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CEESI Iowa Traceability and Reference Meter Replacement

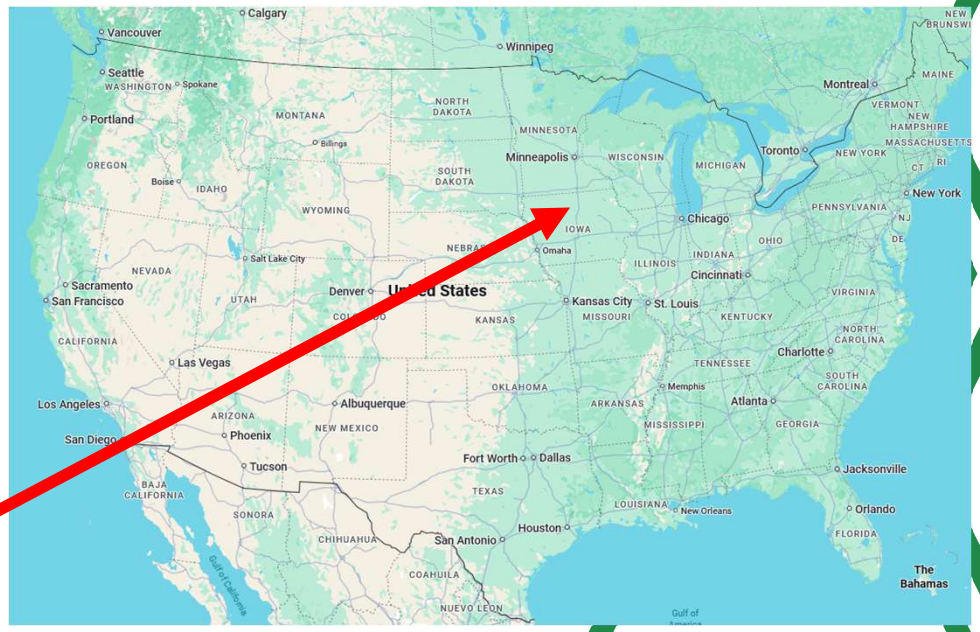
Presented by Brad Sims (CEESI)

June 9, 2026

Agenda

- CEESI Iowa History
- Layout and Capabilities
- NIST Traceability
- Reference Meter Replacement Reasoning
- Reference Meter Selection Criteria
- Reference Meter Validation Process
- Replacement Program and Continued Testing

CEESI Iowa



- Located near Garner Iowa
- CEESI Iowa is a high-capacity natural gas calibration facility
- Typical perform calibrations of custody transfer flow meters
- ~95% of calibrations are Ultrasonic Meters

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CEESI Iowa History

- **In the 1990's there was a need for a natural gas calibration facility in the United States**

- **Calibration needs could only be met by sending meters to Europe**
  - Expensive
  - Time prohibitive
  - Not directly traceable to NIST

- **CEESI Entered a partnership with the Northern Plains Natural Gas Company to develop a high-capacity natural gas calibration facility**

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CEESI Iowa History

- **The facility was completed in 1999 after multiple years of planning and construction**

- **The facility diverts natural gas from a 42” supply line**
  - Calibration at true pipeline pressure and conditions.
  - Calibration across full flow rate range

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CEESI Iowa History

- **In 2008 CEESI partnered with NIST though a Cooperative Research and Development Agreement (CRADA) to provide the NIST Natural Gas Flow Calibration Service (NGFCS)**

- **Through this partnership CEESI and NIST work closely together to provide high quality low uncertainty natural gas calibrations**

NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY U.S. DEPARTMENT OF COMMERCE

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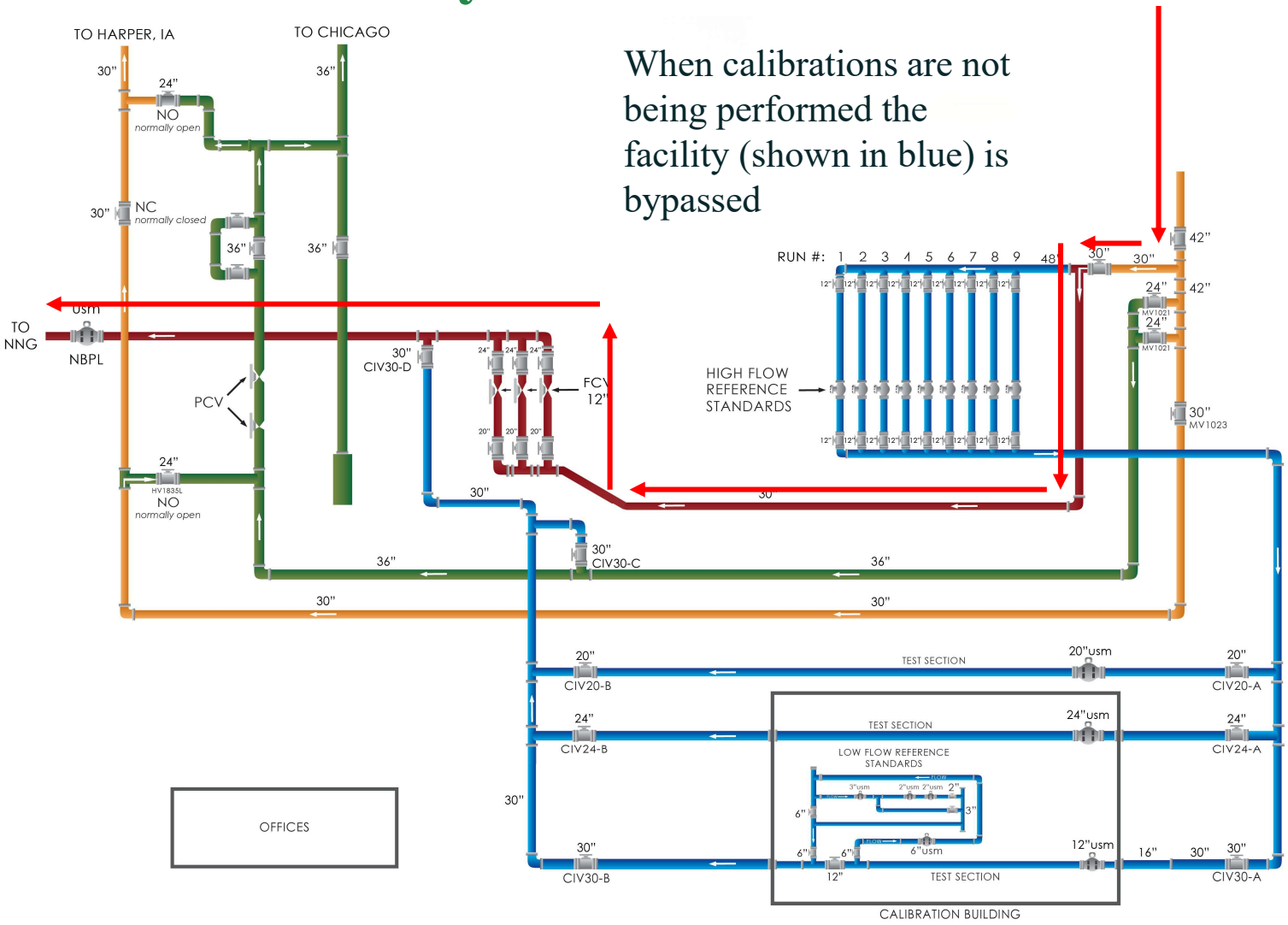
CEESI Iowa Layout



