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Automatic Tank Gauge (ATG) Water Detection Float Performance in Ethanol Blends

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Presentation Overview

- Background
- Environmental Technology Verification (ETV) Quality Assurance Project Plan (QAPP)
  - Tested 4 Water Floats
  - Testing Observations and Results
- Next Steps

UST LD Performance Evaluation Background

- Petroleum and ethanol have different chemical and physical properties (examples: density, conductivity, refractive index)
- A need was identified to determine whether water ingress detection technologies are affected by fuel properties
- Mixing considerations
  - Petroleum and water do not mix, but ethanol is miscible with water
  - If ethanol is a component of the fuel, water will mix with the fuel, compromising the fuel quality.

Overview Environmental Technology Verification (ETV) Process

- Voluntary program that provides decision-makers with credible test data on technology performance without comparison or judgment
- Advanced Monitoring Systems (AMS) Center, operated by Battelle, works with EPA under a cooperative agreement to test monitoring, detection, sampling, and characterization technologies
- Third-party verification following a peer reviewed QAPP
  - "verification" To establish or prove the truth of the performance of a technology under specific, pre-determined criteria or protocols and a strong quality management system. ETV does not endorse, certify, or approve technologies. http://www.epa.gov/etv/

QAPP Design Performance Parameters (Metrics)

- Sensitivity
  - Tolerance Limit (TL)
  - Minimum Detectable Level Change (MLC)
- Precision (Ratio of mean to standard deviation of technology-measured response)
- Accuracy (Bias)
- Observational
  - Phase separation

QAPP Design Tests

- **Test 1:** Water detection of continuous ingress with a splash or without a splash
  - **Test 1a:** To determine the minimum detection height
  - **Test 1b:** To determine the smallest detection increment
- **Test 2:** Water ingress detection of a quick water dump followed by a fuel dump

QAPP Implementation Test Vessel

Thank you for your In-kind contributions!

BP
Tanknology
Xerxes Corp
Marathon Corp

Fiberglass tank shell with glass ends and multiple ports
Diameter: 6 ft
Length: 4.25 ft

QAPP Implementation
Water Ingress System

- Water was dyed blue
- 2-reservoir gravity distribution system with constant head
- Fed to test vessel through a rotometer or dump valve
- Water ingress rates with and without a splash ranged from 152 to 188 ml/min
- Placement of the delivery tube was either to free fall into the fuel (with splash) or follow the fill tube (without splash)

