

# Case Study

## Canadian School of Hydrocarbon Measurement, Calgary Alberta

### Advanced Thermal Well Testing

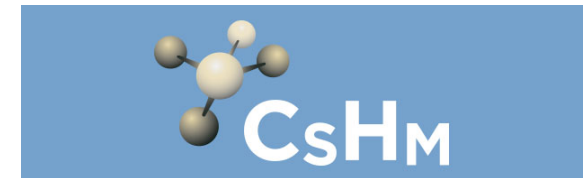
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# Introduction

The SAGD area, there have not historically been many reliable options available for well testing and flow measurement, besides test separators

- Usually operating temperature above 150 °C at the well head

One technology that has been adapted for SAGD over the last 6 years is the multiphase measurement.

- Currently only a few oil sands operators have evaluated this technology, with some interesting results.

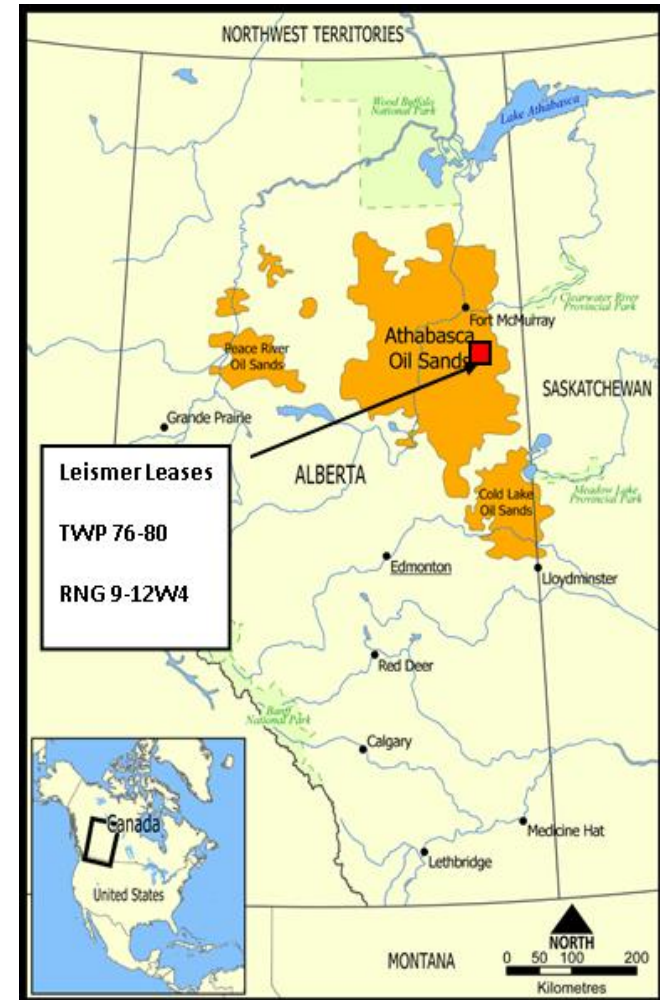
The use of MPFM is not something new for Statoil

- Experience with permanent MPFMs configuration for well testing on onshore and offshore business

The technology and the process for the qualification of the AGAR multiphase flow meter as an well testing equipment is described along this presentation.