When calibrations are not being performed the facility (shown in blue) is bypassed

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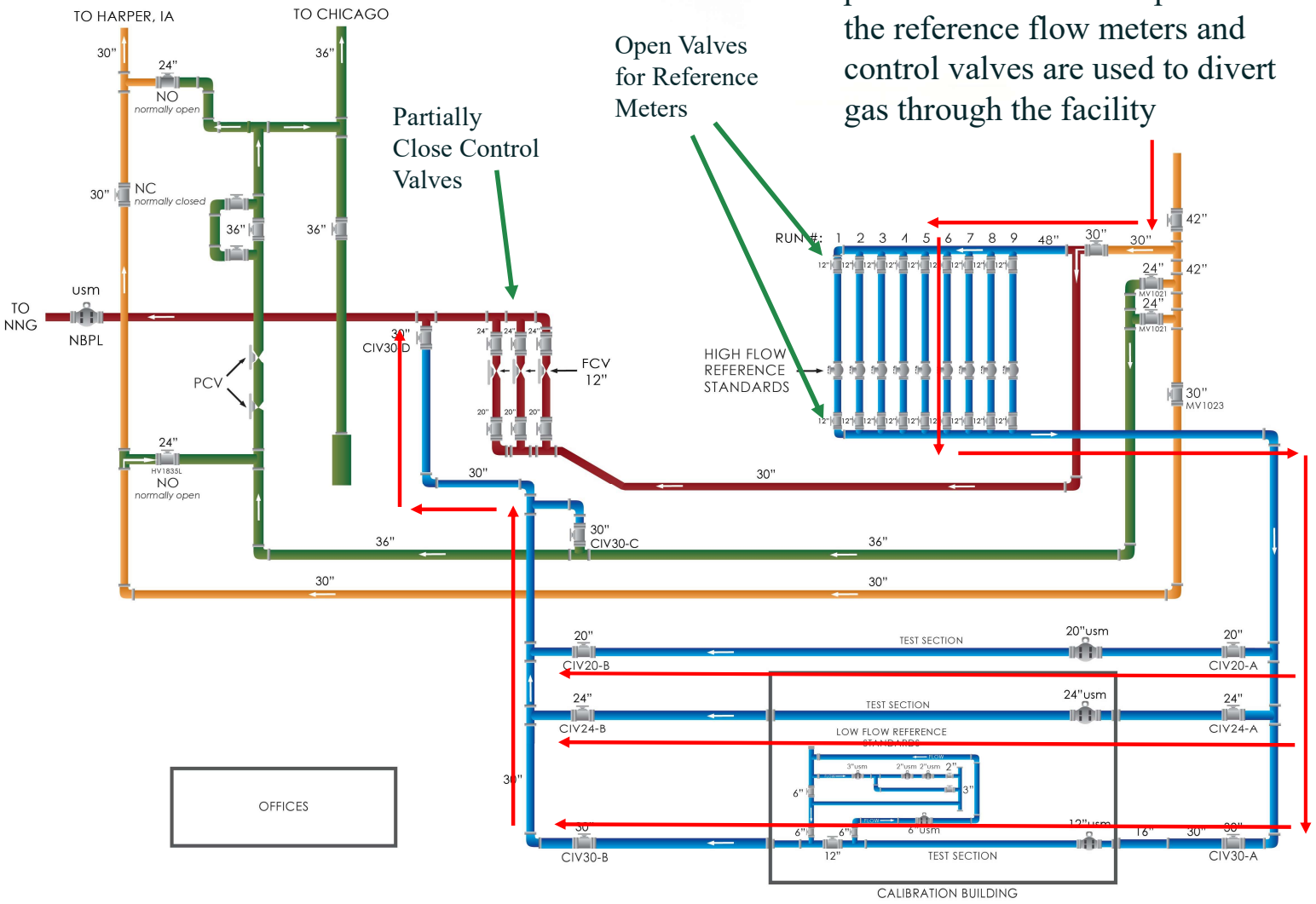
CEESI Iowa Layout

When calibrations are being performed valves are opened at the reference flow meters and control valves are used to divert gas through the facility



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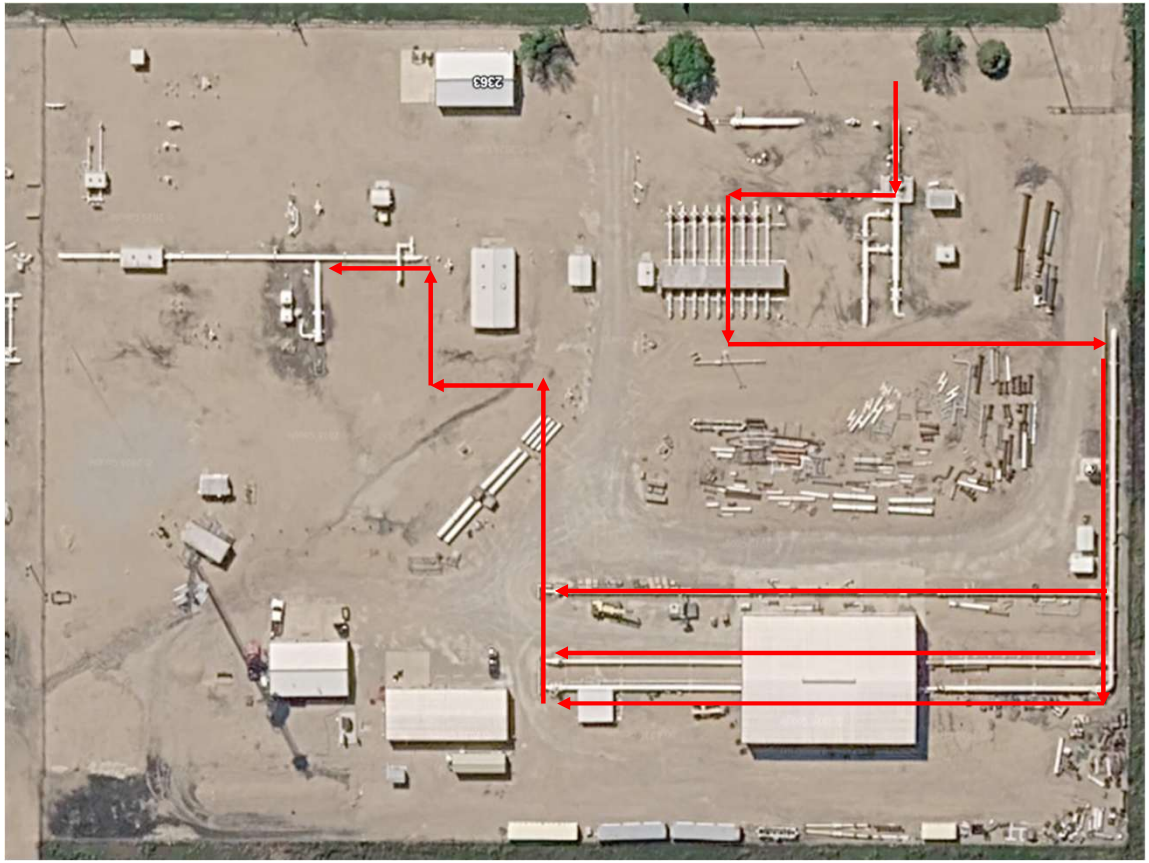
CEESI Iowa Layout