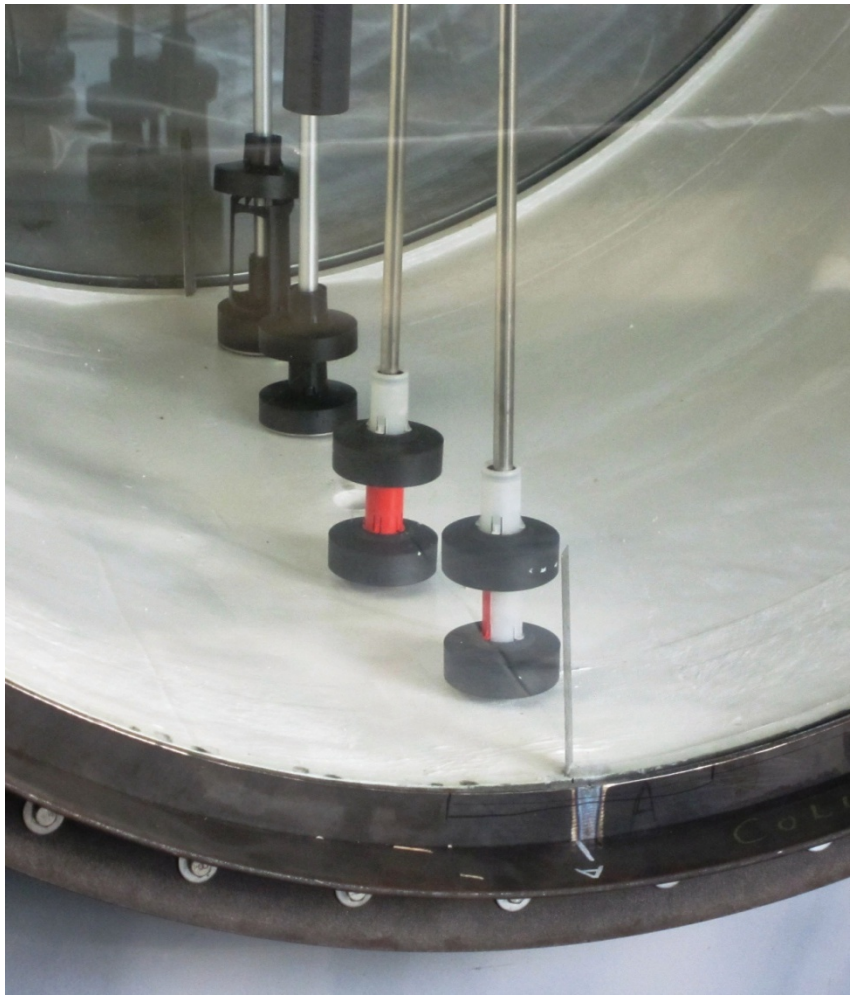

15-65-Without Splash


E15-65-With Splash

QAPP Implementation
Vendor Participation

Veeder-Root Standard Water Float and Phase-Two™ Water Detectors

Franklin Fueling Systems TSP-IGF4 and TSP-IGF4P Floats

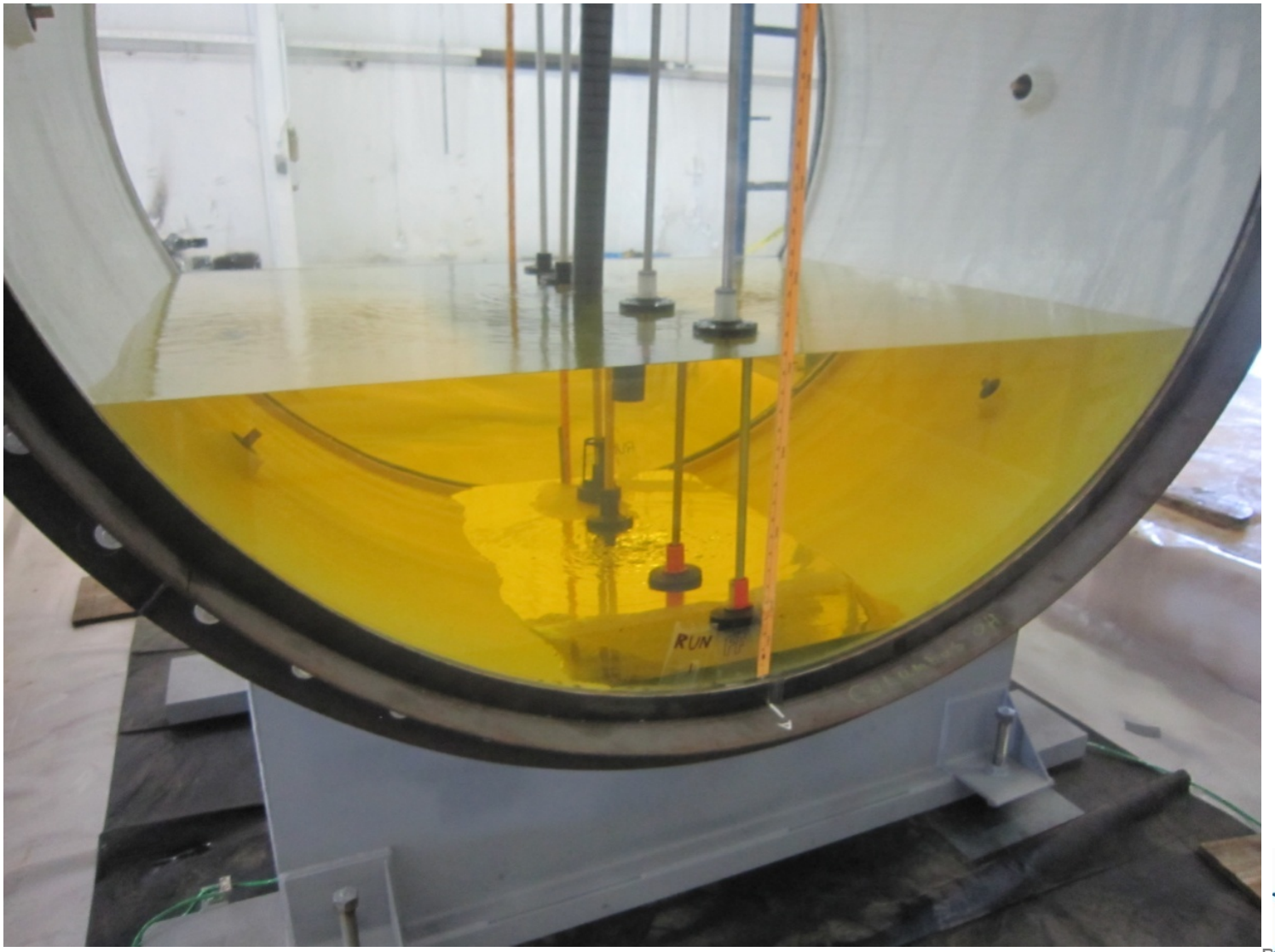


QAPP Design
Matrix of Test Runs

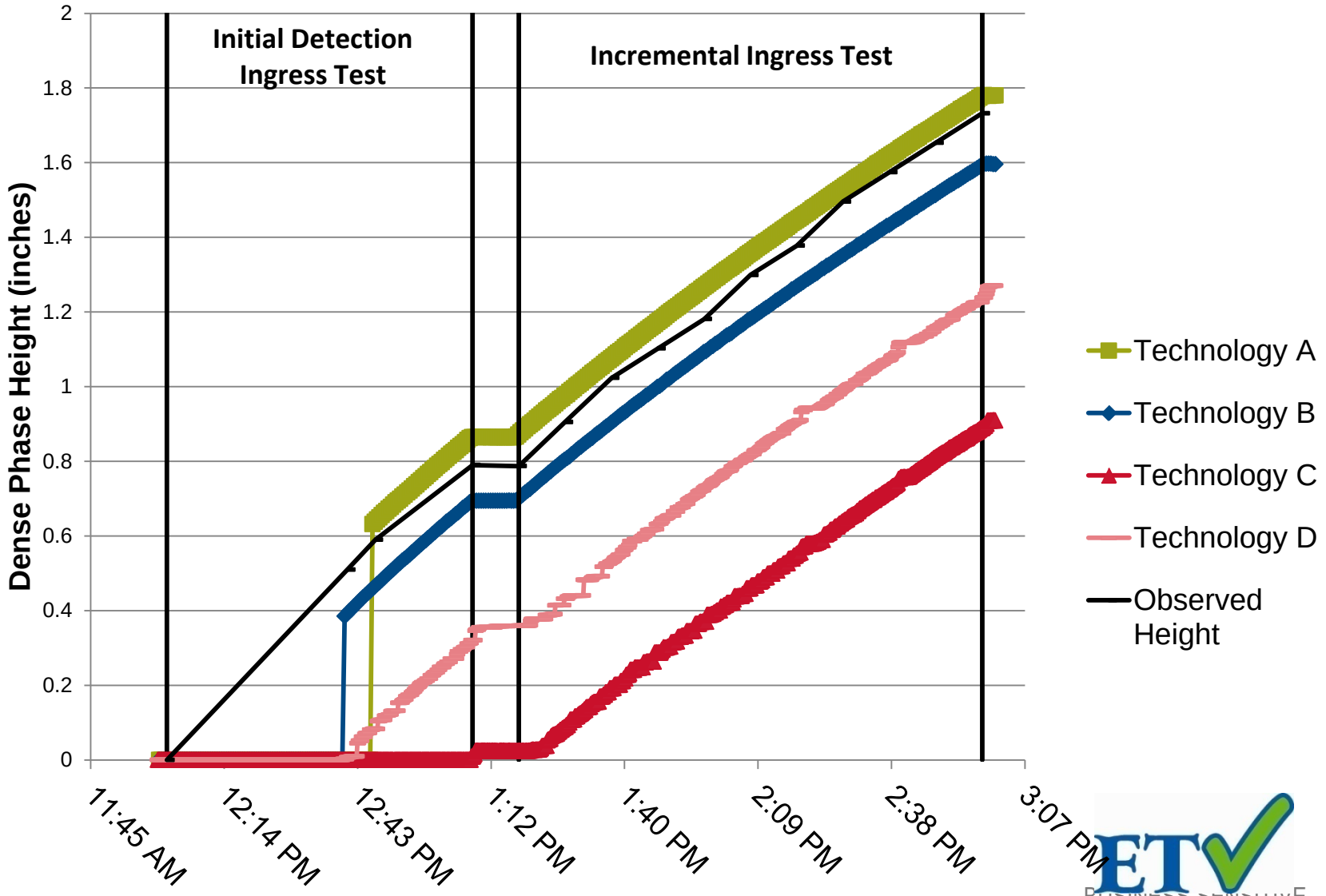
Fuel Type	Test 1 Runs				Test 2 Runs
	Fill Height				Dump
	25%		65%		
	Without Splash	With Splash	Without Splash	With Splash	
E0	X	XX	XX	X	X
E15	XX	X	X	XX	X
E85	X	X	Not Conducted	Not Conducted	X

