

INCREASE YOUR

H₂IQ

hydrogen.energy.gov

The #H2IQ Hour

Today's Topic:

Overview of H₂ Rescue—Hydrogen Emergency Relief Vehicle

This presentation is part of the monthly H₂IQ hour to highlight hydrogen and fuel cell research, development, and demonstration (RD&D) activities including projects funded by U.S. Department of Energy's Hydrogen and Fuel Cell Technologies Office (HFTO) within the Office of Energy Efficiency and Renewable Energy (EERE).

This webinar is being recorded and will be available on the [H2IQ webinar archives](#).

Technical Issues:

- If you experience technical issues, please check your audio settings under the “Audio” tab.
- If you continue experiencing issues, direct message the host, Cassie Osvatics

Questions?


- There will be a Q&A session at the end of the presentation
- To submit a question, please type it into the Q&A box; **do not** add questions to the Chat

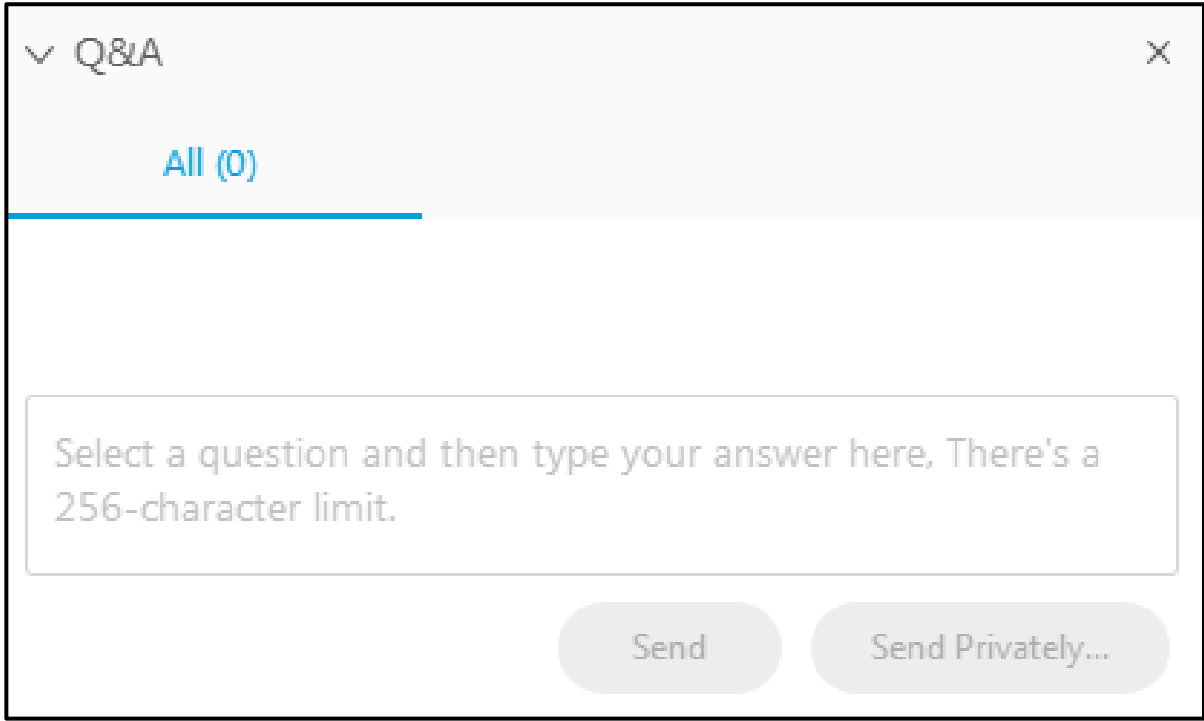


The #H2IQ Hour Q&A

Please type your questions
into the Q&A Box

Open the Q&A panel

To open the Q&A panel, click Panel options (Windows)
or More options (Mac)  and select **Q&A**





H2RESCUE A NOVEL FUEL CELL POWERED EMERGENCY VEHICLE

DESIGN AND DEPLOYMENT OF PEM FUEL CELL- BATTERY POWERED HYBRID EMERGENCY RELIEF TRUCK

Mr. Nicholas Josefik

Ms. Carol Bailey

Construction Engineering Research Laboratory

U.S. Army Engineer Research and Development Center



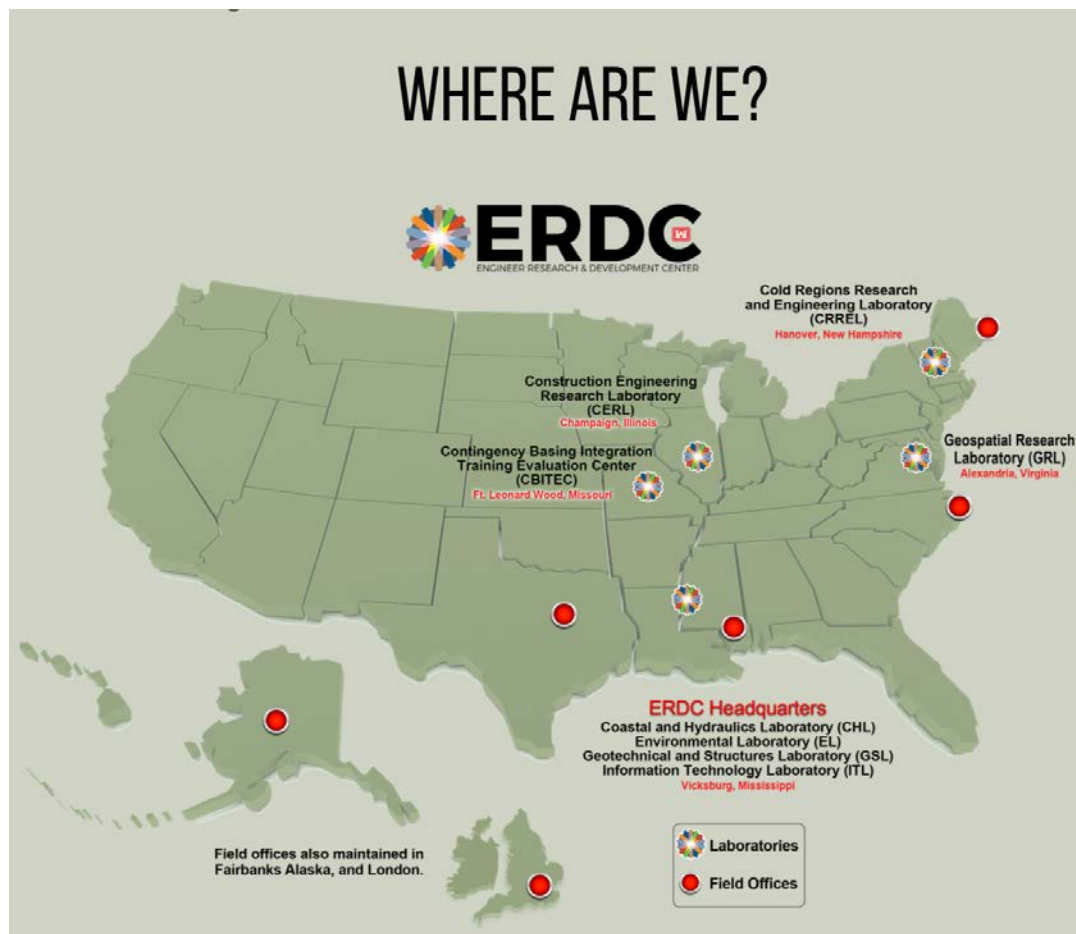
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WHO IS ERDC

