

# Retrofitting a Panamax-class container vessel for Liquefied Natural Gas operation along the Northern Sea Route

*E. Randa-Boldt and M.Y. Pilskog*

DTU Mechanical Engineering, Technical University of Denmark

## INTRODUCTION

To meet the increasing demand for high-volume short-transit transportation of containerized goods between East Asia and northern Europe with the existing container vessel fleet, the utilization of an alternative sea route – the Northern Sea Route (NSR) – is proposed. This solution is to be combined with the retrofitting of current-generation green technologies for further reduction of greenhouse gas emissions.

## THE SOLUTION

The Northern Sea Route runs along the north coast of Russia, and has previously been inaccessible for commercial shipping due to the arctic icecap. Global warming has, however, caused the icecap to retreat to such a degree that this route may be used a feasible route of commercial transportation. Using this alternative, as opposed to the southern route through the Suez Canal (SR), the travel distance between Rotterdam and Shanghai is reduced by approximately 45%, from 22,000 to 12,000 km.

Traditionally, container ships have been built to meet requirements imposed by the infrastructure of their intended service routes. Hence, a substantial share of the current container fleet tonnage is built to meet the dimensional requirements of the Panama Canal, which has a width limit of 32.31 m (*Panamax*). These ships are typically built relatively narrow and tall, compromising the maneuverability of the ships.

Currently, the Panama Canal is being expanded to be able to service larger ships (55 m wide), with expected completion in 2016, making the Panamax segment of container vessels less attractive. Retrofitting these outdated vessels to fulfill the ice-class requirements of escorted operations along the NSR is therefore suggested as a business opportunity with significant potential. Additionally, retrofitting the vessels to be able to use Liquefied Natural Gas (LNG), which will both reduce the environmental impact of the transportation work and lower the operational costs, should be considered.

## CONCLUSION

Modeling the rerouting of a LNG-capable container vessel along the NSR compared to the standard SR has led to a significant reduction of greenhouse gases and fuel consumption (Table 1), as well as shorter turnaround times. These effects are seen both as a result of the shortened travel distance as well as the implementation of LNG-technology.

	FOC	CO <sub>2</sub>	SO <sub>x</sub>	NO <sub>x</sub>	PM
SR (HFO)	1020	3201	55	91	8.0
NSR (LNG)	474	1303	0	4	0.1
Difference	546	1898	55	87	7.9
<b>Reduction</b>	54%	60%	100%	96%	99%

**Table 1:** Comparing the effects of retrofitting and route change, values in t/trip.