Yellow highlighted boxes are examples presented here.

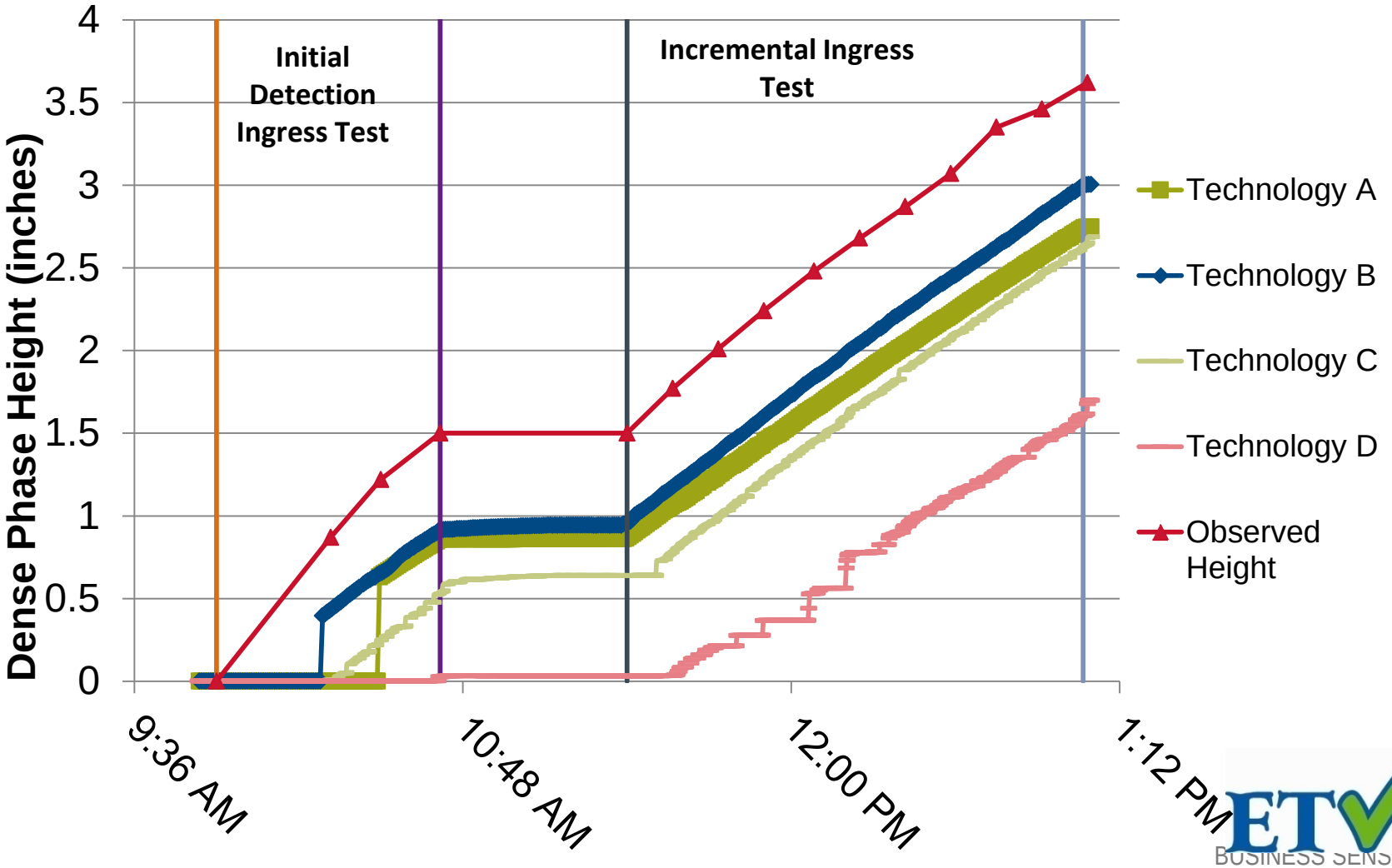
Testing Observations
E0 Fuel-25% Full-Without Splash



