Operator Panel
The processing and interface cabinet includes an Operator Panel mounted in the cabinet door. The panel is a marine approved 13,3” touch screen computer based on the Intel®Core™2 CPU with full solid state technology, and running Windows Embedded 7®. A set of user friendly mimics are provided for presentation of:

- Liquid levels
- Liquid volumes (total, individual tank)
- Cargo temperatures (average liquid, average vapour, individual)
- Tank vapour pressures
- Trim and List readings (if applicable)
- Level alarms (HiHi, Hi, Lo, LoLo)

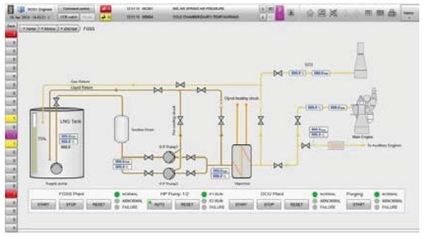

Figure 12: KM FGSS overview mimic picture (example)

K-Gauge Compact
When physical size and limitations of tank penetrations are considered important, KONGSBERG offers a compact solution of tank instrumentation, K-Gauge Compact, where only one penetration cover fully independent sensors and transmitters for the following applications:

- Radar Tank Gauge for level measurements
- Radar Tank Gauge for high level alarm
- Up to five temperature sensors
- Two pressure transmitter connections

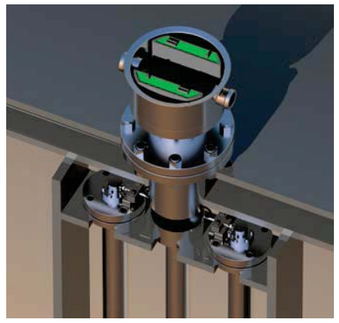

Figure 13: K-Gauge Compact; Dual radar in one penetration

TOPOLOGY DRAWINGS

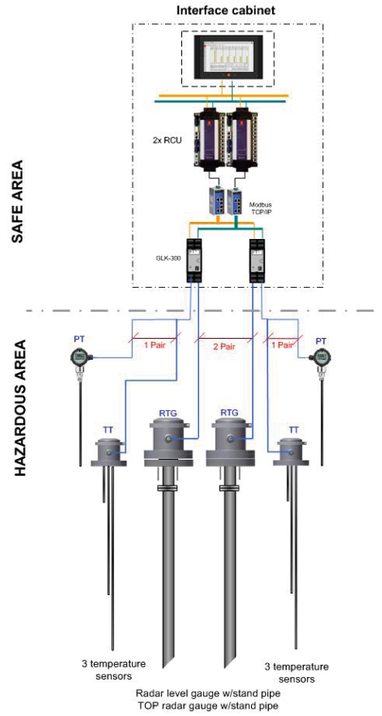

Figure 14: Separate instruments topology (example)

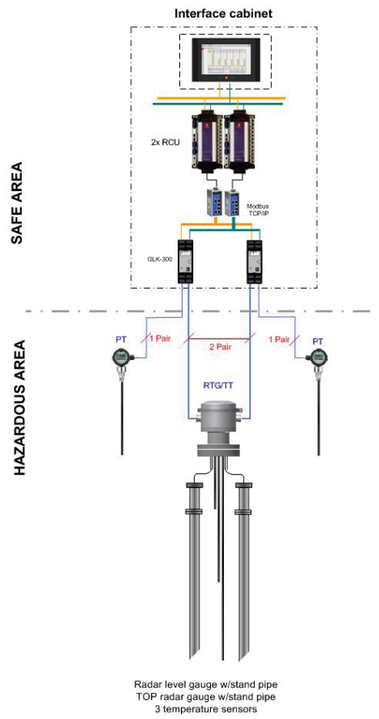

Figure 15: K-Gauge Compact instruments topology (example)

Specifications subject to change without any further notice.

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K-GAUGE GAS

LNG FUEL TANK MONITORING SYSTEM

The K-Gauge GAS LNG fuel tank monitoring system is designed to meet the classification rules and guidelines concerning instrumentation and monitoring of storage tank for LNG fuelled ships. KONGSBERG have many years of experience in measuring LNG and ensure that our solutions fulfil the challenging demands concerning safe and reliable monitoring of liquefied gas storage on board ships. The integrity and safety of shipboard containment and operations are key elements embedded into the system design.

System description
K-Gauge GAS LNG fuel tank monitoring system measure tank levels by use of KONGSBERG well proven Radar Tank Gauges. The package also includes temperature- and pressure transmitters, safety barriers, processing and alarm handling units. Optional display panel offers local operator interaction and monitoring. Integration to other KONGSBERG automation systems will be included with dedicated user friendly mimic presentation on Operator Stations.