Flow path shown from aerial view



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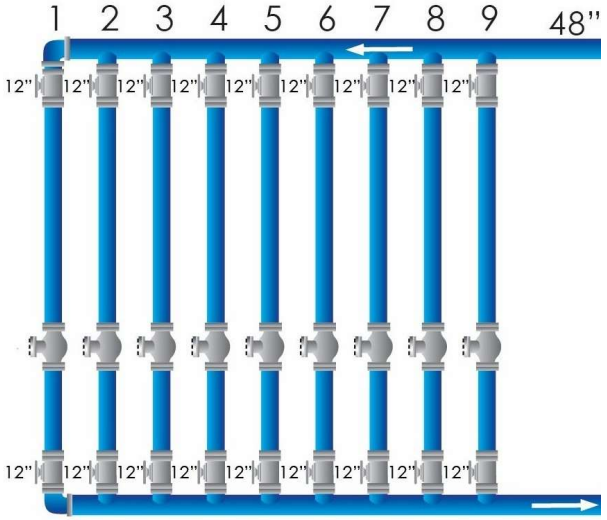
CEESI Iowa Traceability

High Flow Reference Meters

- Quantity 9, 12” Turbine Meters
- These are the “workhorse” reference meters for the facility
- Can be used individually or in parallel to achieve flows up to 1,330,000 ACFH
- Traceable to NIST



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CEESI Iowa Traceability

- The NIST traceability is through an 8-stage process
- The process start on the NIST 677 liter PVTt primary reference systems using low flow, low pressure air.
- The process utilizes critical flow venturis and then turbine meters as intermediate transfer standards.
- Through the stages the flow is scaled up 16,000 to 1 to achieve the CEESI Iowa facility capabilities.

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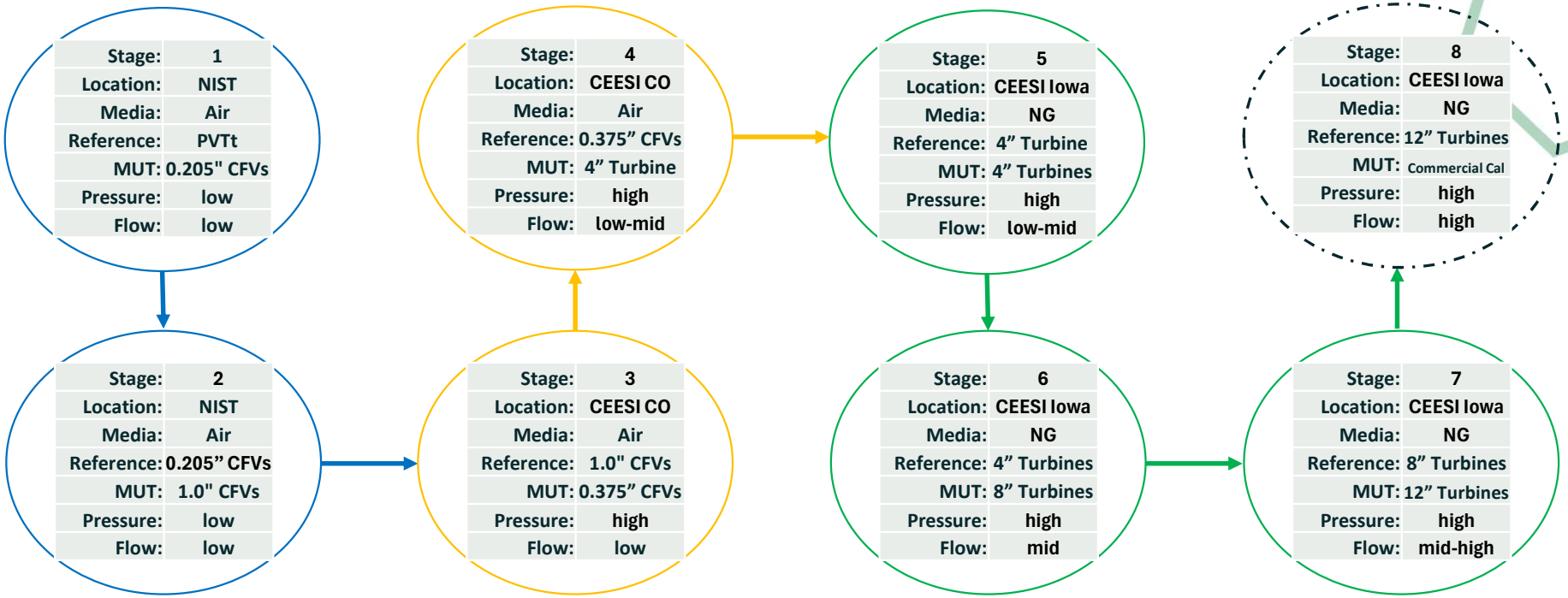
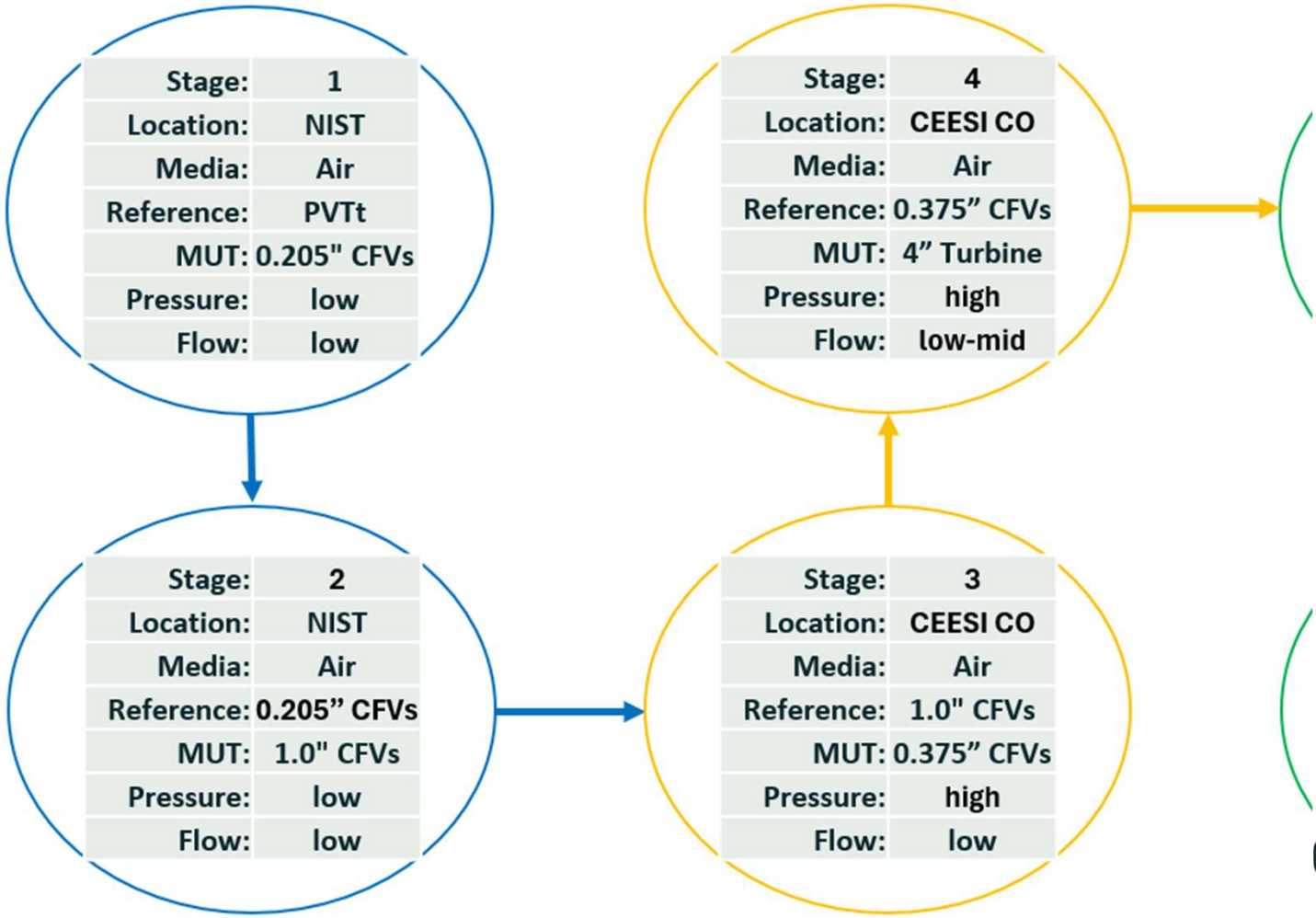
CEESI Iowa Traceability Overview

