The Royal Institution of Naval Architects

Design, Construction and Operation of LNG/LPG Vessels

International Conference

Design, Construction and Operation of LNG/LPG Vessels
29 - 30th November 2017, Glasgow, UK

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COFFEE AND RECEPTION

WELCOME ADDRESS

SHIP DESIGN REVISITED - A MODERN APPROACH FOR A MODERN ERA, D. Scott, C. Tuzzo, Q. Gao, C. Pillai, R. McMullen and G. Mermiris, Thrust Maritime Engineering, UK

It could be argued that cargo ship design has matured substantially over the past three decades. This could be attributed to continuous development of underlying rules and regulations, concerted industry efforts to reduce accidents and improve safety, and broader R&D activity that is focused on improving energy efficiency and environmental performance. The ship design process is an inherently iterative process such that dual fuel operation of ocean going vessels. A new ship may be designed to comply with all rules and regulations but its performance from a financial point of view is meaningful only during its fraction of its operational life. So, while the scope of modern design is broader, it can be expected to grow and the use of ethane as fuel not only in power generation on shore but also as a clean transport fuel for ships. Classification societies are involved in the approval of cargo containment systems used for large scale transportation of liquefied gases. The ship's gas containment system, and the system of LNG/LPG carriers is multi product carrier design which means that the specific issues will have to be considered in the approval. This paper presents a number of such innovative solutions for the containment of any kind of liquid or gas on board of multipurpose gas carriers and some specific case studies in relation with containment systems and marine ethane fuel engines.

NEW GENERATION OF MULTIPURPOSE GAS CARRIERS, Carlos Guerrero, Bureau Veritas, France

Ethylene and LPG have been usually transported in relatively small ships below 20,000 m³ with semi-refrigerated type C tanks. However, new technical developments and the evolution of the regulations are now making big ships, with innovative containment systems such as bi-lobular type C, independent prismatic and membrane. Exports of ethane from the USA shale gas industry to North Europe is essentially transporting ethane in tanker. Independent membrane tanks in the Far East are expected to increase significantly. In addition ethane is considered as an environmental friendly source also for power generation as NOx, SOx and particulate matters are reduced significantly. Today, the whole world is looking for the players in the LNG market to increase the supply of boil off gas generated during the loading and unloading; the transport process and supply of inert gas to the lines seems to be, if not essential, at least recommended. Other interesting services to be performed by the bunkering ship are gas freeing operations and recovery of LNG from the gas fuelled ship. LNG bunkering is an auxiliary service required for LNG carriers and a combination of the transfer process and supply of inert gas to the lines seems to be, if not essential, at least recommended. Other interesting services to be performed by the bunkering ship are gas freeing operations and recovery of LNG from the gas fuelled ship. LNG bunkering is an auxiliary service required for LNG carriers and a combination of the transfer process and supply of inert gas to the lines seems to be, if not essential, at least recommended. Other interesting services to be performed by the bunkering ship are gas freeing operations and recovery of LNG from the gas fuelled ship. 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LNG bunkering is an auxiliary service required for LNG carriers and a combination of the transfer process and supply of inert gas to the lines seems to be, if not essential, at least recommended. The bunkering process considers the compatibility of the bunkering system with the ship's propulsion system and the required accuracy of the fuel injection systems. The bunkering process also involves the management of the fuel tank design, the fuel supply, and the fuel metering systems. The bunkering process must be performed in a safe and efficient manner, taking into account the specific requirements of each ship and the environmental regulations.
COFFEE AND REGISTRATION

09.00-09.30

THE USE OF WASTE HEAT RECOVERY TO IMPROVE THE EFFICIENCY OF DUAL FUEL DIESEL ELECTRIC LNG CARRIERS, Efthimios Petropoulos, Green Marine Ltd, UK