Testing Observations
E0 Fuel-25% Full-With Splash

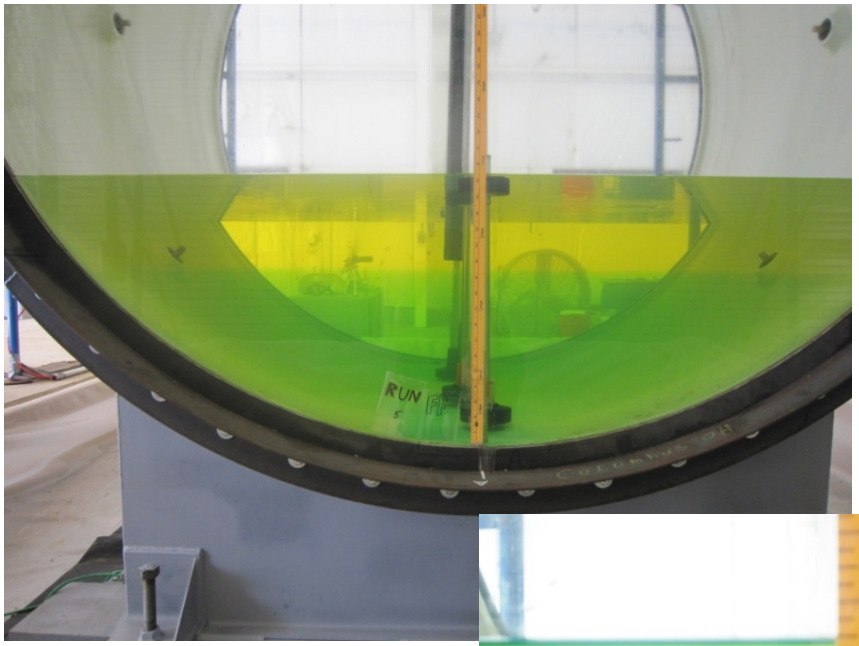


Testing Observations
E15-65% Full-With Splash



Testing Observations
E85-25% Full-Without Splash

9:45AM



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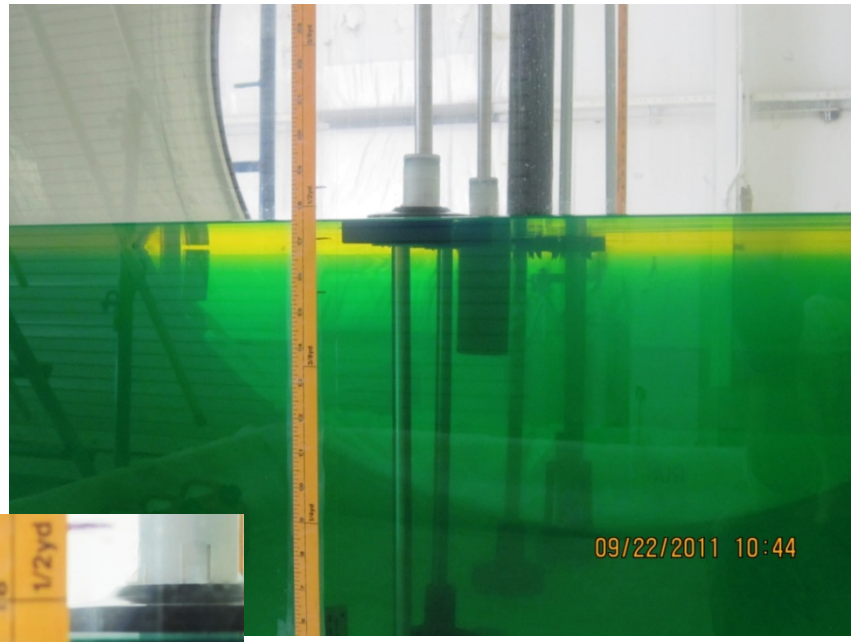