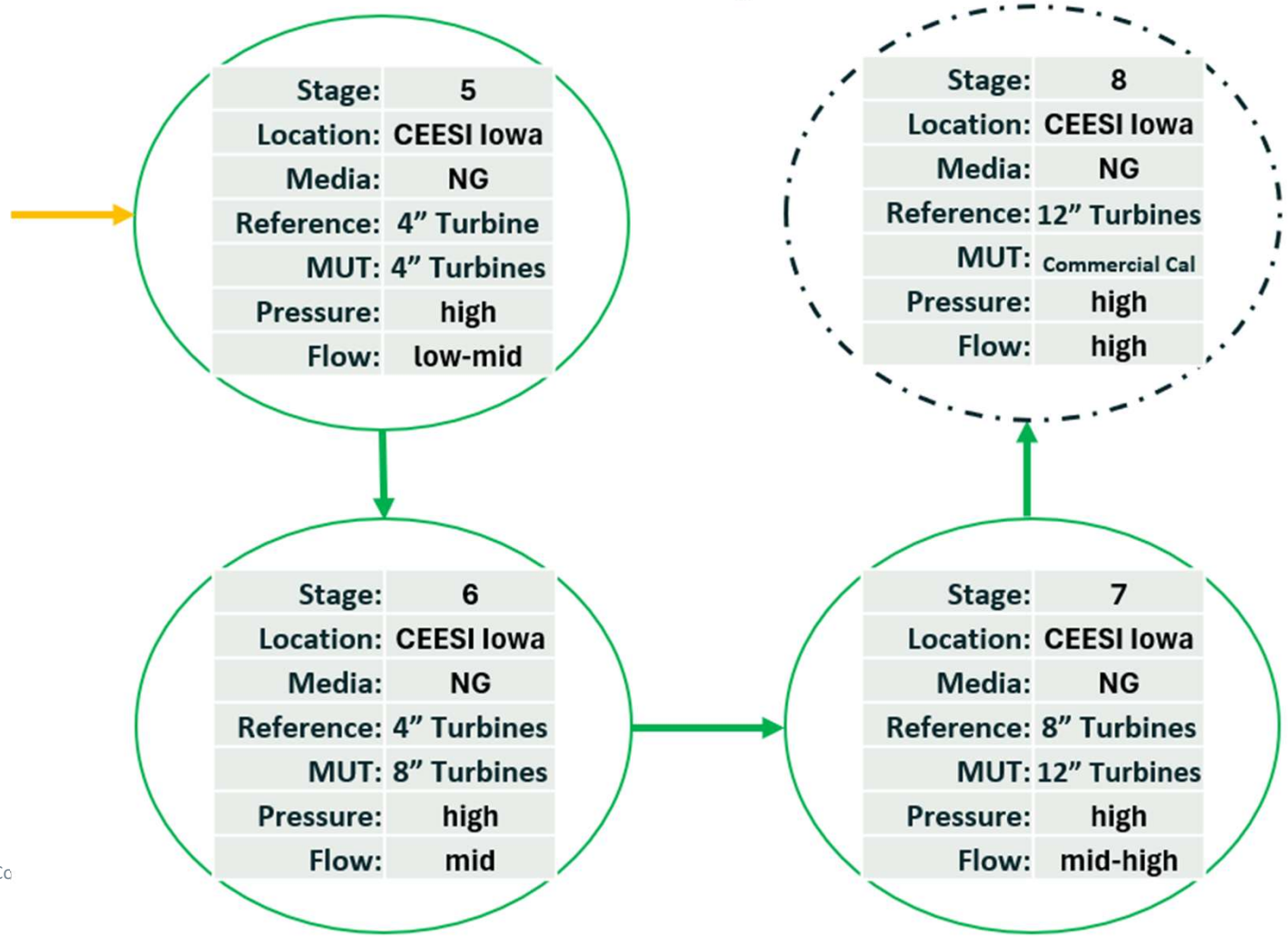
CEESI Iowa is traceable to NIST through a multistage process



