

WHITEPAPER – NECESSITY FOR H₂ REFUELING STATIONS FOR MEDIUM-DUTY FUEL CELL ELECTRIC VEHICLES IN THE U.S.

1. GOAL:

Ultimately, we need a H₂ station network that is not limited to a vehicle class or application but rather highly compatible, flexible, and reliable to maximize utilization for stations and vehicles. The goal of this whitepaper is to establish a common interest by USCAR automakers to accelerate the development of hydrogen refueling stations for medium-duty (MD) fuel cell electric vehicles (FCEV) with 10-35 kg of on-board hydrogen storage. An additional goal is to request assistance from the hydrogen infrastructure industry, Department of Energy (DOE), and other affiliated stakeholders to accelerate the development of H₂ stations capable to refuel MD FCEVs, including the modification of light-duty (LD) stations for SAE J2601 Category D, heavy-duty (HD) stations to support MD FCEVs, and future H₂ refueling stations to accommodate MD FCEVs. This includes, but is not limited to, the completion of a Hydrogen Station Equipment Performance device (e.g., HySTEP trailer) for use to evaluate H₂ refueling stations capability to fuel MD FCEVs.

The content of this whitepaper provides the background of the need, summary of the requirements, and proposed development needs. As recognized by the auto industry, fuel cell electric vehicles offer significant advantages in the medium-duty applications over other zero emission and alternative fuel vehicles, including payload, fueling time, uptime, and total cost of ownership. The current deployment of hydrogen stations through various funding sources and other activities lacks the vision to support the future for the MD FCEVs.

2. BACKGROUND

The USCAR members (Ford, General Motors, and Stellantis) recognize the commercial MD vehicle (class 3 to 6 van/truck with 10K to 26K lbs. GVWR) market as a critical segment for the economy and emissions. Commercial MD vehicles are an essential tool for a broad spectrum of important vocations (e.g. utilities, freight, etc.) and have aggressive regulatory/corporate goals to achieve zero emissions, either using batteries and/or fuel cells. Most studies indicate battery technology will have a notable gap in capability to satisfy the wide range of vocational needs for a commercial vehicle fleet application. H₂ fuel cell technology is a promising solution to achieve the high MD vehicle demands, however, absent a capable H₂ infrastructure network, commercial fleets will be reluctant to shift to H₂ fuel cell technology.

Today, there are over 15,000 fuel cell light-duty (LD) vehicles on the road in California. According to the Hydrogen Fuel Cell Partnership, there are approximately 58 light-duty H₂ stations in California with plans for 176 LD stations by 2026. These previously funded and built LD stations utilized the initial SAE J601 fueling protocol that limited the vehicle fueling capacity to a maximum of 10 kg. This limitation would not allow MD FCEVs to refuel at these stations with a capacity of 10 to 35 kg. The latest release of SAE J2601 includes a category D for greater than 10 kg fueling although existing and recently funded LD stations are not including this category D fueling capability. LD H₂ stations are typically limited in fueling capacity due to a variety of factors which include compression capability, H₂ storage size, cooling capacity, and back-to-back refueling time interval.

In addition to LD fuel cell vehicles, there are fuel cell drayage trucks operating at the California ports as well as other Class 8 HD fuel cell trucks that are planned for operation between the ports and close distribution centers. Drayage trucks at California ports are creating demand for HD H₂ stations along state highway corridors and within existing facilities (i.e., H₂ forklifts at warehouses). OEMs engaged in Class 8 over-the-road fuel cell applications are investigating networks along interstate highway routes

for specific customers. HD FCEVs and Class 8 tractor trailers require much larger hydrogen on-board hydrogen storage to support greater payloads and longer distance travel and thus are targeting greater than 35 kg H₂ refueling capability. The HD H₂ stations are (anticipated) to target ~50+ kg H₂ refueling and are presently considering different nozzle diameters to accommodate higher flow rates to achieve lower refueling times. The HD stations stakeholders are not so willing to allow MD trucks at their HD dedicated H₂ stations.

To summarize, the LD H₂ Stations are not being designed to accommodate greater than 10 kg H₂ refueling, and the HD H₂ Stations are not being designed to accommodate 10-35 kg H₂ refueling. It is extremely difficult to imagine the H₂ infrastructure industry will build three independent H₂ station networks, each dedicated to a specific H₂ FCEV segment. For existing LD stations, upgrades are needed according to SAE J2601-2020 (with category D), allowing for 10-35 kg hydrogen refueling. For future H₂ refueling stations, funding should only be provided if stations are built according to SAE J2601-2020 (with category D) or other protocols, allowing for refueling FCEVs with 10-35 kg hydrogen storage.

3. REQUIREMENT SUMMARY FOR MD VEHICLES

- Vehicle On-board Storage Capacity: 10 to 35 kg
- Fueling time for existing/upgraded Light-Duty Stations using SAE J2601-2020 with category D (H70-T40D):
 - 10kg up to 4.3 minutes fill times (based on 20 bar to 700 bar with 137 liter $V_{station_D}$)
 - 35kg up to 15.2 minutes fill times (based on 20 bar to 700 bar with 137 liter $V_{station_D}$)
- Fueling time for future stations (using higher flow fueling protocols in development):
 - 10kg up to 3 minutes fill times
 - 35kg up to 9.5 minutes fill times
- Time between fills: Target 6 fills per hour based on tank size of 25 kg fills
- Typical State of Charge Range: 97% to 100%
- Minimum/Maximum Gas Temperature: -40°C / 85°C
- Maximum Dispenser Pressure: 87.5 MPa (70 MPa NWP)
- Maximum Flow Rate: 60 g/s (existing/upgraded LD station), 90 g/s – 120 g/s (future station)
- Communication Protocol: SAE J2799
- Hydrogen Fuel Quality: SAE J2719 and ISO 14687
- Station layout to accommodate medium-duty vehicle sizes, weight classes, and maneuverability

4. DEVELOPMENT NEEDS

- Engage H₂ station, infrastructure, energy suppliers, and stakeholders to upgrade existing LD H₂ refueling stations and/or include future funding to allow filling 10kg-35kg for MD FCEVs.
- Support the required tools and devices (e.g., HyStep) to evaluate H₂ refueling stations.
- Advance the development of high flow fueling protocols and interfaces (e.g., receptacles).
- Encourage and analyze interaction of LD/MD/HD FCEVs with highly adaptable H₂ stations.
- Determine H₂ station deployment and location strategy to accelerate MD FCEV adoption.
- Incorporate lessons learned for LD H₂ stations to improve customer utilization.

5. Submitted and concurred by:

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These individuals submitted this document with the intention to highlight an important gap that needs to be solved by the industry for medium-duty fuel cell electric vehicles.