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The Application of a New Tank Containment System to ULTRA-Large LNG Carriers

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Abstract

The maximum size of LNG Carriers on order has doubled in the past few years. These ULTRA-large LNG Carriers introduce a number of unique problems because of their size, such as liquid sloshing and the requirement that they must stay within the current draft restriction of 12.2 m even as their deadweight doubles. This means that their length, beam and/or block coefficient must be increased more than for ships without draft restrictions. It also suggests that because of the draft restriction there may be a practical size limit for LNG Carriers. This also impacts efficient propulsion, building, and operating costs. Another somewhat lesser problem is the significant increase in the above water profile area.

The paper examines the size problem and reports on the benefits of the Cubic Doughnut tank containment system on the supporting ship design. The new tank containment system is described for its specific advantages for large capacity LNG Carriers, but it is noted that these benefits also apply to existing size LNG Carriers, LPG Carriers, and Floating LNG/Oil and LNG Production and Storage Offshore Units.

1.0 Introduction

The transport of LNG by sea started in the late 1960s and has continued to grow, almost constantly, since then. Economic trends suggest that this will continue for the near future with new fields and new consumers entering the market. With the growth in demand the size of the LNG Carriers also increased. The recent annual growth in size has been about10% over a number of years until the jump from 135,000 to over 250,000 m^3 in 2006 (NOBLE, LEVINE & COLTON 2004 and SCHEIBACK, NOBLE & BROMAN 2006).

These ULTRA-large LNG Carriers introduce a number of unique problems because of their size. Liquid sloshing limits the carriage of LNG in large side to side membrane tanks to be either over 80% or less than 10% full to avoid damage to the tank lining and insulation. The current draft restriction of 12.2 m is a significant design constraint as LNG Carriers increase in size. The 267,000 m^3 LNG Carriers can only increase the draft by 10% (11 m to 12.2 m) compared to 138,000 m^3 LNG Carriers though the deadweight and thus displacement almost doubles. This means that the length, beam and block coefficient must all be increased greater than normal for ships without draft restrictions. This also adversely impacts efficient propulsion, building, and operating costs. It is possible that a technical size limit exists at some point because of this draft restriction. Another somewhat lesser problem is the significant increase in the above water profile area. This can require improved propulsion, steering, and other design features to maintain acceptable maneuverability.

The paper will consider these problems (and the resulting design opportunities) by reporting on a ship design synthesis study to find if there is a technical size limit. It will be seen that this limit is well above the current 267,000 m^3 LNG Carriers; however the associated sloshing problems will be more severe for these larger ships. The sloshing problem may be the factor that restricts the ship size.