CEESI Iowa Traceability Overview



CEESI Iowa Traceability Overview



CEESI Iowa Capabilities

CEESI Iowa Accreditation Scope using working standards

Flow Rate Range	Uncertainty
actual ft^3/hr	%, k=2
42-900	0.24
900-40,000	0.23
40,000-60,000	0.21
60,000-250,000	0.18
250,000-1,100,000	0.16
1,100,000-1,330,000	0.17

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“Workhorse” Reference Meter Retirement

- The nine 12in “workhorse” turbine have been in use since 1999, or more than 26 years
- They are still performing well but due to multiple factors they need to be replaced over the next few years
  - no manufacturer support
  - spare parts supplies are running out
  - potential for measurement improvements with new meters
- Replacement meters need to be selected and extensively tested before being put into service

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Replacement Meter Selection Criteria

- Operation and Calculation Transparency
  - No proprietary correction factors
  - Well known physics
- Mechanically Simple
  - Fewer variables that could affect stability
  - Increased reliability
- Repeatability (short term stability)
  - As good or better repeatability that current meters (sequential data points)
- Reproducibility (long term stability)
  - As good or better reproducibility than current meters (long term stability; weeks, months…. years)

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Replacement Meter Selected for Testing

Turbine Meter

- NIST accepted reference
- Well known physics model
- No proprietary calculations
- Single Rotor
  - Mechanical simplicity
- Outputs
  - Blade Tip Sensors
  - High frequency output
  - No reference wheel or encoders

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Replacement Meter Validation Procedure

- Meter performance validated over 6-month period
- Meter calibrated with CEESI Iowa Refences
- Tested against two validation setups; two 8in turbines in parallel and a 12” 8 path USM
- 30+ test calibrations performed against each setup
- 1600 data points collected

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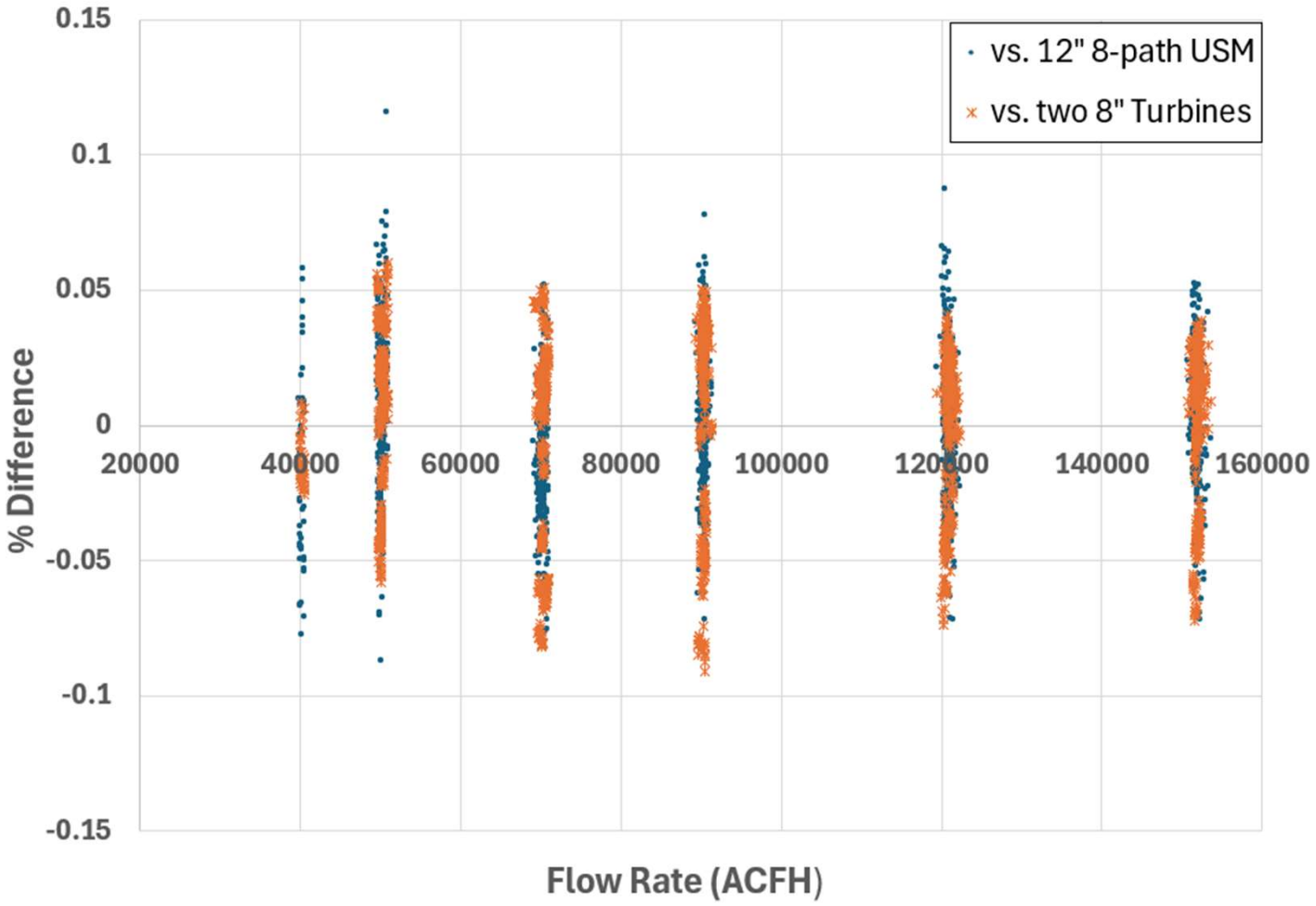
Replacement Meter Validation Procedure