ERDC-CERL

ERDC is the premier research and development facility for the U.S. Army Corps of Engineers. It consists of seven laboratories at four geographical sites, with more than 2,000 employees.



Vicksburg, MS

- Coastal and Hydraulics Laboratory (CHL)
- Environmental Laboratory (EL)
- Geotechnical and Structures Laboratory (GSL)
- Information Technology Laboratory (ITL)

Champaign, IL

- Construction Engineering Research Laboratory (CERL)

Hanover, NH

- Cold Regions Research Engineering Laboratory (CRREL)

Alexandria, VA

- Topographic Engineering Center (TEC)

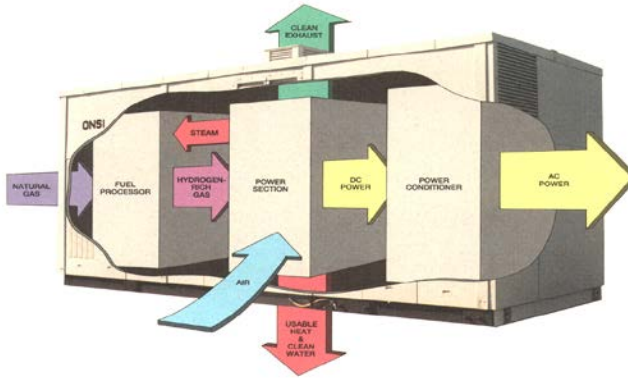


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ERDC-CERL Fuel Cell, Hydrogen, and Electrolyzer Research

- Policy
 - Strategy and Roadmaps
 - Increased resiliency and energy security
 - Improved energy generation efficiency
 - Reduction in electricity costs
 - Reduction in fossil fuel consumption
 - Overall reduction in criteria pollutants
- Stationary Fuel Cells
 - Emergency Backup Power
 - Prime Power
 - Microgrid Integration
- Mobile Fuel Cells
 - Over the Road Vehicles
 - Forklifts
- Hydrogen Research
 - Production
 - Storage
 - Delivery –"Hydrogen Hubs"
 - Wastewater to Hydrogen

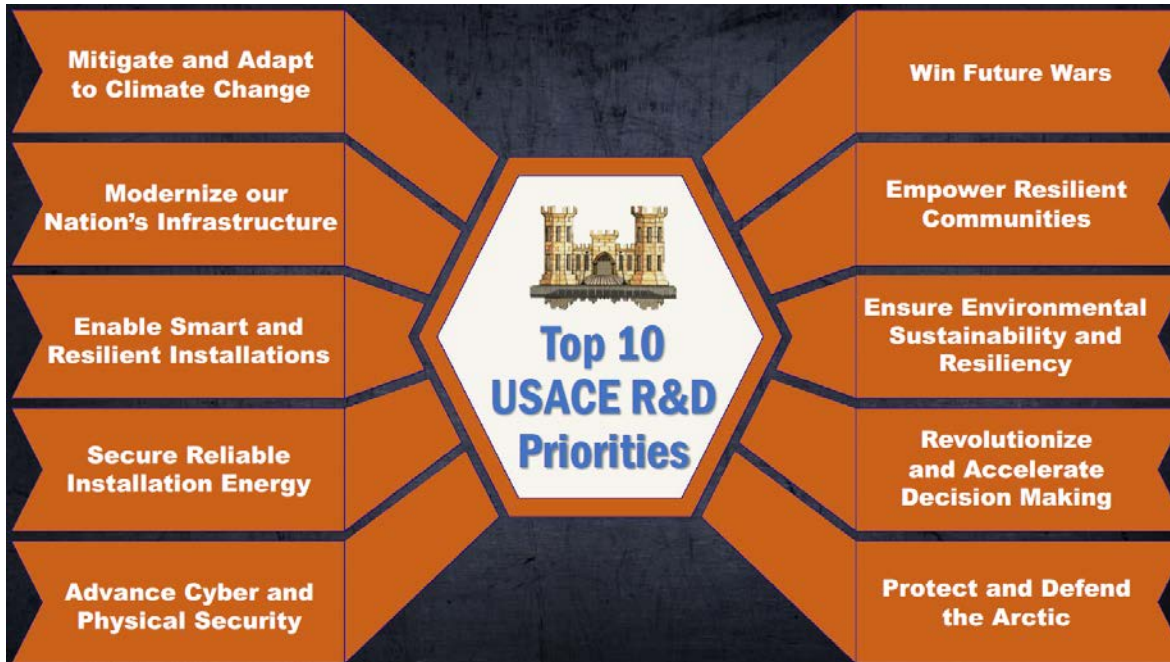


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USACE R&D PRIORITIES

ERDC-CERL Fuel Cell, Hydrogen, and Electrolyzer Research



#1 Mitigate and Adapt to Climate Change

- Support Resilient and Renewable Energy Production

#5 Enable Smart and Resilient Installations

- Develop and integrate advanced technologies to modernize military installations and enhance their strategic readiness
- Promote resilient installations by using a coordinated approach to energy, water, and waste management

#6 Ensure Environmental Sustainability and Resilience

#7 Secure Reliable Installation Energy



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H2RESCUE

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PARTNERS

H2Rescue

- **U.S. Department of Energy- Hydrogen and Fuel Cell Technologies Office (HFTO)**
- **U.S. Department of Energy - Vehicle Technologies Office**
- **U. S. Army Ground Vehicle Power and Mobility (GVSC)**
- **U. S. Army Corps of Engineers – ERDC-CERL**
- **Science & Technology Directorate- U.S. Department of Homeland Security**
- **Federal Emergency Management Agency**
- **U.S. Naval Research Laboratory**
- **Accelera by Cummins™**



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PROJECT GOALS

H2Rescue

Purpose:

- Design, build, test and demonstrate PEM fuel cell-battery powered hybrid emergency relief truck that can complete 180-mile round-trip to relief destinations and provide up to 25 KW of load following exportable power for a sustained period of up to 72 hours once on-site.

