

Note: The below summary has been provided by Johnson County Codes staff to Johnson County fire districts for further discussion and continued coordination.

## KEY FIRE AND LIFE SAFETY CONSIDERATIONS FOR OUTDOOR SOLAR PHOTVOLTAIC BATTERY ENERGY STORAGE FACILITIES INSTALLED IN THE UNINCORPORATED PORTIONS OF JOHNSON COUNTY, KANSAS

As people seek alternatives to fossil fuel energy sources, renewable energy sources are becoming increasingly popular. This includes electrical energy storage systems affiliated with solar photovoltaic power systems. However, such systems are not without risks. The greatest risk currently faced with these Battery Energy Storage Facilities (BESF) is a cascading thermal runaway involving the Lithium-ion batteries, which produces flammable gases (predominately hydrogen), filling the interior of a facility's Battery Energy Storage System (BESS). These gases can explode when access is made to the storage container and fresh air is introduced.

To ensure the safety of all operations and maintenance personnel, emergency responders, and the citizens of Johnson County, any proposed design for an outdoor solar installation shall take the following items into consideration:

- ▶ All designs shall conform to the latest edition of all applicable codes and standards. Currently this includes the 2018 International Fire and Building Codes, the 2020 edition of NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, the 2021 edition of NFPA 70, *National Electrical Code*, the 2019 edition of Underwriter's Laboratories (UL) 9540A, *Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*, and all relevant codes and standards that are referenced within these documents.
- ▶ BESF installations shall be designed by a registered design professional licensed in the State of Kansas and plans shall be submitted to the County Building Official for review and approval before construction begins (2020 NFPA 855 Section 4.1.2.1.1, 2018 IBC Section 107.1).
- ▶ Emergency responder training shall be provided by the owner of the facility or other qualified person at the time the BESF is commissioned and at least annually thereafter. Local response agencies (fire, sheriff, EMS) will have the opportunity to decide whether or not to have future training provided by the owner or have a member within their organization provide the training. They will also be able to adjust training frequency to their specific needs (2020 NFPA 855 Section 4.1.3.1).
- ▶ An emergency response plan (ERP) shall be drafted as a cooperative effort between the facility owner and the responding agencies. The ERP shall include procedures for extinguishment, ventilation and entry into the BESS container. Instructions on how to respond to a potential explosion or how to enter the system after the fire suppression system has been discharged shall be included in the ERP. Emergency shut-down procedures shall also be detailed. (2020 NFPA 855 Section 4.1.3.2.1).
- ▶ A needs analysis shall be conducted to determine what equipment will be necessary to respond to an incident involving the BESF and whether or not the local emergency response agencies currently have the proper equipment. Where deficiencies exist, a plan

shall be generated for the procurement of equipment and the party responsible for the cost of such equipment shall be identified.

