

Operator Station

A number of computers can be connected in a network to provide redundancy and the possibility to arrange control stations at several locations onboard. The Operator Stations consist of marine approved HP computers running Windows 7, a choice of 22", 24" or 27" wide screen monitors and a set of user friendly mimics for presentation of:

- Liquid levels.
- Liquid volumes (total, individual and group).
- Cargo temperatures (average liquid, average vapour, individual).
- Tank vapour pressures.
- Trim and List readings.
- Level alarms (HiHi, Hi, Lo, LoLo).
- Master Clock indications.

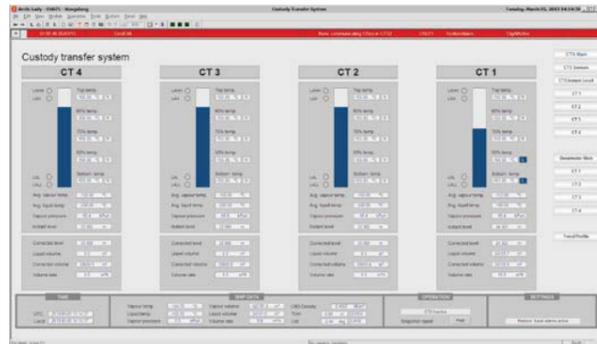


Figure 8: CTS overview mimic picture (example)

Custody Transfer report

An official transfer document is automatically generated and printed. The flexible report generator offers an easy way to adapt the printed reports to the changing requirements on the spot market and/or changes in SPA. The function allows changing both report layout format and CTS parameters, incl.:

- Implementation of Trim/List correction.
- Number of decimals for certain parameters.
- Ship cargo average temperature calculation.
- Selectable temperature used for CTS calculation.
- Selection of pressure unit, mbar or kPa.
- Calculation method for one cargo operation can be stored for later use.
- Calculation method for volume transferred.

Filtering function

The level filter function will ensure accurate reading of the cargo level when operating in a rolling condition. The function utilizes the following features in the system:

- Mechanical filtering by the standpipe and the AutoCAL® reference markers.
- Dual sweep FMCW technology that eliminates the Doppler effect caused by cargo movement.
- Simultaneous filtering of Trim/List values for level corrections. With the filtering function enabled, the same accuracy is achieved as for steady conditions at port.

Density measurement function

The density measurement function provides an online tool for monitoring of LNG density, LNG aging and the profile of density in the cargo down the tank. See K-Gauge DPMS Product Sheet, KM doc. ID 376818 for details.

TOPOLOGY DRAWINGS

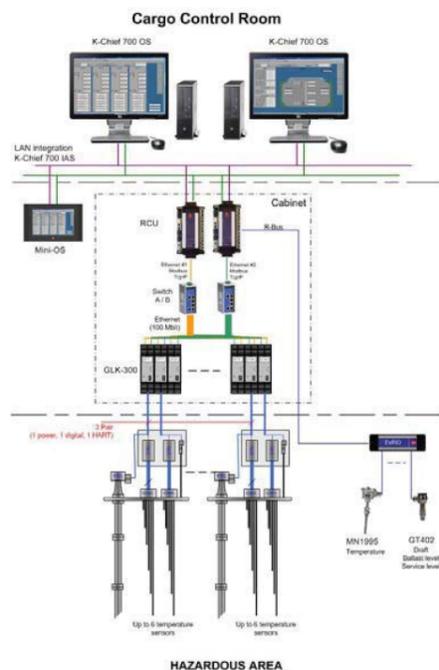


Figure 9: Single radar configuration (example)

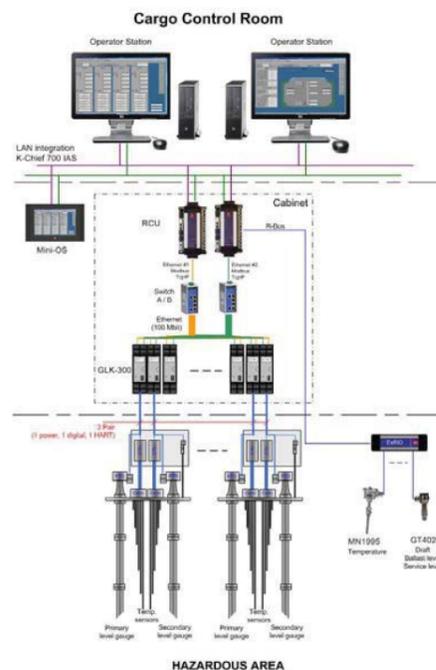


Figure 10: "4-in-2" Dual radar configuration (example)

Specifications subject to change without any further notice.

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387265 Rev. B



K-GAUGE CTS

CUSTODY TRANSFER MEASUREMENT SYSTEM

K-Gauge CTS Custody Transfer Measurement System is suitable for use in all type of LNG tank designs. The calibrated and certified Radar Tank Gauges, temperature sensors and pressure transmitters are designed to provide continuous and reliable accuracy in the demanding environment of liquefied natural gas (LNG). Independent third parties and authorities such as NKKK, SGS and Intertek have certified our K-Gauge CTS for custody transfer operations on board ships.

Functional description

K-Gauge CTS is a complete tank monitoring and Custody Transfer Measurement System including calibrated and certified instruments with calculating and reporting functionality.

