available information on how these ESS behave in a fire. The industry is looking to the future for more large scale fire tests to be conducted.
7. *Variety of Types*. There are many different types, sizes and chemistries of energy storage systems that it is hard to have a "one size fits all" approach to fire safety.

Extinguishment

One popular myth about extinguishment is that you cannot put out a lithium ion battery fire with water. This conclusion is usually jumped to because pure lithium metal is reactive with water. Lithium ion batteries, however, do not have pure lithium in them and are made with lithium salts that can be extinguished with water safely.

The unique hazards listed above can make extinguishment of Energy Storage Systems quite difficult. A recent study by DNVGL and Con Edison recommend a two tiered approach to fire extinguishment with a total flooding gaseous agent to control a fire early on that is followed up by ventilation and copious amounts of water being added to the fire if the fire gets too hot for the gaseous system to cool.

With the advancement of technology and the creativity of applications I do not see ESS going away anytime soon. With ESS here to stay the NFPA is working on the



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development of a Standard to address many of these safety issues, NFPA 855, *Standard on the Installation of Stationary Energy Storage Systems*.

If you need more information on regulations regarding ESS you can look into NFPA 70, Article 706 and NFPA 1 Chapter 52.



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