2020

SOLAR BEST PRACTICES GUIDE

A GUIDE TO ASSIST MUNICIPALITIES WITH SOLAR LAND USE REGULATIONS

Prepared by Pioneer Valley Planning Commission with assistance from towns and cities in the Pioneer Valley: *Belchertown, Blandford, Easthampton, East Longmeadow, Hadley, Northampton, Pelham, Ware, Westhampton, WIlbraham, and Williamsburg*, with Support from the Massachusetts District Local Technical Assistance Fund

Emergency Access

K. Emergency Access. The CSPI owner or operator shall provide a copy of the project summary, electrical schematic, and an approved site plan, to the local fire department and the Building Inspector. Upon request the owner or operator shall cooperate with local emergency services in developing an emergency response plan, which may include ensuring that emergency personnel have immediate, 24-hour access to the facility. All means of shutting down the CSPI shall be clearly marked. The owner or operator shall identify a responsible person for public inquiries throughout the life of the installation and shall provide a mailing address and 24-hour telephone number for such person(s). **These components shall be included in the Operation & Maintenance Plan.**

OTHER CONSIDERATIONS

ENERGY STORAGE

As battery technology improves, energy storage has recently made its way into solar PV site plans as an additional component of larger CSPIs. As of April 2020, energy storage will now be required for new solar projects larger than 500 kW seeking incentives under the SMART program. Because this is a relatively new technology, there are not yet clear standards and criteria for development of these systems. The DOER Model Solar Bylaw does not address them.

Current energy storage systems are most often composed of large banks of lithium ion batteries, although new technologies are being developed and beginning to enter the market. Energy storage systems are beneficial to the electricity grid, because they allow for a more regulated flow of electricity into the grid, and also allow intermittent renewable energy sources to provide electricity during times when it is not being directly generated, for example, allowing for the use of solar-generated electricity at night. Of course, energy storage systems add additional complexity to a proposed solar PV project, and additional considerations with regards to safety, environmental hazards, noise, aesthetics, operations and maintenance, and decommissioning must be addressed.

Local boards and planning departments are beginning to gain experience in reviewing battery storage systems, and examining the extent to which they fit into existing local zoning regulations. Unfortunately, because they are a relatively new technology, there are not yet clear standards and criteria for development of these systems. This gap has been recognized at both the state and federal level. The U.S. Department of Energy (DOE) has established an Energy Storage Safety Collaborative, which is currently working on updates to the various safety codes, regulations, and standards (collectively known as CSR) applicable to energy storage systems. The Massachusetts Clean Energy Center reports it is supporting the development and implementation of appropriate CSRs, as well exploring outreach and education opportunities for emergency personnel and other relevant authorities. Because energy storage systems are evolving quickly, the guidance provided below is relatively general and preliminary. We encourage you to check the resources identified at the end of this guide for any updates on the regulation of energy storage systems.

Safety

Energy storage systems are regulated by a variety of safety codes, standards, and regulations – the "CSRs" noted above. The US DOE has identified over 40 codes and standards that may require updates to address energy storage systems - including building codes, electrical codes, and fire safety codes – but not all of these codes require enforcement by local officials.

Safety codes in a given municipality are enforced by Authorities Having Jurisdiction (AHJs), which is a collective term for the organizations, agencies, or individuals responsible for enforcing the requirements of a specific code or standard. The AHJ in a given community may vary, depending on the municipality and the code being enforced. According to the Massachusetts Department of Fire Services, *the phrase "authority having jurisdiction," or its acronym AHJ, is used in … a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the AHJ may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority*.

Your municipal fire chief, building inspector, and electrical inspector should be able to identify areas in which they qualify as an AHJ, and which safety codes they are responsible for enforcing. When an energy storage project comes forward, it is important to ensure these officials are staying abreast of any new additions to national safety codes applicable to energy storage systems, and any modifications of these rules specific to Massachusetts. For example, the National Fire Prevention Association (NFPA) issued an updated *NFPA 1 Fire Code* in 2018, which addresses energy storage systems specifically. The State Fire Marshall announced Massachusetts amendments to that code in October 2019, including provisions relevant to energy storage systems.

In the absence of additional guidance regarding safety planning, the Safety Subgroup of the national Energy Storage Integration Council has the following recommendations regarding incident preparedness and training of emergency response personnel. These recommendations can inform the portion of the Operations and Maintenance Plan composed by the facility developer in consultation with emergency response personnel.