Custody transfer is defined as a metering point where the fluid transfer is being measured for sale from one part to another. During custody transfer, accuracy is of great importance to both the company delivering the cargo and the recipient of the cargo. The K-Gauge CTS system is designed in accordance to GIIGNL guidelines and the relevant ISO standards for instrumentation and calculation of LNG transferred.

The calculations are based on the methods stated in the International Standard ISO 10976. The system automatically logs tank data by use of Kongsberg calibrated instruments, and the average values are determined from the arithmetic mean value of the last five measurements with an interval of 15 seconds.

The system automatically calculates the tank volume during the loading-/unloading operation and generates a CTS volume report; the official document used for input to the overall energy transfer calculation.

The report layout is flexible and offers functionality for the operator to alter the report layout, as well as change decimals and units. A snapshot report can be printed on demand at any time, providing a quick overview of the current status of all the parameters relevant of the CTS calculations. The snapshot report can also be scheduled at certain intervals, for instance every day at noon.

All components in the K-Gauge CTS tank monitoring and Custody Transfer Measurement System are designed for marine use and type approved by the major classification societies. The intrinsically safe apparatus are certified Ex ia according to ATEX and IECEx.

BUILDING BLOCKS

Radar Tank Gauge (RTG)

The KONGSBERG Radar Tank Gauge (RTG), GLA-310/5, is designed to measure level in tanks containing liquefied gases. Accurate measurement is possible regardless of the tank atmospheric conditions.

The RTG consists of a horn antenna and an electronic unit. The electronic unit includes a sophisticated signal detection method that ensures optimum performance, which combined with its superb signal-to-noise ratio, offers the highest measurement reliability and accuracy.

The horn antenna is designed to emit a frequency sweeping microwave signal through a 50 mm standpipe. The standpipe is considered as an integrated part of the level gauge, and comes in sections adjusted to match the total tank height. The RTG is specially designed to withstand the severe mechanical and physical conditions in a maritime environment. Only AISI 316L acid-resistant steel and PTFE/PEEK materials are used.

"4-in-2" multifunction dual radar concept

The K-Gauge CTS multifunction system with dual radars offers Automatic Tank Gauging and Tank Overfill Protection by using two separate RTGs, connected to the Custody Transfer calculation system. Flexible hardware and software modules provide both primary and secondary level gauging functions. At the same time, one RTG is dedicated for the independent overfill protection sensor (TOP RTG). In normal operation, the TOP RTG covers two functions; overfill protection and back-up level gauging.

Signal Processing Unit (SPU)

Each RTG is connected to a dedicated processing unit. The GLK-300/LNG Signal Processing Unit (SPU) is located in safe area and provides necessary communication and intrinsically safe power barriers to the instrumentation located in hazardous area. The SPU employs powerful processing of the data from the Radar Tank Gauge, Cargo Temperature Unit and vapour pressure sensor.

Communication with the Remote Controller Unit (RCU) is done by dual high speed Ethernet. The SPU is equipped with LEDs in the front for easy condition monitoring by the crew.

AutroCAL®

AutroCAL® is a unique calibration and verification function in the KONGSBERG system. Gas vapor density and mixture of gases influence the propagation speed of the radar signal, thus the accuracy of the measurement. By using pipe joint reference markers, AutroCAL® continuously compensates for the changes caused by the differences in the propagation speed.



Figure 1: Radar Tank Gauge GLA-310/5



Figure 2: Signal Processing Unit GLK-300/LNG

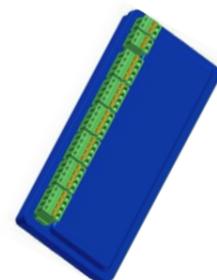


Figure 3: Cargo Temperature Unit GC-306



Figure 4: Cargo temperature sensor



Figure 5: CTUs and pressure transmitter cabinet installation (example)



Figure 6: Remote Controller Unit RCU502



Each pipe section is supplied with flanges prepared with reference markers. The liquid level and the markers are measured simultaneously, hence the system automatically verifies itself at every measurement. By careful calibration of the pipe section lengths before installation, the position of the markers are recorded and stored in the system. By comparing the liquid echo with the reference marker echo, a continuous auto-calibration of the measurement is done.

AutroCAL® ensures high accuracy over the whole measurement range, independent of the gas mixture, pressure and temperature.

Cargo Temperature Unit (CTU)

Temperature measurement is a crucial parameter for correct volume calculation of the liquefied gas. High quality sensors with reliable accuracy are an important factor when monitoring cryogenic cargoes.

KONGSBERG Cargo Temperature Unit (CTU), GC-306, is a marine approved multi-channel signal converter. The CTU is designed for installation on deck and to accurately transform and transmit temperature measurements from up to six sensors installed inside cargo tanks onboard liquefied gas carriers.

Cargo temperature sensors

KONGSBERG temperature sensors are specially designed for accurate temperature measurements, manufactured to meet the requirements set in the governing international standards for Custody Transfer Systems. Calibrated Pt100 1/10 DIN elements are used for optimum performance. Each sensor is delivered with a unique serial number and a calibration certificate.

Vapour pressure transmitter

The pressure transmitter is used for accurate measurement of vapour pressure, specially calibrated to ensure the highest accuracy. The pressure transmitter comes with a 3-way control valve.



Figure 7: Standpipe installation with marker for auto-calibration by AutroCAL® (example)