Expected goals and outcomes:

- One Department of Transportation (DOT) road-certified (for demonstration purposes) hydrogen fuel cell Class 7 emergency truck with a primary power PEM fuel cell-battery hybrid power system capable of providing both propulsion and stationary export power
- Fuel cell-battery powered hybrid emergency relief truck performance data through the required data templates. Test data report will include comprehensive performance data, safety data, and a listing of issues identified during operation of the unit



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POTENTIAL IMPACT

H2Rescue

Economic/Market Opportunity:

- Emergency Response
- Electric Utility Companies
- Department of Defense

Emissions:

- 2.5 metric tonnes of carbon dioxide annual reduction of GHG emissions
 - Compared to the diesel truck and genset combination
- 1,825 gallons of diesel fuel could be displaced per truck annually.

Commercialization Opportunity:

- Proof of technical feasibility for a fuel cell powertrain system adapted to export power as a mobile power generator
- Critical 1st step in identifying improvements and enhancements moving towards full production.
- Minimize impacts of planned outages and improve unplanned outage resiliency



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OVERVIEW

H2Rescue

Timeline

- Project Start Date: October 1, 2020
- Design Complete: November 2, 2021
- Build Complete: March 3, 2023
- Project End Date: September 30, 2023

Field Demonstration

- West Sacramento: (4/10-4/14)
- National Renewable Energy Laboratory (NREL) Golden Colorado: (5/8-5/17)

Vehicle Showcase

- US Army Ground Vehicle Systems Center , Warren, Michigan (5/31)
- DOE Headquarters -Forrestal Building, Washington, DC (6/5)
- FEMA Headquarters, Washington DC (6/6)

Dynamometer Testing

- University of California Riverside, Riverside CA (6/26)



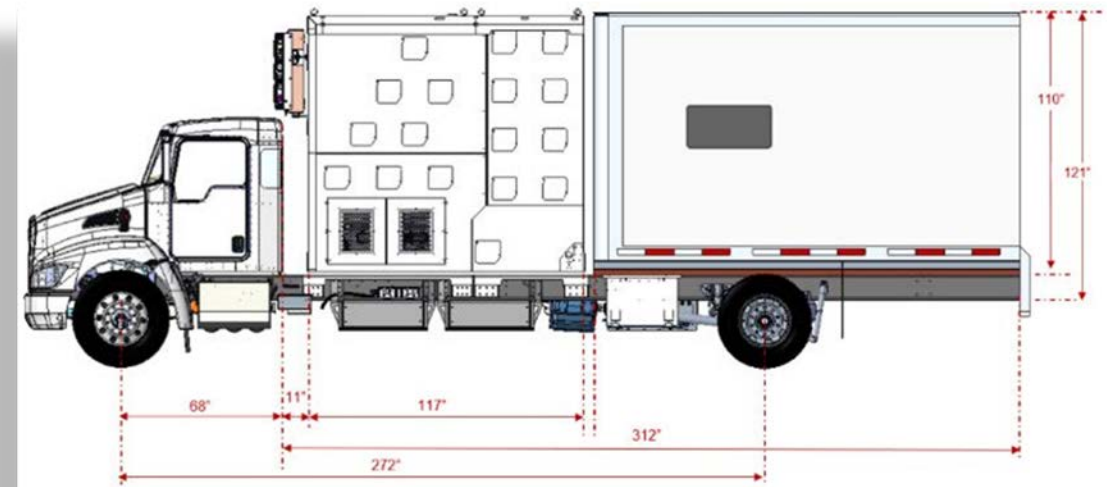
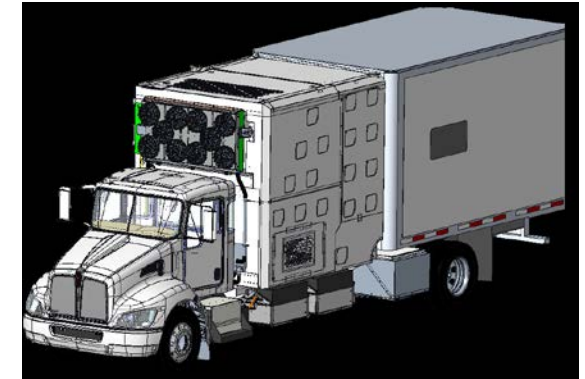
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VEHICLE SPECIFICATIONS SUMMARY

H2Rescue

Vehicle Specifications	
Make/Model	Kenworth/T370 MY2020
Classification	Class 7 Medium Duty Conventional
Application	Rescue Vehicle with Mobile Command Center
Truck Dimensions:	
Length	421"
Height	121" (from bottom of frame rail)
Width	108"
GVWR	33,000 lbs
Wheelbase	272"
Powertrain	Cummins PowerDrive PD7500FC
Traction Motor	
Rated Power	245 kW (350 kW peak)
Rated Torque	3400 Nm (2507 lb-ft)
Transmission	Direct Drive
Hydrogen Fuel Cell	Cummins HD90 PEM Fuel Cell (90kW)
High Voltage Battery	155kWh (2 pack); 500-700Vdc
Hydrogen Storage	176.4kg @ 700bar, 18 tank system
Target Range	180 miles + 72 hours of Export Power up to 25kW
Emissions	Zero emissions Fuel Cell Electric Hybrid

