Fault detection involving unfavorable interaction effects to enhance the fault diagnostics of refrigeration systems in commercial supermarkets

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Aims and scope

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Abstract

Most HVAC&R machine issues are inherently caused by problems in routine operations, decommissioning problems, improper design, and poor installation, and these issues can result in excessive energy consumption and a short equipment lifespan. Existing fault detection and diagnosis (FDD) methods for refrigeration systems have been considered in supermarket environments. However, typical HVAC systems are generally operated without considering indoor conditions as the drivers of refrigeration operations. This issue leads to unreliable refrigeration data for FDD design. This article systematically proposes a novel fault detection method for faulty HVAC operations related to problems in routine operations and the excessive energy use of refrigeration systems. Four steps are developed as a novel unfavorable interaction strategy to identify abnormal HVAC operations based on identified energy signatures. Outdoor and zonal air temperatures (OAT and ZAT) are concurrently utilized to specify typical area operations for rooftop units (RTUs). A fault detection approach is proposed based on RTU

outliers using plots of OAT and ZAT versus the energy consumption of the refrigeration system based on fixed 10% differences in the indoor relative humidity range. The findings of a case study involving five supermarkets demonstrate the potential to identify the outliers that cause unsuitable dead-band zones and temperature set points for RTU operations, which can lead to excessive energy consumption of refrigeration units. The proposed methodology enhances the data reliability and robustness of FDD for refrigeration systems.

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