5. Total Energy Release Potential

Any large energy storage system has the risk that energy released in malfunction will be uncontrollable in ways that will do major damage. BESS can release electrochemical energy in the form of thermal runaway or "battery fires". In addition they can release chemical energy in the form of explosions or conventional fires of inflammable gases, or of polymer components. Many thermal runaway "fires" have now happened, as has explosion of evolved inflammable gases.

An important indicator of the foreseeable scale of a "worst credible hazard" is provided by the total stored energy in the system. For BESS, this comprises two components:

(i) The stored electrical energy which might be released in the event of thermal runaway incidents, a self-reactive electrochemical energy release not requiring oxygen at all, and

(ii) Stored chemical (fuel) energy which might be released in complete combustion of the inflammable gases which might be released by (i).

Electrochemical energy release is uncontrollable once started, by any measure except cooling – of all cells and cell parts – below about 150°C. Water is the only fire-fighting substance with the necessary heat capacity. Concurrent conventional fire would first heat cells above the thermal runaway temperature, causing more thermal runaway. Chemical energy release from inflammable gases is also uncontrollable once those gases are mixed with air and ignited: explosions result.

What might be the scale of such energy releases? The Sunnica proposal is estimated to have a stored energy between 1.5 – 3.0 GWh in total, spread across 3 separate sites called Sunnica East A, Sunnica East B and Sunnica West A (see calculations in Appendix 1). It is between 2 – 4 times the capacity projected for Cleve Hill (700 MWh). It is 8 – 15 times the capacity (193 MWh) of the "Hornsdale Power Reserve" in Australia, at installation (2017) the world's largest.

Compared to other energy storage technologies, the Dinorwig Pumped Storage Scheme in Snowdonia stores about 9 GWh [14]; the Sunnica BESS corresponds to 17 – 33 % of Dinorwig.

Compared to major explosions, the energy released in the Beirut warehouse explosion of August 2020 has been estimated [15] by Sheffield University at about 0.5 kilotons of TNT (best estimate) with a credible upper limit of 1.12 kilotons. A totally independent estimate [16] (based on seismic propagation instead of eye-witness footage) gives the same range, without specifying a "best" estimate. The popular measure of major explosions in "kilotons of TNT" has an agreed definition[2] of 1.162 GWh of released energy; in this paper we shall take "one Beirut" to be an explosive energy of 0.5 kilotons of TNT or about 580 MWh of released energy.

The projected BESS storage at Sunnica corresponds to 1.4 – 2.7 kilotons of TNT in total, across all three sites. In the "low" case, this would be "0.92 Beiruts" at the Sunnica West A site alone, or "2.7 Beiruts" over the whole scheme. In the "high" case "2.7 Beiruts" could be stored in the Sunnica East B site alone. Note that these are stored electrochemical energy only; the potential for conventional fire or explosion of evolved inflammables could be **up to 20 × larger** [11]. See Table 3, Appendix 1.

This is plainly a quantity of stored energy which, if released uncontrollably, could do major damage. Explosions and fires at individual BESS are matters of record. They can propagate from failure in a single cell out of many thousands. Cell-to-cell and module-to-module propagation occurred at McMicken. Rack-to-rack propagation was avoided, but could readily occur if continuous

[2] See e.g. Wikipedia.