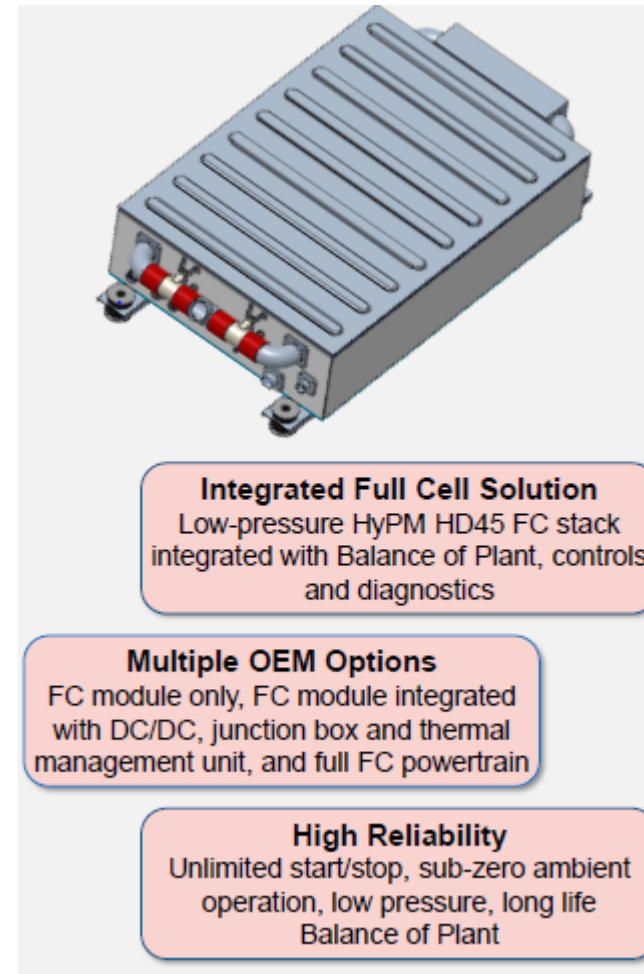


HD90 GEN2 FUEL CELL MODULE

H2Rescue

Product Specification

Type	Proton Exchange Membrane Fuel Cell
Rated Power	90 kW (121 hp)
Operating Voltage	200 – 360V DC
Operating Current	0 – 450 A DC
Dimensions	1767 mm x 988 mm x 384 mm
Ingress Protection	IP67
Cooling	DI water + Ethylene Glycol
Fuel	Gaseous Hydrogen ISO14687-2
Ambient Temperature	-25 to 46 °C operating
Control Interface	CAN



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HD90 GEN2 FUEL CELL MODULE & ACCESSORIES

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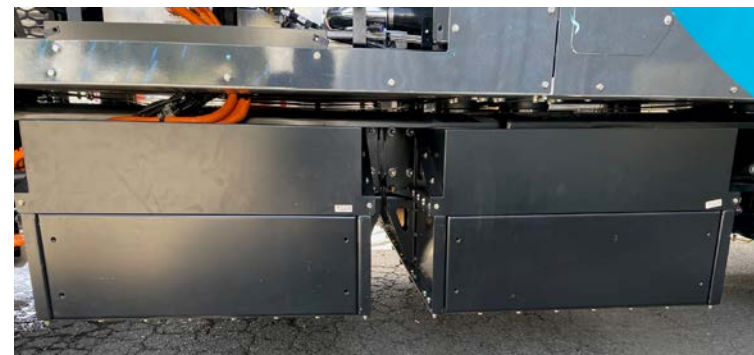
HD90 Fuel Cell



Export Power Unit



FC Radiator



HV Batteries



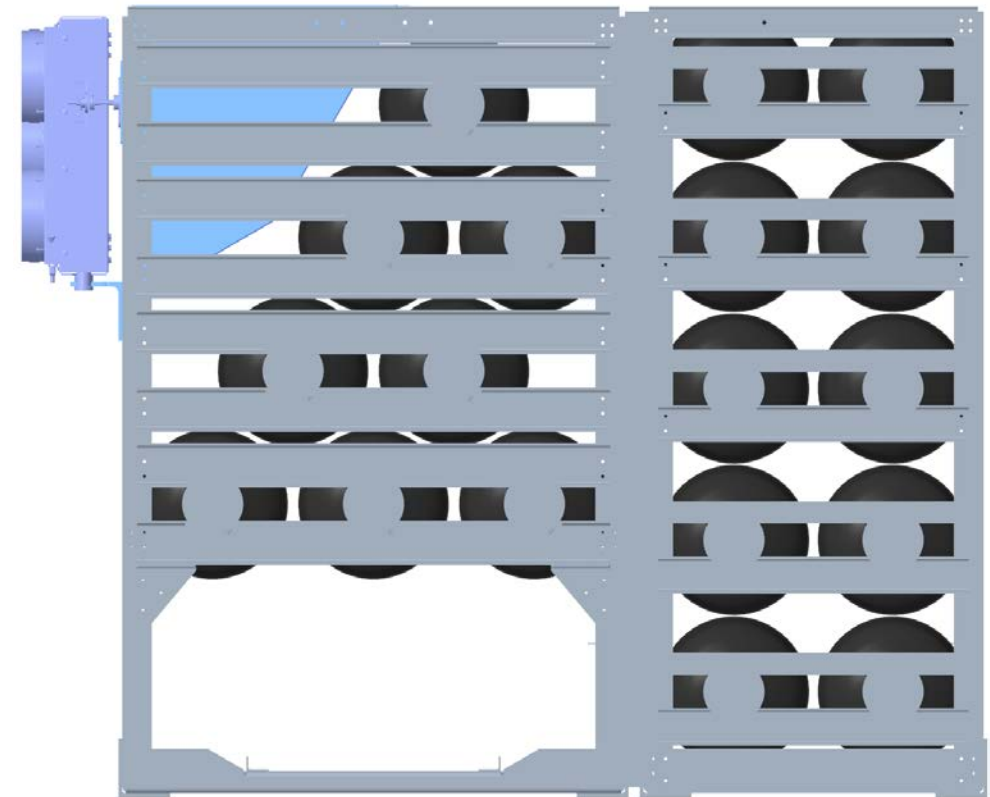
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H2 STORAGE SYSTEM

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System Specifications	
Make	Hexagon Purus
Service Pressure	700 bar (10,000 psi)
Number of tanks	18 units of type 4 composite cylinders
Tank Certification	HGV2
System Standard	System designed to NFPA52
Refueling Standards	SAE J2600, SAEJ2601, SAEJ2799
Storage Capacity	176.4kg total
Safety Devices	Temperature Pressure Relief Devices
	Excess Flow Valve
	Output Pressure Relief Valve
	Hydrogen Leak Detection Sensors
	Fuel Cap Status
Controls	Integrated Controller, CAN based communication
Refueling Panel	1 refueling panel, located Driver Side (Street Side)



