



BunkerLogix

FLEXIBLE LNG BUNKERING
VALUE CHAIN IN THE SPANISH
MEDITERRANEAN COAST

Custody Transfer Measurement System



Co-financed by the European Union
Trans-European Transport Network (TEN-T)

"The sole responsibility of this publication lies with the author. The European Union is not responsible for any use that may be made of the information contained therein."

INTRODUCTION

The scope of this document is to define the state of art of the formulation, instruments and procedures to be considered to make a reliable custody of the LNG transferred between ship/shore and ship/ship.

The custody transfer system (CTMS) is based principally on the “LNG custody transfer handbook”, and, although it is not specifically intended to work out procedures for ship-to-ship LNG transfer and custody transfer for LNG carriers with type C cargo tanks, contains useful information and it is completed with specific instruments and procedures. The “LNG custody transfer book” is itself based on the ISO 13398 standard" LNG - Procedure for custody transfer on board ship". Subsequent to the publication of the “LNG custody transfer handbook”, the ISO standard 13398 has been revised by the ISO 10976 - Refrigerated light hydrocarbon fluids - Measurement of cargoes on board LNG carriers.

Additionally to the Custody Transfer, this document is also intended to fulfill the requirements of the Spanish Government regarding determination of the offloaded energy by Gas Carriers (PD-05).

TABLE OF CONTENTS

1. INTRODUCTION
2. MEASUREMENTS SYSTEMS
 - 2.1 Volume measurement of LNG quantities
 - 2.1.1 Calibration tables
 - 2.1.1.1 Main gauge tables
 - 2.1.1.2 Correction tables
 - 2.1.1.3 Approval by authorities
 - 2.1.2 Instruments for measuring the level of liquid in the tanks
 - 2.1.2.1 Main gauge system
 - 2.1.2.2 Secondary gauge system
 - 2.1.3 Temperature measurement
 - 2.1.3.1 Liquid temperature
 - 2.1.3.2 Vapour temperature
 - 2.1.4 Vapour pressure measurement
 - 2.1.5 Dynamic volumetric measurement
 - 2.2 Mass measurement of LNG quantities
 - 2.2.1 Dynamic mass measurement
 - 2.3 Measurement of LNG components
 - 2.3.1 Sampling System
 - 2.3.1.1 Continuous Sampling
 - 2.3.1.2 Discontinuous Sampling
 - 2.3.2 Gas analysis. Chromatography.
 - 2.3.3 Gas analysis. Raman Spectroscopy
 - 2.3.3.1 LNG composition
 - 2.3.3.2 Impurities
 - 2.3.3.3 Density
 - 2.3.3.4 Gross Calorific Value
 - 2.3.3.5 Knock Resistance (Methane Number)
 - 2.4 Measurement of energy transfer
 - 2.4.1 LNG energy
 - 2.4.2 Gas return energy
 - 2.4.3 Energy of gas consumed as fuel
 - 2.5 Partial loading or unloading
3. UNCERTAINTIES
 - 3.1 Uncertainties of volume
 - 3.1.1 Loading/Unloading operation
 - 3.1.2 Bunkering operations
 - 3.1.2.1 Bunkering at full tank
 - 3.1.2.2 Bunkering with tank loaded at 50% of the height
 - 3.1.2.3 Bunkering at empty tank
 - 3.2 Uncertainties of density
 - 3.3 Uncertainties of gross calorific value
 - 3.4 Uncertainties of the energy transfer determination

- 3.5 Financial Risks
- 4. RESPONSIBILITIES OF PEOPLE INVOLVED IN THE PROCESSES
 - 4.1 Loading/unloading at terminal
 - 4.1.1 Shipowner
 - 4.1.2 Master
 - 4.1.3 Loading terminal/Cargo Shipper
 - 4.1.4 Unloading terminal/Cargo Receiver
 - 4.1.5 Independent Cargo Surveyor
 - 4.2 Bunkering operations
 - 4.2.1 Person in Charge (PIC)
 - 4.2.2 Master of the receiving ship
- 5. METROLOGIC CONFIRMATION PROCESSES
 - 5.1 Certificate of cargo tank calibration
 - 5.2 Level gauge calibration
 - 5.3 Temperature probe calibration
 - 5.4 Pressure sensor calibration
 - 5.5 Withdrawal from service - out of service repairs
- 6. REALISATION OF THE MEASUREMENTS
 - 6.1 At the loading terminal
 - 6.1.1 Cargo loading operation before loading commences
 - 6.1.2 Cargo loading operation after loading is complete
 - 6.1.3 Cargo calculations
 - 6.1.3.1 Calculation of trim
 - 6.1.3.2 Data from calibration tables (Volume before loading)
 - 6.1.3.3 Data from calibration tables (Volume after loading)
 - 6.1.3.4 LNG composition
 - 6.1.3.5 Energy of LNG Calculation
 - 6.1.3.6 Energy of Gas Return
 - 6.1.3.7 Energy of Gas Consumed as fuel (if applicable)
 - 6.1.3.8 Energy Transferred
 - 6.2 At sea
 - 6.3 At unloading terminal
 - 6.3.1 Cargo discharge operation before discharge starts
 - 6.3.2 Cargo operations on board after discharge completed
 - 6.3.3 Cargo calculations
 - 6.3.3.1 Calculation of trim
 - 6.3.3.2 Data from calibration tables (Volume before Discharge)
 - 6.3.3.3 Data from calibration tables (Volume after discharge)
 - 6.3.3.4 LNG composition
 - 6.3.3.5 Energy of LNG Calculation
 - 6.3.3.6 Energy of Gas Return
 - 6.3.3.7 Energy of Gas Consumed as fuel (if applicable)
 - 6.3.3.8 Energy Transferred
 - 6.4 At receiving ship
 - 6.4.1 Cargo discharge operation before bunkering starts

- 6.4.2 Cargo operations on board after bunkering completed
- 6.4.3 Cargo calculations
 - 6.4.3.1 Calculation of trim
 - 6.4.3.2 Data from calibration tables (Volume before bunkering)
 - 6.4.3.3 Data from calibration tables (Volume after bunkering)
 - 6.4.3.4 LNG composition
 - 6.4.3.5 Energy of LNG Calculation
 - 6.4.3.6 Energy of Gas Return
 - 6.4.3.7 Energy of Gas Consumed as fuel (if applicable)
 - 6.4.3.8 Energy Transferred
- 7. UNACCOUNTED GAS LOSSES
 - 7.1 Shore measurements
 - 7.2 Ship measurements
- 8. PERFORMANCE REPORTS
 - 8.1 Custody Report
 - 8.2 Calibration Report
 - 8.2.1 Instrumentation
 - 8.2.2 Cargo tank calibration and tables
 - 8.3 Delivery Note
- 9. REFERENCES