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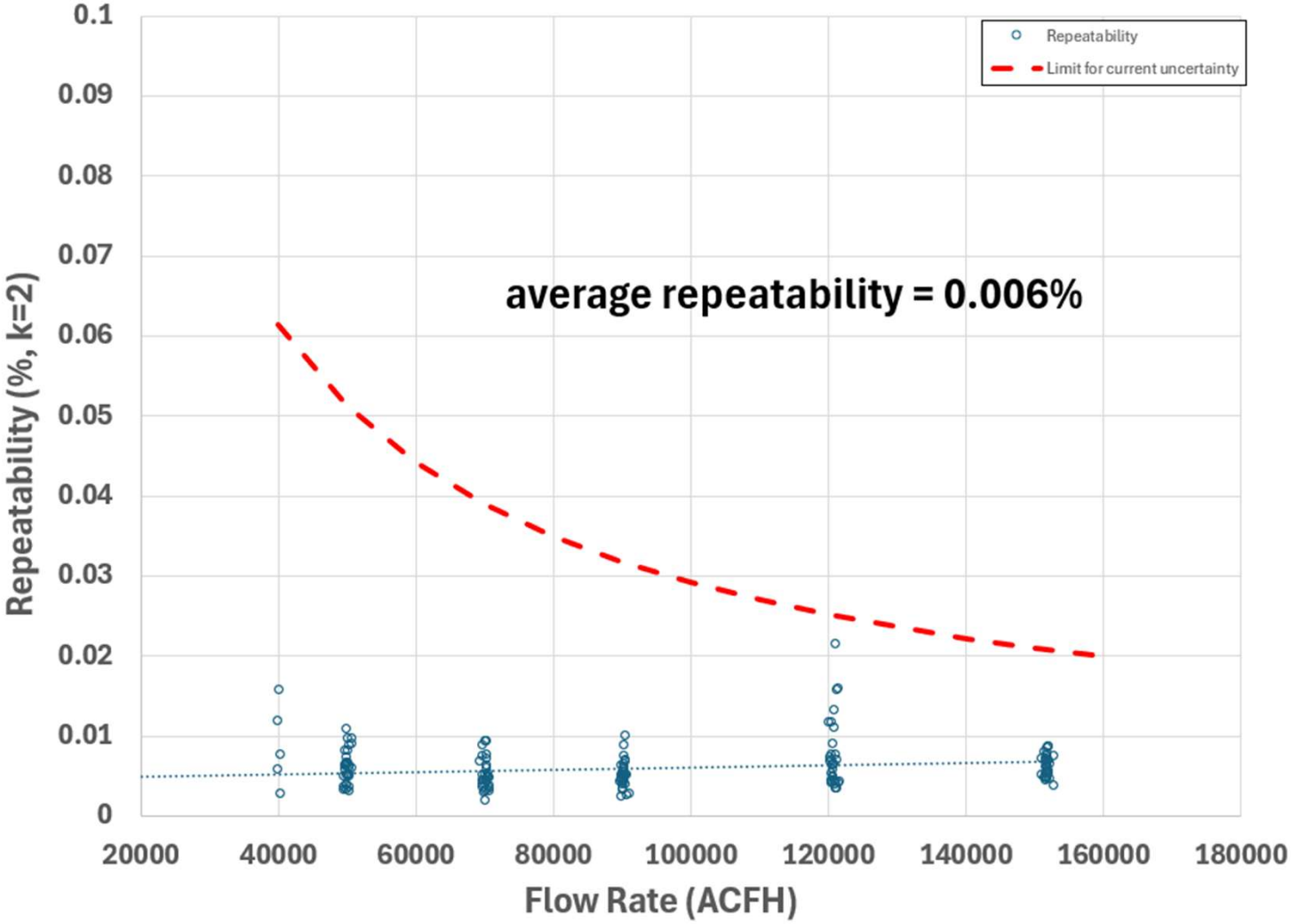
Replacement Meter Repeatability

- At each flow rate ten sequential points were collected to quantify the meter repeatability.
- The repeatability is presented with a 95% confidence limit (k=2) value.
- This calculated repeatability is due to random effects from the replacement meter, the validation meter, and the calibration process.
- The repeatability contributions cannot be easily separated so the combined value is conservatively assigned to only the replacement meter.

Replacement Meter Repeatability



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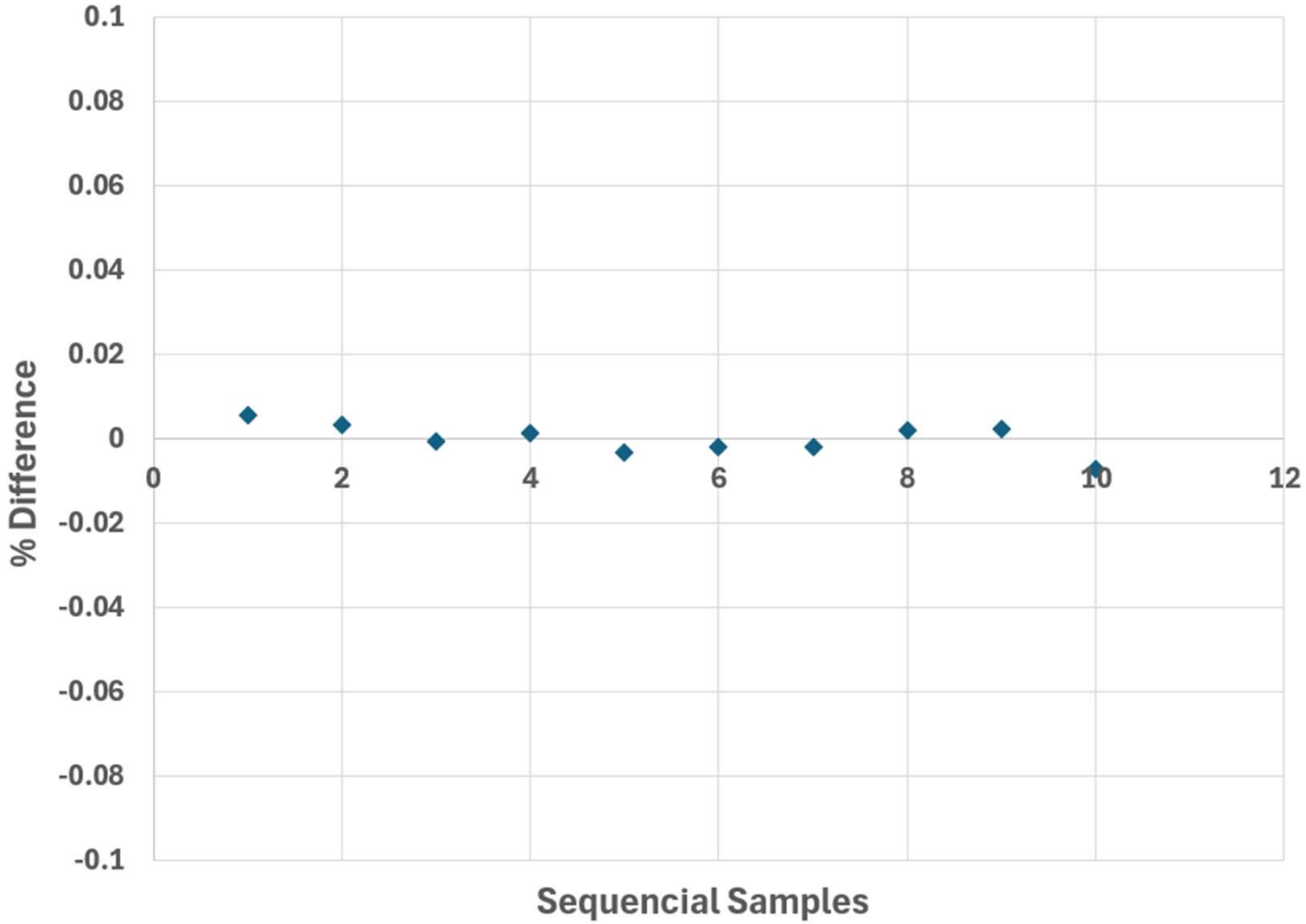
Replacement Meter Repeatability at 90,000 ACFH