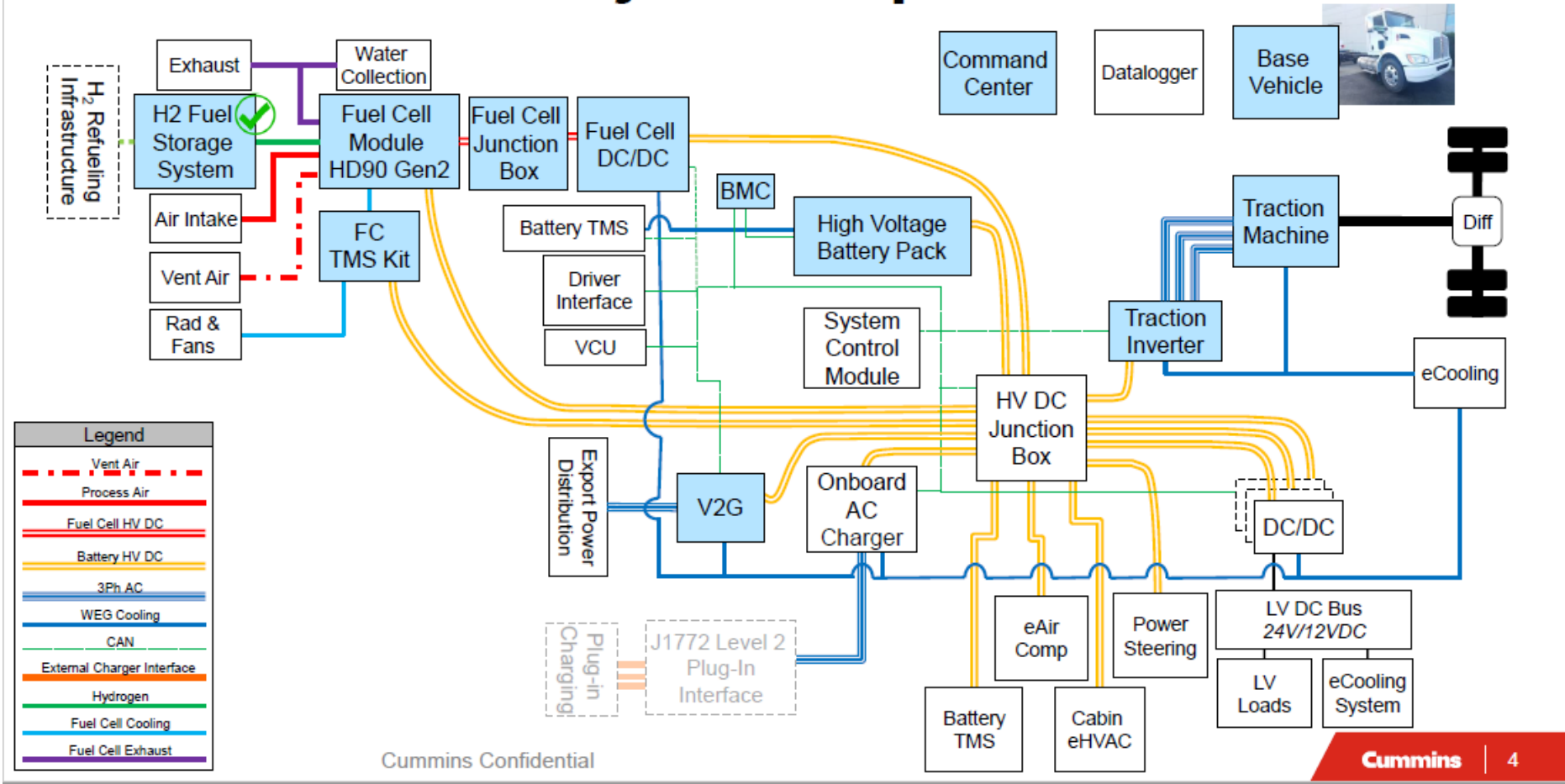
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MAJOR COMPONENTS

H2Rescue

H2Rescue – Major Components