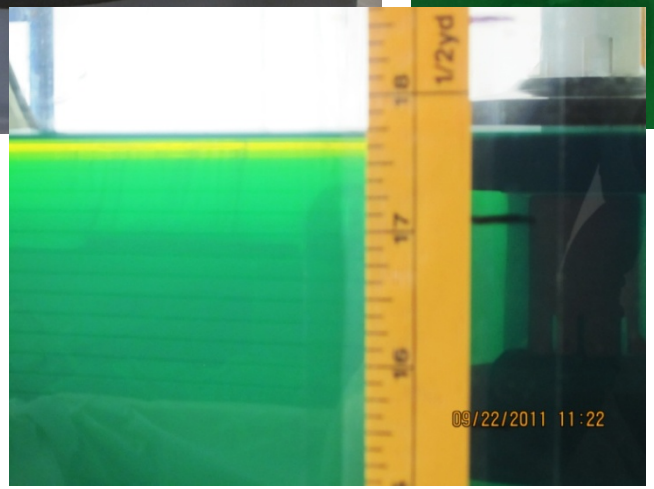

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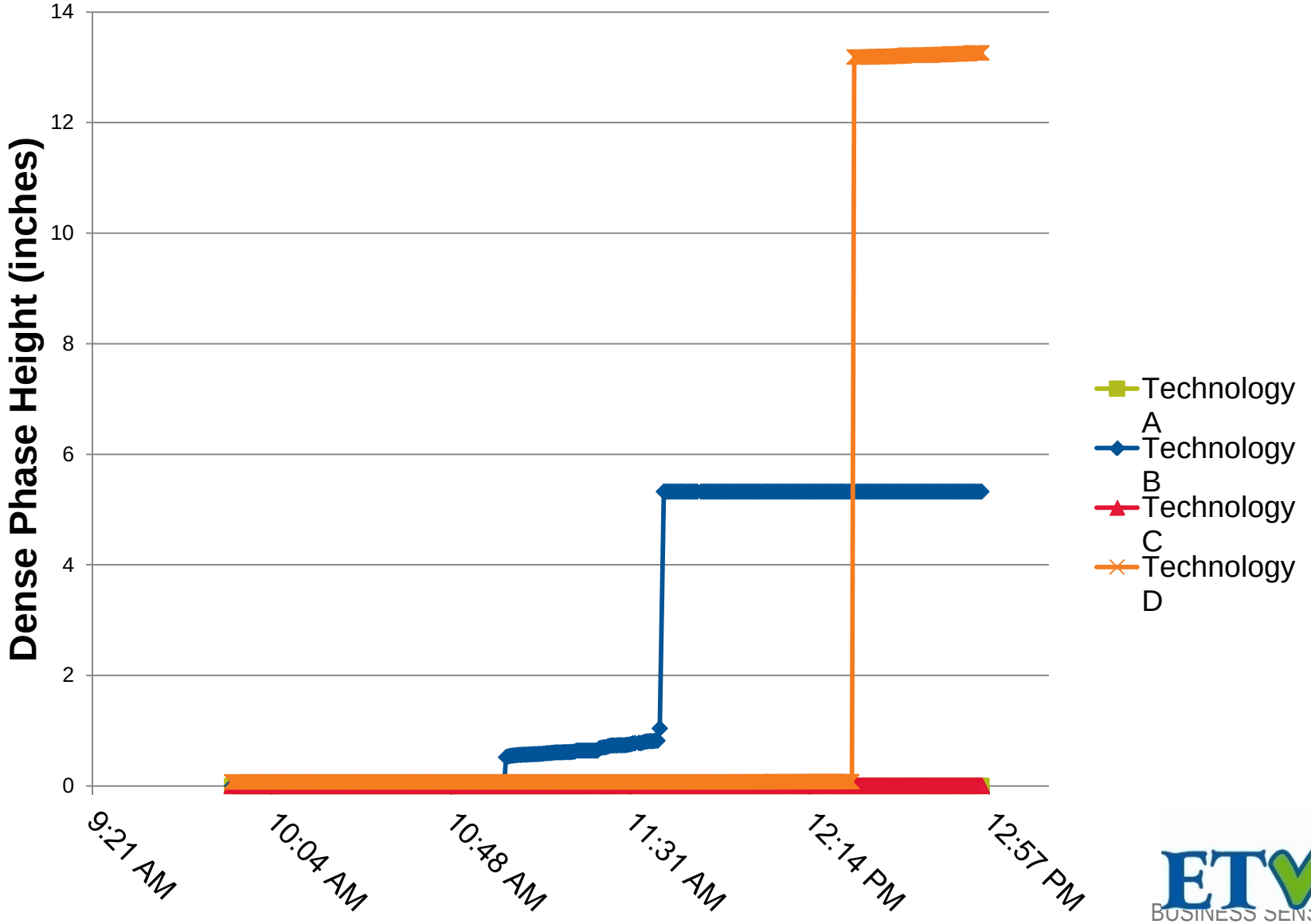
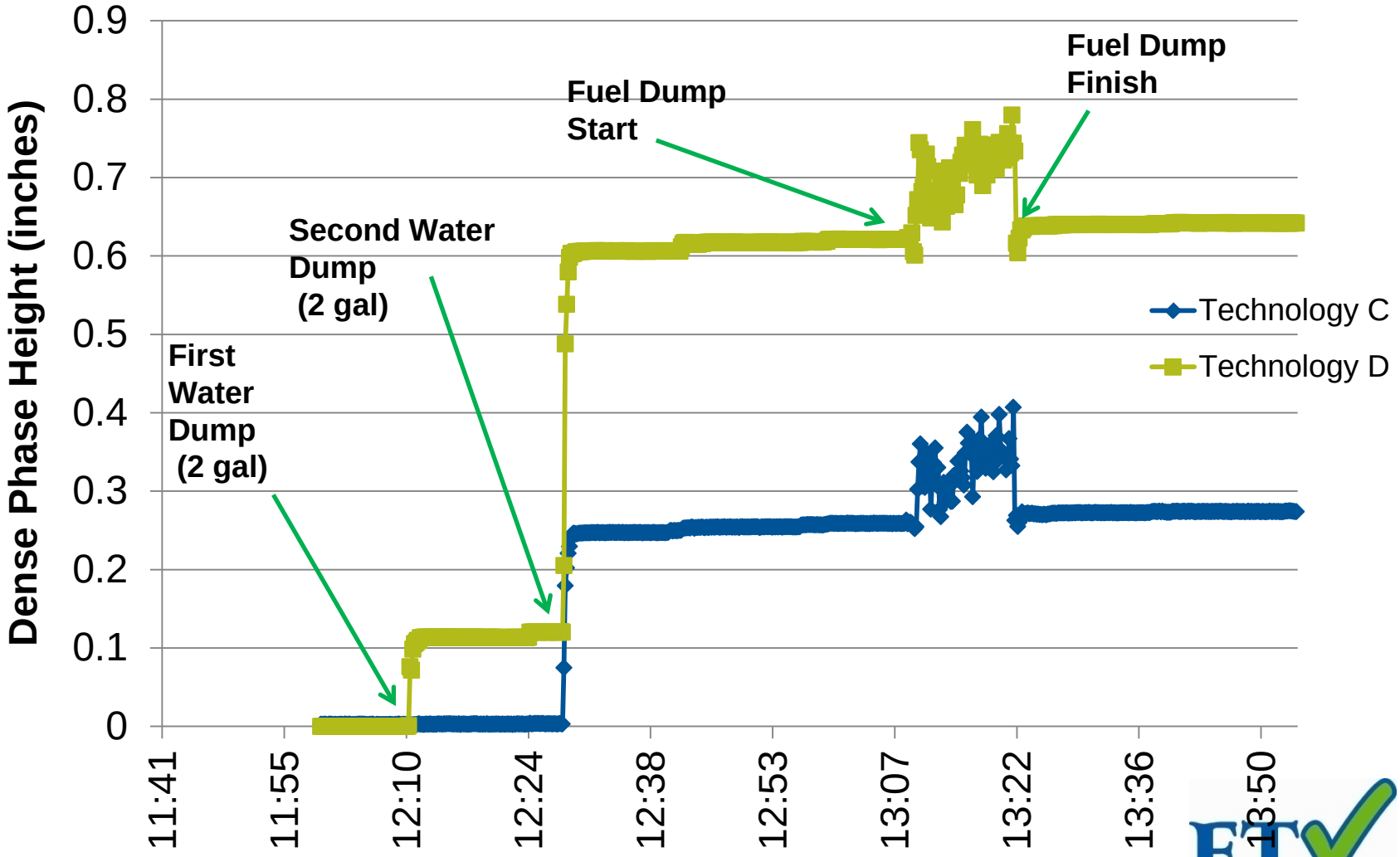
Testing Observations
E85-25% Full-With Splash