For those personnel called on during emergency situations an important consideration is appropriate training to recognize and respond to all reasonably foreseeable incidents that may occur at the site of an energy storage installation, whether the incident source is the system itself or something external (e.g. wildfire or flood). It is recommended that … the energy storage supplier make available all necessary emergency action information related to their system. This information could also be included in the operations and maintenance manual. This emergency action information will contain salient information for preparing for incidents and could be used by the utility and other stakeholders, such as local responders, to prepare a site specific, emergency action plan.

The action plan could address possible incident scenarios starting during construction and commissioning and continuing through operation and decommissioning. This could include a call/email list for all those who need to be informed of a situation potentially including: emergency personnel, operators, owners, regulators, and many others. Actions for these parties may include urgent responses, such as responding to a medical emergency, or non-urgent responses, such as performing an incident investigation. This plan could account for all reasonable accidents that could occur at the project site possibly including but not limited to medical emergencies and incidents associated with fires, chemical spills, explosions, shocks and mishandling of the system or materials related to the installation.

The incident training manual could allow utility personnel and their contractors, as well as first and second responders, to understand the likely incident scenarios associated with the energy storage installation and appropriate actions to take to for each scenario. It could include, at a minimum, emergency shutdown procedures, a Materials Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) along with any first-aid requirements. Steps and actions listed in the incident training manual could be consistent with the Occupational Safety and Health Administration (OSHA) hazard communications standard (HCS).

Several technical recommendations regarding design for safety are included in *Appendix D.*

Responding to emergencies at a solar facility may require special training and equipment. Lithium ion battery fires, for example, cannot be treated like common fires; they have different burn characteristics and toxic byproducts. The relevant permitting authority for a commercial-scale solar PV facility – be it the Site Plan Review Authority in As-of-Right zones, or the Special Permit Approval Authority – should be prepared to include conditions on the permit necessary to ensure that emergency personnel have access to the appropriate training and equipment in order to respond to any emergencies that may occur on-site. It is not inappropriate for the municipality to request or require that the solar developer cover the costs of necessary training or equipment. NFPA currently has an on-line training available for fire personnel (see Resources).

In many cases, both the solar PV facility owner and local emergency personnel may prefer that specialized emergency response personnel employed by the facility owner respond to directly address certain kinds of incidents specific to solar sites, including electrical and chemical fires. Local emergency personnel may not have the expertise or equipment necessary to respond appropriately to these situations, nor a comfort level working in close proximity to high voltages. Where this is the case, emergency personnel's main role may be to contain any fires to the facility property, while ensuring that appropriate personnel employed by the facility are alerted and responding to the scene. Solar PV arrays and energy storage systems typically include remote monitoring systems which alert the facility owner to any problems or unusual conditions occurring on-site. However, ensuring that emergency contact information for the facility is readily accessible and up-to-date is imperative, especially since solar PV facilities often change hands multiple times over their operational life.

Environmental Considerations

Large battery systems are an evolving technology, but many batteries contain heavy metals, which could cause damage if leached into the environment. In addition, fire suppression systems may include release of a chemical agent to suppress the fire. Material Safety Data Sheets (MSDS) for fire suppression chemicals should be reviewed carefully, and the potential for any leaking, leaching, or chemical spills reviewed with the solar developer. The Site Plan Review Authority, and Conservation Commission where applicable, should take special care in reviewing plans for energy storage systems placed in environmentally-sensitive areas.

Environmental Considerations

Because batteries require climate-controlled conditions, these systems must be actively heated and cooled over the course of the year, to prevent freezing or overheating. The fans associated with these units do produce noise, which in some conditions may be audible to nearby abutters. It is important to ensure that these systems meet any noise regulations or bylaws applicable in the municipality.

In addition to this long-term noise consideration, there are also noise issues to consider during construction. Depending on the order of workflow at the site, energy storage systems may be installed at the site before the solar PV facility is in full operation. These energy systems may sit idle for multiple weeks before the utility finishes its approval process and the facility goes into operation. During this time, battery systems need to be kept from freezing or overheating; in the absence of an operational solar array, the solar developer may expect to power climate control systems through a diesel generator, which can disturb abutters. Don't forget to ask the solar developer about the timing of installation of the energy storage system, and their plans for keeping the batteries climate-controlled until the system is fully operational.

Aesthetics

Batteries for energy storage are often packaged into large metal shipping containers, installed over a concrete pad. These units are not always the most attractive, and some permitting authorities have requested that these units be painted such that they blend in with the surrounding scenery. However, these systems may need to be painted white or another light color, to reduce heat load on the unit. Vegetation screens, situated at a safe distance from the unit, may provide an alternative method to screen these systems from view, as well as offer cooling value. One innovative approach in more developed areas could be to have a mural painted on the side of the unit.

