Development of the control description for the LCHRS refuelling process

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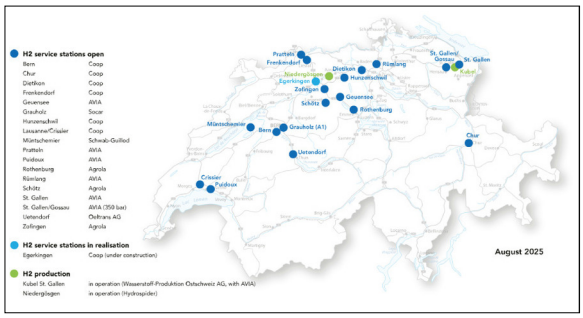
Introduction: The mobility sector is changing, especially in the area of electrification of personal vehicles. Even if the share of battery electric vehicles in 2025 in Switzerland was only 5.2 %, of the newly registered cars, they accounted for 20.7 % in 2023 and 19.0 % in 2024. Unfortunately, in neither of these two statistics, hydrogen vehicles are mentioned. Nevertheless, the industry is growing. The growth of hydrogen mobility in Switzerland is not coming from the public with personal vehicles, but from the industry where about 20 companies started using heavy-duty vehicles for the transportation of goods. The first transport trucks in Switzerland have mainly been Hyundai trucks. Now other manufactures started bringing hydrogen trucks on the market and over the course of 2025 the first IVECO hydrogen semi-trucks have arrived in Switzerland.
To support the increase in hydrogen vehicles, Switzerland needs a well-established refuelling station network. At the moment, there are 18 hydrogen refuelling stations in operation, with Coop and AVIA being the two main operating companies. To enable the transition to a more sustainable mobility sector, the IET Institute for Energy Technology developed a modular hydrogen refuelling station with the goal of lowering the investment costs for small on-premise refuelling stations that may be used by logistics companies.

Approach: Within this thesis, the refuelling process was developed, i.e. the refuelling protocol that is necessary to deliver hydrogen from the storage to the vehicle, for the refuelling station developed by IET. For this, the necessary standards have been researched and evaluated. Whereas the SAE and ISO standards define the refuelling process on a global level, there is also a European standard developed by CEN that has been adopted as a Swiss national standard by SNV. After evaluation of the existing standards and standard protocols a refuelling protocol based on the SAE J2601 has been adapted to the specific needs of the hydrogen refuelling station at IET.

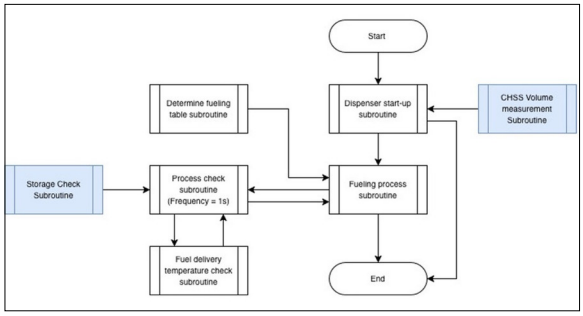
Result: The Result of this thesis are two control descriptions: One for H35 refuelling without communication to the vehicle and one for H70 refuelling with an IR-data communication to the vehicle. For this new process routines and calculations have been developed to enable the estimation of the size of the vehicles storage system and to enable the process control to follow the pressure ramps needed for refuelling. In addition, several sensors have been evaluated for an optimised positioning for a later version of the refuelling station, in order to optimise the process control trough more precise measurements.
The next step following this thesis is the implementation of the developed control description at the refuelling station, as well as an ambient temperature sensor fulfilling all measurement requirements of the process description. In addition further evaluations for the sensors and system behavior are needed to be able to validate the calculations done with reference measurements.

Map of all Swiss hydrogen refuelling stations.
https://h2mobilitaet.ch/en/filling-stations



Overview of the standards connected to hydrogen refuelling
Own presentment

Overview of the H35 non-communication refueling subroutines
Own presentment



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