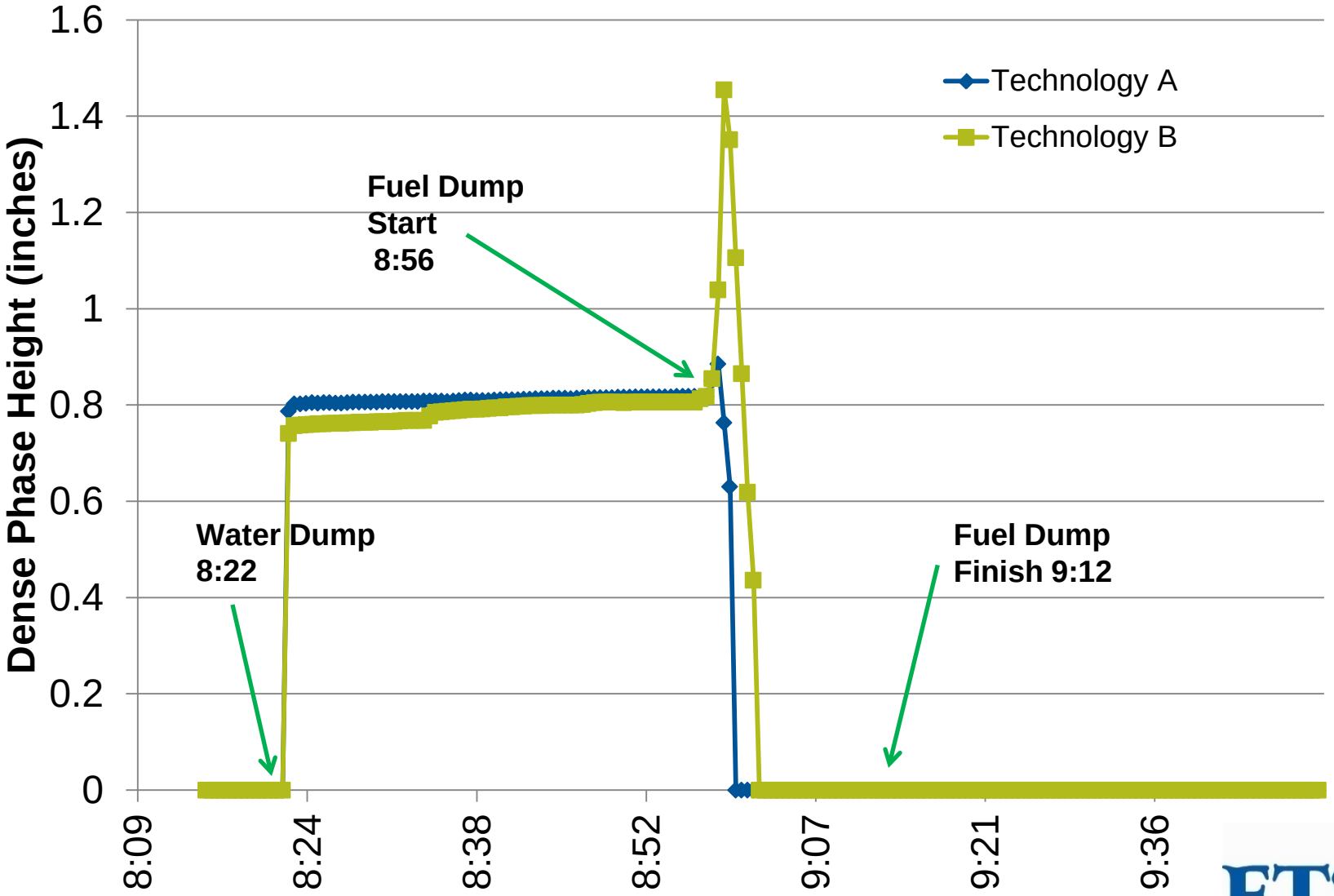


Testing Observations
E0 Dump Test




RUN
2
E0-Dump

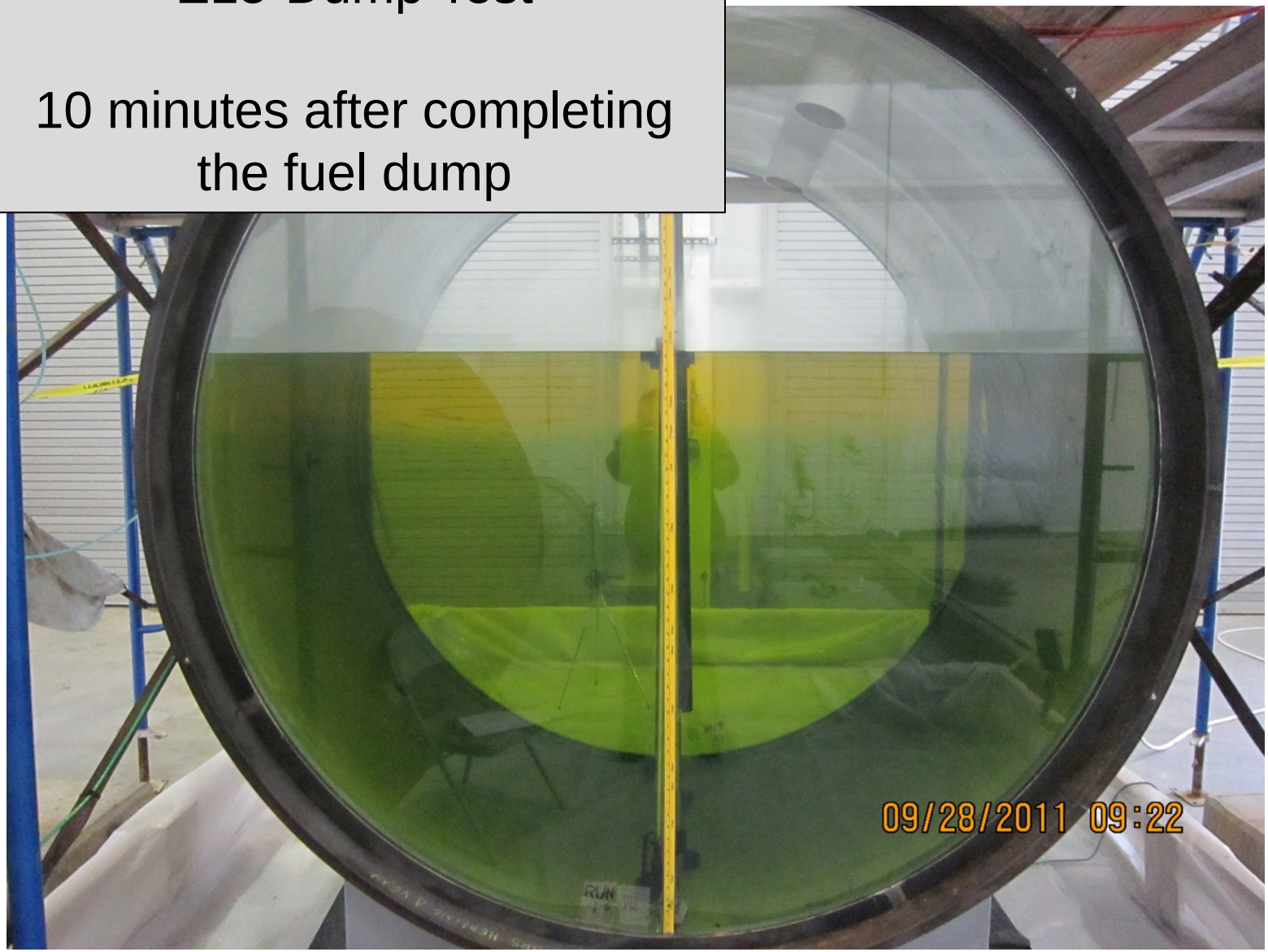
Testing Observations
E15 Dump Test



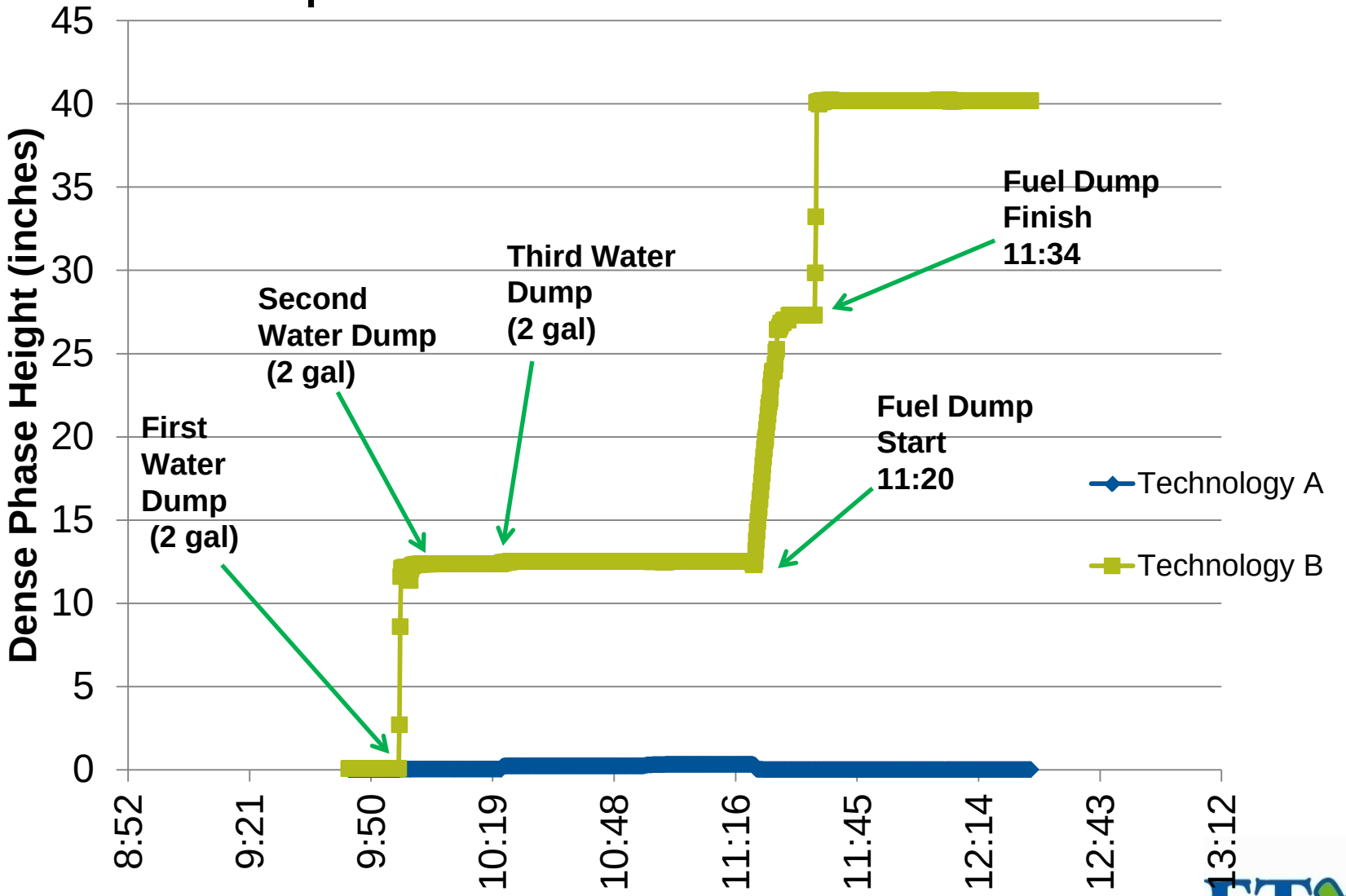

E15-Dump

E15-Dump Test

10 minutes after completing the fuel dump



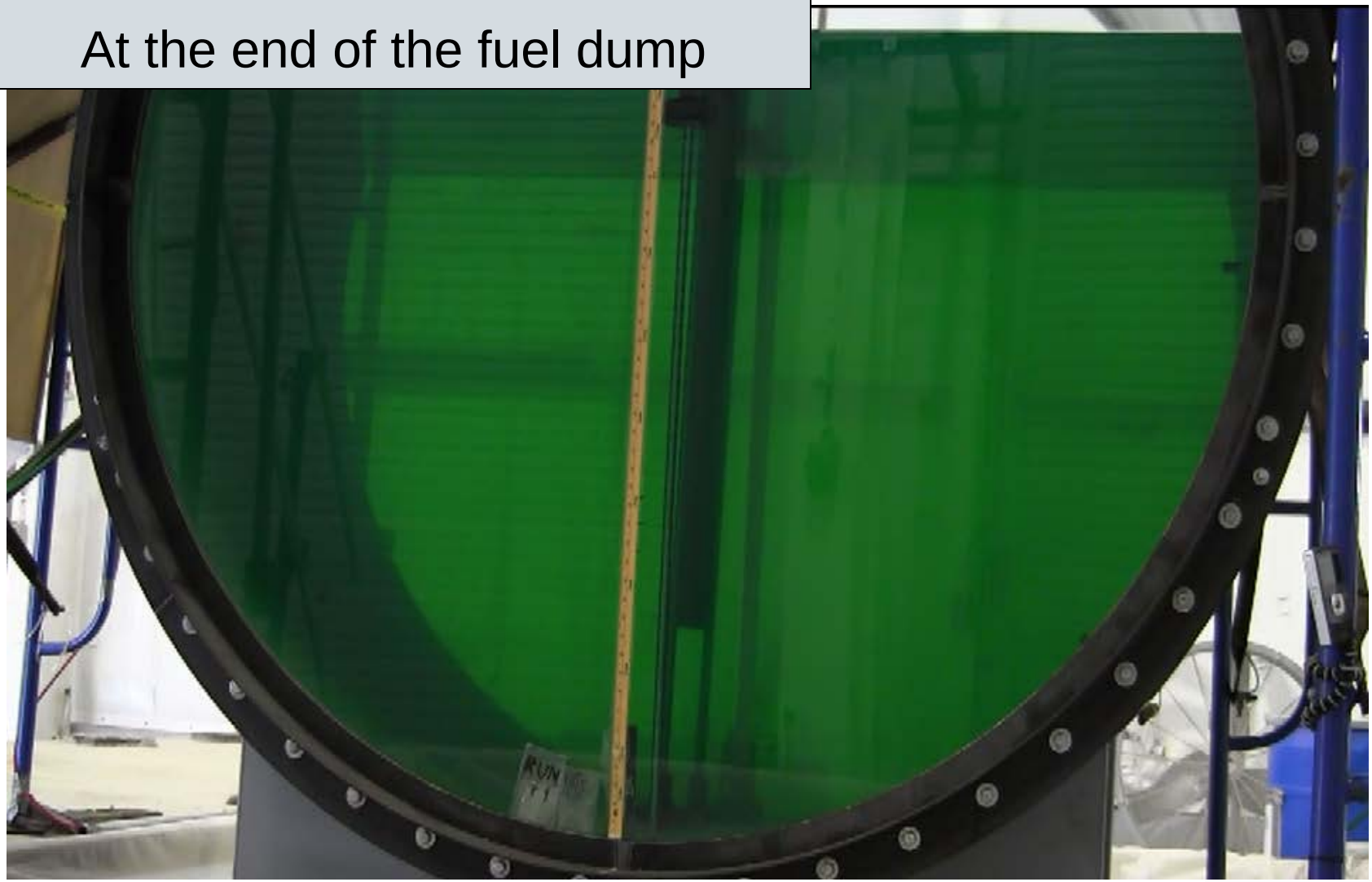
Testing Observations
E85 Dump Test




RUN
11
E85-Dump

E85-Dump Test

At the end of the fuel dump



Performance Parameter Results

Overall Performance	Sensitivity		Precision	Accuracy
	Tolerance Limit (inches)	Minimum Level Change (inches)	(mean/SD)	Bias (inches)
Technology A	0.68	0.06	53	-0.17
Technology B	0.51	0.06	12	-0.27
Technology C	0.03	0.13	2.0	-1.09
Technology D	0.04	0.07	1.8	-0.70