Operations and Maintenance

The municipality may wish to include requirements to ensure the energy storage component of the Operations and Maintenance Plan is complete. According to the Energy Storage Integration Committee Safety Subgroup, the plan the solar developer provides to the utility could be designed to include:

- Plans for inspecting, servicing, repair and renovation as well as any addition to the system (e.g. installation of additional storage capacity).
- A complete operation and maintenance manual. This manual could provide instructions for all required operating and maintenance activities, the timing for these activities, and who will perform them. Ideally the manual could be in electronic form and automatically prompt utility personnel and/or their agents

to initiate, perform, and document required actions after the system is commissioned and placed in operation. This manual could also include conditions under which the system will have met end of warranty, service life, and operational life.

A municipality may choose to require all or a subset of these components.

Decommissioning

Decommissioning costs and protocol for the energy storage system should also be considered. The Energy Storage Integration Committee Safety Subgroup provides the following guidance regarding decommissioning, which may be already addressed by the utility, but is worth noting here: *It is recommended that the energy storage supplier be required to develop a decommissioning and disposal plan for utility approval. This plan could explain the procedure for decommissioning, including any hazards this may present, as well as the steps to disconnect the system from external automated control systems. It could elaborate who is responsible for disposal and recycling, what costs this will incur, how articles could be packaged for disposal, and who is responsible for shipping the materials to the disposal or recycling site.*

D TECHNICAL RECOMMENDATIONS FOR SAFE ENERGY STORAGE SYSTEMS

The recommendations below are pulled directly from Energy Storage Safety Guidelines compiled by the Energy Storage Integration Council for Distribution-Connected Systems in 2016. These guidelines are directed towards energy storage system suppliers, but may serve as a starting point for electrical inspectors or other safety personnel making inquiries about the safety of the system. The complete report is available at: https://www.epri.com/research/products/000000003002008308

- While it is often beneficial to design a closed system for heating and cooling efficiency, pressure relief valves could be considered to prevent a hazardous buildup of pressure. Closed systems can lead to oxygen starvation which can cause a backdraft if sufficient heat builds up for a fire. In systems where an explosion hazard may exist, deflagration venting could be considered as well.

- Fire suppression systems may be an effective control for component fire potential. Claims on effectiveness could be supported with some combination of testing, analysis, and/or simulation. However, it is important to consider the material that may experience a fire when selecting the type of system to be used. In the case of lithium-ion batteries, sufficient heat can be generated internally to sustain or reignite a fire if extinguished by an oxygen starvation system. In these cases a water suppression system may be considered if properly designed to remove enough heat from the cells that the exothermic chemical reaction can be slowed or stopped.

- It is important to consider both normal and unexpected operating conditions in the design of the contactors. Inverter based systems often require large capacitive filters on their DC bus to reduce the magnitude of the AC current (noise) component. These capacitors draw significant current when first connected to a battery or other DC source; thus, all inverters come with a pre-charge circuit. This circuit allows the input capacitors to be resistively coupled to battery voltage thereby reducing the in-rush current. Abnormal conditions during pre-charge include voltage spikes, incorrect contactor switching, and battery short circuit. If the contactors in this circuit open unexpectedly while pre-charging the capacitors, they can fuse and cause an inverter fault requiring extensive repair or, in rare cases, an inverter fire.

Impressed current systems or sacrificial anodes may be used in environments where corrosion could affect system operation or safety. Essentially, they work by holding the system at a somewhat positive potential to slow the rate of chemical reaction with this environment. Impressed current systems accomplish this through the use of a DC power supply or rectifier. Sacrificial anodes accomplish this by providing an anode of an appropriate chemical to produce a negative potential as it reacts with the air or soil.

- When an energy storage system contains large volumes of liquid, it is important to consider secondary containment. Recommendations can be adapted from stationary battery standards for flooded lead acid batteries which stipulate that secondary containment be sufficient to contain and allow for the safe disposal of either 30% of the total volume or 100% of the largest single container, whichever is greater.

- Cyber security may be considered as a safety issue for internet connected systems, SCADA connected systems, and even stand-alone systems. This involves an analysis of what access to system information and system control could produce a hazard. For example, changing BMS parameters could lead to reduced system life or fire through the improper enforcement of safety constraints. The National Institute of Standards and Technology publishes a general cyber security framework which may be applied to energy storage systems and installations.

- Energy storage technologies that contain or produce hydrogen gas are subject to the appropriate controls for this hazard. Examples of these controls can be found in section 500 of the National Electrical Code (NEC), and NFPA 2: Hydrogen Technologies Code those other standards may be more appropriate for specific technologies.