EXPLOSION PROTECTION SOLUTIONS FOR BESS APPLICATION – FAQ

1. **Is explosion venting always required?**
   Standard NFPA 855 prescribes that explosion venting for BESSs is always required, unless it can be demonstrated by testing that the flammable gas concentration cannot exceed 25% of the lower flammability limit, in any part of the container where flammable gases are likely to accumulate. Under ATEX no specific guidance exists for BESSs, but following general ATEX philosophy, the same conclusion is reached.

2. **Can explosion vent panels be installed on the roof of the instrumentation room?**
   It's preferable to install panels as close as possible to the hazard, such as in the room that contains the Li-Ion batteries. If this is impossible or impractical, panels may be installed on the adjacent instrumentation room, provided enough container surface area is available, and provided inside the container a free venting path between Li-Ion storage room and instrumentation room exists, so there is no wall in between the rooms. The cross section of the internal free venting path should be at least equal to the provided vent area. If no wall is present, keep in mind that flammable gases may accumulate in both rooms and the total volume of both rooms should be used for vent area calculation.

3. **When calculating the vent area, can the volume occupied by the racks be subtracted from the container volume?**
   We recommend not to do this. The presence of the racks may contribute to increased gas explosion turbulence and intensity. On the other hand, they consume volume that cannot contribute to the gas explosion. In typical arrangements, both effects compensate for each other. Calculating with the total container volume and ignoring the racks results in the most accurate vent area.

4. **Can vent ducts be used on this application?**
   Yes, vent ducts can be used, even though vent ducts may make the explosion more intense, and the use of vent ducts may need to be compensated with more or larger vent panels. If the required vent duct length is specified, Fike will support you by including vent ducts in the vent area sizing calculations.

5. **Can the container have a maritime certification with the explosion vent panels installed, or shall they be installed on site?**
   Currently, Fike doesn't have experience with marine certification for this application. Fike supports other marine applications, but the panels are usually installed on site.

6. **The demonstration picture shows that after the explosion the container is deformated. Is it always like that?**
   Vent sizing may be calculated to allow or disallow plastic deformation. If plastic deformation is undesirable, typically more or larger panels are required.

FIRE PROTECTION SOLUTIONS FOR BESS APPLICATION – FAQ

1. You have not talked about inert gas to protect an ESS. Is this a viable option?

Inert gas is a viable option. However, one reason we don't see inert gas being widely used in this application is because the spaces are relatively small. In these volumes, a chemical agent system is typically less expensive than an inert gas system, and you're not going to have as onerous over pressure relief venting requirements with chemical agent. Chemical agent also provides more of a cooling effect than inert gas will -- a water mist system with a continuous water supply will provide the greatest cooling effect.

2. Is the Fike Watermist system large-scale fire tested as mentioned in NFPA 855?

Fike's DuraQuench system and Micro Mist system are approved to FM 5560. DuraQuench is FM approved for protection of machinery spaces and turbine enclosures up to 162,800 ft^3 in volume. It is also approved for the protection of data centers. Micro Mist is approved for protection of machinery spaces and turbine enclosures up to 9,175 ft^3 in volume. Large-scale fire testing of lithium ion storage systems is done on a case-by-case basis with a particular battery/ESS manufacturer's energy storage system, and is typically tested according to the methodology laid out in UL9540A. Fike can't comment on any testing done in this regard due to confidentiality concerns with specific ESS manufacturers.

3. What detection would you generally utilize to activate the Watermist system?

In a lithium ion battery energy storage system application, all of the discussed detection methods may be used, and which one is chosen depends on the desired protection scheme and how early or late in the process one wants to activate the water mist system. This could range from very early activation with off gas detection or air sampling, to later detection using smoke or heat detectors.

4. Are thermal cameras an alternative since theoretically those could detect temperature increase prior to thermal runaway?

Thermal imaging is a valid detection option and could be used for detection prior to thermal runaway. However, considering the amount of cameras that could be required along with the minimal space available in typical ESS systems, Li-ion Tamer is often preferred for most applications. Thermal imaging is viable if there are a large number of ESS systems in one area, and the thermal cameras are used to detect elevated temperatures from exhaust venting off the units. In this situation, the ESS unit would be in thermal runaway, but it could be a detection method to cover several units and contain damage to that single ESS if that is an appropriate and acceptable strategy and acceptable for the end-user.

5. How about CO_2 for suppression? It provides fire extinguishment and cooling too.

CO_2 is a viable option when gaseous agents are being considered, and it does provide extinguishment and cooling as well (as all gaseous agents do to some degree), but Fike's approach would be to consider Novec 1230, FM-200 or ECARO-25 first, as they can be used without introducing the human safety concerns we have to consider with CO_2.

6. What would be a fire suppression recommendation for battery testing inside an occupied facility ranging from 1-500 kWh of energy density?

This would depend on the configuration of the facility, its volume, size, other contents and a number of other factors. All of the options presented in the webinar would come into play,

however. This particular hazard should be reviewed by a fire engineer or fire suppression system designer to make a final determination.

7. **Is the Li-ion Tamer product capable of functioning inside a thermal chamber? (for testing -40°C to -100°C)**
   Environmental specifications for Li-ion Tamer solution Temperature -10 to +60 degrees , C Humidity 5 to 95% RH, Max temperature change 8.6oC/min.

8. **Is there any heat associated with the chemical reaction that leads to off gassing? Or is elevated heat only after something else breaks inside the cell?**
   Increased temperature occurs within the battery prior to off-gassing occurring and thermal runaway.

9. **Has Fike provided any white papers or testing of Novec or Li-Ion fires?**
   Not at this time, but we continue to do testing related to this application and will publish results as we are able.