water temperature set point remains at the low end of the reset range (generally between 12.8 and 14°C), except during the early morning hours. This low temperature set point makes it even more challenging for the radiative cooler to contribute towards cooling of the building's chilled water loop. On both mornings, there is a 3-hour period from 5:00 a.m. to 7:00 a.m. where the building is being cooled from tank water alone. By 9:00 a.m. both mornings, the chiller is providing 100% of the cooling.

Figure 7 shows monthly results on thermal analysis of the hydronic loop in Las Vegas. The radiative cooler was sufficient to meet the cooling load in 5 months (i.e., Jan., Feb., Mar., Nov., and Dec.) and addressed at least 17% of the total hydronic loop load in the peak summer months (i.e., Jul. and Aug.). Daytime charging accounted for between 25% to 58% of the overall energy charged to the tank. As expected, the predominant portion (>80%) of energy discharged from the tank occurred during the daytime when the cooling load was high.

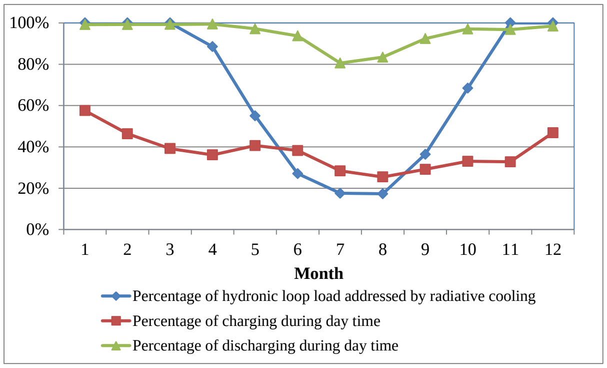

Figure 7: Monthly hydronic loop load analysis

CONCLUSION

Detailed thermal modeling of the photonic radiative cooler was described in the paper. The strategy of using EMS in EnergyPlus to simulate a photonic radiative cooling system, which consists of two hydronic loops coupled via a cold water storage tank, was discussed. Simulation results showed that the radiator surface temperature remains well below the ambient air temperature even during summer in Las Vegas. The radiative cooler was sufficient to meet the entire cooling load during five months and at least 17% of the total hydronic loop load in the peak summer months.

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