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Evaluation of Differential Pressure Setpoint of Chilled Water Pumps in Clean Room HVAC Systems for Energy Savings in High-Tech Industries

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Abstract:
Variable-frequency speed control technologies are widely used in chilled water pumps in clean room heating, ventilation, and air-conditioning (HVAC) systems in high-tech industries to reduce energy consumption. Pumps with variable frequency drivers work based on the reading from the differential pressure sensor placed between the chilled water supply and return lines before the secondary and tertiary pumps. The determination of the differential pressure setpoint must take pipeline topology and material, chilled water flow demand, heat loading, and system equipment aging into account so as to provide operating flexibility for energy conservation while ensuring the secure operation of the clean room. To enhance clean room energy efficiency, a new methodology is proposed in this paper for determining the proper chilled piping pressure setpoint for the pumps. The mathematic model of head loss required for generic secondary and tertiary chilled networks widely used in clean rooms is derived using the Hazen-Williams formula principle. The field testing results confirm the validity of the proposed approach through a practical clean room HVAC system for electronic semiconductor manufacturing, and the energy savings and investment benefits due to the use of the proper differential pressure setpoint are determined.

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Contents

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