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ELECTRIC VEHICLE INFRASTRUCTURE DEMONSTRATION (EVID)

2025

ELECTRIC VEHICLE INFRASTRUCTURE DEMONSTRATION (EVID)

PROJECT DESCRIPTION

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The Electric Vehicle Infrastructure Demonstration (EVID) project will design, construct and operate two hydrogen fuel sites. Site one will be located within the Suncor Refinery and will support hydrogen production. Site two will be located at a Suncor Terminal and will support hydrogen storage and hydrogen dispensing. This project will integrate two hydrogen systems and enable 18-months of hydrogen vehicle operations.

Hydrogen Production

Hydrogen Storage & Dispensing

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BACKGROUND

The heavy-duty freight transportation sector is one of Canada's largest contributors to greenhouse gas (GHG) emissions. The operation of heavy-duty hydrogen vehicles will contribute to achieving Canada's 2050 decarbonization goals.

Hydrogen fueling infrastructure is a key component to operating hydrogen vehicles that must leverage the nation's ability to produce cost effective, low carbon hydrogen. EVID will:

- Produce hydrogen from natural gas
- Purify hydrogen to SAE J2719 (fuel cell grade hydrogen)
- Compress hydrogen to 450 bar
- Store and transport 540kg of hydrogen
- Dispense hydrogen
    - Refinery → bumping cabinet → storage trailer → terminal
    - Storage trailer → gas transfer module → vehicle

Timeline

Construction: 2020 - 2022
Operation: 2022 - 2027

Project Partners

Suncor
HTEC
AMTA

Funding Partners

EVID: Natural Resource Canada
AZETEC: Emissions Reduction Alberta

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OBJECTIVES

The Electric Vehicle Infrastructure Demonstration (EVID) will design and operate hydrogen production, storage and dispensing systems to support the operation of two long range fuel cell electric vehicles (FCEVs). Hydrogen production will be completed at 801 Petroleum Way. The hydrogen will be moved via storage trailer and dispensing at the Suncor terminal located at 803 Petroleum Way, Sherwood Park, AB.

Project Objectives:

- Develop fueling infrastructure that will operate in temperatures ranging from -40C to +40C.
- Enable safe and reliable operation and management of the hydrogen fueling station.
- Ensure dispensed hydrogen meets SAE J2719 standards for fuel cell electric vehicles.
- Validate gaseous hydrogen fueling for heavy-duty trucks at 350 bar.
- Develop a fill solution that will complete vehicle fills in 20-45 minutes.

HYDROGEN PRODUCTION: SUNCOR REFINERY

Inlet Lines
- Feedstock to site

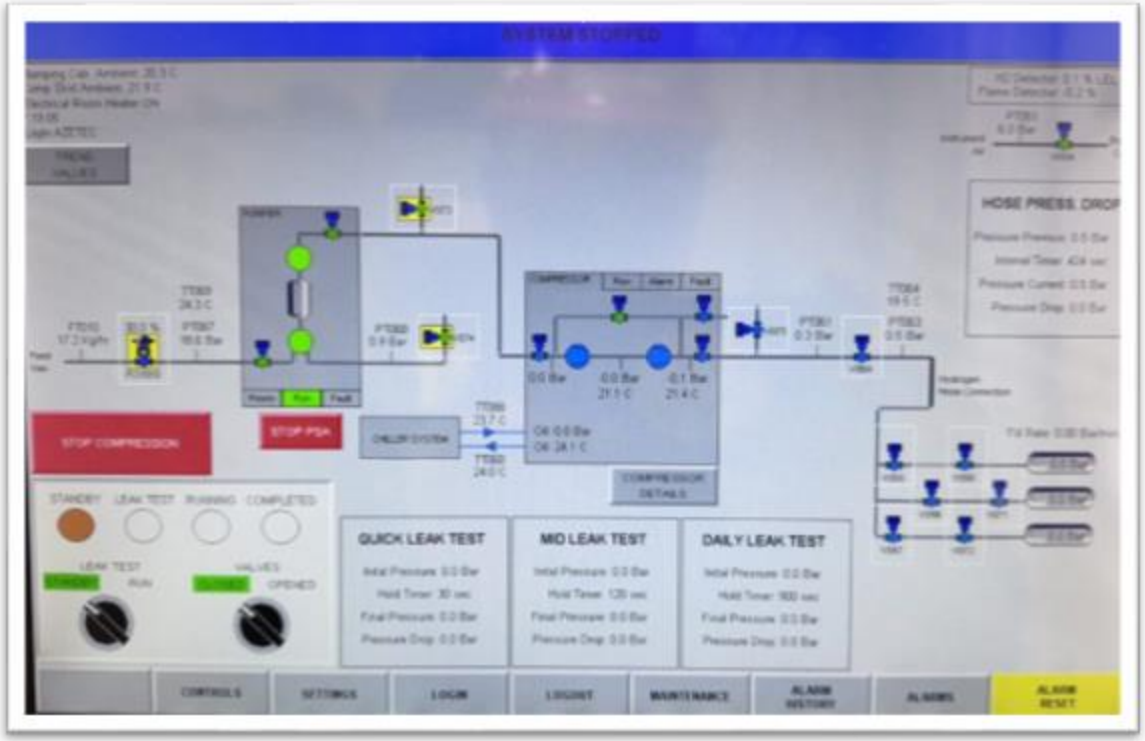
Pressure Swing Absorption Unit
- Hydrogen purification

