Guidance for Development of DERST Training Props

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1. Introduction

As the use of distributed energy resources (DERs) grows, the fire service must adapt to new challenges posed by technologies like **Energy Storage Systems (ESS)**, **Electric Vehicles (EVs)**, and **Solar Panels**. These systems, while beneficial for reducing energy consumption and promoting sustainability, present unique hazards during emergency situations, including fire suppression, hazmat responses, and rescues.

This guide is designed to provide prop developers with design and component benchmarks, ensuring that firefighters have access to DERS Training Props that reflect the key components they have learned about. Aligning prop design with previously learned knowledge will ensure firefighters are prepared to handle these technologies safely and effectively during real- world incidents.

This Guide includes Key Focus Areas for the Design of DERS Props, highlighting important design themes.

The Guide also includes Critical Elements to be included in the design of the training prop, highlighting key elements firefighters have been trained on.

2. Training Props for DER Field Evolutions

2.1: Obtaining Props

Realistic training props are essential for effective DER evolutions. There are several options to obtain props:

- Surplus or Decommissioned Systems: Coordinate with utility companies, solar providers, or EV manufacturers to acquire outdated or damaged equipment.
- Mock-Up Props: Build mock-ups of ESS, EVs, or PV systems using non-functioning components. These can be constructed in training grounds to simulate real systems.
- Commercial Training Providers: Some companies specialize in providing fire training props for DER, such as electric vehicle simulators, solar panel roof simulators, and battery fire training props

2.2: Use of Actual DERS

Using actual DERS sites/equipment as training props requires extensive pre-training surveys to ensure all hazards have been removed/addressed.

The owner and knowledgeable party must be engaged prior to the training, with the knowledgeable party physically present during the training.

An advantage of using actual DERS locations for training is that it is the real-life environment where DERs are installed, and the fire service may respond to:

- ESS Training: Industrial parks or commercial sites with large battery systems.
- EV Training: Municipal facilities or partnerships with local EV dealerships or repair shops.
- Solar Panel Training: Buildings with rooftop solar or dedicated solar farms.

2.3: Coordination with Stakeholders

Coordinate with key stakeholders such as:

- Utility Companies: Partner with local utilities to provide access to live or simulated systems for training purposes.
- EV Manufacturers and Dealerships: Engage with automotive companies for access to electric vehicles and their components for training.
- ESS Providers: Work with energy storage system companies to develop hands-on training with real or mock ESS setups.

3.General Safety Precautions

Safety is the top priority with any fire service training prop. DERs technologies present the following real-world hazards:

- Electric Shock Hazards: High voltage and stored energy present in ESS, EVs, and solar panels.
- Thermal Runaway: Especially in lithium-ion battery systems, where a failure in one cell can lead to cascading failures.
- Toxic Gases: Battery fires can release hazardous gases like hydrogen fluoride (HF) and other chemicals.
- Arc Flash: High voltage systems can cause arc flashes that pose serious risks to personnel.
- Fire Behavior: Fires involving ESS and EV batteries behave differently from traditional fires, requiring specialized tactics.

DER's training props should be designed/constructed to ensure fire service learners are not exposed to any of these hazards and eliminate the risk of physical harm and injury.

But the actual DER's prop should allow the fire service learner to gain an awareness of these hazards, through realistic design/simulation.

If a decommissioned DERS is being used as a training prop, there must be a thorough inspection of it before use, ensuring the above listed hazards have been eliminated.

Personal Protective Equipment (PPE)

Prop designers must remember in real DERS incidents, fire service personnel will be wearing appropriate PPE for DER operations, including:

- Full structural firefighting gear, including SCBA, for all evolutions involving fire.
- Personal protective equipment for emergency medical calls; gloves, masks,
- Personal protective equipment for confined space/technical rescue operations

Prop designers should consult with the relevant NFPA PPE Standards to gain an understanding of the different ensembles and consider them during prop design.

4. BESS Training Props Key Focus Areas & Critical Elements

4.1: Objective: Through design of a DER Training Prop, allow firefighters to identify, isolate, and mitigate risks associated with energy storage systems, including lithium-ion battery banks and other high-energy batteries.

