Measurement of LNG by Dynamic Methods

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The Need

- Dynamic Measurement of LNG stalled by lack of primary online standard at flowing conditions

- Expansion of LNG use throughout the globe and especially in Europe
  - Optimization of resources
  - Increase of partnerships – comingling
  - Plant balances
  - Incentive for shared facilities to spread capital costs

- Efforts underway to increase accuracy and traceability of both static and dynamic measurement for LNG throughput

Current Challenges In LNG Measurement

- LNG properties, sampling, analysis
- Effects on primary element and auxiliary equipment
- Traceability and delivery rates
- Installation effects

Current LNG Custody Transfer by Static Tank Measurement

- Uncertainty ± 0.5% to 0.78% or beyond
  - Delivery vessel volume
  - Density/gross colorific value
  - “Gas to engine room” energy consumption
  - Instrument calibration

- Goal to achieve uncertainty of ±0.15 - 0.20% or better not sampling inclusive

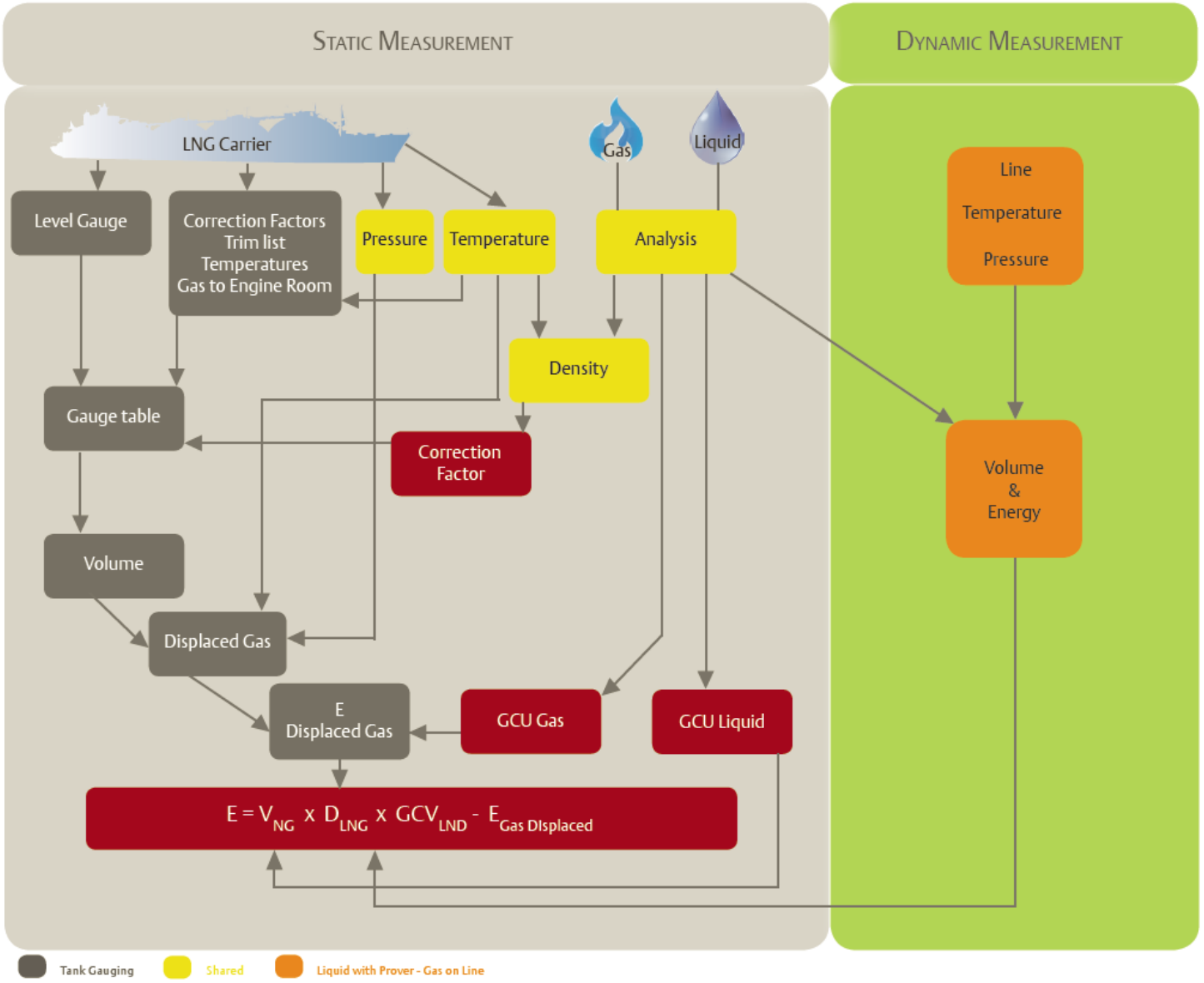
Current Direct Measurement Methods

- Currently turbine, coriolis and ultrasonic meters used in LNG service
- Meters calibrated in lab on water or light product, transferred to meter via Reynolds number equivalency
- Case to be made that the Reynolds number alone does not constitute similarity of flow
- Precise control in lab seldom translate to field conditions
  - Installation effects can effect sub-regions of flow profile

Gaskets Protruding	Pipe Wall	Flange Gaps
Weld Beads	Vibration	Noise

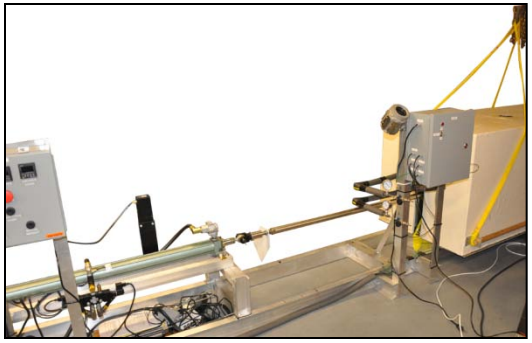
