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Fire Safety in Data Centres

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Background

The reliance on cloud-based data storage and increasing demand for supplying energy from alternative sources has seen a dramatic increase in the use of Lithium-Ion battery based Energy Storage Systems (ESS). One common application for ESS are data centres to help cater for the increased demand for cloud-based data storage. One of the fundamental requirements of a cloud-based data centre is business continuity via zero downtime requirements. ESS are mandatory, to provide continuous data centre operation during a power outage. Lithium-Ion based ESS are prone to thermal runaway leading to the production of flammable gases and subsequent uncontrollable combustion. The additional ESS fire risks are not readily covered by the Deemed-to-Satisfy (DtS) provisions of the Building Code of Australia (BCA), Furthermore, ESS trigger the application of BCA Clause E1.10 - Provision for Special Hazards which prescribes that additional provision must be made if special problems of fighting fire could arise because of the nature or quantity of materials stored, displayed or used in a building or on the allotment; or the location of the building in relation to a water supply for fire-fighting purposes.

Fire Safety Strategy

Therefore, a comprehensive fire safety strategy is required to adequately address the following:

I. Impact on business continuity;

II. Occupant evacuation;

III. Fire protection services required in the facility; and

IV. Fire brigade intervention.

Due to these considerations it is common for the fire systems design in data centres to incorporate a two-stage fire detection system (double knock) which requires the activation of two (2) systems to activate suppression.

The first knock consists of a smoke detection system which is commonly an aspirated system. These systems are capable of providing significantly quicker detection times when compared to conventional point type detection. In addition, data centres often contain cooling systems to keep the storage hardware cool at all times. These systems can introduce high velocity air currents which can disrupt the operation of a standard point detector.

The second knock will generally consist of a secondary detection system to activate the suppression system or can be incorporated into the operation of the suppression system.

Suppression Systems

A number of suppression systems can be considered for specific use in data centres including sprinklers, gaseous suppression and water mist systems. Sprinklers are able to operate as a second knock as they require a fire to physically break the bulb based on a temperature change. Where sensitive equipment is present, pre-action systems are often utilised to prevent accidental discharge of the sprinkler system with water only filling the system when the smoke detection system is triggered.

It is important to note that as with any suppression system it needs to be designed to the potential fire hazards within the space. The Australian Standards do not currently consider the use of Lithium batteries in ESS. However, NFPA 855 provides some guidance on the classification of the area containing the ESS. As shown in Figure 1, NFPA 855[1] outlines the maximum stored energy thresholds. Areas or ESS with stored energy above the maximum thresholds are considered to be high hazard areas and suppression systems should be designed accordingly.

FM Global is a major insurer / underwriter for data centres. FM Data Sheets provide sprinkler design criteria for various battery configurations based on the large-scale fire testing of Energy Storage Systems[2 & 3]. They recommend consideration of battery chemistry, isolation distance, rack spacing, fire compartmentation and sprinkler protection commensurate to the hazard.

Full article: https://newsroom.fmglobal.com/releases/fm-global-shares-new-fire-protection-and-installation-guidance-for-lithium-ion-energy-storage-systems

Table 4.8 Maximum Stored Energy

ESS Type	Maximum Stored Energy[a] (kWh)
Lead-acid batteries, all types	Unlimited
Nickel batteries[b]	Unlimited
Lithium-ion batteries, all types	600
Sodium nickel chloride batteries	600
Flow batteries[c]	600
Other battery technologies	200
Storage capacitors	20

Figure 1 – Table 4.8 extract from NFPA 855

Latest Developments

With the increasing popularity of Lithium ion batteries as an Energy Storage Systems, fire safety systems are evolving to bridge the gap between the emerging hazard and risks arising.

One example of such a technology is off-gas detection which can be installed within the ESS units. The off-gas detection system specifically measures the gaseous

1 NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems, 2020 Edition
2 FM Global (June 2019) *FM Global shares new fire protection and installation guidance for lithium-ion Energy Storage Systems*
3 Fire Australia (2019) *Energy Storage Systems and Fire Protection,* Issue 4 2019.

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products produced prior to the occurrence of thermal runaway and the power to the batteries is shut down to mitigate fire starts.

Please contact Lote Consulting for further information on the fire safety design of Lithium-ion battery based Energy Storage Systems (ESS).

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