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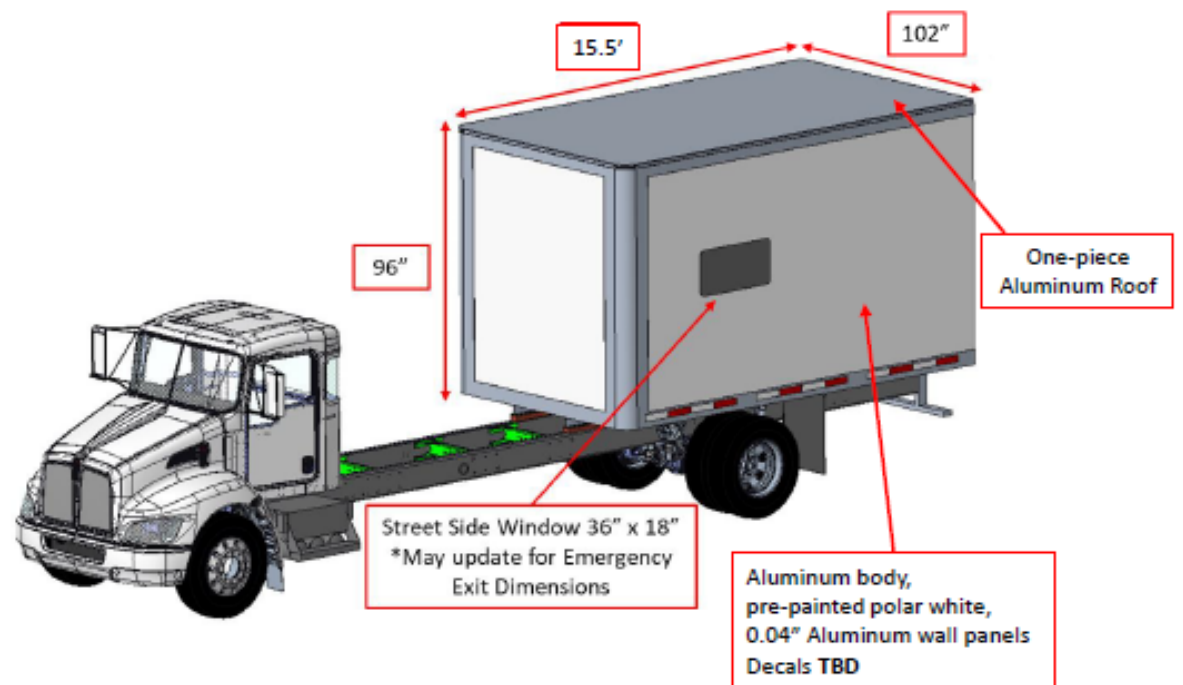
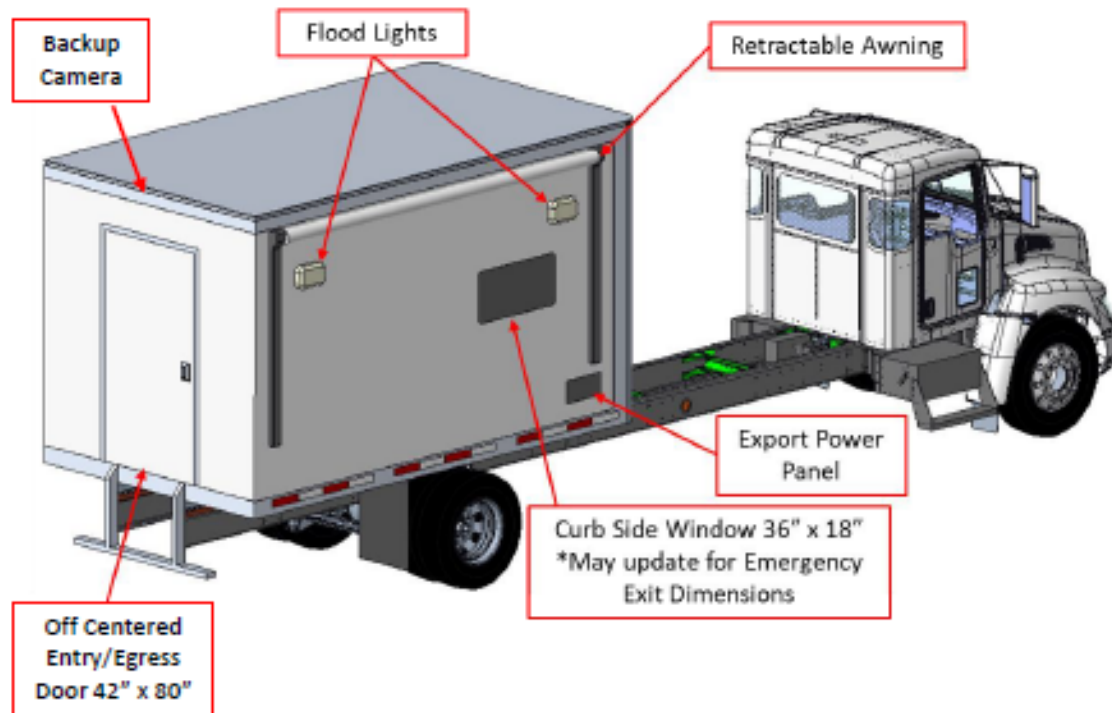