The K-Gauge GAS LNG fuel tank monitoring system is designed to fulfil the challenging demands concerning safe monitoring and storage of liquefied gas on board ships. The integrity and safety of shipboard containment and operations are key elements embedded into our system design.

The implementation of new dual fuel engines and growing interest in using LNG as a marine fuel, raise many practical challenges regarding risks of bunkering, storing and processing LNG. Extensive surface movements, combined with the low dielectric constants of the LNG, require high quality instrumentation and processing in order to provide trustworthy and reliable measurements. The unique Radar Tank Gauge design, the high signal-to-noise ration and powerful signal processing, offers and unbeatable level filtering functions and a safe choice for LNG fuel monitoring.

With more than 15 years of experience in production, design and servicing LNG automation and tank monitoring systems, KONGSBERG has developed extensive knowhow and designed complete solutions for main engine control, Fuel Gas Supply and tank gauging system with instrumentation for monitoring of LNG fuel tanks.
All equipment is designed and certified for marine use and manufactured in AISI 316L stainless steel. Accurate measurement is possible regardless of the tank atmospheric conditions. Flexible hardware and software modules ensure easy adaptation to all IMO type tank designs, and all kind of liquefied gases.

BUILDING BLOCKS

Radar Tank Gauge (RTG)
The KONGSBERG Radar Tank Gauge (RTG), GLA-310/5-FUEL, is designed to measure level in tanks containing liquefied gases. Accurate measurement is possible regardless of the tank atmospheric conditions. Flexible hardware and software modules ensure easy adaptation to all tank designs.

The RTG consists of a microwave 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 guide a frequency sweeping microwave signal through a 50 mm standpipe. The distance is derived from the time delay of the reflected signal.

The standpipe has ventilation holes allowing the vapour pressure inside and outside the pipe to stabilize, thus allowing the liquid to rise or fall in the pipe. The standpipe is considered an integrated part of the level gauge, and is delivered to match the total tank height.

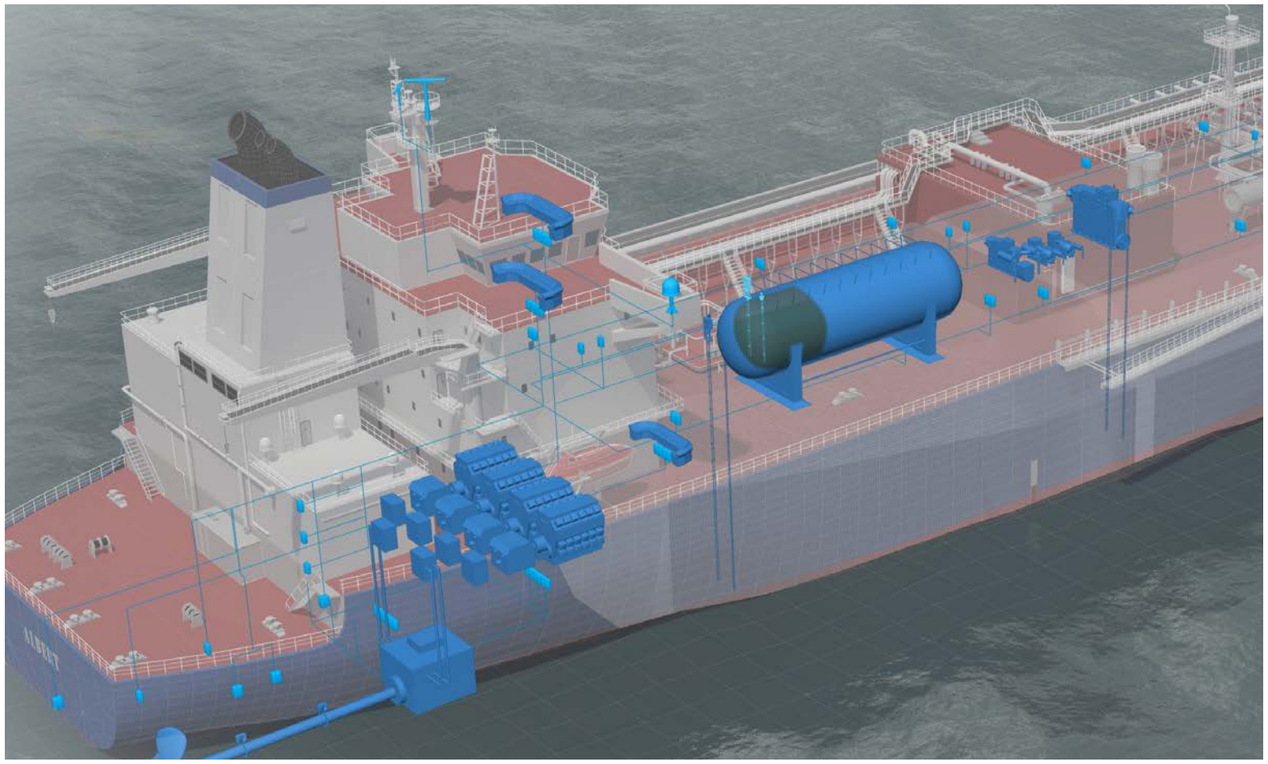
The RTG is specially designed to withstand the severe mechanical and physical conditions in a maritime environment. Only AISI 316L acid-resistant steel and PTFE/PEEK materials are used.