The Dual Fuel Diesel Electric (DFDE) Technology has become the dominant propulsion choice for modern Liquefied Natural Gas (LNG) tankers, gradually replacing the previous choice- Steam Turbine Propulsion in current and future designs. This change is due to the higher thermal efficiency of the DFDE technology resulting in financial savings in operation expenditure of the vessel (OPEX) over the vessel life cycle when compared to the steam turbine propulsion system. However, Greenhouse Gas (GHG) reduction regulations such as the Energy Efficiency Design Index (EEDI) on CO2 reduction and new competing LNG propulsion technologies such as gas injection slow-speed diesel engines are highlighted. A new generation of LNG carriers is therefore required, which is still not commercialised with current DFDE Technologies. This need has led to the development of the waste heat recovery system (WHRS) as an option to improve the efficiency of DFDE vessels. This paper presents a WHRS as a method of improving the efficiency of DFDE carriers. The paper will cover three major aspects: 1) the WHRS design concept to be employed, 2) Trial Run of the WHRS in actual sea going operations. 3) Discussion of results and implications for future designs.

09.30-10.00

THE PRACTICAL IMPACT OF THE 2016 IGC CODE MODIFICATIONS ON A VLGC HULL DESIGN, Lucian Viorel Anghel, Ionel Hristache and Marcel Negrea, Icpeolonav Engineering SRL, Romania

This paper describes a programme of work to quantify signature performance during the design process and develop new tools to support decision making. This new capability enables flow generated noise performance to be progressively assured against requirements and the performance to be balanced against programme, cost and risk considerations. A range of tools and techniques are now available, which are applicable across the design process. This comprises scoping calculations for application during concept design where the quality and availability of information is low and there is a need to rapidly explore the design space. During the preliminary or FEED stage, more sophisticated techniques are employed to make use of the greater quality of information. At this stage analytical methods are fused with empirical relationships to provide a hybrid approach which is sensitive to design changes, most important to enable design exploration and sensitivity studies. During detailed design, high fidelity numerical methods are used to capture design details and produce high resolution predictions. New flow noise mitigation strategies are also discussed, including avoidance of cavitation and the application of silencing devices for fluid systems.

10.00-10.30

COFFEE

10.30-11.00

DRIVING RELIABILITY, EFFICIENCY AND SAFETY ON LNG/LPG VESSELS THROUGH AUTOMATION, B O Berntsen and K Høglund, Høglund Marine Automation AS, Norway

As the popularity of LNG as a marine fuel grows, the LNG carrier segment continues to expand, while a new generation of vessels is emerging to meet the growing demand for LNG bunkering services. Høglund is pioneering the automation of these vessels, and has fitted 15 LNG-powered ships with its automation solutions, which represent 12% of the global LNG-powered fleet. While automation system interfaces and design have evolved to fit big scale LNG carriers over the last four decades, medium and small scale LNG carriers have a new mating, which is still not documented. This opens up the opportunity for new ideas and fresh thinking to ensure success in the automation of these new vessel types. But as always with new technologies, reliability, efficiency, and safety must be prioritized to make sure systems are working as intended, while still reducing CAPEX and OPEX.

10.40-11.00

LPGREEN: LPG CARRIER OF TOMORROW CONCEPT DESIGN, George G. Dimopoulos, DNVGL, Greece

LPGreen was a joint development project between Greek shipowner Consolidated Marine Management, South Korean shipyard Hyundai Heavy Industries, Finnish cargo handling specialists Wartsila Oil & Gas and classification society DNV GL. The project aimed at developing a more energy efficient, environmentally friendly, and safer LPG carrier. In the project, the latest advances in ship design, machinery technology, cargo handling systems and operational experience, within the bounds of existing shipbuilding methods, were utilised with a clear target: to arrive at an LPG carrier concept that can be ordered and been built immediately. The resulting concept achieves improved performance on several fronts. Compared to the reference vessel, there is an improvement of 6-9% in energy efficiency, depending on machinery configuration and fuel used. Loading duration has been decreased by 30%, by the proposed cargo handling system resulting also in a 5% reduction in energy demand. Most importantly, LPGreen has demonstrated the technical feasibility of a LPG fuelled propulsion concept, which, depending on fuel prices and the development of the CNG/LNG fuel framework, could result in a cut of up to 30% in fuel expenses. To realise these gains, advanced computer tools were used. Hydrodynamic CFD hull form optimisation both in calm water and waves was conducted, while the overall concept integration and machinery system evaluation and optimisation was conducted using DNV GL’s Cossimos modelling framework. The LPGreen concept demonstrates that the close collaboration of industry leaders coupled with advanced analysis methodologies and computer tools can lead to efficiency improvements and innovation in practice.

