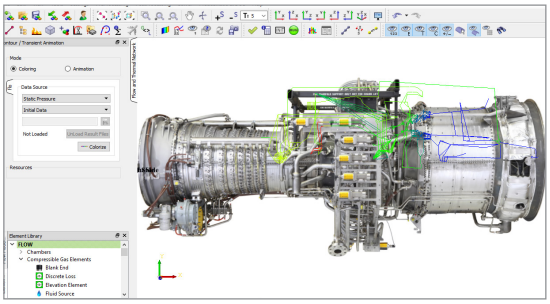
Case Study

GE's Flow Simulator Increases Lifespan of BHGE's Gas Turbine

Challenge

The BHGE Secondary Flow & Heat Transfer team is dedicated to a large variety of analyses in the gas turbine design process. The scope is the estimation of the secondary air requirements for the entire turbine, including rotor, casing, flow path cooled components, bearings, etc. In addition, the team provides the boundary conditions for the thermo-mechanical analyses of the main components of the engine, such as nozzles and blades, as well as the support for estimation of the performance of the thermodynamic cycle, the thrust sensitivity for the selection of the bearing, and other side activities.

Looking at hot gas path components, the aim of the thermal design process focuses mainly on two aspects: on the lifespan, directly connected to control the local temperature and thermal gradients, and on the reliability of the components. In addition, it is important to pay attention to the required amount of cooling mass flow and the back flow margin (BFM) that quantifies the pressure margin to hot gas ingestion through a cooled component wall. The evaluation of the BFM cannot be performed in a deterministic way, but should be conducted statistically, taking into account all uncertainties of geometrical and thermo-fluid dynamics boundary conditions. Therefore, the component failure is evaluated probabilistically, thus determining the probability of failure.

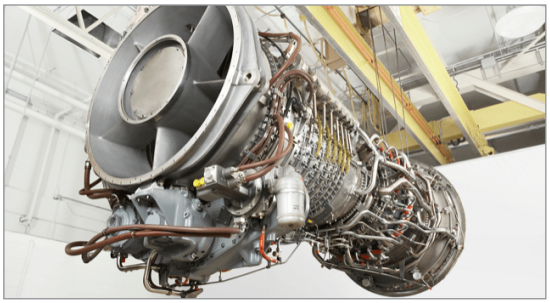


Solution - Flow Simulator

1. Smart GUI that allows to upload in the background the cross-section of the engine. This is very helpful to position the elements of the network and, therefore, to have a clear overview of the model and its results. In addition, the GUI should permit one to perform some measurements directly on the imported cross section for a fast model setup.

2. A large database of 1D-elements suitable to simulate all the features of the secondary flow network of an entire gas turbine. Thanks to the many correlations implemented and possibility to tune and implement custom correlations, Flow Simulator has become a very flexible software.

3. Stable and fast solver together with a fast set up of multiple runs. This is important to simulate the behavior of the system in different working conditions of the engine or performing statistical multirun approaches for a robust design. The tool is successfully employed for the analyses of the gas turbines of the BHGE fleet, as well as in the design and validation process of the recent gas turbines of the NovaLT family.



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