Compressor Room

Bumping Cabinet
- Hydrogen transferred from the compressor to the storage trailer

HYDROGEN PRODUCTION: SUNCOR REFINERY

Process Control System



Human Machine Interface (HMI)

Programable Logistics Controller (PLC)

HYDROGEN STORAGE & DISPENSING: SUNCOR TERMINAL

Gas Transfer Module (GTM)

Connection to the storage trailer

Dispensing to the truck at 350 bar

GTM, Safety Systems, Hydrogen Storage Trailer

Terminal Site

HYDROGEN STORAGE TRAILER

The hydrogen storage trailer is filled at the refinery and moved to the terminal for dispensing. There is 540 kg of 450 bar hydrogen onboard. The system supports cascade filling. Fueling to the GTM is programed from the control panel and hydrogen is dispensed from one of three defined storage banks. Each storage bank supports four sets of five hydrogen cylinders, twenty tanks per bank, sixty cylinders in total. Pressure relief valves are located on each cylinder to prevent overfilling and ensure safe operations.

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GAS TRANSFER MODULE (GTM)

The GTM is the fueling interface between the hydrogen storage trailer and the hydrogen vehicle. This unit has an internal nitrogen system to power pneumatic equipment on the trailer as well as hydrogen sensors, oxygen sensors, ESD pushbuttons, warning beacons, fire eye sensors, a fire extinguisher and relief valves to prevent over-pressure fueling. The unit is designed with an explosion-proof electrical junction box and all piping complies with industry standards. Valves and pressure indicators manage the hydrogen dispensing process that fuels the vehicle.

Dispensing Panel

Supply Panel

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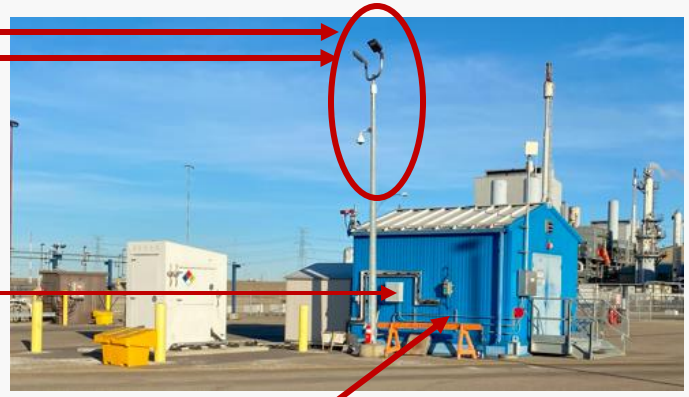
TERMINAL SAFETY SYSTEMS

GTM Main Switch

Hydrogen Sensors

Fire Eyes



Beacon

Locking Dispensing Nozzle

Breakaway coupling

Check Valve

OVERVIEW | Why is this Important

- Heavy duty transportation is an ideal anchor to support the transition to a “Made in Canada” hydrogen economy.
- Alberta has an opportunity to realize significant economic benefits as a producer and exporter of hydrogen.
- Hydrogen vehicles reduce GHG emissions and support Canada’s 2025 net zero targets.
- The investment in hydrogen fuel in infrastructure will create new employment opportunities for Canadians that include manufacturing, construction, equipment installation, equipment service & maintenance as well as hydrogen production, delivery, storage, and dispensing.
- Hydrogen vehicle adoption to support heavy duty transport emission reductions can not occur without reliable and redundant fueling infrastructure.
- EVID will design, trial and safely operate the first hydrogen dispensing solution in Alberta.