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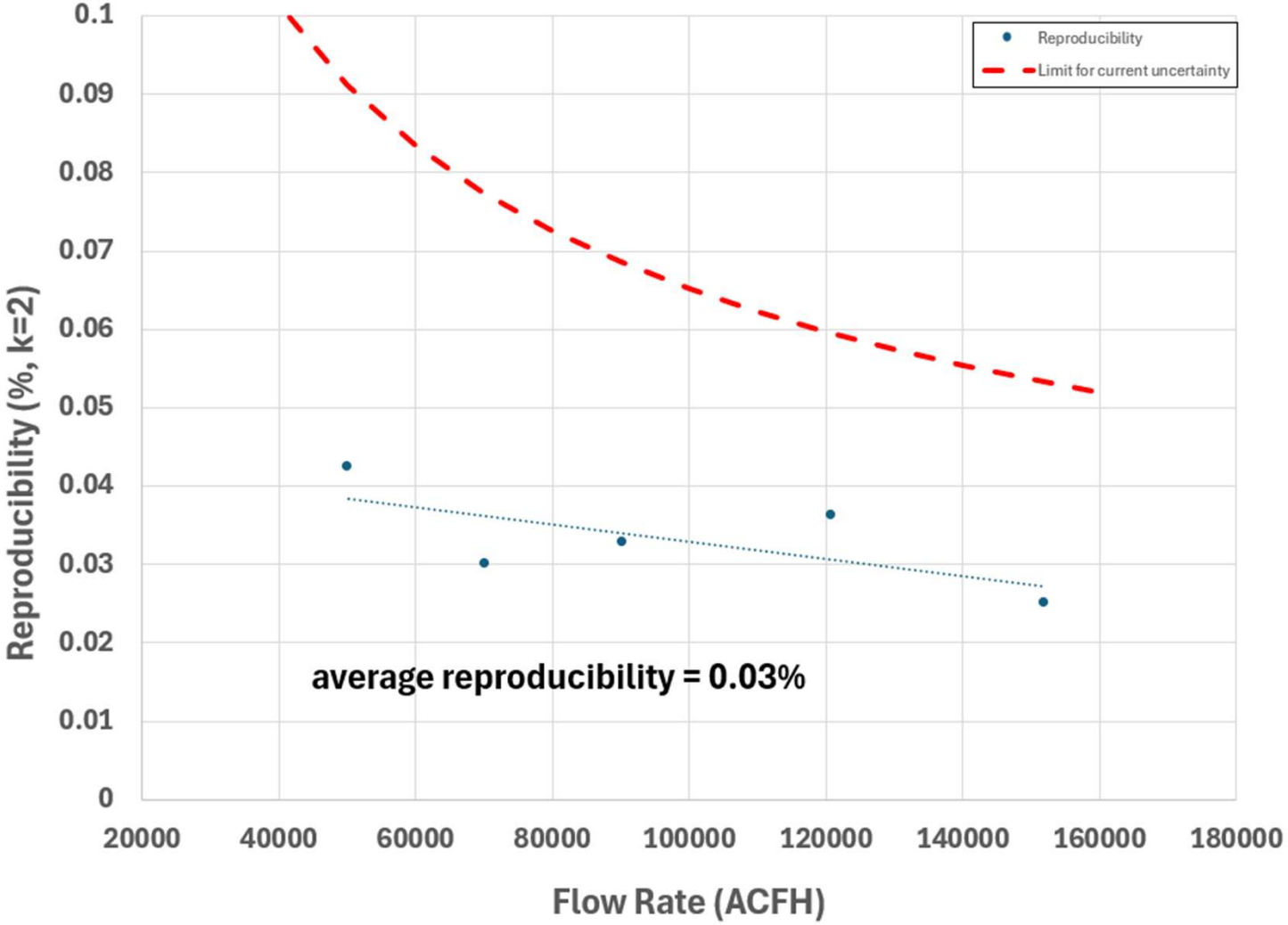
Replacement Meter Reproducibility

- Each calibration run was performed multiple times across multiple days and during a variety of different conditions.
- The reproducibility is presented with a 95% confidence limit (k=2) value.
- This calculated reproducibility is due to random effects from the replacement meter, the validation meter, and the calibration process.
- The reproducibility contributions cannot be easily separated so the combined value is conservatively assigned to only the replacement meter.