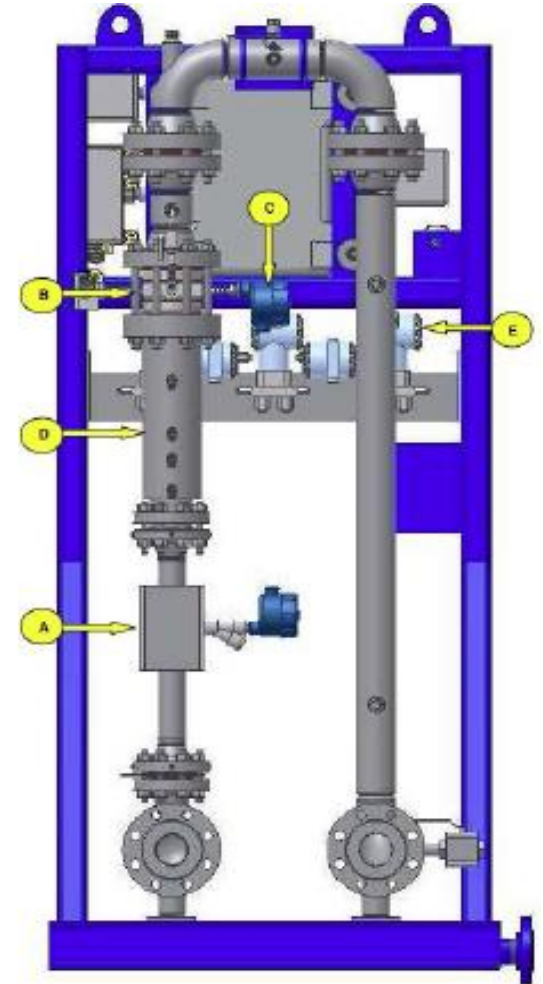
# Leismer Project SAGD Facility

- Statoil Canada operates the Leismer (~ 25 km northwest of Conklin and 100 km south of Fort McMurray).
- SAGD used for oil recovery
- CPF capacity 20Kbpd
- Started-up in 2010
- Currently 5 pads in operation
- Total of 32 producing wells



# AGAR Multiphase Flow Meter

- The MPFM-50 is a complete system that integrates commonly used oilfield measurement technologies. Agar combines these devices to accurately measure the flow rates for oil, water and gas in a multiphase environment.
- The MPFM-50 consist:
  - A. AGAR Coriolis Meter
  - B. AGAR OW-200 Water cut meter
  - C. AGAR Interface Detector
  - D. Venturi
  - E. Pressure transducers

