Operation optimization of an ATES system for a High-Tech industrial building

Confidential Report

Master of Science Thesis on

Operation optimization of an ATES system for a High-Tech industrial building

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Table of Contents

Abstract

Buildings in Europe are responsible for the 40% of the total energy consumption and one third of the total CO_2 emissions. Following this worrying trend, European Union has issued the Energy Performance of Buildings Directive in an effort to reduce the energy consumption in the built environment and increase the share of renewable energy. The Netherlands adopted these measures and have enforced the ‘’Energy Agenda’’ under which they want to stop using gas and replace it by other more sustainable sources like thermal energy storage (TES) in combination with a sustainable energy supply.

Different operation strategies in order to reduce the energy consumption of a high tech industrial building are investigated in this research. The Brainport Industries Campus (BIC) built in the area of Eindhoven is used a study case. BIC aims to be an energy neutral ‘gas-free’ campus and for this reason uses an ATES system for heating and cooling, and a process cooling system to supply the cleanrooms which are located in the main building.

Due to lack of metered heating, cooling and process cooling data, simulation software tools (IES VE, Dymola) are used to create demand scenarios in order to be used as input to the models of ATES and process cooling system. These systems are modelled using the object oriented modelling interface of Dymola. Two operation strategies, one addressed only to the operation of the ATES system and one combining ATES and process cooling systems, are evaluated based on the achieved energy savings compared to the initial operation strategy.

The obtained results showed that energy savings from 11 MWh to 41MWh can be achieved from the operation of the ATES system by applying strategies to thermally balance the cold and warm wells. Also, applying operation strategies which combine the systems of ATES and process cooling can be preferable only when there is enough process cooling demand, otherwise it can lead to little or no energy savings. In general, for both strategies the energy savings increase as heating, cooling and process cooling demand increase.

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