- The differmorphism of the flow regime in both the calibration facility and the field installation show identical geometry then dynamic flow similarity can be accomplished
- A combination of flow similarity and Reynolds number equality will result in a direct lab-field transference
- Question is how to obtain similarity of flow and how to prove similarity of flow is obtained without a common standard methodology
- Although many meters have diagnostic capabilities in accordance to manufacture standards, currently no proof in flow is available

Static vs. Dynamic Measurement



The Method

- Bi-directional floating piston pipe prover developed from existing low temp design (-50°F/-46°C)
- Valve manifold with leak detect in lieu of four way valve
- Material of construction to suit service
  - Piping
  - Piston seals
  - Proximity detector switch and piston target ring suitable for service
  - Pipe wall finished to facilitate long seal life

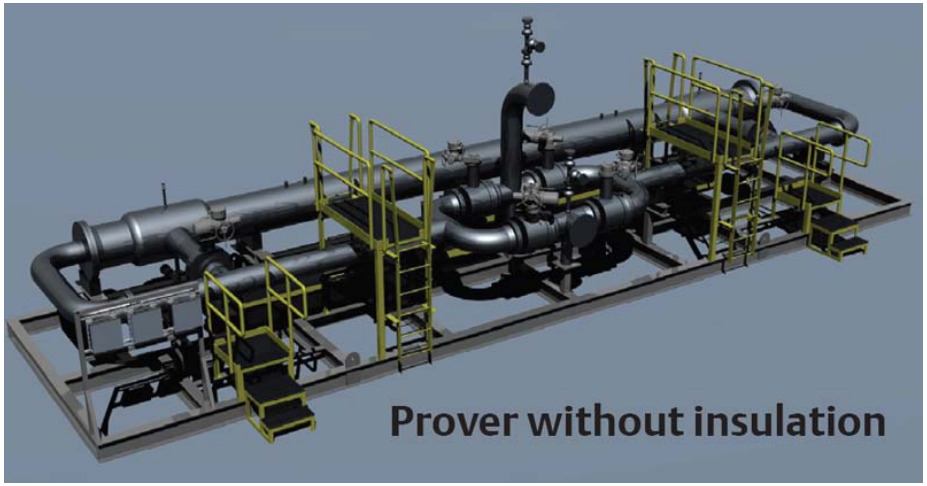


Testing

- Means of testing prover without a flow loop had to be devised
- Piston exercised in bi-directional direction utilizing pneumatic ram
- Fine trigger point of detector could be tested in ambient and cryogenic conditions
- Ambient and cryogenic results compared
- Operating velocities and target ring position verified by Lasik triangulation

Conclusion

A floating piston type bi-directional prover, modified for process conditions is able to operate satisfactorily to API criteria in an LNG application



Sources:

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