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RESULTS & ANTICIPATED OUTCOMES

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KEY ACHIEVEMENTS

Hydrogen Storage Trailer

- A hydrogen storage trailer was designed, tested, certified and is in operation.
- The trailer holds 540 kg of 450 bar hydrogen.
- Standard operating procedures were developed.
- Twenty Suncor and Trimac staff were trained to operate the trailer and fueling system.

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KEY ACHIEVEMENTS

Hydrogen Storage Trailer, ERAP

- An Emergency Response Assistance Plan (ERAP) was developed, accepted, and is registered with Transport Canada.
- Ten staff from Rapid Response were trained to support emergency response activities that might occur during the movement of the hydrogen storage trailer.

KEY ACHIEVEMENTS

Gas Transfer Module (GTM)

- The GTM was designed, manufactured, and moved to the Suncor terminal.
- Site permits were issued and approvals attained.
- A concrete pad was installed to support the GTM.
- Defined safety systems and monitoring equipment were procured and installed to support safe hydrogen fueling.
- Standard operating processes were developed for the hydrogen storage trailer and GTM unit.
- Three sets of staff training session have occurred. Over 40 Suncor, AMTA and Trimac employees are trained to operate the hydrogen tube trailer and GTM located at the Suncor terminal.
- All drivers supporting vehicle operations must complete an online training session and wear the defined PPE to bring vehicles to the fueling terminal.

KEY ACHIEVEMENTS

Regulatory Influence

- Certifying bodies including the Alberta Boilers Safety Association (ABSA) and Intertek have inspected all site equipment and commissioning and have provided operational readiness approvals.
- Alberta government has developed safe hydrogen fueling processes that were influenced from EVID project learnings.

  https://open.alberta.ca/publications/alberta-hydrogen-refuelling-station-guidebook
- AMTA is also participating on the CSA committee to advise on first responder interactions with hydrogen vehicles and hydrogen fueling.

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KEY ACHIEVEMENTS

EVID was intended to support two AZETEC Class 8 FCEVs.

With operational fueling infrastructure, additional hydrogen vehicles were attracted. Over 10 hydrogen vehicles have been introduced to the region due to the available hydrogen supply.

Hydrogen vehicles supported by EVID include:

- Two AZETEC fuel cell electric vehicles
- City of Edmonton hydrogen bus
- County of Strathcona hydrogen bus
- Two Nikola fuel cell electric vehicles
- Hyzon fuel cell electric vehicle
- Hydra hydrogen diesel dual fuel Class 8 truck
- Diesel Tech Industries hydrogen diesel dual fuel Class 8 trucks

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KEY ACHIEVEMENTS

Station Availability

- The Suncor terminal has been available for operation since August 2023.
- System is designed with capacity to purify 13, 320 Kg H2/month (based on H2 feed @18.5 Kg/h)
- System flow rate is approx. 0.85 kg per minute.

Vehicle	KG of hydrogen on board	Fueling time
Hydrogen Buses	30 kg, 350 bar	25 minutes
Dual Fuel Trucks	20 kg, 350 bar	17 minutes
Hyzon FCEV	50 kg, 350 bar	34 minutes
AZETEC FCEV	70 kg, 350 bar	51 minutes

- The dispensing terminal operated successfully 99% of the time when hydrogen was available.
- Several hydrogen production challenges have been experienced. Consistent hydrogen fueling at the Suncor terminal has not occurred (see project challenges below).

MILESTONE AND PERFROMANCE MEASURES

Site Engineering & Construction

- Both ABSA and Intertek required additional testing before site certifications were granted. As regulatory expectations are better understood the approval process should become less cumbersome.

Equipment Procurement

- Specialized parts including the hydrogen nozzles, fire eyes and hydrogen sensors have long lead times. When an item is not operating as expected replacement parts have been delayed up to six months.

Detailed Equipment Engineering

- Hydrogen leakages were experienced with four tanks that were located within the three banks. These tanks have been sealed off and have reduced the system capacity from 540 kg to 504 kg.

Station Operation

- The first fueling event was completed in August 2023.
- When hydrogen is available, fueling at the terminal has been seamless. Hydrogen production has experienced challenges that have restricted fueling operations.

