PHOENIX REGIONAL STANDARD OPERATING PROCEDURES	
Policy Name: **BATTERY ENERGY STORAGE SYSTEMS**	Policy Number: **M.P. 205.20A**
This policy is for internal use only and does not expand an employee's legal duty or civil liability in any way. This policy should not be construed as creating a duty to act or a higher duty of care, with respect to third party civil claims against employees or the Phoenix Fire Department (PFD). Remedies for violations of this policy, if proven, are limited to administrative disciplinary action against PFD employees.	
Related Policies: 205.20, 202.19, 202.19A	
Other Reference:	
Date Implemented: 04/2023-R	Review Date: 04/2028

Battery energy storage systems (BESS) pose unique hazards to firefighters. With recent advances in battery technology and renewable energy, lithium-ion batteries have become one of the leading solutions for large-scale energy storage. Buildings or facilities containing a BESS may not have markings that specifically identify the presence of these systems. Markings may only indicate a general electrical hazard is present. An independent facility containing a BESS may appear to be a steel building resembling a shipping container or other smaller enclosures. These facilities may be found anywhere. They may be stand-alone or incorporated in another structure, including residential areas. The use of BESS to support the electrical grid is becoming standard and these systems can be found throughout our communities.

The types of catastrophic failures that can occur in all battery systems are amplified by the size and scale of the BESS. Larger systems contain more energy and have the potential to create large volumes of toxic, flammable gases that can become explosive when contained. The hazards are dependent on the design of the BESS, characteristics of the compartments containing the BESS, and levels of fire protection systems in the structure.

In smaller residential settings, a lithium-ion battery module may undergo thermal runaway as a result of exposure to a heat source unrelated to the battery. For example, a battery module located in or near a garage that is exposed to a car fire can be damaged and has the potential to have a thermal runaway event. This may cause it to liberate toxic, flammable gases and lead to a potentially high energy ignition. Fires involving Lithium-Ion battery have a very high heat release rate and present extinguishment challenges.

Stranded energy is residual energy within a lithium-ion battery or BESS. This presents a significant fire, electrical shock, and/or explosion hazard to firefighters. The severity of the hazard is in direct relationship to the state of charge in the battery. Assume they are charged.

BESS failures can occur for a variety of reasons including but not limited to:

1. Thermal abuse (external temperatures)
2. Physical/mechanical damage
3. Electrical abuse (over-charging or repeated excessive charging rates)
4. Environmental impacts (electrical surge, lighting, etc.)
5. Internal faults within the battery cell
6. Other electrical faults or system failures

RESPONSE TO BATTERY ENERGY STORAGE SYSTEMS

- BESS must always be considered energized. Firefighters should exercise extreme caution when dealing with BESS and all energized electrical equipment.
- Request utility company to respond.
- Request a 3&1 or greater hazardous materials response.
- **Do not make entry or approach BESS building or compartment. Introducing fresh air may result in a deflagration.**
- Isolate the area. Recommended initial evacuation distance is 150 feet. Do not enter the fenced area. The exception to this is a savable life/known rescue.
- **Be aware of explosion potential and off-gassing of hazardous materials. White colored smoke is a good indication of hazardous off-gassing.**
- Place apparatus in a safe location away from BESS and overhead power lines.
- Protect exposures.
- DEFENSIVE FIREFIGHTING, water streams are the preferred agent for response to lithium-ion battery fires (Lithium-ion is not water reactive).
- If a fire has not developed and only smoke is visible, take a defensive stance toward the system and be prepared to apply water spray to exposures.
- If a fire develops, take a defensive stance toward the burning unit and apply water to neighboring battery enclosures and exposures.
- Maintaining a safe distance from the unit involved (large commercial systems, at least 150').
- Response crews should allow the battery to burn out. Water should be applied to adjacent battery enclosures and exposures (building).
- The Incident Commander will make the ultimate determination regarding hazard mitigation. The hazard mitigation plan should be developed in partnership with the utility representative and/or responsible party.
    - Through this careful approach, hazardous materials technicians may take calculated steps to mitigate the hazard.
    - Depending on the BESS type and size, mitigation steps may include identification of the hazard, separating it from electrical supply (i.e., electrical grid or photovoltaic system), ventilation, and cooling.
- Firefighters must wear full personal protective equipment, including SCBA with face-piece.

