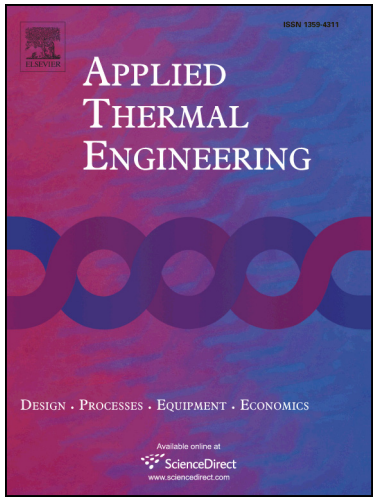

Development, Validation, and Assessment of a High Fidelity Chilled Water Plant Model

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Development, Validation, and Assessment of a High Fidelity Chilled Water Plant Model

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Abstract

Effective simulation models of complex systems must achieve an appropriate balance between computational complexity and model fidelity. This work assesses that compromise, in the context of chiller plant modeling, simulation, and optimization. A high-fidelity, equation-based model of a water-cooled chiller is developed and evaluated in comparison to the DOE-2 semi-empirical model, as well as operating data from a real plant. The developed model is found to be realistic in a broader operating range, but computationally expensive for use in real-time optimization, taking approximately 10x computational time compared to the empirical model. The value of this high-fidelity model is demonstrated in simulation case studies that expand beyond the scope of the empirical model and through its suitability as a basis for the development of advanced control architectures. This work identifies the value proposition of the high-fidelity model and illustrates the advantages and disadvantages of each modeling approach, concluding with an outlook of the need for custom, reduced-order models for advanced analysis of chiller plants, targeted to specific uses, such as efficiency optimization and fault detection and accommodation.

Keywords: Process Simulation, HVAC, Chiller, Model Fidelity

Highlights:

- A detailed model of a vapor compression chiller cycle is developed
- A model of a chiled water plant is developed
- The developed models are evaluated by comparison to existing models and plant data
- The developed models are found to be accurate and useful for ongoing work