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Energy Efficient Cooling Infrastructure for CERN Accelerators

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Following global sustainability concerns, "pursuing actions and technologies aiming at energy savings and reuse"is listed as one of the main objectives for 2021-2025 at the European Organization for Nuclear Research (CERN). This objective extends to the Cooling and Ventilation group, within the Engineering department, who oversees the operation of CERN's cooling infrastructure. This large, energy intensive infrastructure ensures a stable thermodynamic condition for critical accelerator machinery. Over recent years, several actions regarding energy savings have been implemented. Algorithms, mostly based on classical controls, have been developed, leading to energy savings up to 50%. One notable example is the new controller design for the cooling tower plants of the LHC (CERN's largest accelerator), with more than 2700MWh yearly saved. Another recent initiative was a study supported by the digital twin technology concerning efficiency improvements in water distribution systems. The study concluded with the discovery of significant potential for electricity savings. Ongoing research includes further development of methods for energy savings, including more advanced control algorithms which rely on artificial intelligence, as well as simpler ones, with the common goal to utilize available resources in the most efficient way, without compromising performance.

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