SimBuild 2020 Abstract

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Title: Evaluating the Load Flexibility Potential of Ice Thermal Energy Storage Design and Control Strategies

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Applicable Conference Topics:

* Component and Systems Modeling and Load Analysis
* Modeling Advances (New techniques, automation, scripting, etc.)
* Grid-interactive Efficient Buildings and Resiliency

Abstract (231 of 250 words max):

With the increasing interest in grid-interactive efficient buildings, energy storage technologies in buildings are being re-evaluated for their role in the future grid. Ice thermal energy storage (TES) has a large potential to provide load flexibility to a grid dominated by variable generation assets but requires careful design, analysis, and control to be effective. This evaluation is possible using building energy simulations but is not often done because of the complexity (and added time) related to add ice storage to building simulation models. The objectives of this study are two-fold: (1) automate the addition of ice energy storage to building models through OpenStudio measure scripting and (2) evaluate the load flexibility potential of various TES design and control strategies. This paper presents a new OpenStudio measure that provides the ability to rapidly and accurately model a variety of potential design options and common control schemes. After applying this measure, we then bound the ability of the building to increase or decrease its predicted future electric load over 1, 2, 4, and 6-hour windows using chiller and ice storage performance constraints at each simulation timestep. Results showing the upper and lower limits of facility demand flexibility (kWe) for each timestep are presented to illustrate this potential. Preliminary results indicate that storage-priority control strategies produce more consistent daily flexibility profiles over the cooling season. Our methodology provides a means to quantify and visualize the available electrical flexibility at a given point in time for a building using ice TES.