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COMMAND CENTER

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FIELD DEMONSTRATION

H2Rescue

Demonstrations:

- West Sacramento: (4/10-4/14)
- National Renewable Energy Laboratory (NREL) Golden Colorado: (5/8-5/17)

Requirements:

- 180-mile drive test
- 72 hours of export power mode
 - Continuous 25kW output

Data Collection and Analysis:

- Efficiency (overall and electrical)
- Operating temp range
- MTBF for major balance of plant components
- Fuel cell stack durability, power degradation

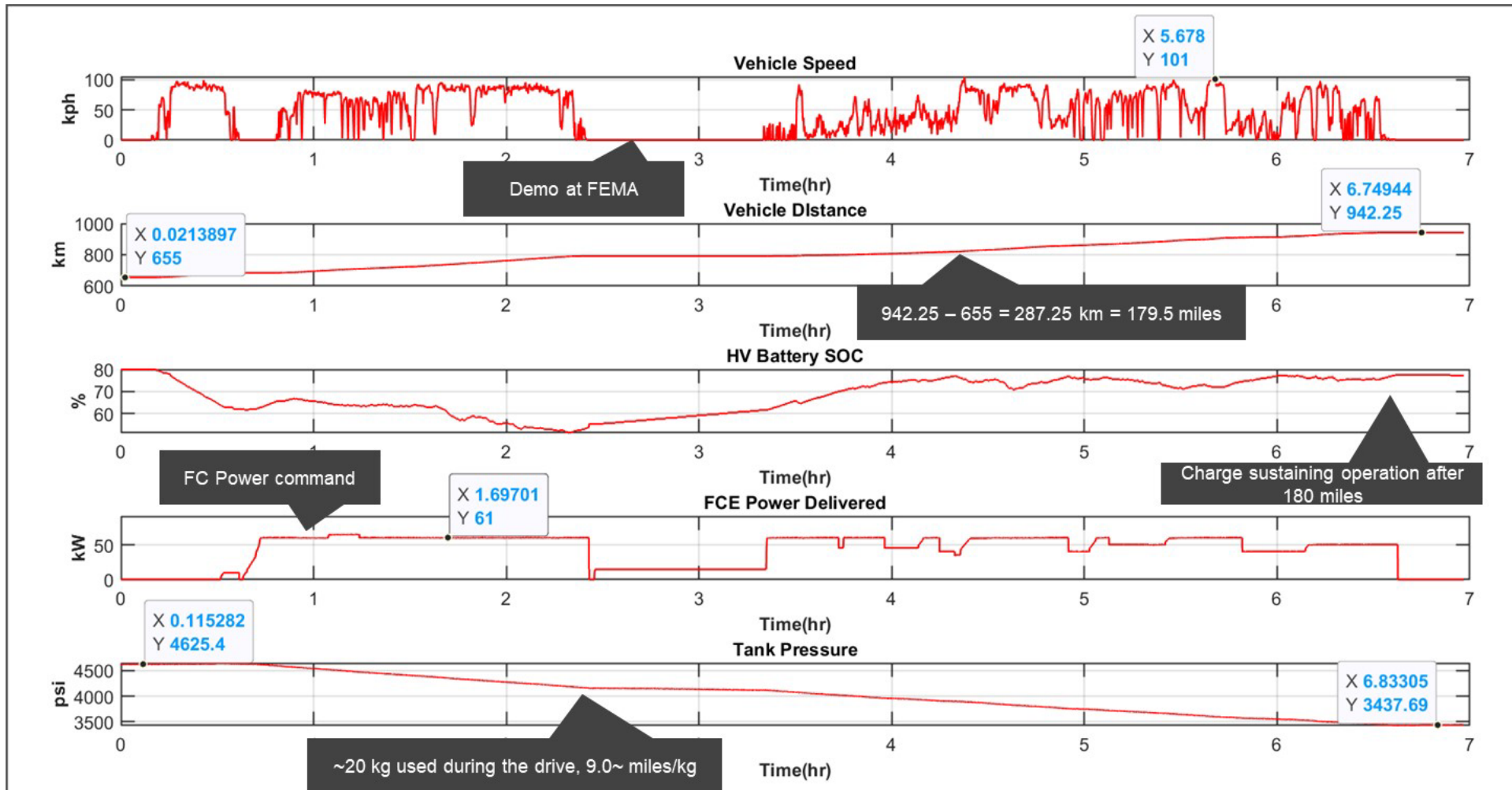


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OPERATIONAL H2RESCUE

H2Rescue 180 Mile Drive Test - West Sacramento – Oakland CA

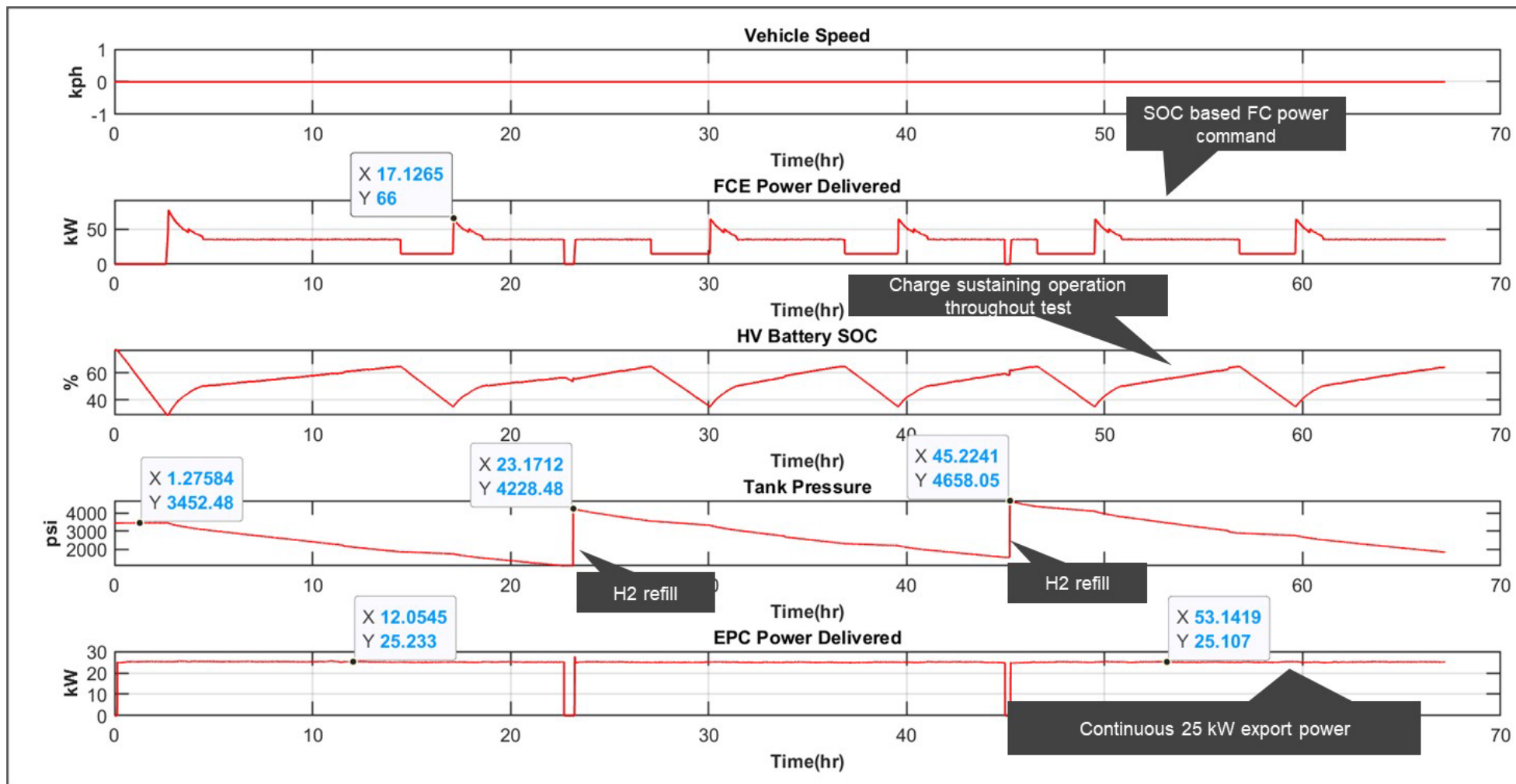


H2 consumption is an estimate (pending confirmation from HP)



