

# Performance

THROUGH LEADERSHIP

Flow Measurement Uncertainty  
Due To  
Transducer (Re)placement  
In  
Caldon® LEFM Check and CheckPlus Systems

NON-PROPRIETARY

## Background

- During a review of the accuracy of LEFM Check and CheckPlus systems, NRC staff raised a question about the error associated with replacing transducers.
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- NRC requested empirical confirmation of the uncertainty
  - Via demonstration at ARL during Seabrook LEFM CheckPlus calibration, and
  - Via statistically significant tests and analysis

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## Results from Seabrook Calibration

- Test Performed at Alden Research Laboratory.
  - One transducer replaced and the observed difference in Meter Factor was 0.00% (Tests 193G and 193H)
  - Test performed at high flows (15,000 to 20,000 gpm)
  - Not a statistically significant test

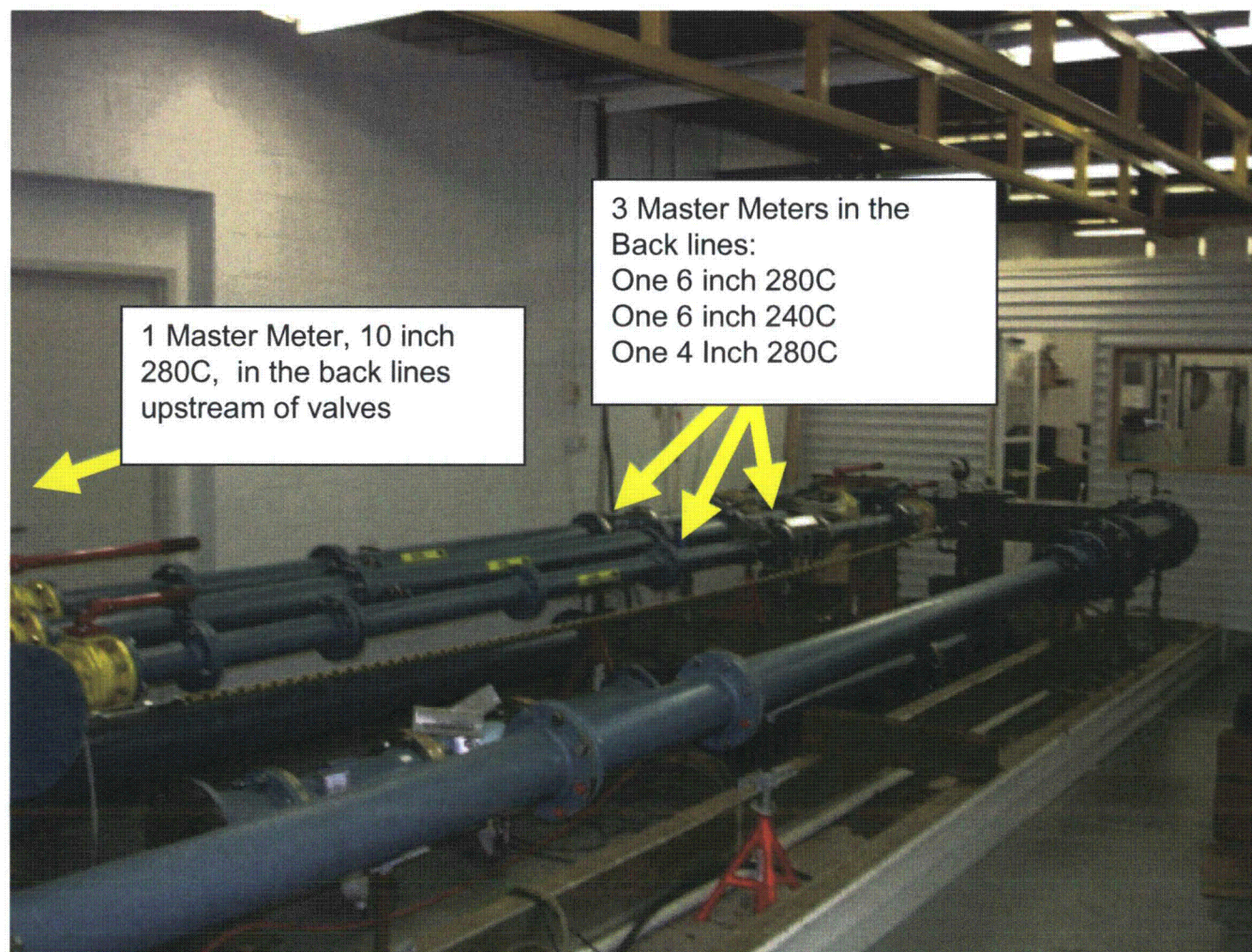
## NRC SER Dated July 5, 2006

- Requested Cameron to perform statistically significant tests to determine the uncertainty for transducer replacement

## Transducer Change Out Tests Performed on the Cameron Flow Loop

- The test was performed at the Cameron flow loop (nominal maximum flow of 5700 gpm)
  - One 150 HP Variable Speed Pump
  - Flow loop is designed for the full flow range of an 8 inch meter
  - Only ~20% of the 18 inch LEFM✓ + flow meter's range

