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An optimal control approach for an overall cryogenic plant under pulsed heat loads

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This work deals with the optimal management of a cryogenic plant composed by refrigeration plants in parallel, which provide supercritical helium to pulsed heat loads. First, different strategies to estimate the efficiency of each refrigerator are analyzed. Then, taking into account these efficiencies, an optimal operation of the cryoplant is proposed and studied. It ensures a long and stable operation of the cryoplant during a typical pulsed heat load sequence minimizing the power consumption of the refrigerators. The management of the refrigerators is carried out by an upper control layer, which balances the relative production of helium in each refrigerator. In addition, this upper control layer deals with the mitigation of malfunctions and faults in the system, such as a compressor stop or a turbine stop. The proposed approach has been validated using a dynamic model of the refrigerators and of the distribution system developed with the software EcosimPro based on first principles modelling and thermo-hydraulic equations.

Primary author: Mr GOMEZ PALACIN, Luis (CERN)

Co-authors: Dr BRADU, Benjamin (CERN); Dr BLANCO VINUELA, Enrique (CERN); Dr CHALIFOUR, Michel (ITER Organisation); Dr MAEKAWA, Ryuji (ITER Organisation)

Presenter: Mr GOMEZ PALACIN, Luis (CERN)

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