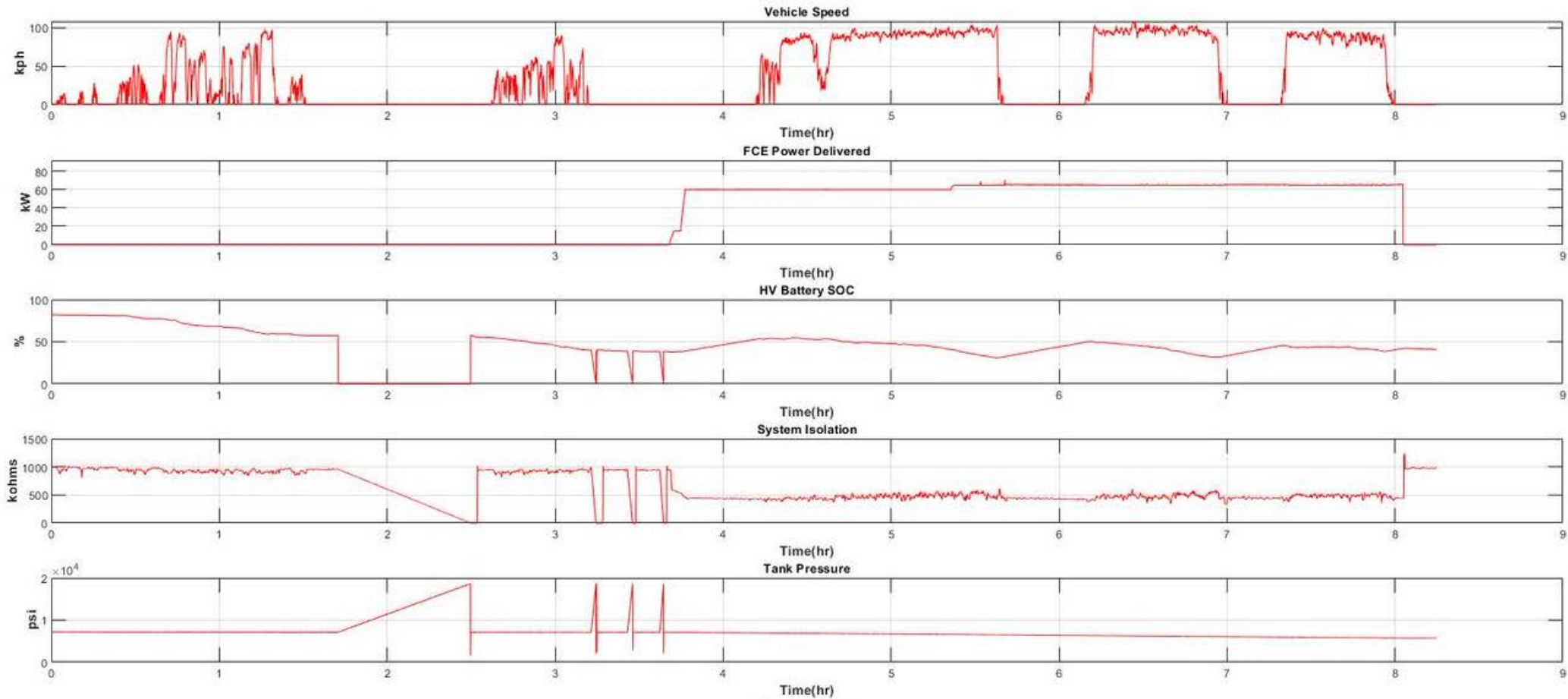
OPERATIONAL H2RESCUE

H2Rescue 67 Hour Export



OPERATIONAL H2RESCUE

H2Rescue 180 Mile Drive Test - NREL, Golden, CO



Draft data, still being analyzed.

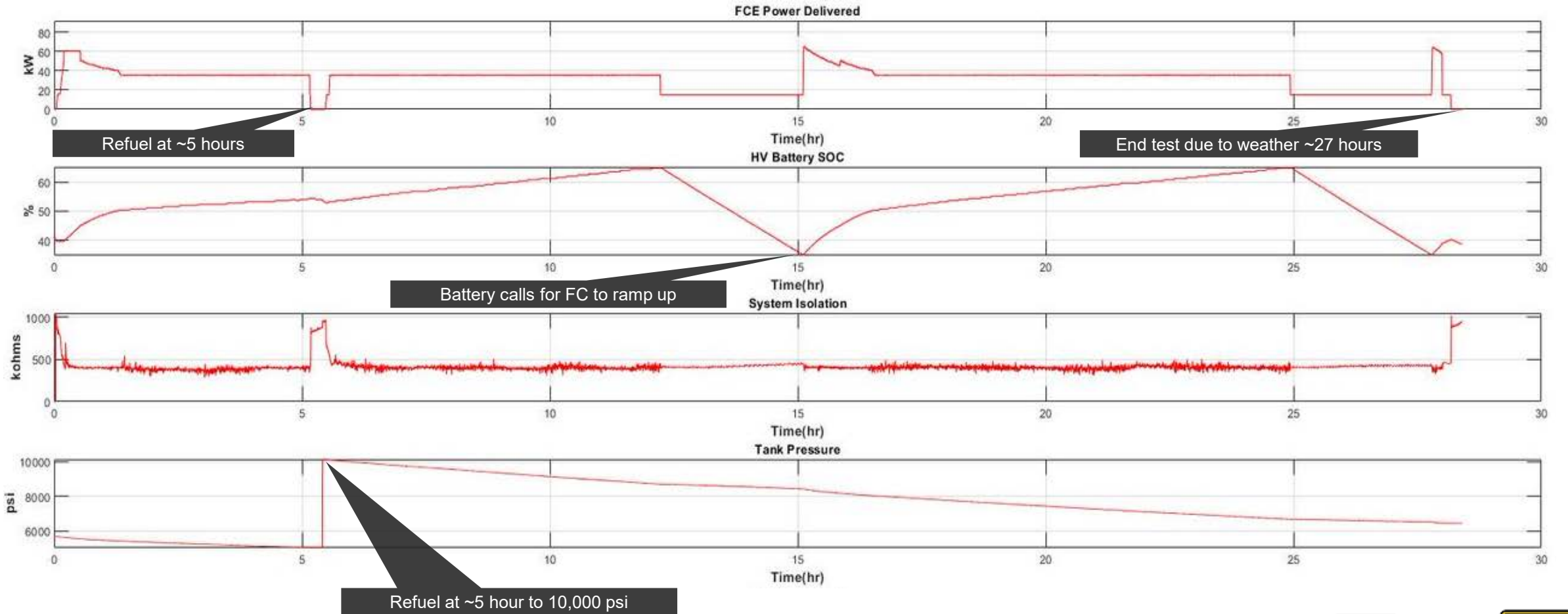


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OPERATIONAL H2RESCUE

H2Rescue 27 Hour Export - NREL, Golden, CO



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VEHICLE SHOWCASE

GVSC (5/31)



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VEHICLE SHOWCASE

DOE Headquarters (6/5)



- Dimitri Kusnezov, Under Secretary for Science and Technology, Department of Homeland Security
- The Honorable Rachel Jacobson, Assistant Secretary of the United States Army Installations, Energy and Environment, Department of the Army
- Pete Devlin, Program Manager Hydrogen and Fuel Cell Technologies Office, Department of Energy
- David Turk, Deputy Secretary, Department of Energy
- Sunita Satyapal, Hydrogen Program Coordinator and Hydrogen and Fuel Cell Technologies Office Director, Department of Energy



VEHICLE SHOWCASE

FEMA Headquarters (6/6)



DYNAMOMETER TESTING (JUNE 2023)

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Item	Task	Estimated Duration (hrs)	Vehicle Weight	Day of Testing
1.	Truck delivery to fueling station	4		Day 1
2.	Refuel to full: 150 kg @ 700 <u>bar</u>	4		Day 1
3.	Drive truck to dyno	2		Day 2
4.	Chassis roll setup	4		Day 2
5.	Steady State: 35/45/55/65/75 mph	8	GVWR	Day 3
6.	Gradeability @ 1%/3%/6%/12% Grade	4	GVWR	Day 4
7.	Startability @ 20%/25% Grade	4	GVWR	Day 4
8.	3x UDDS-HD @ 70%/60%/50% SOC	8	GVWR	Day 5
9.	3 x HHDDT Composite @ 70%/60%/50% SOC	8	GVWR	Day 6
10.	3 x NREL Utility Truck @ 70%/60%/50% SOC	8	GVWR	Day 7
11.	Reserved for Contingencies	8		Day 8



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WHAT'S NEXT

H2Rescue 2.0

Future Partners & Demonstrations:

- Identify future demonstration & showcase partners
- Perform long duration drive test
- Improve emergency response requirements upgrades for potential integration into fleets

Water:

- Enhance water purification to potable levels

Building Interconnection & Microgrids:

- Advance grounding & interconnection with a single building
- Integrate with a microgrid to meet the technical microgrid standards (TMS)



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QUESTIONS

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CONTACT INFO

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