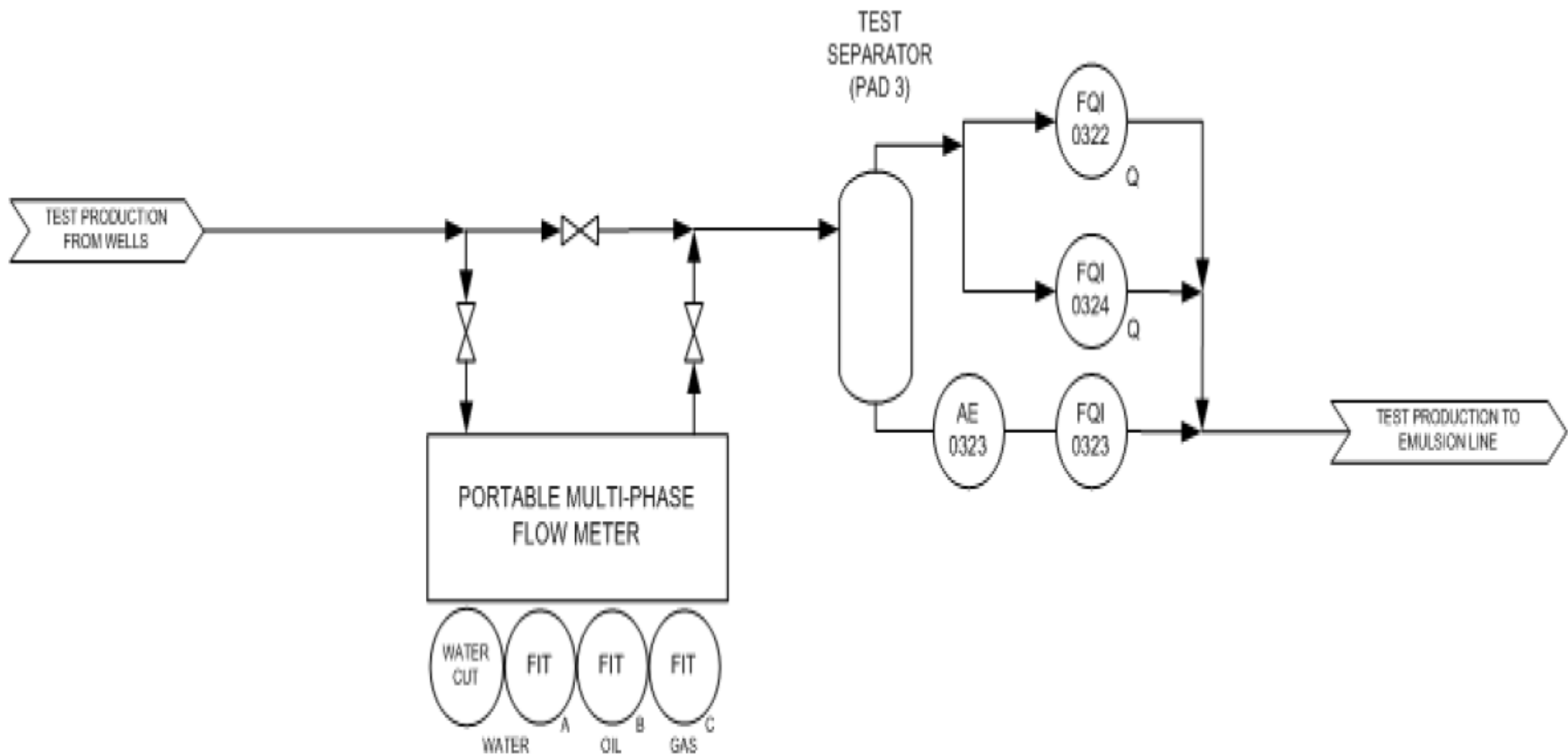


# Field Testing Program & Plan

- The Field Testing conditions used the following references:
  - a. Well PAD L3 was used for the trial (6 SAGD producer wells)
  - b. MPFM was installed upstream of the Test Separator to expose it directly to the well conditions
  - c. Coriolis meter in the Test separator used as reference for Liquid comparison.
  - d. Water cut analyser in the Test Separator and Pressurized Samples used as reference for water cut comparison

# Field Testing Program & Plan

## MPFM Tie ins on Pad L3



# Field Testing Program & Plan

## Field Testing Plan

- All producer wells on Pad L3 were run through the MPFM.
- Each testing period was no more than 12 hr, with 1 hr for stabilization time.
- The Sampling was performed using an automatic sampler system that allows to collect the sample under pressurized and isokinetic conditions.
- Statoil operational staff collected all the samples and sent to the external lab for dean stark analysis and then results were sent only to Statoil

# Field Testing Program & Plan

## Field Testing Plan

- Commissioning of MPFM by AGAR
- Statoil requested AGAR to assist onsite only during the commissioning of the unit; therefore, the meter was transferred to Operations after the commissioning was completed.
- Prior to performing the test, AGAR provided training session to Operations and Maintenance staff at Leismer. These sessions included theoretical as well as practical training with the meter and sampler.



