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V1	23.02.2023	First Version	Marcus-Benedict Buntz (AER)	Markus Schudy (AER)

List of Acronyms and Abbreviations

Abbr.	Description
2-PC	Two-phase cooling
BoP	Balance of Plant
BRAVA	BReakthrough fuel cell technologies for AViAtion
DI	Deionized
EGW	Ethylene glycol water
FC	Fuel Cell
FSTC	Full scale test cell
GDL	Gas diffusion layer
H2	Hydrogen
HFE7100	Hydrofluoroether fluid of 3M™
IF	Interface
LEL	Lower explosive limit
MEA	Membrane Electrode Assembly
MeOH	Methanol
MPL	Mechanically Pumped Loop
NLR	Netherlands Aerospace Center
PEM	Polymer electrolyte membrane or Proton-exchange membrane
PGS	Power Generation System
ZAL	Zentrum für Angewandte Luftfahrtforschung
ZEROe	Airbus initiative towards zero emission aircraft

1. Executive Summary

This document contains the requirements for a two-phase cooling (2-PC) system that is going to be used for cooling a fuel cell (FC) prototype within the project of BRAVA. The focus of this report lies on the interface definition between fuel cell and cooling loop as well as the operation limits of the coolant loop and fuel cell. The requirements derive from the top level requirement of the propulsion system stated in D2.1 Deliverable "PGS system architecture and high level requirements on PGS level and the sub-system requirements".
The following figure shows the classical architecture for a two-phase mechanically pumped loop (MPL) cooling architecture. The main components of this architecture are the evaporator which in this use-case is the to be cooled fuel cell. Within the fuel cell cooling channels an isothermal boiling process occurs which absorbs the reaction heat of the fuel cell.
The heated two-phase flow is then guided to the condenser, where the heat exchange to the ambient occurs. For controlling the pressure and thus the temperature in a two-phase system an accumulator is used. To circulate the fluid in the loop a pump is used. An electrical preheater is installed to control the evaporator inlet temperature.

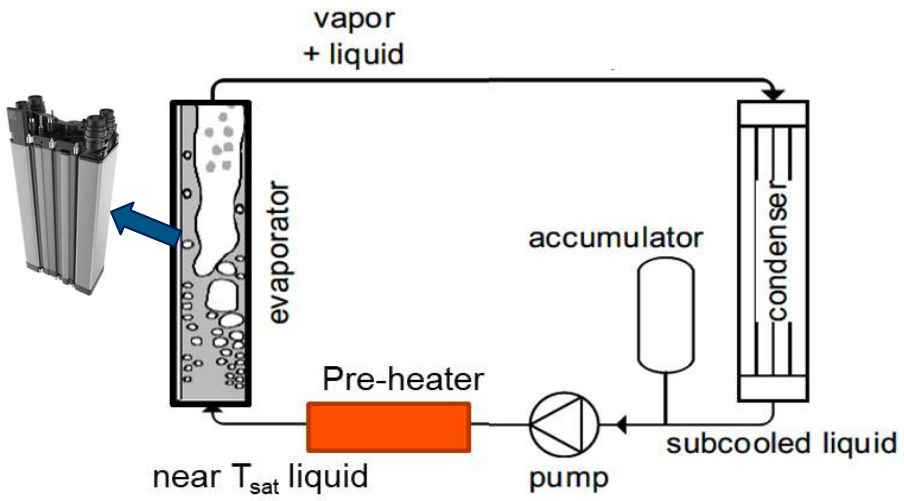

Fig. 1: Classical Two-phase Mechanically Pumped Loop (MPL) Architecture. The evaporator is in this use case a fuel cell stack (Photo EKPO NM12, https://www.ekpo-fuelcell.com/en/products-technology/fuel-cell-stacks)

This document contains several assumptions made till the time for release. If new requirements happen to be considered important, they will be updated in this document after the report date to make sure the developments of the project are most up to date.

5. Acknowledgments

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1	A-D	AIRBUS OPERATIONS GMBH
2	A-E	AIRBUS OPERATIONS SL
3	AER	AEROSTACK GMBH
4	CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
4.1	UM	UNIVERSITE DE MONTPELLIER
5	HER	HERAEUS DEUTSCHLAND GMBH & CO KG
6	LTS	LIEBHERR AEROSPACE TOULOUSE SAS
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