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Author: Mr. Tobias Traudt
DLR (German Aerospace Center), Germany, tobias.traudt@dlr.de

Mr. Robson dos Santos Hahn
Germany, Robson.DosSantosHahn@dlr.de

STATUS OF THE TURBOPUMP DEVELOPMENT IN THE LUMEN PROJECT

Abstract

The Liquid upper stage demonstrator engine (LUMEN) to be built at the German Aerospace Center will use the expander bleed cycle. The propellants for LUMEN will be liquid oxygen (LOX) and liquid methane or more specifically liquid natural gas (LNG). The demonstrator will provide a test bed for future component development as well as to enhance the understanding of the operation of the complete cycle. The cycle will feature two turbopumps in order to simplify the turbopump design, while on the same time allowing more freedom for a modular exchange of components. By this approach the DLR hopes to create interest of interested parties to use the LUMEN demonstrator for turbopump component research on demonstrator level. In this paper we will give an overview on the current development status of the turbopumps. The critical design phase (CDR) is finished and the design of the components will be discussed as they are ready for manufacture. Extensive CfD work has been done since the preliminary design phase in order to make sure that the LOx and LNG pump will perform as expected. On the turbine side a full 3D simulation has been performed. The design of the housing for the oil lubricated off the shelf hybrid bearings as well as the design of the shaft has been completed. To ensure smooth operation of the turbopumps throughout the operational envelope of the LUMEN demonstrator, the critical frequencies of the turbopump rotor assembly have been determined and verified by FEM calculations. Finally we will give an overview on the necessary future steps to put the turbopumps into service.