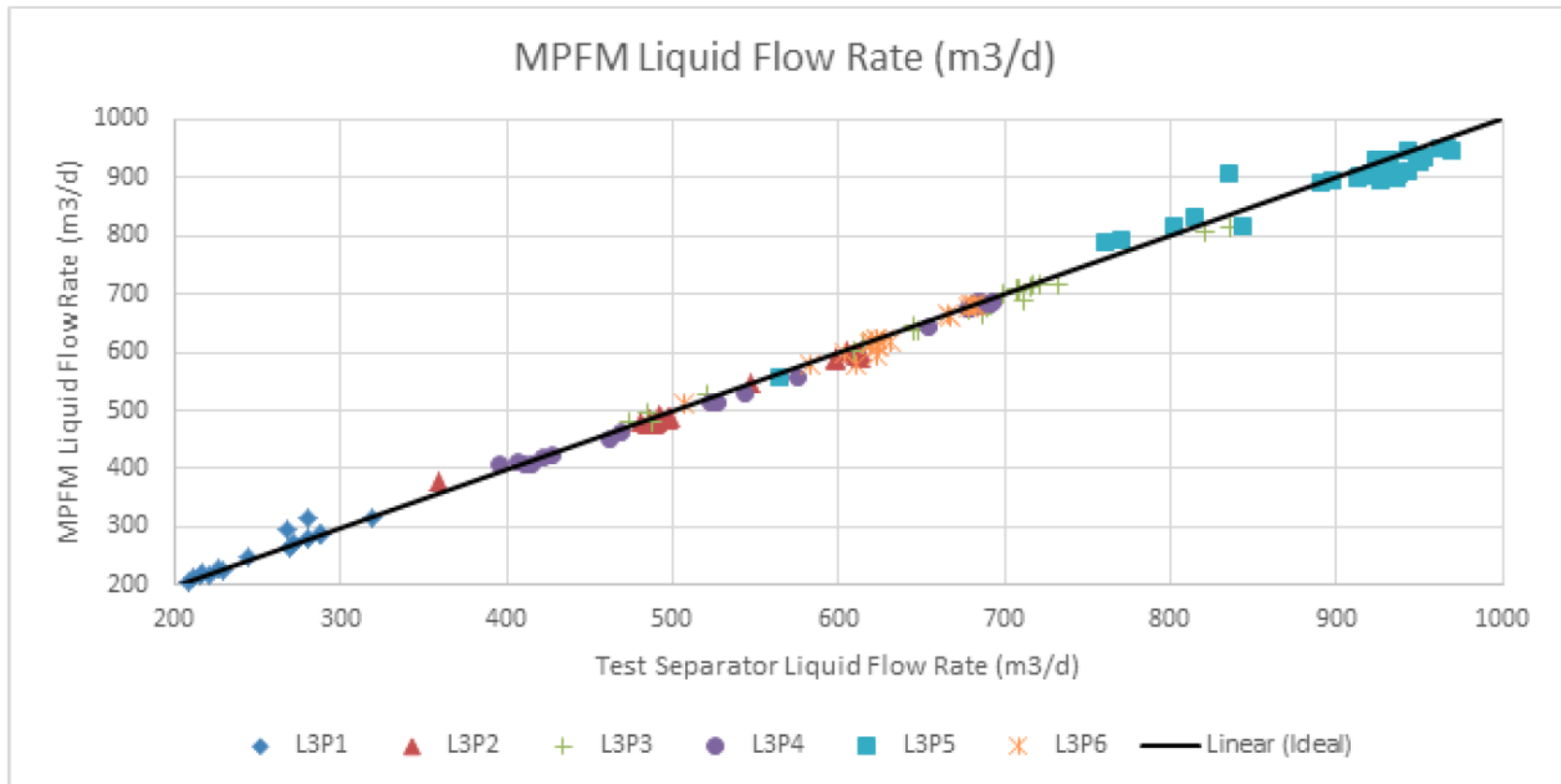
# Field Testing Results

## Liquid Flow Rate Results

- The analysis for the liquid flow rate was done comparing the liquid rate from the MPFM against the liquid rate of Test separator.
- A total of 147 tests were used for this evaluation (over 1500 hours).
- The liquid flow range tested during the trial covered from 200 m<sup>3</sup>/d up to 970 m<sup>3</sup>/d.
- The average relative liquid flow rate error for the trial between MPFM and Test separator was 1.50% with a standard deviation of 1.72.