MAIN OUTCOMES | ACHIEVED & EXPECTED

- Technology has been advanced from TRL Level 6 to TRL Level 9.
- Sensors, beacons, shutoffs, safety systems and standard operating systems are in place to support safety equipment operations
- Operational procedures have been formalized for the refinery and terminal.
- Training programs have been developed for site staff, drivers, emergency response crews and first responders.
- The fueling dispenser and hydrogen storage trailer are operating as expected.
- Hydrogen production challenges have impeded the ability to provide reliable routine fueling.

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KEY LESSON & CONSIDERATIONS

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SUNCOR

Environmental assessments were completed to host the fuel dispensing at Alberta Motor Transport Association located on Edmonton International Airport land. An agreement was formed between HTEC and Suncor where Suncor would produce the hydrogen within their Refinery and product dispensing would be moved from AMTA to the Suncor terminal on Petroleum Way.

Suncor provided huge value add to the EVID project.

As a leading energy provider, Suncor ensured high attention to process and safety. Every decision prioritized safety and attention to risk identification and mitigation. Suncor's experience, talent, and commitment to operational excellence influenced and supported (EVID) project success.

Refinery turnarounds will affect operational up time. Turnarounds are planned well in advance and pros of working with a highly experienced energy company far outweigh the cons of resulting operational shutdowns.

DUE DILLEGENCE

With a safety-first mindset the following due diligence was in place as a part of the EVID project.

Equipment:

- Factory acceptance tests (FAT)
- Equipment drop tests
- Intertek Certification
- Alberta P.Eng approvals
- Suncor CRN approvals
- Equipment Commissioning
- Equipment manuals and SOPs
- ERAPs
- Maintenance schedules

Site Acceptance:

- CSA Inspectors
- Alberta Boilers Safety Association (ABSA)
- HAZOP assessments
- Electrical and Civil engineering stamped drawings
- Standard operating procedures (SOPs)
- Equipment training

EMERGENCY RESPONSE ASSITANCE PLAN (ERAP)

Hydrogen that is used as fuel to support the hydrogen vehicles is viewed as an alternative fuel. Hydrogen that is transported via tube trailer is viewed as a dangerous good.

When transporting dangerous goods an emergency response assistance plan (ERAP) is required to ensure 24/7 support is in place if a release or vehicle incident occurs when the hydrogen is being transported. As the hydrogen tube trailers are amongst the first hydrogen storage/transport trailers in Canada, the ERAP process was rather cumbersome.

The development of the ERAP proposal required back-and-forth discussions with Transport Canada. Additional factory acceptance tests (FAT) and inspections were required for due diligence to certify this specialized equipment. Equipment certification for the trailers required nine months, delaying equipment operations by six months.

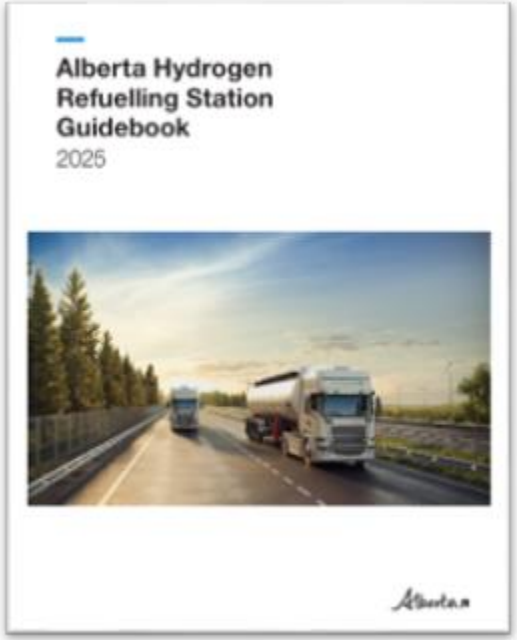
TRAINING

The hydrogen storage trailer is filled at the refinery and moved to the terminal for dispensing. There is 540 kg of 450 bar hydrogen onboard. The system supports cascade filling that is programmed from the control panel and dispensed from one of three defined storage banks. Each storage system supports four sets of five hydrogen cylinders, twenty tanks per bank, sixty cylinders in total. Pressure relief valves are located on each cylinder to prevent overfilling and ensure safe operations. Four training sessions have occurred with this equipment to ensure technicians supporting the fueling process are comfortable with fueling and equipment interactions.

