GTT Inside 3
The GTT newsletter - JANUARY 2015 - n°3

Message from David Colson

GTT is well known for our membrane containment systems for LNG carriers, which have and continue to be our core activity. In this issue of GTT Inside, you will discover how we reinforce our containment systems and also other important contributions GTT is making to other areas of the overall LNG containment system environment, including an innovative tank sump design for optimization of cargo use and Emergency Departure Procedures.

We are committed to continue improving our technologies in order to meet market expectations. We will also give you an insight into the advanced high-density foams which can be used in GTT systems for specific applications such as offshore units and the transport of other liquefied gases (ethane, butane, etc.).

As we enter 2015, I would like to take this opportunity to wish you all the best for the coming year and hope that GTT will continue to meet and surpass your expectations.

David Colson – Commercial Vice President.

TECHNOLOGIES / Mark III High Density (HD) Foam

Launched in 2009, the Mark III Flex programme included, right from the start, the concept of a higher density foam to resist occasional higher sloshing loads. GTT concentrated more on the other aspect of the programme (increased thickness in order to reduce the Boil-Off), however.

The development of the MARK III FLEX HD FOAM system was launched and obtained a General Approval for Ship Application from classification societies ABS and DNV.

This new system which consists in a reinforcement of the CCS (Cargo Containment System) against severe sloshing impacts meets the new market requirements in terms of partial fillings, offshore operations and multi-gas carriers.

Very large multi-gas carriers carry heavier gases than LNGCs. For example, liquefied butane and liquefied ethane are respectively 38% and 25% heavier than LNG. These heavier gases generate larger sloshing loads on the CCS, which may require reinforcement.

For offshore markets, partial filling operations under all weather conditions on site location are necessary for project viability. These operations include LNG processing on floating LNG storage systems (FSRU/FLNG) and GTT can propose solutions for a shuttle tanker and for tandem transfer.

Partial fillings are not a requirement in large LNGC vessels. But the traditional unauthorised filling levels can be relaxed thereby offering more flexibility for these vessels. In addition, for small scale and LNG bunker vessels, partial loadings are a common practice and thus require all filling operation.

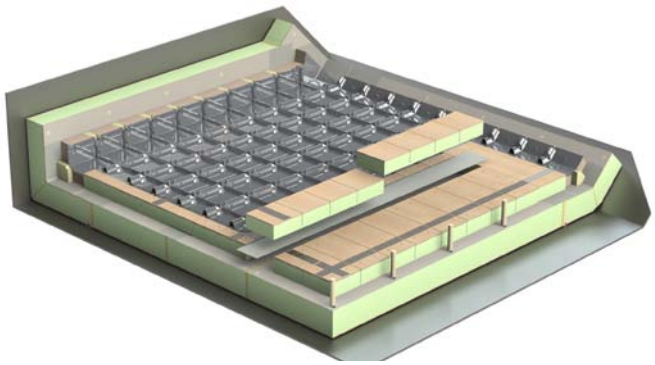
In order to meet all these market requirements, several innovative reinforcements have been designed to withstand higher sloshing loads.

Firstly, the reinforced polyurethane foam has been further reinforced by increasing its density which can vary from 130k/m3 to 210kg/m3, depending on the design. The use of 210kg/m3 RPUF multiplies the dynamic strength threefold in comparison with 130kg/m3 density with only a 30% increase of thermal conductivity (higher Boil-off).

The connexion of the CCS with the inner hull has also been reinforced thanks to an increase of back-plywood thickness from 9mm to 15mm and a decrease of mastic spacing from 100mm to 80mm.

The secondary bonded barrier has undergone a patented design modification to withstand the extra stresses generated by the higher density foam. This modification consists in rigid sheet bonded at prefabrication stage below the Top Bridge Pad which lowers the stresses in the tight FSB and enhances its static and fatigue strength.

Finally, the design of primary barrier wedges is being reinforced to withstand higher sloshing impacts.



The BOR impact due to higher thermal conductivity of high density foam is limited thanks to an optimization of the tank reinforcement. Only areas subjected to sloshing impacts are reinforced. Generally these areas are located along the longitudinal walls and in the cofferdam corners. Moreover, the optimal density of the foam is chosen between 130kg/m3 and 210kg/m3 to withstand the design loads.

The system has been subjected to a complete qualification program which includes Finite Element analyses, sloshing assessment, fatigue tests, mock-up erection tests and R-PUF specification and homologation.

MARK III FLEX HD FOAM is already on the market with the first application in recent orders of membrane multi-gas carriers. ■

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INNOVATION / Maximizing Operational Volumes

GTT recently received an Approval in Principle from ABS for its maritime sump design destined for LNGC, Multigas Carrier and Bunkering applications.