11.15-12.20

THE USE OF WASTE HEAT RECOVERY TO IMPROVE THE EFFICIENCY OF DUAL FUEL DIESEL ELECTRIC LNG CARRIERS, Efthimios Petropoulos, Green Marine Ltd, UK

The Dual Fuel Diesel Electric (DFDE) Technology has become the dominant propulsion choice for modern Liquefied Natural Gas (LNG) tankers, gradually replacing the previous choice- Steam Turbine Propulsion in current and future designs. This change is due to the higher thermal efficiency of the DFDE technology resulting in financial savings in operation expenditure of the vessel (OPEX) over the vessel life cycle when compared to the steam turbine propulsion system. However, Greenhouse Gas (GHG) reduction regulations such as the Energy Efficiency Design Index (EEDI) on CO2 reduction and new competing LNG propulsion technologies such as gas injection slow-speed diesel engines are highlighted. A new generation of LNG carriers is therefore required, which is still not commercialised with current DFDE Technologies. This need has led to the development of the waste heat recovery system (WHRS) as an option to improve the efficiency of DFDE vessels. This paper presents a WHRS as a method of improving the efficiency of DFDE carriers. The paper will cover three major aspects: 1) the WHRS design concept to be employed, 2) Trial Run of the WHRS in actual sea going operations. 3) Discussion of results and implications for future designs.

11.45-12.20

THE PRACTICAL IMPACT OF THE 2016 IGC CODE MODIFICATIONS ON A VLGC HULL DESIGN, Lucian Viorel Anghel, Ionel Hristache and Marcel Negrea, Icpeolonav Engineering SRL, Romania

This paper describes a programme of work to quantify signature performance during the design process and develop new tools to support decision making. This new capability enables flow generated noise performance to be progressively assured against requirements and the performance to be balanced against programme, cost and risk considerations. A range of tools and techniques are now available, which are applicable across the design process. This comprises scoping calculations for application during concept design where the quality and availability of information is low and there is a need to rapidly explore the design space. During the preliminary or FEED stage, more sophisticated techniques are employed to make use of the greater quality of information. At this stage analytical methods are fused with empirical relationships to provide a hybrid approach which is sensitive to design changes, most important to enable design exploration and sensitivity studies. During detailed design, high fidelity numerical methods are used to capture design details and produce high resolution predictions. New flow noise mitigation strategies are also discussed, including avoidance of cavitation and the application of silencing devices for fluid systems.

12.00-13.00

LUNCH

13.20-13.50

SLOSHING AND SWIRLING IN MEMBRANE LNG TANKS AND THEIR COUPLING EFFECTS WITH SHIP MOTION, Makoto Arai and Gustavo Massaki Kurimoto, Yokohama National University, Japan and Hideaki Ando, Ako Membrakai Technology Institute, Japan

Experimental and numerical studies of sloshing in membrane tanks of LNG carriers were carried out. By using partially filled membrane models, a series of model experiments was carried out with a motion bed facility. Pressure and total hydrodynamic forces to the tank were measured under regular and irregular excitation. A finite-difference method was used for the numerical simulation of the liquid in the tank and the results were compared with measured ones. In the prismatic shaped membrane tanks with partially filled condition, a violent two-dimensional sloshing in the transverse direction of the tanks can occur when the tanks are excited at near resonance frequencies. However, in the case if the tank-length-to-tank-
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