- The calculated performance parameters were determined using the pooled data from the E0 and E15 water ingress runs only.

Overall Conclusions

- Currently 40 CFR, Section 280.43(a) states water detection technologies should detect “water at the bottom of the tank,” which does not address water entrained in the fuel due to increased miscibility with the presence of ethanol.
- The water sensors did not detect water in the test vessel containing either intermediate (E15) or high (E85) ethanol blends if the water was suspended in the product or the water did not reach the bottom of the tank.
- There is not sufficient data to evaluate whether these technologies, when used with UST systems containing intermediate or high ethanol blends, would indicate a potential release under every circumstance.
- Reports (per vendor) and verification statements (report summaries per technology) at: http://www.epa.gov/etv/vt-ams.html#ustldt

Next Steps: Do UST leak detection technologies work in ethanol-blended fuels?

- Prepared a DRAFT Technology Assessment paper and are collecting data to incorporate into the assessment
  - To inform decisions of the NWGLDE and government regulators
  - QAPP design in 3 phases
    - Investigate fuel properties and mixing behaviors,
    - Investigate applicability of water ingress testing on a laboratory scale, and
    - Field demonstration of technologies operating under real world conditions with ethanol blend.
  - Soliciting in kind contributions of technologies for laboratory testing and sites for field demonstration

Acknowledgments

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