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## Engineering for energy efficiency

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IT is covered by one monolithic system. Also, it is assumed that the monolithic system has the ability to modulate (power output or cooling capacity) to match the four loading points.

**2. Modular design:** This approach consists of providing four equal-sized units that correspond to the four loading points.

It is important to understand that this analysis demonstrates how to go about developing a numerical relationship between energy efficiency of a monolithic versus a modular system type. There are many additional variables that will change the output and may have a significant effect on the comparison of the two system types.

For the electrical system, the efficiency losses of a monolithic system were calculated at the four loading points. The resulting data points were then compared to the efficiency losses of four modular

systems each loaded to one-quarter of the IT load (mimicking how the power requirements increase over time). Using the modular system efficiency loss as the denominator, and the efficiency losses of the monolithic system as the numerator, a multiplier was developed.

For the chillers, the same approach is taken comparing chiller compressor power of monolithic and modular systems. A monolithic chiller system was modeled at the four loading points to determine the peak power at each point. Then four modular chiller systems were modeled, each at one-quarter of the IT load. Using the modular system efficiency loss as the denominator, and the efficiency losses of the monolithic system as the numerator, a multiplier was developed. The electrical and chiller system multipliers can be used as an indicator during the process of optimizing energy use, expandability, first cost, and reliability.

## Conclusions

Data centers are planned to meet the requirements of the IT equipment, both what is planned for day one and what is planned for a future installation. The rate that the IT equipment "goes live" in the data center will also shape the solution for the building design, power, and cooling systems. For many industry sectors, using a modular design approach will help in lowering capital spent while at the same time increasing efficiency, reliability, and expandability. The analysis techniques demonstrated in this article can be used as a component to the overall planning and design of the data center. **cse**

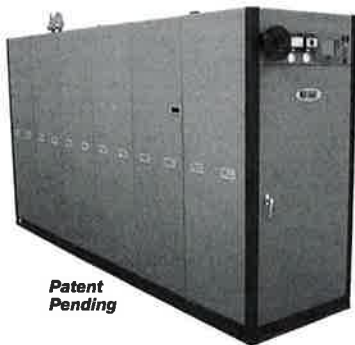
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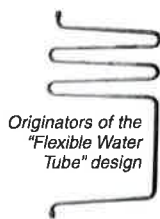
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