Replacement Meter Reproducibility



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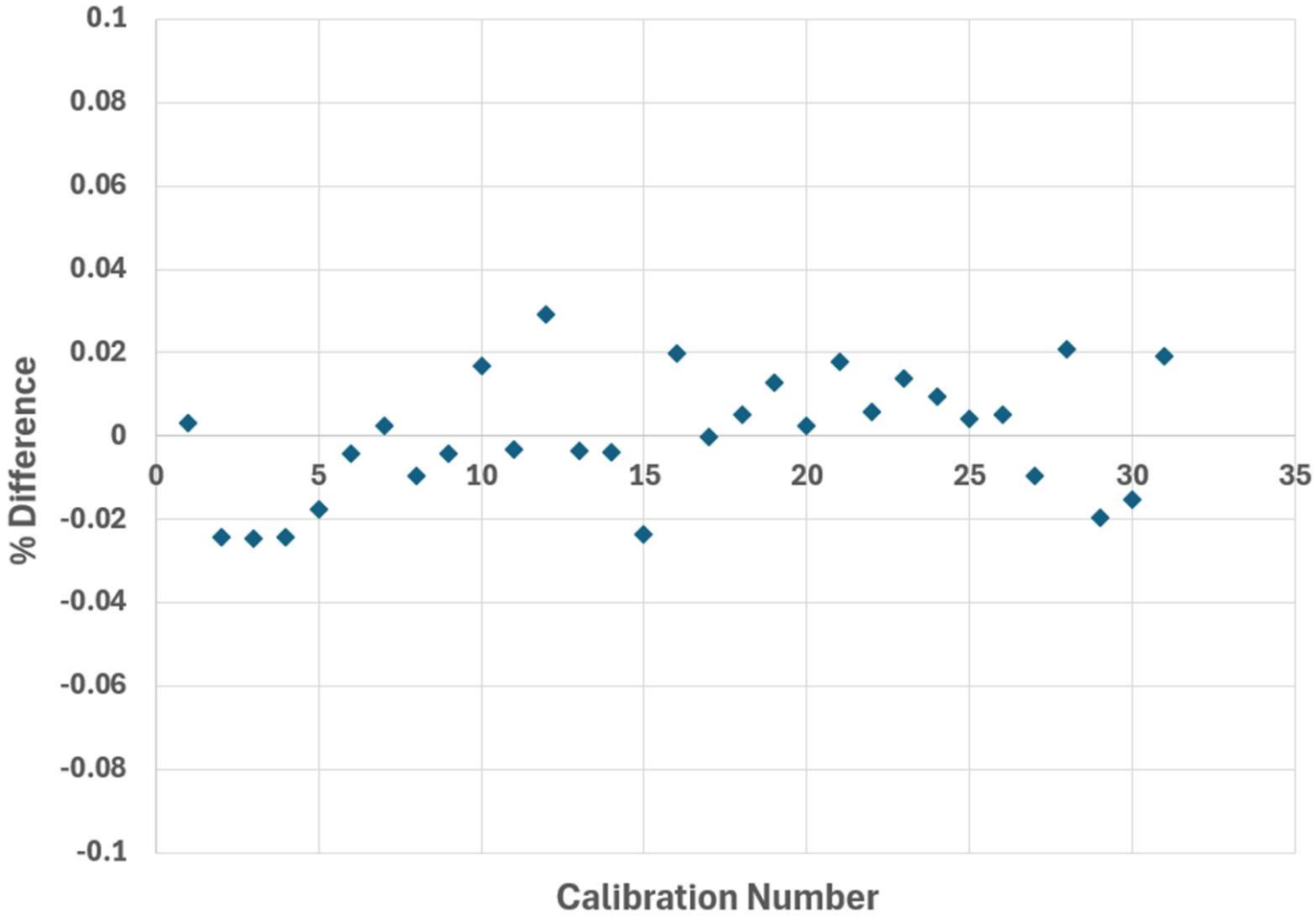
Replacement Meter Reproducibility at 70,000 ACFH



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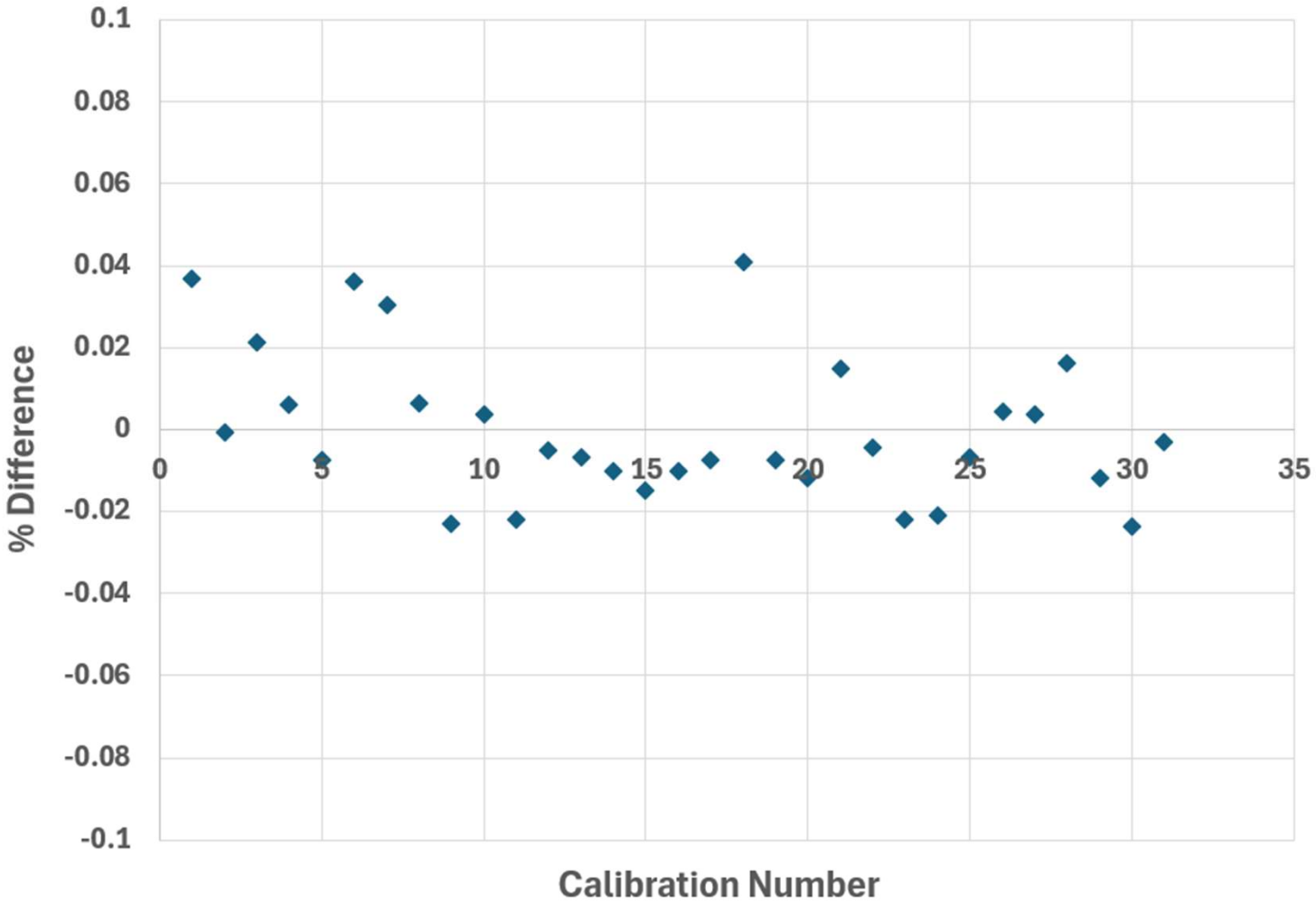
Replacement Meter Reproducibility at 120,000 ACFH



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Replacement Meter Performance

- Repeatability is 25% of current uncertainty requirement
- Reproducibility is 50% of current uncertainty requirement
- Replacement meter demonstrates both short- and long-term stability that surpasses current requirements
- Replacement Meter showed no drift

Continued Testing and Deployment

- Periodically re-test for the duration of 2026
- Further validate the long-term stability
- Calibrate new meter with identical existing traceability chain
- Place into service in 2027
- Once in service the meter will be periodically audited vs 8 path USM and the ILU 8” Turbine skid (as are all the “workhorse” turbines)

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Replacement Continued Testing and Deployment

- If the new meter continues to perform well, all 9 “workhorse” meter will be retired and replaced over the next 3 years.

- Based on the quantified repeatability and reproducibility of the tested meter, a reduction in the overall facility uncertainty is expected as the turbines are replaced.

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Questions?

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