TRAINING & STANDARD OPERATING PROCEDURES

The equipment and integrated systems used to support the hydrogen production, hydrogen transfer and hydrogen fueling required training and standard operating procedure to be developed.

Lessons learned in developing these guides and executing training programs supported the development of the Alberta Hydrogen Fueling Guide.



GASEOUS HYDROGEN at 350 BAR

Today's hydrogen vehicles are fueled with gaseous hydrogen. While hydrogen can be stored as a gas, liquid or in cryo-compressed forms, vehicle technology does not yet support these configurations. It is common to transport liquid hydrogen to a dispensing site, but before liquid hydrogen can be used for vehicle operations it must be converted to gas. For the EVID project, gaseous hydrogen is being compressed to 450 bar and stored in the hydrogen trailer. This gas is then transferred from the storage trailer through a GTM and into the vehicle at 350 bar.

Hydrogen vehicles require hydrogen that is compressed to either 350 or 700 bar:

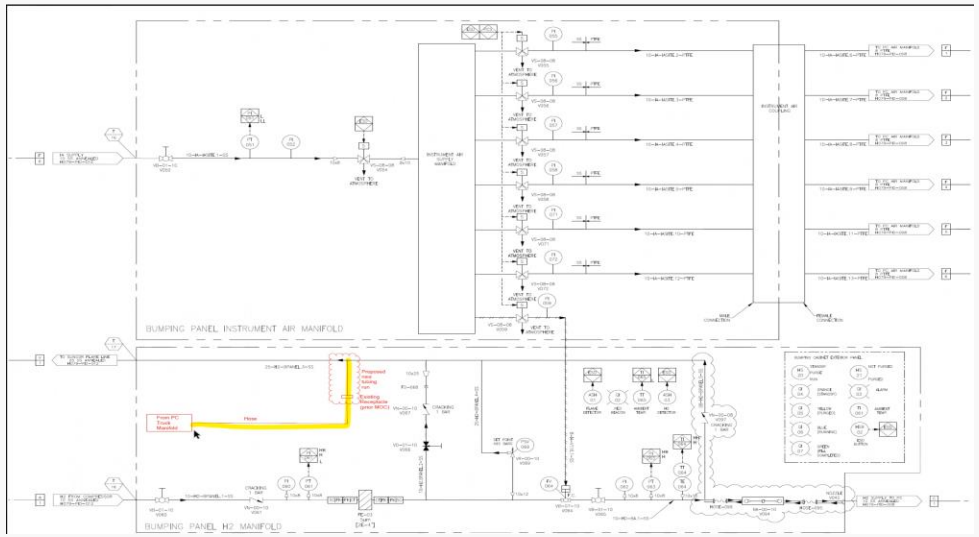
- Hydrogen compressed to 350 bar can support 350-bar vehicles or 700-bar vehicles.
- Hydrogen compressed at 350 bar will provide a full fill to a 350-bar vehicle and a partial fill to a 700-bar vehicle.
- Hydrogen compressed to 700 bar can only be used to fuel 700-bar vehicles.

Fueling nozzles for 350-bar and 700-bar vehicles differ. Fueling nozzles for heavy-duty trucks (high flow) and passenger vehicles (low flow) also differ. The Suncor terminal supports 350-bar heavy-duty vehicles.

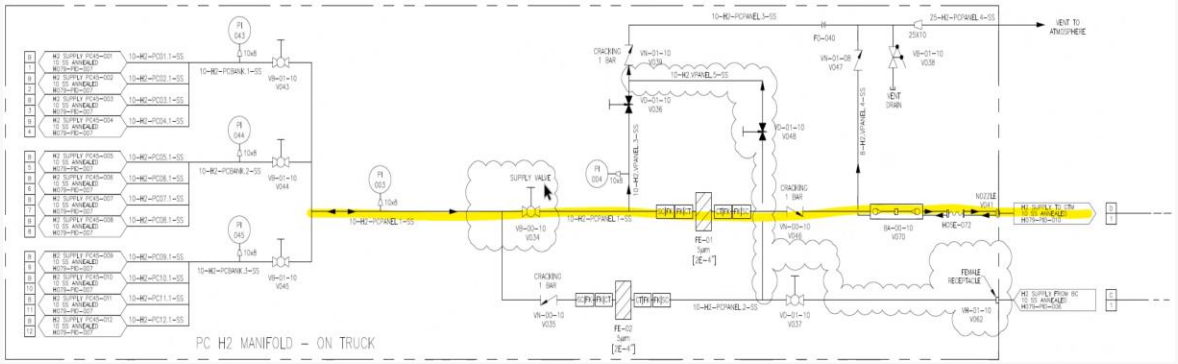
H2 STORAGE & DISPENSING - HTEC

HTEC supported the equipment fabrication, testing, certification, maintenance and training. HTEC also oversaw the onsite construction and equipment commissioning.

