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Development of MATLAB based dynamic model of the Helium Liquefier / Refrigerator

Content :

Static simulation of the thermodynamic model of the liquefaction / refrigeration process was reported by a number of researchers using commercially available software. Rigorous controls are required for high pressure (HP) and low pressure (LP) stream, turboexpander flow, Joule-Thomson valve opening and Dewar pressure. Performances of the control system can be evaluated by proper dynamic modelling of the liquefaction process and subsequent simulation of the control system in synchronization with the model is necessary. It is planned to implement the entire system by four split models as mentioned earlier, which can be later integrated for the entire process. The design methodology includes mathematical modelling of different sub-systems and incorporation of control system into them which stabilizes load disturbances and process parameter fluctuations by controlling or modifying some manipulated variables using actuators. A dynamic model of the process is developed using some commonly available mathematical software so that it can be easily interfaced with the SCADA developed in open platform and the Programmable Logic Controller (PLC). It will enable the real time check of the control system in line with the dynamic model. First simulation model was materialized by two closed-loop PI controllers – one for HP and other for LP. The LP coarse control is achieved by changing the Variable Frequency Drive (VFD) setting whereas the fine control by manipulating the opening of the by-pass valve only. The other PI controller output drives either the loading or the unloading valve in split rage approach based on process variable lower or higher than the set point. A simulation is performed in MATLAB to depict the performance of the pressure control loop. The results obtained are discussed in this article.

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