NLR Thermal Management Tools for Hydrogen Powered Aircraft

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BACKGROUND

A shift to aircraft electrical power trains driven by batteries and/or fuel cells create more waste heat at lower temperature levels creating thermal challenges

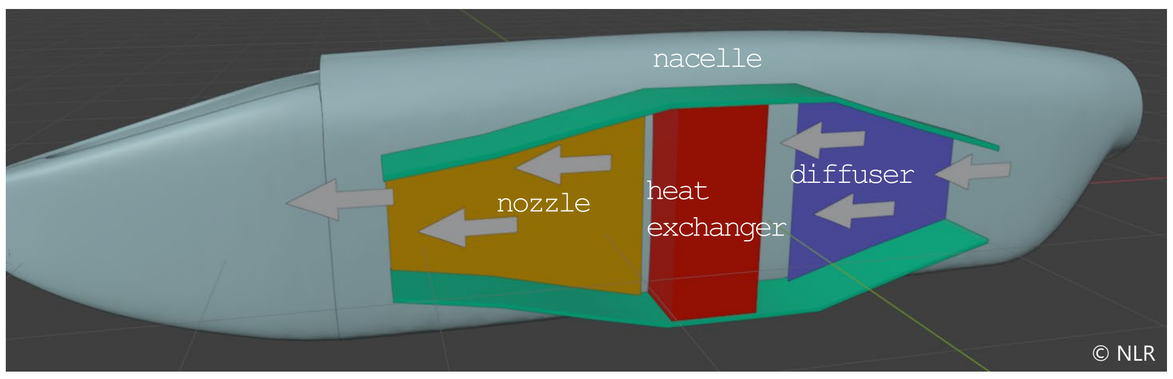
- 50-300 kW >500 °C vs 1-4 MW at 95 °C
- Bleed air pressurisation vs Electrical compressor
- Small RAM air HX's vs Large RAM air HXs
- TO straightforward vs TO drives TMS design

HOW?

- Step 1: Development of stationary subsystem models
- Step 2: Development of transient subsystem models
- Step 3: Combine models to a platform model
  - Define and run defined use cases
- Step 4: Perform model verification with demonstrator loops of LiT projects and EU Clean Aviation and Clean Hydrogen projects:
  - TePS 2PPL, HAPSS, TePS VaCS, FC conditioning Pipistrel Range extender
  - Thema4HERA, HEROPS,

RESULTS

- 1-D RAM air scoop optimization model using a 2D air HX model in MATLAB



OBJECTIVE(S)

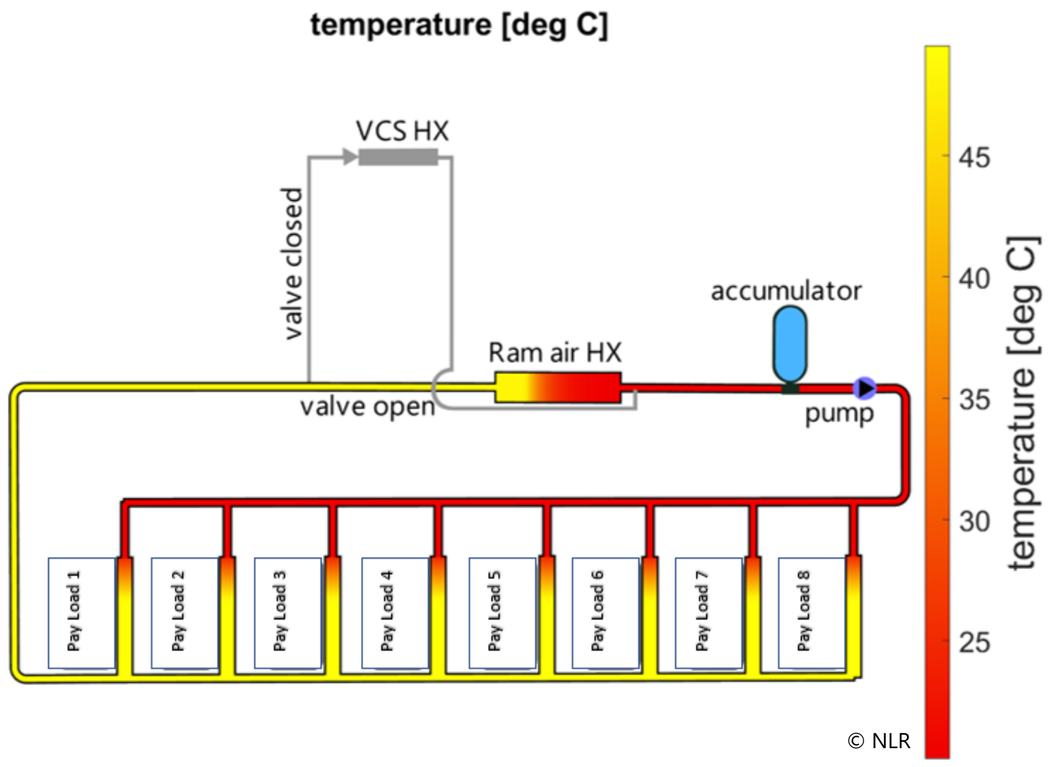
- To develop Thermal Management System (TMS) Modelling Tools for new HER aircraft concepts
  - To predict TMS concept design performance in critical flight phases for concept trade-offs
  - To verify and optimise TMS design and operational performance in all flight phases

WHY?

- Improve the knowledge on new HER aircraft TMS concepts
  - To advice NL SME in TMS subsystem and component developments, like 2-Φ MPLs, Fuel Cell Turbocompressors, RAM air HX's, Vapour Cycle Systems)
  - To become a valuable partner and co-developer of TMS systems for Airbus/Leonardo and Tier 1 suppliers like Honeywell, Liebherr, Collins and P&W

RESULTS

- Stationary 2-Φ MPL for fuselage P/L cooling in MATLAB
  - Plug and play model to model systems up to 8 Power Electronics units in parallel



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