- If identified shut off the unit/system by operating any visible disconnects or E-stops (shutting off the disconnect does not remove the energy from the battery). To isolate any PV system and ESS in an emergency, multiple disconnects may need to be shut off.
- Lithium-ion batteries that are in thermal runaway or off gassing will create hazardous flammable and toxic atmospheres.
- Firefighters must stay out of the vapor cloud / smoke.
- Due to construction of the unit, thermal imaging cameras or infrared temperature sensors may not give true thermal conditions. But can be used to identify trending temperatures.
- Hazardous failure of batteries can occur from physical damage, exterior fire, or an internal malfunction of a cell. Smoke, popping or hissing sounds from an ESS system can be an indication of a hazardous condition. When batteries or cells enter thermal runaway, there is typically a period of smoke (may be under pressure). The smoke is flammable and may ignite at any time.

Responding to a Venting ESS Product

- Evacuate the area. Never open any doors or remove panels to ESS units.
- Maintaining a safe distance from the unit involved (large commercial systems, at least 150').
- Contact vendor-specific technical support for assistance including battery management system (BMS) data.
- For residential units that are located inside a dwelling unit or garage, the space should be properly ventilated with charged handlines in place (open garage door only if safe to do so).
- Maintain a safe distance from the ESS and monitor visually for signs of thermal runaway. A remote FDC may be present on larger commercial or utility ESS to support a sprinkler system inside the enclosure.
- Each manufacturer will have a recommended time for a battery pack to cool down. This can be near a full work cycle of 12 hours or more.
- Defensive firefighting, water spray is the preferred agent for response to lithium-ion battery fires (Lithium-ion is not water reactive).
- If a fire has not developed and only smoke is visible, take a defensive stance toward the system and evaluate the need, and practical ability to safely apply water on exposures.
- If a fire develops, take a defensive stance toward the burning unit. Evaluate the need and practical ability to safely apply water on exposures.
- Response crews should allow the battery to burn out. Water should be applied to adjacent battery enclosures and exposures.

Lead Acid

Lead Acid batteries are also used as BESS. These systems pose chemical burn hazard, inhalation hazard and the risk of contaminated runoff. If found upgrade the assignment to a hazardous

materials assignment and operate electrical disconnects. Utilize full PPE and direct water application from 40 feet can be applied to control a fire.

Lithium Ion

Lithium-ion Batteries can produce heat, toxic and flammable gases, and contain stranded energy.

RESIDENTIAL BESS

BESS are typically found as part of a modern photovoltaic system but may be present even in the absence of a PV system. BESS systems can be lithium-ion battery or lead acid battery based. Each of these poses a potential for toxic exposure, fire and thermal burns, and chemical exposure. Refer to Photovoltaic MP 205.20B.

Emergency Procedures for Residential BESS systems.

If a residential BESS system is identified the following steps shall be taken:

- Notify Command
- Upgrade assignment to a 3-1 Hazardous Materials Response, isolate the area.
- It is critical to operate electrical disconnects if it is safe to do so. This will isolate the battery system.
    - After operation of the electrical disconnects it is important to recognize that the batteries will still pose an electrical hazard due to the stranded energy that they contain.
- Crews will wear full PPE and with SCBA Face Piece in place
- A charged hose line will be in place.
- Isolate the area surrounding the residential BESS a minimum of 40 feet. Hazardous Materials crews will set a hot zone.
- Avoid parking apparatus directly in front of the house
- Evaluate if the Battery Pack has been impacted by the initial fire or other event
- Contact vendor-specific technical support for assistance including BMS data.
- Consider a monitoring / cooling period of 12 hours in which the battery is monitored for signs of thermal runaway. This is a passive cooling period without water being applied.
    - Direct application of water is ineffective for cooling to prevent a thermal runaway due to the construction of the battery pack.
    - Temperature readings should be taken as early as possible and repeated at regular intervals (10 minutes) to identify trends. Is the battery getting hotter or beginning to cool?
- Contact the RP. They will be informed that they must contact the manufacturer for technical support.
- Command Officers shall make attempts to notify the building owner or occupant that there is a risk associated of a secondary event including fire as a result of continued power generation from the PV panels.

- Command or their designee may make notification over the radio that this notification has been made.
- Water application is the recommended method of firefighting.
- Protect exposures through defensive firefighting.
- The Responsible Party must arrange for proper disposal and cleanup.

Note: All BESS contain quantities of hazardous materials. In the event of an emergency with a BESS, a toxic environment may be created that is not visible. Metering of the environment by hazardous materials crews is necessary as is the usage of full personal protective equipment.