

Abstract:

Battery aging - Impacts on safety, reliability and performance of PV storage systems

Lithium-ion batteries are used in the mean-time in various stationary applications including small solar home systems in rural off-grid areas, photovoltaic home storage for increased self-sufficiency, district storage in distribution grids, mini-grids with high shares of renewables, storage integrated in photovoltaic and wind power plants as well as storage for providing primary control power.

In dependence of the application specific ambient and operating conditions but also in dependence of the quality of the used lithium-ion battery cells and the system design, aging mechanisms have a significant influence on the safety and reliability as well as on the performance – efficiency and effectiveness – of the battery storage. Thereby capacity fade and increase of inner resistance of battery cells as well as corresponding increase of cooling demand have to be considered.

Within this presentation, results of comprehensive testing of market available photovoltaic home storage systems are shown. These tests have been conducted in status “new” and in status “aged”, which is necessary to identify critical conditions in terms of safety and reliability. E.g. central questions arise with the increase of inner resistance: Can the cooling system cope with increased heat production? Has the battery storage to be switched off as a result of too high temperatures, which results in unreliable operation? In terms of performance, inner resistance results in reduced efficiencies and e.g. in case of photovoltaic home storage – besides capacity fade – an additional effect for reduction of self-sufficiency rates is the consequence. This can influence the economics of such systems strongly.

The second part of this presentation provides results of an extensive simulation study for a district storage, which includes the effect of aging on the performance of battery storage by using aging models for the considered lithium-ion cells, which are validated with data obtained by extensive laboratory testing.