



THERMAL ENERGY AND WATER FLOW METERING ON DATA CENTER COOLING SYSTEMS



Data centers have high electrical power consumption, meaning effective thermal management is crucial

“Emerson’s Flexim non-intrusive measurement technology in cooling system monitoring reduces engineering and planning efforts and increases system availability and safety.”



Lars Vogel,
Industry Manager Building Automation,
Emerson



Measuring Task

Non-intrusive, high precision ultrasonic thermal energy and water flow measurement on 20 inch main lines in a cooling system

Modern data centers – large scale facilities housing thousands of high-density IT servers – are among the most energy-intensive building types in operation today. A significant portion of the electrical power consumed by this equipment is ultimately converted into heat, making effective thermal management a mission-critical requirement. Even short-duration temperature deviations can lead to equipment failures, unplanned shutdowns, and substantial financial losses. As a result, data center operators place a strong emphasis on the reliability, transparency, and efficiency of their cooling infrastructure, supported by precise performance monitoring to ensure operational continuity, system resilience, and optimized energy use.

A large global data center operator has carried out an expansion project at one of its locations in Germany - the design for the newly added buildings provides passive cooling via heat exchangers and air coolers, or active cooling supported by chillers. During cold periods, passive cooling is sufficient, and no chiller support is required. During hot periods, chillers provide on-demand support to help keep chiller water temperatures low. A heat pump is used for office space heating, with the primary cooling system serving as the energy sink. This approach achieves high energy efficiency for the cooling system.



Solution

In 2020, Emerson was engaged to propose a solution for measuring thermal energy flow rates using Flexim clamp-on ultrasonic flow measurement technology on 20 inch piping lines downstream of the buffer system.

To support compliance with the European Energy Efficiency Directive (EED), specifically the monitoring and reporting requirements introduced through Commission Delegated Regulation (EU) 2024/1364 and its Annex II, the implementation of Flexim clamp-on ultrasonic flow measurement across the data center's key water and energy metering points would be especially advantageous.

The Delegated Act mandates the measurement and reporting of defined performance indicators in accordance with EN 50600-4, including energy and sustainability KPIs such as total water input, potable water consumption, and waste heat reuse. Flexim flow meters provide a dedicated, non-intrusive solution well suited to these applications, enabling accurate flow measurement at the main water intake, cooling water supply, spray water cooling towers, and building sanitary installations.

With a measurement accuracy of up to $\pm 1\%$, factory calibration supported by Advanced Meter Verification (AMV), and optional re-calibration services, the solution exceeds typical industry accuracy recommendations. Integrated data logging with automated recording intervals and seamless connectivity to building management systems via M-Bus, BACnet, Modbus, or Ethernet ensure reliable KPI data collection and reporting, helping operators meet regulatory compliance while maintaining operational efficiency.

Flexim thermal energy and volume flow meters are a perfect fit for medium to large sized cooling water lines. The non-intrusive system can be installed with redundancy very easily, without ever shutting down the critical cooling, and costs are reduced as bypasses are not needed.

At the time, electromagnetic flow meters from a previous supplier were specified for the remaining measurement points throughout the system. However, due to the high cost associated with an electromagnetic flow meter at 20 inch size, an alternative solution was evaluated.

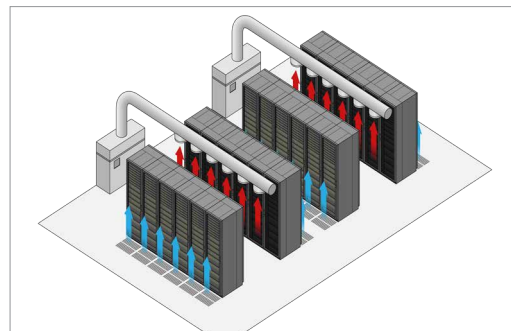
Emerson provided a comprehensive quotation that included the 20 inch application, as well as all other required measurement locations. During the evaluation process, the customer recognized that the advantages of clamp-on Flexim technology extended beyond large-diameter piping and were equally applicable to smaller pipe sizes. While the initial investment showed only a marginal difference in equipment cost, the clamp-on approach eliminated the need for bypass lines and associated isolation valves at each measuring point.

This design simplification resulted in significant overall project benefits. In addition to reducing installation and material costs, it minimized engineering complexity and reduced the physical space required for flow measurement infrastructure. These factors were particularly valuable in the constrained environment of a data center mechanical room.

As a result, Flexim clamp-on ultrasonic flow meters were selected and implemented across all 13 measuring points for one of the 5 buildings. Following the successful deployment and proven performance of the technology, additional buildings within the Frankfurt 4 data center campus were subsequently equipped with Flexim flow measurement solutions.



Chiller for active cooling



Data centre hot and cold aisle layout



Data centre rooftop cooling system installation



Heating, ventilation and air conditioning unit



Non-intrusive ultrasonic thermal energy meter FLUXUS F731 TE

Advantages

- Minimum installation costs, no downtime for critical cooling
- FLUXUS F721 TE measurement uncertainty for volumetric flow: $\pm 1\%$ of reading ± 0.02 ft/s
- Simple retrofitting without opening the pipework and without disrupting operation and supply
- No built-in components, no modifications to the existing pipework system, no new structures required
- Practically wear-free measurement, minimal maintenance effort
- *Advanced Meter Verification* allows reliable assessment of the measurement quality at all times
- Reduced engineering and planning, short delivery times and fast installation results in quicker project realization

Measuring points and instrumentation

Pipelines:	8 inch, 12 inch, and 20 inch
Media:	Water and water-glycol
Measurement systems:	13 x non-intrusive FLUXUS F721 TE clamp-on ultrasonic flow meters