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Modeling and simulation of cryogenic processes using EcosimPro

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Differential and Algebraic Equations (DAE) are especially adapted to model and simulate thermo-hydraulic systems. CERN has developed a dedicated library to model helium cryogenic plants handling usual cryogenic components using DAE with a commercial software called EcosimPro. The aim of such a library is to provide a simple way to model large-scale cryogenic systems and perform dynamic simulations in an acceptable timescale to assist both, control and operation teams, in the optimal commissioning and operation of the cryogenic plants. Moreover, EcosimPro allows users to develop easily models related to their specific components such as cryogenic transfer lines or superconducting magnets. During the last years, this library has been used to model several CERN cryogenic systems, namely the CMS cryoplant, the CERN central helium liquefier, a LHC 18 kW @ 4.5 K refrigerator and a LHC 2.5 kW @ 1.8 K cooling unit. The simulations have been used for different purposes i.e. operator training, virtual commissioning of control systems and control optimization. This paper presents in detail the modeling of some basic components and shows simulation results compared with experimental data obtained on different CERN cryogenic plants.

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