Solving the Large Building All-Electric Heating Problem

Regarding October's "Solving the Large Building All-Electric Heating Problem" by Brandon Gill, P.E., Member ASHRAE, I'd like to know what Mr. Gill thinks about:

The practical (smallest) building size (or other criteria) for which the time-independent energy recovery (TIER) system is applicable.

- The best strategy for selecting/sizing components. I could imagine some trial and error, perhaps using an energy model?
- Whether it's practical to model such a system with available software such as EnergyPlus with or without a lot of scripting?
- How to provide clear BAS sequences of operation for contractors not likely to be familiar with such a complex system.
- The best way to guide commissioning agents as they test the system.
- The best methods for ensuring building operator success as they observe and maintain such a system.

Thanks for the thoughtful article!

James V. Dirkes II, P.E., Life Member ASHRAE, Grand Rapids, Mich.

The Author Responds

The reader poses several good questions. Responding in order:

- We have considered applying the time-independent energy recovery (TIER) concept in buildings as small as roughly 100,000 ft^2 under unique circumstances, but 150,000 ft^2 or 200,000 ft^2 is probably a more reasonable cutoff for most applications. Essentially, when a building is large enough that a chilled water plant is under consideration in lieu of direct expansion systems, TIER may be viable.
- The trickiest design aspect is appropriately sizing the thermal energy storage tank and trim heat source, which is generally air-to-water heat pumps in all-electric designs. This requires a design heating day 24-hour load profile for both heating and cooling—extracted from load calculation software or other modeling software—so that the heat recovery, storage and trim heating dynamics can be appropriately modeled.

With known load profiles and projected equipment efficiencies, the amount of trim heat can be manipulated to determine the required tank size. As noted in the article, we generally try to maximize tank size subject to architectural constraints to minimize cost and maximize efficiency.

- I am not an EnergyPlus expert, so I cannot state definitively whether modeling condenser water TIER is possible or not with extensive scripting. I can state, however, that it is likely to be quite difficult. Thus far we have developed "Exceptional Calculations" for code compliance using detailed spreadsheet models to capture plant dynamics. Load and weather data outputs from compliance software are fed into these models allowing for 8,760 hourly energy calculations. These spreadsheets use the same multivariate regression curve models for chillers, towers, etc., as EnergyPlus to produce defensible results.
- Thorough, well-written sequences of operation are undoubtedly required to ensure that a complex TIER system operates to its fullest potential. We recommend writing sequences of operation in the style of ASHRAE Guideline 36 to clearly convey design intent. The designer must be well versed in control theory and understand plant equipment dynamics to do this well.
- Hopefully, we will have a better opportunity to address commissioning in a follow-up lessons learned article. We will be commissioning a couple TIER systems in the near term.
- Training, training and more training are required to ensure that building operators understand the design intent and system dynamics since they are not necessarily intuitive, nor obvious.

Brandon Gill, P.E., Member ASHRAE, Alameda, Calif.

Errata

In November's "A Bipolar Ionization Primer for HVAC Professionals" by David N. Schurk, Member ASHRAE, guidance from the CDC was incorrectly attributed to ASHRAE.

In addition, a sentence in that paragraph contained a typo. The corrected sentence is "Consumers should request efficacy performance data that quantitatively demonstrates a clear protective benefit under conditions consistent with those for which the consumer is intending to apply the technology." *ASHRAE Journal* regrets the error.

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