This sump brings significant operational advantages:

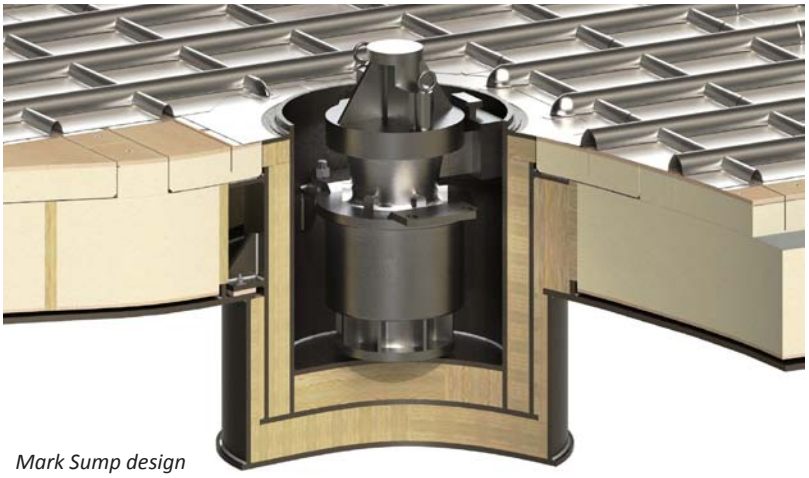
- Firstly in a reduction near to zero of the unpumpables during tank decommissioning or change of cargo. This brings time and cost savings.
- Secondly, the heel level necessary to feed the fuel gas pump during ballast voyage is reduced by ensuring a buffer reserve around the pump. Low fillings and ship motions can induce absence of LNG around the fuel gas pump and consequently its trip. The 1m heel level currently recommended by GTT to avoid pump trip without a sump could be reduced to 0,3m, thus maximizing the loading volume at the LNG terminal.

The patented sump design consists of a stainless steel welded bowl integrated in the CCS with membrane tightness identical to the well-known Pump Tower Base Support (PTBS) design. Its internal diameter can go up to 600mm and its depth to 650mm depending on the pump dimensions.

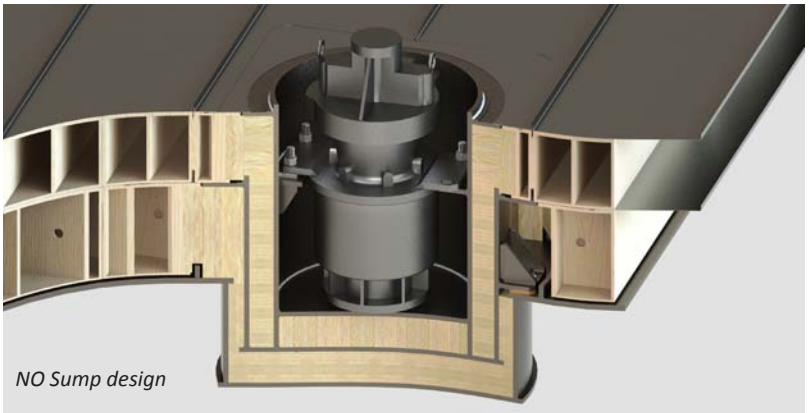
The sump is destined for Stripping Pumps, Fuel Gas Pumps and Deep Well Pumps with MARK and NO systems. Submerged cargo pumps are not covered by this sump because of their large size. Submerged cargo pumps in a sump are in any case not necessary.

Several studies have been carried to ensure the safety of the system. Moreover, several elements are derived from sea proven PTBS design notably for the membrane tightness.

The Sump is now available for any new order for LNGC, MGC and Bunkering applications. ■



Mark Sump design



NO Sump design

Focus

OPERATIONS / The GTT Emergency Departure Procedure

Occasionally, an LNG Carrier is required to leave a terminal during its LNG transfer operations. Some cases are predictable, such as bad weather or cyclones and the unberthing of the LNG carrier can be planned in advance. On the other hand, there are some situations (such as earthquakes, fires in the terminals, etc.) which are unpredictable and an immediate unberthing of the LNG Carrier is required. In such a situation, the ship will have to leave the terminal with potentially unauthorized filling levels in the tanks.

This may also occur during either a ship-to-ship or a barge-to-ship transfer. In particular, excessive relative motions between the two ships can cause an emergency disconnect.

Several years ago, GTT established simple guidance for the crew to deal with navigation with non-approved fillings under emergency conditions. Membrane ships can continue to follow this guidance (reference ED3202) to mitigate liquid motion in tanks. GTT also provides services and studies to manage, in the most effective way, the emergency departure, and to limit the risk of incident by acting on specific operational parameters.

GTT proposes further support to address this emergency departure scenario through its hotline HEARS, where experts are available to provide the crew with the best possible advice to handle the situation, based on ship-specific data and procedures.

Ship operators can also benefit from GTT's expertise in sloshing directly onboard. GTT has released on the market its SloShieldTM sloshing monitoring system, which is an efficient tool for these circumstances. First of all, by providing constant information about sloshing activity in the tanks, linked with ship motions, it helps build up and improve crews' sloshing awareness and their ability to efficiently mitigate it. For the case of emergency departure, it will provide precious information on the current sloshing activity to support decisions, and will also allow post voyage analysis by our experts.

Last, but not least, at the design stage, GTT can include, at ship owner's request, for emergency departures cases in its liquid motion risk assessment and propose an adapted tank design. ■

Save the date

GTT will be at **Euromaritime**, Paris,
3-5 February 2015.
Please come and visit us at **booth I52.**