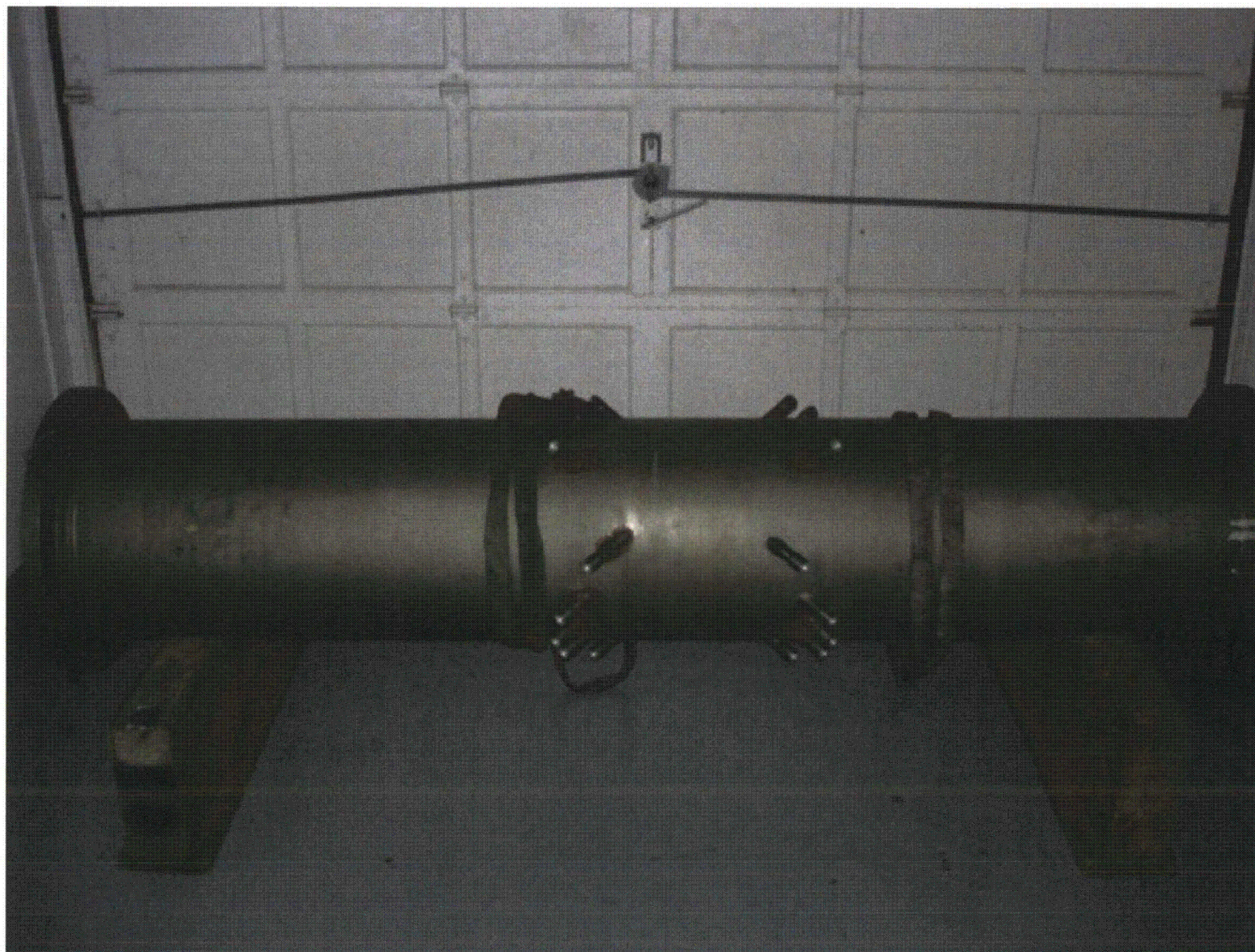
## Cameron Flow Loop



**Cameron Flow Calibration Laboratory**

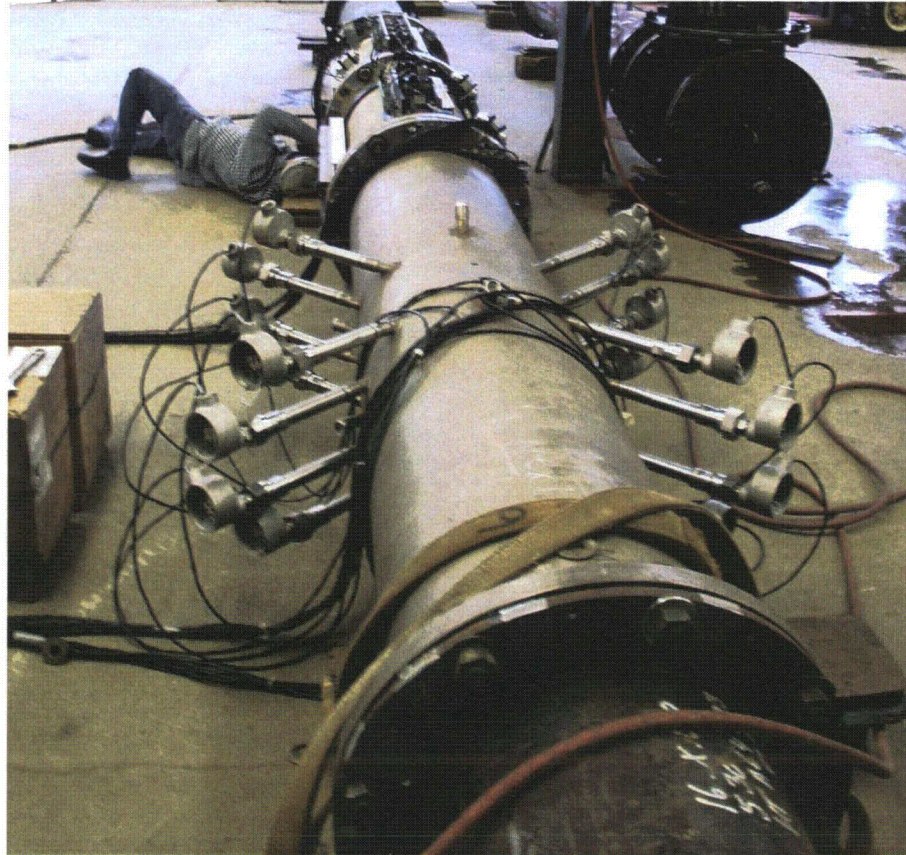


## Meter Under Test – LEFM CheckPlus at Cameron





## LEFM CheckPlus Meter – Assembled at Alden





## Procedure

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# Fix Transducer Replacement Test Procedure

- Install/replace all transducers at zero-flow conditions (16 transducers replaced for each test)
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- Set flow rate
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# Test Results Summary

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## Test Results Summary

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## Path Angle Sensitivity

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## Calculation of Path Angle Sensitivity

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# Transducer Clearance Uncertainties a Function of Pipe Size and Number of Pipes

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## Complicating Variables

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## Conclusions

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## Actions

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## Review of Existing Fleet

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## Proposed Action Plan Summary

- Document review of all analyses

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- Send CIB informing all customers of issue and requiring no action items

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