HEALTH HAZARDS AND POLLUTION RISK FROM LARGE BATTERY ENERGY STORAGE SYSTEMS

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Abstract

Energy storage systems are deployed to decrease the costs and improve the dependability of a power supply, especially electricity generation. Conventional generating stations (hydroelectric or powered by fossil fuels) tend to work continuously at the same rate, whereas demand fluctuates. On the other hand novel "renewable" sources such as wind turbines fluctuate more than demand. In both cases it is useful to store electricity when there is a surplus, and release it when there is a shortage. In the case of hydroelectricity, the same infrastructure can be used for this purpose — surplus power is used to pump water back up into the reservoir. Most other sources require special infrastructure. For example, surplus power can be used to split water into hydrogen and oxygen by electrolysis; the hydrogen is stored and can later be used as fuel to power a generating station. The drawback is not only the expense of the infrastructure but also the significant exergy losses during the process. Hence the attraction of "battery" storage, by which is meant electrochemical cells such as those based on nickel–manganese–cobalt, vanadium, sodium or lithium. The enormous worldwide increase in the number of electric automobiles has provided a strong impetus for developing such "batteries", especially the lithium ion type, and large batteries of such batteries can be used to store energy on a scale commensurate with the requirements of a countrywide electricity grid. Since intermittency of supply is of particular problem with the so-called "green" or renewable sources, governments have provided subsidies for energy storage, typically by selling surplus electricity very cheaply. This has encouraged the construction of battery energy storage systems (BESS), for which a business case can be made because of the price differential of electricity between times of surplus and scarcity, regardless of whether the surplus electricity actually comes from a renewable source. Nevertheless, these installations are not hazard-free. Those based on lithium ions, in particular, are susceptible to overheating ("thermal runaway"). In a dense array typical of BESS, fire can percolate from one battery to another and a major conflagration, possibly accompanied by explosions, can result. This in turn implies release of toxic contaminants to the air and to groundwater. This contribution assesses the hazards and risks of such incidents.