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C1Po3C-03: Thermodynamic Analysis of Cold Energy Replenishment in Liquid Air Energy Storage System

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Liquid air energy storage (LAES), as a promising large-scale energy storage technology, offers significant advantages due to its geographical independence and the ability to store energy at ambient pressure. It holds great potential for future applications. The cold storage unit is the core component of the LAES. During the energy storage phase, the unit supplies cold energy to compress the air, while in the energy release phase, it recovers cold energy from the liquid air. However, as the cold storage unit operates in a cryogenic environment, cold energy inevitably leaks from the unit into the surrounding environment. If this cold energy is not replenished in time, the temperature of the cold storage fluid will rise, eventually preventing the compressed air from liquefying and causing the LAES to fail. Therefore, this paper calculates the cold energy leakage from the cold storage unit under different configurations and analyzes its impact on system performance. Additionally, a method is proposed to replenish the cold energy to the cold storage unit by reducing the pressurization of the liquid air. The study also explores the effects of different configurations on the pressure drop of the liquid air and the overall performance of the system. Through these analyses, the paper aims to provide optimized solutions to mitigate cold energy leakage and ensure the efficient operation of the LAES, offering theoretical support and practical guidance for its actual application.

Authors: WANG, Zhikang; DU, Jiamin; LI, Junxian (Key Laboratory of Cryogenic Science and Technology, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences); LI, Yihong (Technical Institute of Physics and Chemistry, CAS); FAN, Xiaoyu (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences); GAO, Zhaozhao; JI, Wei (Zhonglv Zhongke Energy Storage Technology Co., Ltd.); Dr CHEN, Liubiao; WANG, Junjie (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences)

Presenter: Dr CHEN, Liubiao

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