A Reduced Scale Mobile HFC Power Generating Unit for a Hybrid Propulsion System of a Park Railway Train

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RCC Railway Competence and Certification

13th International Hydrail Conference, Rome, June 6-8, 2018
Content:

• Introduction of RCC
• Project History
• Operation Environment
• Train Configuration
• Performance Requirements
• Hardware Selection
• The Solution
• Next Steps
• Impressions
Introduction of RCC:

Certification/Homologation of Railway Vehicles
Accredited Conformity Assessment Body

• Notified Body (NoBo) – Assessments of railway vehicles according to TSI
• Assessment Body (AsBo) – Independent safety assessments according to the CSM
• ECM Certification Body – Cerification of Railway Maintenance Organisations

Clean Rail Technology

• Systemic Consultancy – focused on rail, based on the integrated energy approach
• Development of fuel cell- and hybrid propulsion systems
• Support/project development regarding hydrogen solutions, logistics and homologation
Project History

Original Task in late 2017: Supply an HFC Power Generating Unit

• Power supply for track side measuring equipment (e.g. noise measurements)

• Replacement of Diesel based power units for temporary onboard measuring equipment

• (Back up) power supply for temporary work infra structure
Project History

On Top Tasks (early 2018)

• Build a hydrogen hybrid locomotive to be presented at the 90th anniversary of the Liliputbahn in Vienna

• Present the hydrogen train as an ÖBB-promotion during TRA in Vienna, April 16-19, 2018

• Project Kick Off: February 2018

→ Challenge: Complete Project realization within 9 weeks!!!
Operation Environment

The Vienna „Liliputbahn im Prater“

- 4km / 20min per round trip → 15kph / 10mph average running speed
- Gauge: 381mm (15”)
- Minimum radius 20m
- 4 stops
- Maximum grade 14‰
- approx. 170,000 passengers/year
Train Configuration

Three Vehicle Consist, total weight approx. 5,0t

- **Locomotive**
  - Based on an existing frame
  - New car body
  - New bogies
  - Pneumatic brake
  - Wheel diameter: 235mm
  - Weight: approx. 2,3t
  - Mech. part built by TEMO

- **Tender**
  - Existing flat car
  - Pneumatic brake
  - Weight: approx. 0,5t
  - Carries the pallet mounted HFC PGU

- **Parlor Car**
  - Up to 16 passengers
  - Pneumatic brake
  - Max. Weight: approx. 2,2t
  - Originating from 1928
  - Modernized 2015
Performance Requirements

Train consist and show case application determine system parameters

→ Simulation of operating cycles
→ Matching of batteries and FC

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Hardware Selection

Main Questions:
• How can we streamline the system to minimize risk?
• What is available off the shelf?
• Which components must be project specific?

First Decisions:
→ Hydrogenics HD8/200 is in stock and fits into main requirements
→ Standard BLDC traction motors / motor controllers to minimize drive train design works
→ Floating DC bus between FC and battery saves one customized DC/DC converter
→ No way around customized DC/DC converters for auxiliaries and sensor power supply
→ Industry standard main controller instead of railway specific controller
The Solution – a Modular Concept

• Pallet Mounted Power Supply Module
  - FC module (FC, BOP, 2x DC/DC, master switch, master controller, load contactors, fuses, cutout, H2 and pressure sensors, safety valve etc.)
  - tank module (type 3 tank, TPRD, pressure regulator, H2 sensors, tank receptacle)
  - additional storage box for refueling equipment (from cylinder bundles, easy to use)

• Traction module („Locomotive“)
  - drive controls
  - pneumatic equipment and ballast
  - traction motors and batteries

• Electric interfaces
  - High voltage connection
  - 24V power supply connection
  - Sensor and indicator wires
  - Emergency shut off
The Solution – System Parameters

• Fuel Cell
  - Peak power: 10kW
  - Continuous power: 8.5kW
  - Power Output: 40-70VDC
  - Maximum current: 160A

• Battery
  - 5 x lead acid battery
  - Voltage: 12V
  - Capacity: 75Ah each

• Locomotive Parameters
  - 2 traction motors
  - 2-stage mech. transmission
  - electric air compressor
  - full cab controls

• Hydrogen Storage
  - Storage pressure: 200bar
  - 85l type 3 tank
  - 1.17kg of Hydrogen
  - 38kWh of stored energy

• Traction motor / controller
  - BLDC technology
  - Rated power: 5kW
  - Maximum power: 7.5 kW
  - Input up to 80VDC
  - Weight: 11.6kg
Next Steps

• Further presentations
  - June 11, 2018: 8. vie-mobility Symposium, Vienna
  - June 12, 2018: RailContact 2018, Graz/Oberwart
  - June 16, 2018: Private excursion to the Liliputbahn, Vienna

• Definition of use – short term / long term
  - further use on the Liliputbahn
  - get back to originally intended utilization
  - alternative use cases

• System Upgrades
  - Adoption of (electric) interfaces for future use if necessary
  - Modification from „presentation conditions“ unit into „working conditions“
  - CE Certification of FC-module (tank module already has CE)

→ And then: Let‘s go for something bigger!!!
And now:

Let me take you on a ride through the Vienna Prater with Austria‘s first hydrogen powered train!
Thank you for Your Attention!

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