4.2: Key Focus Areas for DERS/ESS Prop Design:

- System Identification: identify different types of ESS systems (e.g., lithium-ion, flow batteries).
- Fire Behavior: Simulate ESS thermal runaway incidents to demonstrate the difficulty of extinguishing these fires.
- Shutoff Procedures/Energy Isolation: Hands-on training with ESS disconnects and emergency shutoff protocols.
- Ventilation and Hazmat Considerations: Proper ventilation of toxic gases, understanding containment for hazardous substances.

4.3: Critical Elements to be Included in DERS/ESS Prop:

- Battery Management System (BMS)
- Inverter
- Emergency Shutdown /Battery Disconnects
- Battery Pack & Components
    - Cells
    - Modules
    - Racks
- Signage

5. EV Training Props Key Focus Areas & Critical Elements

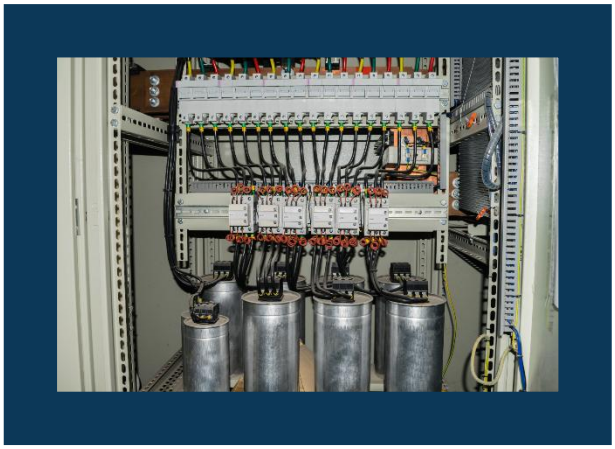
5.1: Objective

Through use of a DER Training Prop, engage firefighters to identify, isolate, and mitigate risks associated with Electric Vehicles (EV), including lithium-ion batteries, low voltage batteries, high voltage wiring, battery disconnects.

5.2: Key Design Focus Areas

- High-Voltage Safety: Include identification of high-voltage components in EVs (e.g., battery packs, power cables).
- EV Fire Behavior: Consider typical high voltage battery pack locations and utilize latest research, how will the battery pack react impact the fire location, growth, and visual characteristics.

5.3: Critical Elements to be Included in DERS/EV Prop:



- 12 Volt Battery Location
- 24 Volt Battery location (typically found in trucks and buses)
- Battery Pack & Components
- Cells
- Modules
- Racks
- Cabling used to transport energy from batteries to vehicle systems, color coded according to amount of voltage
- Inverter/Converter
- Charging Port
- High Voltage Battery Disconnect
- Low Voltage Battery Disconnect
- Battery Pack Vent Port/ Discharge Outlet

6. PV Training Props Key Focus Areas & Critical Elements

6.1: OBJECTIVE

Through use of a DER Training Prop, allowing firefighters to identify, practice energy isolation procedures, and mitigate risks associated with Photovoltaic (PV) Systems, including solar array assemblies, main system disconnects, inverters, signage, energy isolation controls.

6.2: Key Prop Design Focus Areas

- PV System Anatomy.
- Sufficient details to ensure personnel can familiarize themselves with the layout of rooftop and ground-mounted solar panel systems.
- **Shutoff Mechanisms**: Including DC disconnects, inverters, and other shutoff mechanisms.

6.3: Critical Elements to be Included in DERS/EV Prop:

- PV Modules
- Inverters
- Microinverters
- Disconnects
    - Main Breaker
    - PV System Disconnect

    - Rapid Shutdown Switch
- Signage

7. Appendices

7.1: To understand what firefighters have been taught about DERS, visit **Energy Storage Systems (ESS) and Solar Safety | NFPA** and **Electric Vehicle Safety Education Through NFPA Online Training**

7.2: To learn about NFPA 855, Standard for the Installation of Energy Storage Systems, covering signage, disconnects and other responder safety requirements, visit **NFPA 855 Standard Development**

Conclusion

The rise of distributed energy resources requires the fire service to evolve and develop new strategies for handling these emerging technologies. By conducting well-organized field evolutions, using realistic props, and following strict safety protocols, firefighters can be prepared to tackle the unique hazards presented by energy storage systems, electric vehicles, and solar panels in their communities.

Stay current with evolving technologies and continuously assess training needs to ensure operational readiness