# Field Testing Results

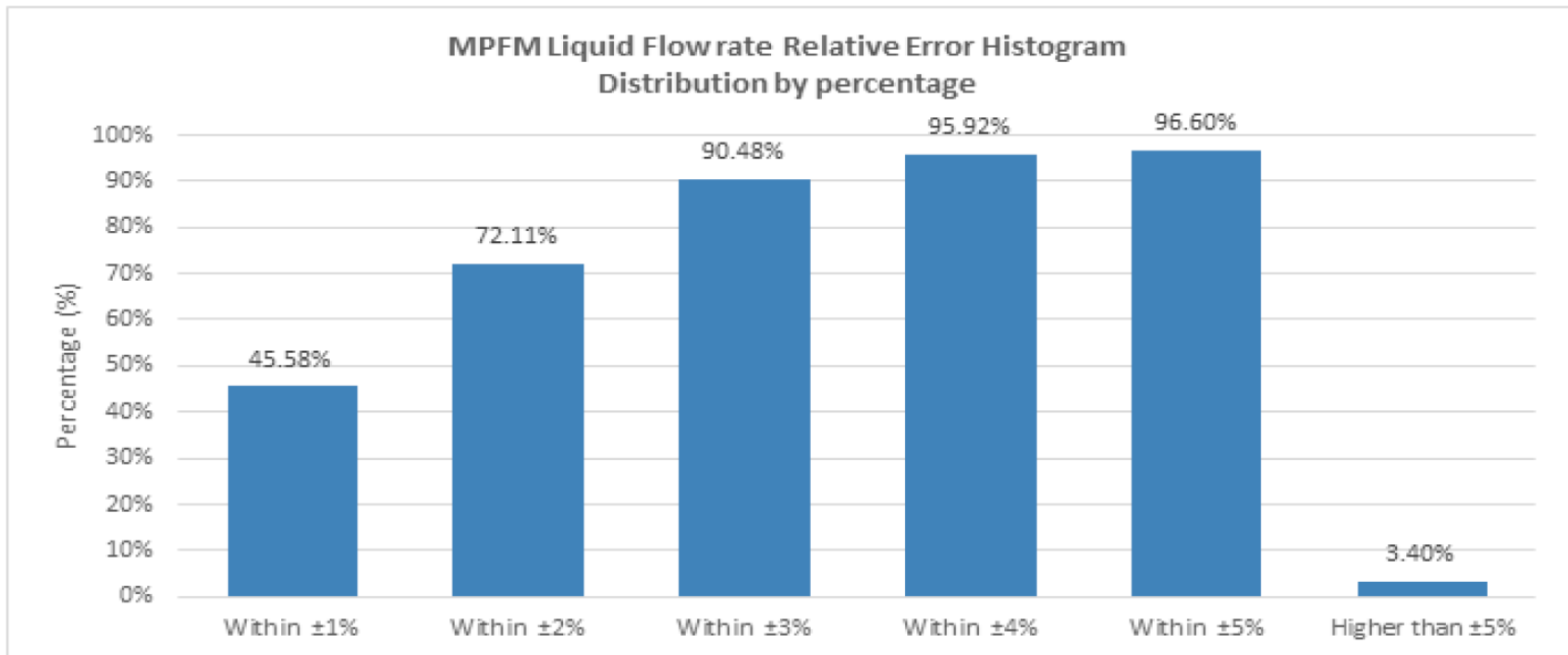
## Liquid Flow Rate Results



# Field Testing Results

## Liquid Flow Rate Results

Graph shows 90.5 % of the test are within  $\pm 3\%$  and 96.6% within  $\pm 5\%$



