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C3Po1C-02: Numerical Simulation Study on the Precooling Process of a Propane Storage Tank in a Liquid Air Energy Storage System

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Liquid air energy storage (LAES) technology offers high energy storage density, long-duration storage capability, and independence from geographical constraints, making it highly promising for large-scale renewable energy integration and grid dispatch. The cold storage system is one of the most critical components of the LAES system, with cold storage methods categorized into liquid-phase and solid-phase storage. Liquid-phase storage media primarily include propane and methanol-water solutions, which are typically stored in large cryogenic liquid tanks. Precooling operations are crucial before commissioning large cryogenic storage tanks, ensuring system safety and optimizing cold storage performance. The uniformity and efficiency of the precooling process directly affect the performance of subsequent energy storage operations. Addressing this engineering challenge, this study establishes a transient numerical simulation model to investigate the unsteady-state temperature field distribution characteristics of a large propane storage tank under specific inlet flow velocity conditions when liquid nitrogen is used as the precooling medium. Additionally, it explores the required precooling time for the propane tank. This study aims to provide theoretical insights for the practical engineering application of LAES systems and offer guidance for the precooling process of propane storage tanks.

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