Signal Processing Unit (SPU)
Each RTG is connected to a dedicated signal processing unit, where the tank design data are stored.
The GLK-300 Signal Processing Unit (SPU) is located in safe area and provides necessary communication and power barriers to the instrumentation located in hazardous area. The SPU employs powerful processing of the data from the Radar Tank Gauge, temperature transmitter and pressure transmitter.

The SPU is equipped with LEDs in the front for easy condition monitoring by crew.

Temperature transmitter
Temperature measurement is a crucial parameter to monitor when storing liquefied gases. The K-Gauge GAS system offers two alternative temperature monitoring configurations:

Alt. 1: Up to three temperature sensors
KONGSBERG Cargo Temperature Unit (CTU), GC-300, is a marine approved intrinsically safe signal converter and connection box designed for installation on tank top for connection of up to three temperature sensors through one tank penetration.



Alt. 2: Up to six temperature sensors
KONGSBERG Cargo Temperature Unit (CTU), GC-306, is a marine approved intrinsically safe signal converter for connection of up to six temperature sensors. The transmitter is designed to be installed in a local cabinet. A connection box for connection of the temperature sensors on tank top is included and provide gas sealing toward the tank atmosphere.

The temperature converter accurately transforms and transmits temperature measurements from sensors installed inside tanks to the Signal Processing Unit (SPU).

Temperature sensors
High quality sensors with reliable accuracy are an important factor when monitoring cryogenic cargoes. KONGSBERG temperature sensors are designed for submerged installation inside tanks, and are made entirely of AISI 316L acid resistant stainless steel. This also includes the mineral insulated, metal sheathed cable. A compression fitting with conical threads ensures gas-tight penetration of the tank top
For accurate reading of the temperature, a 4-wire Pt100 Class B 1/3DIN element according to IEC 60751, is used.

Vapour pressure transmitter
The pressure transmitter is used for accurate measurement of vapour pressure. The pressure transmitter comes with a local display and a 3-way control valve.

Figure 8: RTG and standpipe installation in Type C tank (example)

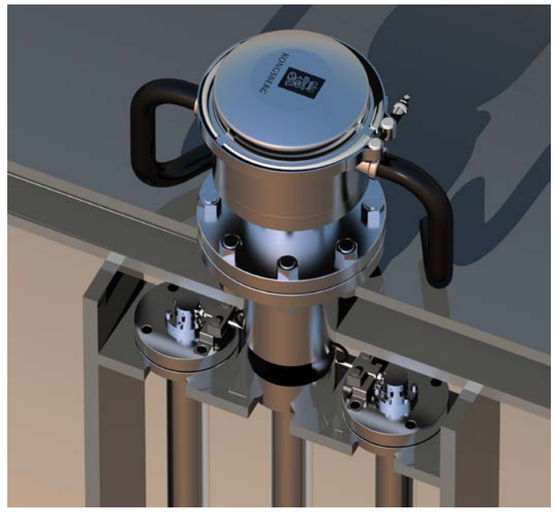


Figure 9: Dual RTG concept with standpipes and temperature sensors in one penetration, Type C tank (example).

Figure 1: Radar Tank Gauge GLA-310/5-FUEL

Figure 2: Signal Processing Unit GLK-300

Figure 4: Temperature transmitter GC-300

Figure 5: Temperature sensor

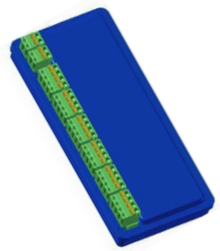


Figure 6: Temperature Unit GC-306

Figure 7: CTU and pressure transmitter cabinet installation

Figure 10: Pressure transmitter GT405 with display

Figure 11: 13.3" IPC Operator Panel