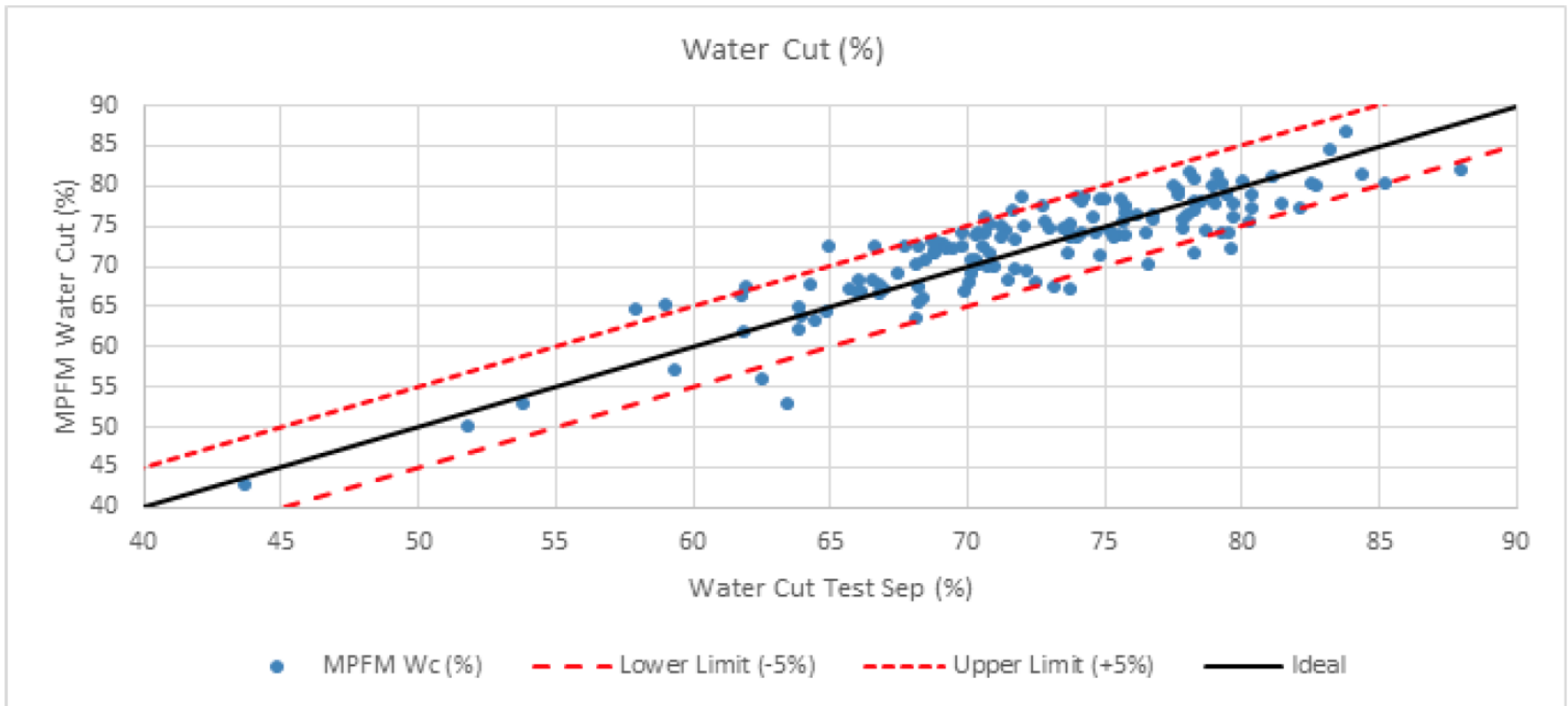
# Field Testing Results

## Water cut Results

- The analysis done comparing the water cut from MPFM against the water cut from test separator and pressurized samples.
- A total of 145 tests were used for this evaluation (over 1500 hours).
- The water cut range tested during the trial covered from 39% up to 87%.
- The average absolute water cut error for the complete trial between MPFM and Test separator was 3.47% with a standard deviation of 2.45.

