Case study

Penta Infra HAM01 – Propane-Based Cooling for a Hamburg Colocation Data Center

Efficient and Environmentally Friendly Cooling for a Medium-Sized Colocation Data Center

Photo credit: Penta Infra

Key information

Client: Penta Infra

Supplier: Secon GmbH

Type of facility: Colocation Data Center

System start-up: 2025

Penta Infra broke ground in September 2023 on a new 4.4 MW colocation data center in Hamburg, Germany, near the airport.

The facility, named HAM01, opened in the first half of 2025 and provides 2,500 m² of IT space. Six Secon R290 air-cooled liquid chillers were installed on the roof, delivering reliable cooling performance with high energy efficiency (EER 4.15 @ +40 °C).

Next to 4 of the 6 chillers, 4 Secon dry-coolers are located. The 4 chillers with separate dry coolers are equipped with additional integrated hydraulic equipment to seamlessly integrate the dry coolers into the operation. In full free cooling mode, the heat is transferred directly to the ambient air without activating compressors. In addition the dry coolers can be integrated as pre-cooling before entering the evaporators of the chillers. Up to 80 % of annual operating hours can be covered without activating the chillers, significantly reducing energy consumption and supporting a low Power Usage Effectiveness (PUE). The system is designed to meet the German Energy Efficiency Act (EnEfG) requirements and provides operational redundancy, safety features, and flexibility for future integration with district heating networks.

Requirements

The data center required a high cooling capacity to support 2,500 m² of IT space while maintaining a very low PUE of 1.2. It was essential to use an environmentally friendly refrigerant with a low global warming potential. The cooling solution also needed to maximize the use of free cooling, taking advantage of Hamburg's mild climate, and provide redundant and reliable control to ensure continuous operation. Additionally, the system had to be flexible enough to allow integration with future district heating networks for potential waste heat reuse.

Solution

To meet these requirements, six air-cooled liquid chillers were installed on the roof. Each chiller has a refrigerant charge of 64 kg R290 distributed across four individual circuits and is controlled via a master-slave network with two fully redundant and self-monitoring master controllers. Automatic Transfer Switch (ATS) and Uninterruptible Power Supply (UPS) systems ensure operational redundancy.

The system integrates free cooling to reduce active chiller operation. Four additional dry coolers expand the free-cooling capacity. These dry coolers, while separate units, are fully integrated hydraulically and via the control system with the chillers, ensuring seamless operation. Water for the IT space is supplied at 20 °C and returns at 32 °C, and the chillers operate with inverter-controlled capacity regulation for energy efficiency.

Key Benefits and Features:

The cooling solution provides high energy efficiency (EER 4.15 @ +40 °C) and reliable performance for medium-capacity applications. By leveraging free cooling for the majority of the year, energy consumption is significantly reduced, contributing to a low PUE. The system uses a natural refrigerant (R290), reducing environmental impact. Operational safety and redundancy are ensured through the master-slave control network, ATS, and UPS, while additional features such as Fast-Restart, Efficient-Flow, and ultrasonic flowmeters enhance reliability. The design also allows for future integration with district heating networks and reversible heat pumps.

Hamburg experiences mild summers (10–36 °C) and winters (-3–4 °C), which allows extensive use of free cooling. The facility complies with the EnEfG, which mandates PUE ≤1.5 by 2026 and ≤1.3 by 2030 for data centers with loads above 300 kW. HAM01 is designed for a PUE of 1.2 and includes two heat exchangers in the basement to facilitate future connection to a district heating network. Client demand for natural refrigerants is growing, and hydrocarbons are preferred over synthetic alternatives where feasible.

Technical data

Cooling capacity: 6 x 960 kW

Refrigerant charge: 4 x 16 kg (each chiller)

Evaporating temperature: Supply 20 °C, return 32 °C

Condensing temperature: +40 °C

Main components:

- 6 × Secon Stratos VP16-4-2400.S-I4-EFMV-PEC1-FCE-LN air-cooled liquid chillers
- Master-slave controllers (2 redundant masters)
- ATS and UPS
- Integrated three-way-valve for free-cooling
- Dry coolers hydraulically and control-integrated with the chillers
- Ultrasonic flowmeter
- Fast-Restart and Efficient-Flow features

Special features:
Capacity regulation: 4 × Inverter
Energy Efficiency Ratio (EER): 4.15 @ +40 °C
Sound pressure level: 57 dB(A)/10 m

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