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C2Po1E-04: Digital twin for the CRAFT helium cryogenic plant

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The helium cryogenic plant of the Comprehensive Research Facility for Fusion Technology (CRAFT) is equipped with four helium refrigerators, to meet the demands of testing superconducting magnets, conductors, and materials. A digital twin platform, Cryo-DT, has been developed based on the cryogenic plant control system. Cryo-DT uses the Experimental Physics and Industrial Control System (EPICS), integrating the physical and virtual spaces in parallel. In the virtual space, dynamic models of the actual refrigerators in the physical space are developed using the EcosimPro software, enabling simulations to reproduce the real operational processes. This paper provides a detailed explanation of the components and connection architecture of Cryo-DT, the implementation of real-time data interaction and synchronization between actual and virtual processes, and presents the deployment and online simulation results on the CRAFT 1 kW@4.5 K refrigerator.

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