# Field Testing Results

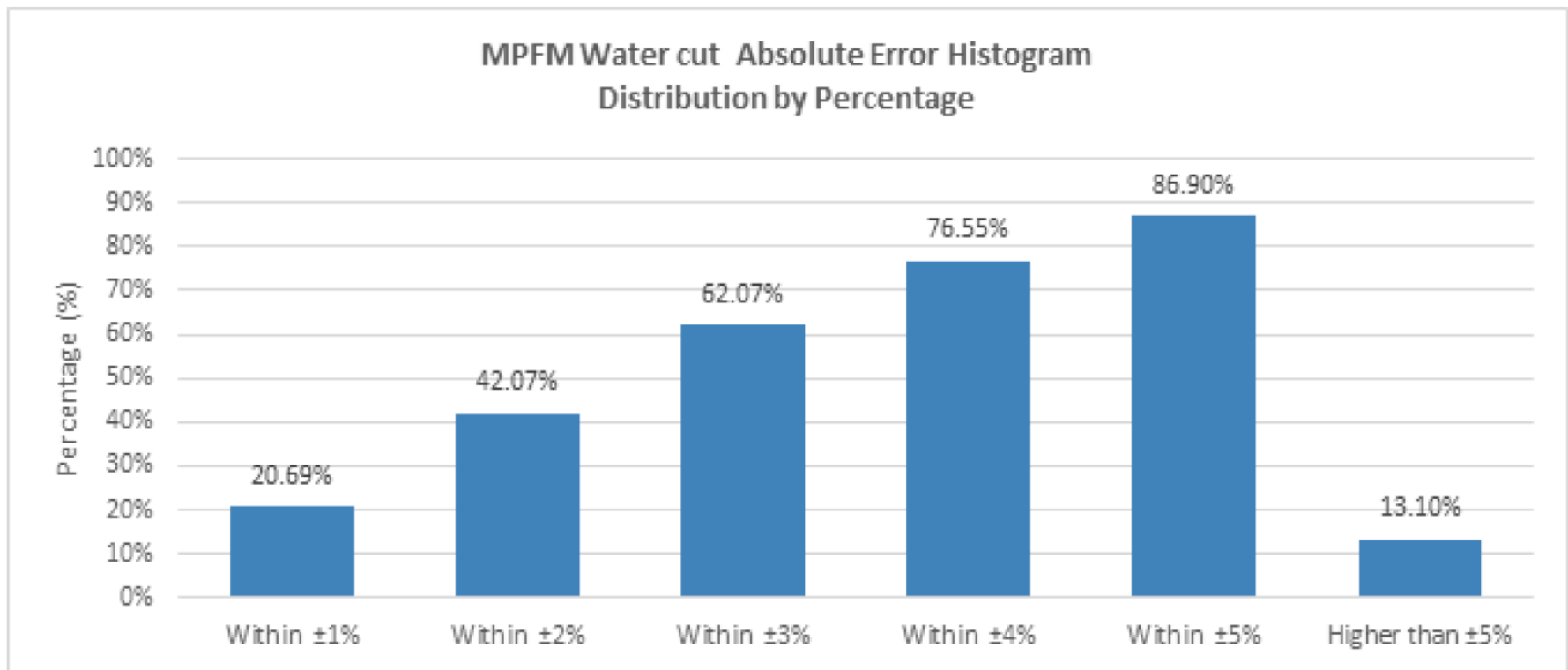
## Water cut Results



# Field Testing Results

## Water cut Results

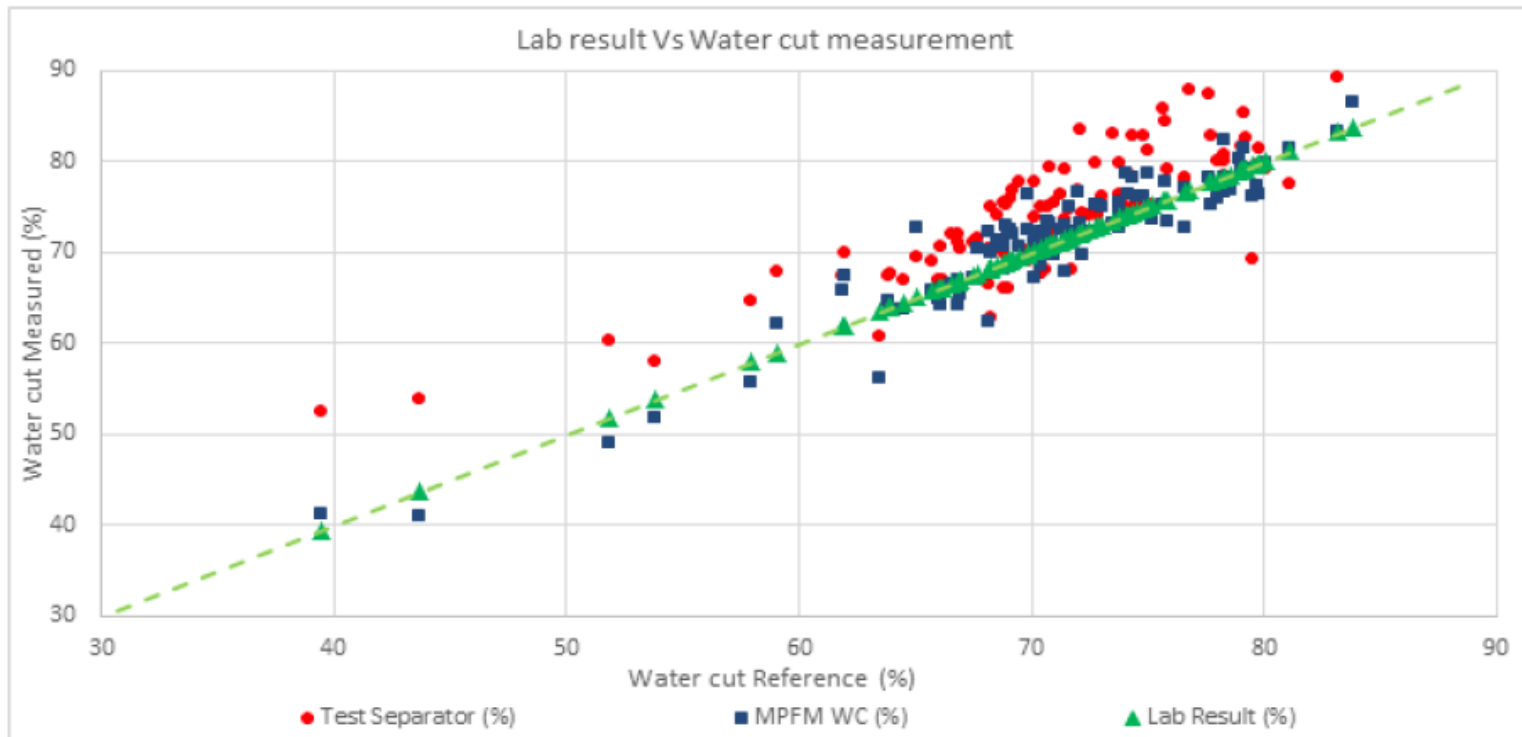
For water cuts between MPFM and Test separator, the trial shows that 87% of the data are within  $\pm 5\%$  of error.