HTEC continues to support daily operations and has been exceptional with providing this ongoing support. Long-distance equipment support is challenging and requires ongoing travel to site. Trained and experienced personnel are required locally to support equipment and operational challenges.



The bumping cabinet is integrated with emergency shutdown (ESD) feature. Valves are interlocked that consider the pressure of the hydrogen filling.



The three banks on the hydrogen trailer are operated by automatic controls. These controls are designed to be FAIL-SAFE as per NFPA-2[2020].

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FUELING FLOW RATE

Hydrogen flow rate is a measurement of how much hydrogen is moving through the system at a given time. Volume flow rate can be adjusted to dispense liters/second or even kilograms/second. Precise control of the hydrogen flow rate is essential for efficient and safe/stable fueling.

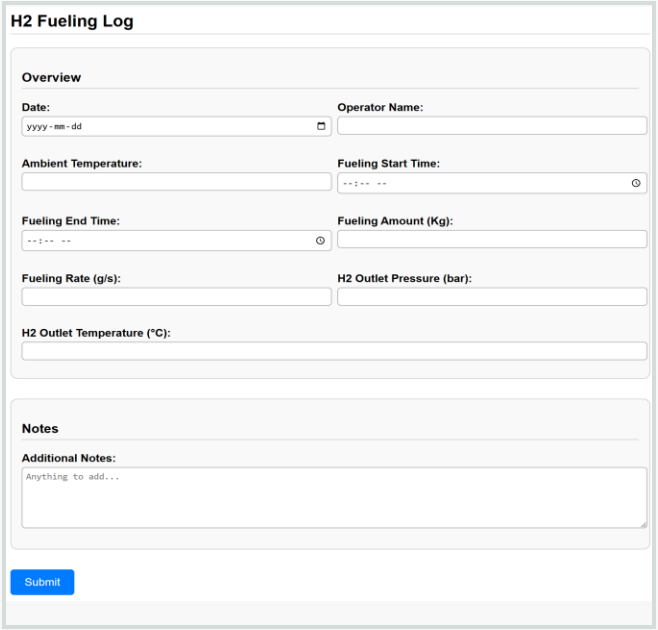
Originally the EVID station was to support high flow rate fueling for the AZETEC truck with 70kg of hydrogen onboard. As additional vehicles were scheduled to conduct hydrogen fueling at Suncor, the flow rate had to be adjusted to a lower flow rate to support vehicles with lower hydrogen volumes. Vehicles fueling at the terminal included Hydra and DTI who require 20kg fills, the City of Edmonton and County of Strathcona buses who require 30kg fills, Hyzon who requires 50kg fills as well as the AZETEC trucks that require 70kg fills.

Note: Passenger vehicles have ~7kg of hydrogen onboard and require a low flow rate fueling.

STORAGE TRAILER FILLING & FUELING

Within the refinery, process data is automatically collected and stored in the local AB CompactLogix PLC system to support the fuel transfer to the hydrogen storage trailer. Trailer filling is communicated to the data server via EtherNET/IP through Prosoft Client/Server Communication Module.

At the terminal, a manual log is used to capture fueling data. The operator captures defined parameters from the sensor/meters on the storage trailed and GTM. These are submitted after each fueling event.