- ▶ A Battery Management System (BMS) that monitors battery voltages and temperatures, container temperature and humidity, off-gassing of combustible gas, fire, ground fault and DC surge, and door access shall be incorporated into the BESS. The BMS shall also be capable of shutting down the system in order to avoid thermal runaway. It should be noted that thermal runaway, once started is an electrochemical reaction that cannot be stopped electronically by a BMS. Therefore, it is highly recommended that each BESS incorporate passive fire control designs to limit the spread of cascading thermal runaway (2020 NFPA 855 Annex C.7.2)
- ▶ Automatic smoke and combustible gas detection systems shall be provided for each BESS and shall be continuously monitored in accordance with NFPA 72, *National Fire Alarm and Signaling Code*. (2018 IFC Sections 1206.2.11.2 and 1206.2.11.4, 2020 NFPA 855 Sections 4.9.3.2 and 4.10.1)
- ▶ An automatic fire sprinkler system designed in accordance with NFPA 13 or an alternative automatic fire control and suppression system designed in accordance with NFPA 12, 15, 750, 2001 or 2010 shall be installed within the BESS. Consideration should be given to installing a water-based dry pipe system with an external fire department connection (FDC) in units provided with non-water-based automatic suppression systems. This will allow the fire department to pump water into the enclosure in order to cool the interior resulting in slowing thermal runaway and reducing the quantity of flammable gasses present in the confined space. Water-based suppression systems shall not be used where they are incompatible with the building contents in terms of increasing the hazard to responders (2018 IFC Sections 1206.2.11.1 and 1206.2.11.1.1, 2020 NFPA 855 Sections 4.11.1 to 4.11.3.2).
- ▶ A permanent water supply shall be installed on site with adequate capacity to supply either the required fire flow or the automatic fire suppression system demand, whichever is greater. Fire hydrants shall be provided in accordance with the requirements of the International Fire Code and located along an approved fire apparatus access road. In areas where a permanent water supply is impractical, an alternative water supply method acceptable to the local fire department and meeting the requirements of NFPA 1142, *Standard on Water Supplies for Suburban and Rural Firefighting* shall be used (2020 NFPA 855 Section 4.13)
- ▶ An explosion prevention system or approved deflagration venting shall be provided where required by NFPA 855 (2020 NFPA 855 Section 4.12).
- ▶ Where required by NFPA 855 Table 9.2, enclosures containing a BESS shall have a ventilation system designed to limit the maximum concentration of flammable gas to 25-percent of the lower flammable limit (LFL) of the total volume of the room, walk-in unit, enclosure, container or cabinet during the worst-case event of simultaneous “boost” charging of all batteries. Mechanical exhaust systems shall be 1) either continuous or

activated by a gas detection system and 2) supervised in accordance with NFPA 72 (2020 NFPA 855 Sections 4.9.2, 4.9.3.1.1 and 4.9.3.1.3).

- ▶ Signage shall be provided on site to indicate the type of technology associated with the BESS, any associated hazards, the type of suppression system installed in the area of the BESS, 24-hour emergency contact information (including a reach-back phone number), as well as disconnect and other emergency shutoff information clearly displayed on a light-reflective surface (2020 NFPA 855 Section 4.3.5).
- ▶ Safety Data Sheets (SDS) for hazardous materials contained in the BESS shall be posted within site of the disconnecting means and shall be protected from the weather (2018 IFC Section 407.2, 2020 NFPA 855 Section 7.1.3).
- ▶ A 10-foot clearance shall be provided between components of a BESF and any combustible materials including vegetation. Single specimens of trees, shrubbery or cultivated ground cover such as green grass, ivy, succulents or similar plants used as ground cover shall be permitted to be exempt provided that they do not form a means of readily transmitting fire (2020 NFPA 855 Section 4.4.3.6).
- ▶ Fire department access roads shall be provided for the BESF in accordance with the International Fire Code (2018 IFC Section 503, 2020 NFPA 855 Section 4.4.3.8)
- ▶ The perimeter of the BESF shall be secured as necessary to prevent unauthorized access. Access to containers storing BESS shall be restricted to safety personnel and emergency responders while the system is in operation. A Knox box shall be located on site that contains keys, access cards and/or codes to allow emergency responders to gain access to the property and inside of buildings, walk-in units, etc. while minimizing delays (2018 IFC Sections 1206.2.8.7.3 and 506.1)
- ▶ Annual fire and life safety inspections of each BESF shall be permitted to be conducted by the County Fire Inspector and records of other pertinent inspections including but not limited to testing, repair and maintenance of fire alarm and detection systems, gas detection systems, and fire sprinkler or alternative fire control and suppression systems shall be made available at the request of the County Building Official, County Fire Inspector or Fire District. Additional records such as data monitored by the BMS or those related to self-inspections shall be forwarded to the County Zoning Administrator and Building Official as required (2018 IFC Sections 104.1, 104.3, and 104.6).

Submitted on March 31, 2022 by Jeff Anderson, Fire Inspector, Johnson County Planning, Housing and Development

Reviewed by the following agencies:

Overland Park Fire Department, Johnson County Fire District # 1, Lenexa Fire Department, Northwest Consolidated Fire District, Consolidated Fire District # 2 of NE Johnson County and Shawnee Fire Department.