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Henri Systems Holland B.V. is one of the main suppliers of Float Type Level Gauges for the marine gas industry worldwide and is the market leader in the measurement of LPG and LNG on seagoing vessels.

## CRYOTRANSFER JIP: Transfer metering for LNG bunkering and small scale LNG Ship-to-ship transfer FINAL SUMMARY SUNETI/HSH

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# **ISH CRYOTRANSFER JIP**

#### **Objectives for SUNETI/HSH**

- Practical experience with in-line flow measurement
- Develop Feasible custody transfer measurement system for small scale Ship-toship LNG transfer and bunkering operations
- Evaluate different In-line measurement principles in practice
- Meet customer requirements and standards

GIIGNL RETAIL LNG HANDBOOK 2015:

"Custody transfer and energy balancing appears to becoming one of the most important commercial considerations that will need to be addressed in the Retail LNG process chain"





## Background: Traditional CTMS<sup>WE LEVEL WITH YOU</sup>

**Traditional (Large Scale) LNG Custody Transfer Measurement System:** 

- Widely adopted guideline "GIIGNL: LNG Custody Transfer Handbook" offers basis for contractual arrangement between supplier and customer;
- LNG pricing based on energy content is commonly calculated from the volume (level measurement), density and the gross calorific value (GIIGNL);
- Overall accepted accuracy on the volume is 0,21% of Full Scale (avg. 140.000m3 LNG) is comparable with MID accuracy class 0.3;
- Laboratory composition analyses of LNG samples and displaced gas are applied to determine gross calorific value and density of LNG.



## Background: Small CTMS

**New Situation:** 

- Custody transfer measurement at retail application are covered by Measuring Instruments Directive (MID 2004/22/EC) and OIML (R117 and R81) recommendations;
- MID requirements applicable for systems for the continuous and dynamic measurement of quantities of liquids other than water and cryogenic liquids in specific (uncertainty class 2,5);
- Common CTMS standard accuracy (%FS), does not comply with required accuracy for partial loading (%RD);
- Transfer to pressurized vacuum insulated tanks results in larger variations in LNG temperature and pressure (critical for calculated density);
- Varying density and composition e.g. due to vapor return and mixture of batches;
- LNG bunkering fuel quality requirements e.g. minimum methane number;
- No commonly agreed measurement practice for LNG retail operations.

#### Question: Is traditional CTMS compatible with small scale transfer?

## **Pre-study results: CTMS uncertainty** WE LEVEL WITH YOU

**Conclusion uncertainty in quantity measurment:** 

- Defined MID Accuracy Class 2.5 for measuring systems for cryogenic liquids (Annex MI-005);
- In-line measurement provides higher accuracy at small scale partial LNG transfer operations due to error as % of reading;
- Flow meter accuracy are provided and calibrated at ideal steady state (ambient) flow conditions not taken the effect of transient (e.g. start, stop) conditions into consideration;
- Uncertainty of pressure and temperature dependency on error %RD over measurement range;
- Level gauging provides higher accuracy at full size large scale transfers due to fixed error as % of full scale;
- Traceable standard applicable for both in-line metering and traditional level gauging based CTMS required.



# **Method:** Tests at real LNG truck offloading

#### LNG Transfer flow skid





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Classification: External summary, Cryotransfer JIP

# Result overview: Tests at real LNG truck offloading

#### LNG Transer flow skid



The test have resulted in the following:

 Better understanding of feasible accuracy that can be achievedby in-line flow measurment as custody transfer measurment system for LNG bunkering;

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- Validated in-line LNG flow custody tranfer measurment system for LNG bunkering;
- Tested design for automated LNG transfer process control system;
- Comparison of Ulto-sonic VS Coriolis (Mass) flow measurment;
- Experience and comparison results of density measurment and calculation.

(Detailed report available at HSH/Suneti)

### Conclusions: small marine LNG CTMS design

Design requirements of STS LNG bunkering and small scale custody transfer measurement system

**Provisions for keeping metering device within required accuracy class:** 

- Importance of cost effectiveness of custody transfer systems for retail applications;
- In-line or so called dynamic flow metering devices show high repeatability proven at small devices e.g. truck fuelling dispensers (small bore Coriolis mass flow meters);
- Unknown overall achievable accuracy (system uncertainty) for small scale custody transfer systems;
- Direct density measurement and in-line composition measurement available;
- Acceptable offloading time and operating envelope accommodating at least 12 Bar discharge pressure; transfer flow 600m3/hr liquid and condensing rate of 1000m3/hr (return) vapor.

### Conclusions: small marine LNG CTMS design

Design requirements of STS LNG bunkering and small scale custody transfer measurement system

**Provisions for keeping metering device within required accuracy class:** 

- Enables pre-cooling of discharge line and flow meter before actual transfer;
- Ensures no vapor or gas, liquid mixture will occur during in during transfer which influence its measuring;
- Enables control at permanent automatic checking in order to keep operation within required accuracy e.g. not exceeding 1% deviation at transient operations;
- Enables active re-condensing of returned vapors;
- Avoids the needs for separate gas separation/ degassing devices;
- Increases operability and because the temperature and pressure can be kept below the boiling point (supercritical fluid);
- Increases compatibility with tanks and gas systems at receiver (incl. LNG fuelled ships);
- Requires electronic sealing in order to comply with MID/OIML requirements.

Classification: External summary, Cryotransfer JIP

## Recommendations: small marine LNG CTMS design

**Objectives of CRYOTRANFER II project** 

**Provisions for keeping metering device within required accuracy class:** 

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- Determine achievable overall accuracy MID class (system uncertainty) of LNG bunkering, small scale CTMS in practice;
- Evaluate cost effectiveness of (different) CTMS solutions;
- Design of associated flow computer with essential electronic sealing to comply with OIML R117 and R84 requirements;
- Evaluate quality and density measurement accuracy.

## **S**-**Current status Development** *WE LEVEL WITH YOU*

#### Phases

- Crytransfer I (Ending)
  - First test: experience
  - Second test: comparison
- Crytransfer II (Starting)
  - System design and selection
  - Pilot study and evaluation
- New build on offer
- Setting the standard for small scale STS LNG bunkering custody transfer measurement system



## **IDENTIFY AND SET OF A STREET OF A STREET**

#### Henri Systems Holland bv

- Experience: 400 Truck Loadings
- Any Questions?

 We are pleased to support your LNG transfer and bunkering project



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