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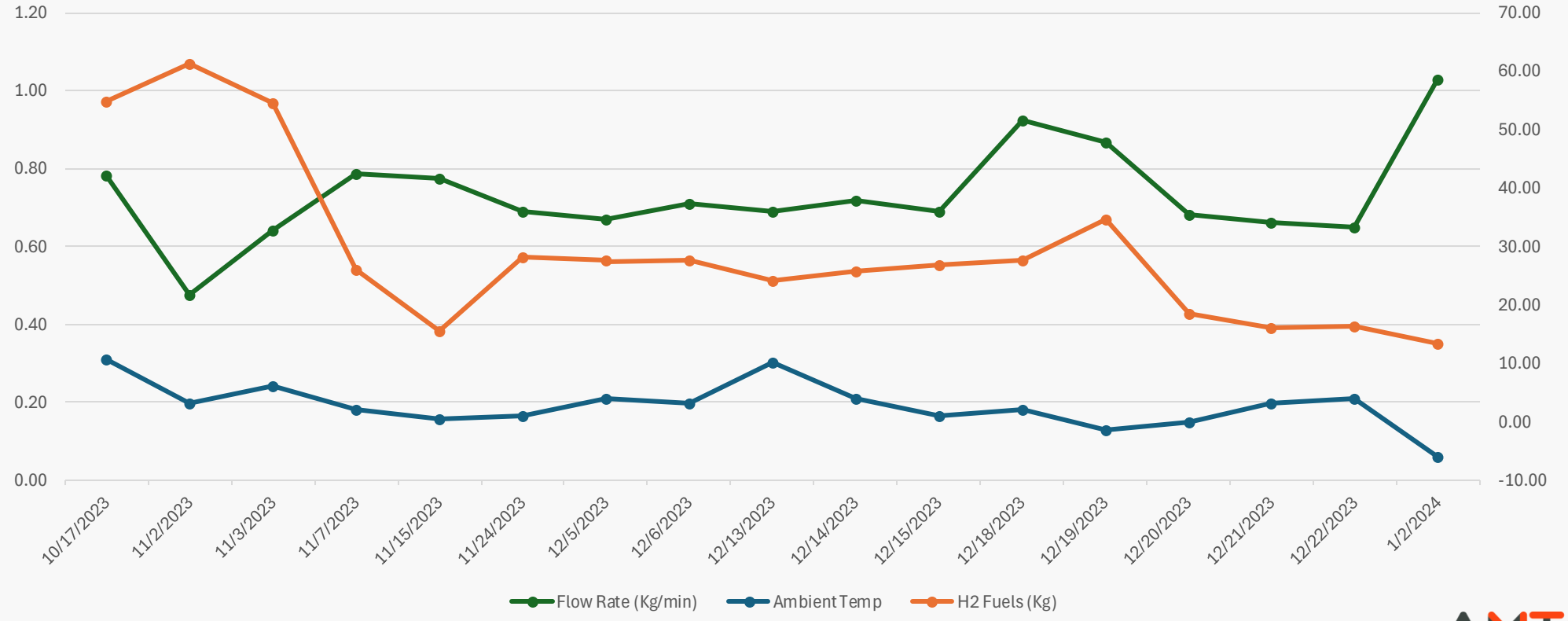
H2 FUELING DATA

Hydrogen fuel cell buses - Fueling data sample at Suncor Station;

average fueling rate is 0.73 kg/min during winter season.



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OPERATING THE PRESSURE SWING ABSORPTION (PSA) UNIT

Feed hydrogen quality is critical and may require pre-treatment, because impurities can rapidly degrade adsorbents; H2 purity can drop due to unstable pressure, which could be caused by leakage or fluctuating inlet pressure;

Regular maintenance, especially for the valves, to check the operating condition, is required.

Real-time monitoring and data logging will help to diagnose failures and optimize operations.

Maintaining stable H2 feeding flow into the PSA is essential, which allows the PSA to output H2 at a consistent pressure (300 psi) to the compressor.

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KNOWLEDGE DISEMINATION

EVID has been a launching pad for AMTA. This project has equipped staff with subject matter expertise in several areas. Knowledge has been used to support speaking engagements at a number of events. Some of these include:

Conventions

- Canadian Hydrogen Convention 2023, 2024, 2025
- World Petroleum Congress 2023
- Canadian Clean Energy Summit 2025
- Southern Alberta Institute of Technology (SAIT) hydrogen address
- AMTA Alternative Fuel Expo

Developed Materials

- Training Guides and SOPs
- Hydrogen Basics
- Northern Alberta Institute of Technology (NAIT) course (consultant)
- Alberta Hydrogen Fueling Guide (consultant)
- Montana First Nations Hydrogen Training Materials

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PROJECT CHALLENGES

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COVID

The COVID-19 pandemic coincided with the EVID project extending project risks that affected timelines as well as the ability to attain parts and services required for equipment fabrication, testing and delivery.

Restrictions in movement delayed site construction and organizational collaborations that were required for site commissioning and staff training.

