Bosch Engineering

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GIANTLEAP

Fuel Cell System Design and Balance of Plant

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Fuel Cell System Design

Main focus for Bosch Engineering within GiantLeap project is the design and development of the fuel cell system and balance of plant. This includes all necessary subsystems and components under consideration of function, availability, cost, and durability over lifetime. In addition, Bosch Engineering is responsible for implementation and calibration of the main controller, hence integrating the control and diagnostic algorithms developed throughout the project team.

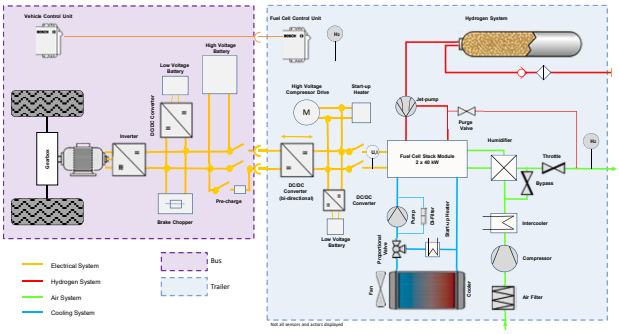

Figure 1: Pipe and instrumentation diagram of the GiantLeap fuel cell system (simplified)

System Requirements

- *Hydrogen fuel cell system for range extension of electric busses*
- *Minimum charging power of 60kW @ 600V nominal voltage (system output, end of lifetime)*
- *Target price for series production < 500 EUR/kW*
- *Target lifetime > 12.000 hours @ 95% availability*
- *Tank to wheel efficiency > 45%*
- *Ambient temperatures -15°C to 35°C*
- *Reduced requirements for demonstrator vehicle*

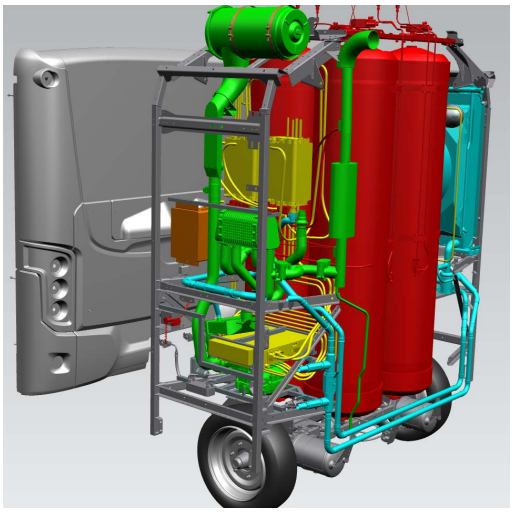

Figure 2: CAD drawing of the main system components

Subsystem Stack

- *2 x ElringKlinger NM5 40kW PEM Stack Module*

Subsystem Air Supply

- *Mechanical and chemical air filtration (Mann&Hummel)*
- *Rotrex C15-20 air compressor with Bosch SMG138 electric motor*
- *Indirect charge air cooler (Mahle), connected to main system cooling circuit*
- *Fumatech Ecomate H50 hollow fibre air humidifier, not controlled*
- *Passive shut-off valves (spring loaded) for cathode intake and outlet ports (Bosch Engineering Prototype)*
- *Bosch DV-E 5C throttle valves for back pressure and system bypass control*

Subsystem Hydrogen Supply

- *4 x 8 kg hydrogen tanks with integrated solenoid shut-off valves and mechanical pressure regulator (Wystrach)*
- *Hydrogen low pressure regulation valve Bosch HGI F1*
- *Integrated anode recirculation via jet pump, including water separation, purge, and drain valves (ElringKlinger)*
- *Hydrogen concentration monitoring in stack exhaust, stack housing, and tank compartment (AppliedSensors)*

Subsystem Cooling

- *80kW cooling capacity @ 40°C ambient temperature for main system cooling circuit*
- *De-ionized coolant Glysantin FC G20-00/50 (BASF)*
- *2 x Pierburg CWA 400 G3 coolant pumps*
- *2/3-way bypass control valve (Buschjost)*
- *Webasto HVH 7kW start-up heater*
- *Separate low temperature cooling circuit for power electronics*

Subsystem Power Electronics

- *Bosch InvCon 2.3 inverter for air compressor motor*
- *Brusa GIC246 galvanically isolated bi-directional DC/DC converter*
- *Auxiliaries run directly on stack voltage level*

Subsystem Controls

- *Bosch FCCU EGC4-C66 fuel cell control unit with custom software*

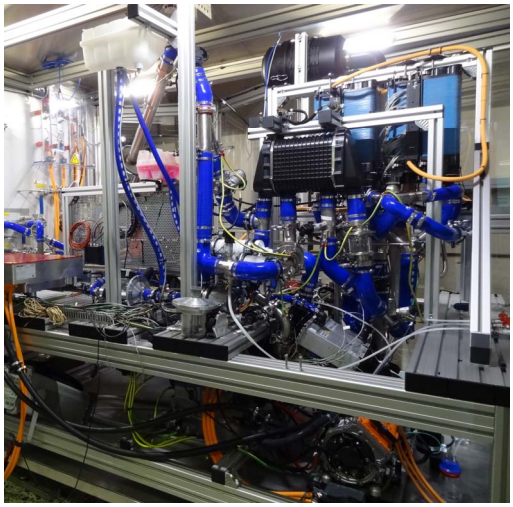

Figure 3: GiantLeap fuel cell system on the test bench

Hannover Messe 2019, April 1st – April 5th, Hannover

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