# Field Testing Results

## Water cut Results

Lab results (sampling) vs Water cut from Test Sep and MPFM

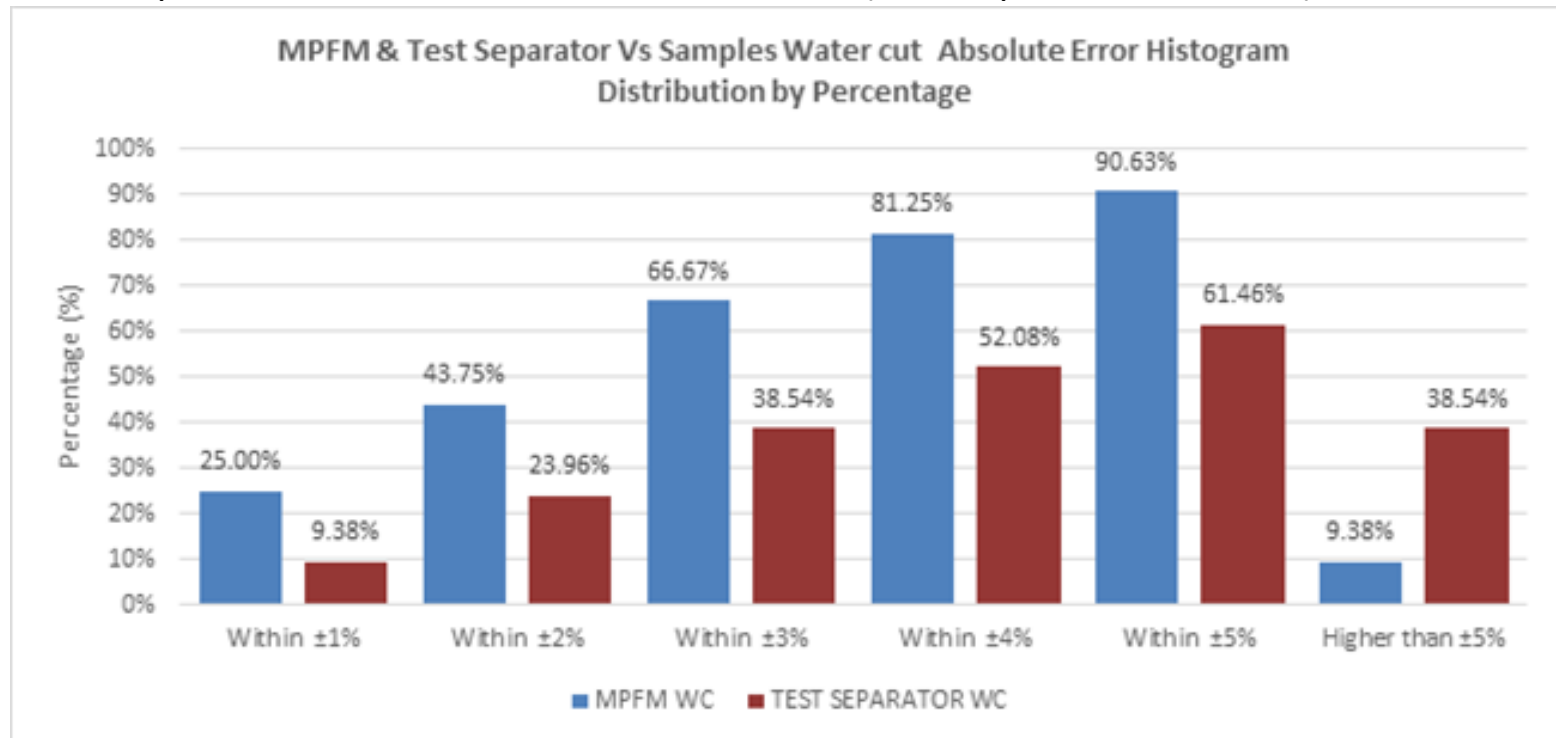


# Field Testing Results

## Water cut Results

MPFM water cut measurement shows that 91% of the data are within  $\pm 5\%$  (87 samples from a pool of 96)

For the test separator, 61% of the data are within  $\pm 5\%$  (59 samples of total of 96)





# Summary and Conclusions

- The average relative liquid flow rate error for the trial between MPFM and Test separator was 1.50% with a standard deviation of 1.72.
- For liquid rate between MPFM and Test separator, the trial shows that 91% of the data are within  $\pm 3\%$  and 97% within  $\pm 5\%$  error.
- The average absolute water cut error for the complete trial between MPFM and Test separator was 3.47% with a standard deviation of 2.45.
- For water cuts between MPFM and Test separator, the trial shows that 87% of the data are within  $\pm 5\%$  of error.
- The absolute average water cut error when comparing MPFM and samples was 2.51% with a standard deviation of 1.97.

# Summary and Conclusions

- When water cuts from samples (lab results) were compared to the MPFM and Test separator, MPFM water cut measurement shows that 91% of the data are within  $\pm 5\%$ . For the test separator, 61% of the data are within  $\pm 5\%$ .
- An application to use the AGAR MPFM in lieu of a Test separator was successfully submitted and approved by the AER under the application No. 1821958 on January 2015.
- An AGAR MPFM has been recently installed in the PAD L4 at the Leismer