The highest impact to the project was supply chain disruptions. Equipment components including chips, electronics and safety systems were delayed. Unit assembly, testing and commissioning were delayed on many occasions.

OPERATIONAL CHALLENGES

The AZETEC and EVID projects are interconnected meaning that challenges experienced by one project affect the other. Project challenges on the hydrogen production side have resulted in low operational time for the EVID equipment.

AZETEC: Hydrogen Production	
Fuel Cell Grade Hydrogen	Critical project impact
SAE J1939 fuel cell grade hydrogen is 99.999% pure. The refinery has experienced great difficulty in producing fuel cell grade hydrogen. Accumulated water, intermittent operations, and the pressure swing absorption unit have all contributed to the downtime related to hydrogen purity.	
HTEC Operations in BC	Critical project impact
Troubleshooting requires on-site interactions with the equipment. Delayed site response time has affected streamlined troubleshooting with down equipment on the hydrogen production side.	
Suncor Refinery Turnaround	Low project impact
Several plant turnarounds have occurred during the project. While these refinery closures impact the ability to attain fuel the impact has not yet been felt.	

PRESSURE SWING ABSORPTION (PSA) UNIT

The pressure swing absorption unit uses cycles of high and low pressure to cycle the hydrogen gas through seven beds of absorbent material. The intention is to purify the hydrogen to SAE J1939 hydrogen standards for fuel cell grade hydrogen. Hydrogen for fuel cell electric vehicles (FCEVs) must be at a purity of 99.999% to avoid damaging the fuel cell. Several challenges have been experienced during the hydrogen purification process.

Valves
If there is a way for hydrogen to escape the system, it will find it. Valve threads provide an ideal escape route for hydrogen. Unit valves have had to be replaced to ensure pressure remains constant and a sealed system is maintained.

Desiccant
The desiccant bed had to be replaced due to water that leaked into the unit.

Springs
Reinforced springs were added to the unit to ensure proper seal age.

Holding Vessel
The volume of hydrogen flowing between the PSA and the compressor had to be increased to support the compressor unit.

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SCHEUDLED FUELING

Commercial fleets are used to being able to fuel anywhere at anytime.

As the EVID terminal is not fully automated, we have chosen to support fueling with an assigned and highly trained fueling attendant.

While scheduled fueling times are restrictive and at times inconvenient, assigned times ensure fueling support, limit lost time for fleets (no waiting in line) and ensure supply is available for every vehicle scheduled to fuel at the station.

The PowerCube Trailer must be refilled when the pressure in the banks gets low and is not sufficient to support cascade fueling.

HYDROGEN TESTING

Hydrogen that is needed for fuel cell electric vehicles (FCEVs) is 99.999%. If hydrogen is introduced to the vehicle that does not meet this standard, the fuel cell will not function as intended, resulting in system errors with the vehicle and state of charge.

Hydrogen for FCEVs must comply with SAE J2719 standards and be 99.999% pure.

As of today, hydrogen testing is only completed in the U.S. Tests are costly and turnaround times range from two to three weeks. Hydrogen sampling must be completed at regular intervals to ensure contaminated hydrogen is not introduced to a FECV. After a sample is taken, we are left waiting for results and when the results are received, we are already needing to retest.

Two local labs are beginning to develop these test procedures, but today hydrogen testing is a tedious, time-consuming, expensive, and necessary process.

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NEXT STEPS

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DATA ANALYSIS & REPORTING

Data collection for the EVID project was minimal. The project was focused on the development, design and initial operation of the refinery and terminal sites. Attention was focused on the development of SOPs and training programs and knowledge gains were focused on system integration and equipment adjustments and calibrations. As the sites are now operating as intended, a stronger focus can be place on diversified data collection.

As the system automation level was low, manual data collection has employed temporarily. Some data has been collected and will serve to fine tune data collection methodologies and analysis. The upcoming year will be used to advance this area of the project.

HYDROGEN TRANSPORT

The hydrogen storage trailer was designed to support the Suncor terminal.

During 2024 when the refinery was unable to produce fuel cell grade hydrogen the trailer was used to support fueling at a secondary location in Nisku, Alberta.

The hydrogen storage trailer is a valuable resource that can be used to complete small demand fueling at any location. While it a gas transfer module (GTM) is still required for fueling this dispensing unit is a fraction of the cost of a full station.

Plans are being developed to support fueling in Calgary and other municipalities.

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