

COSCO SHIPPING LNG Investment
(Shanghai) Co.,Ltd.

LNG transportation review and COSCO-Shipping practices



01

Chinese LNG transport capacity



Chinese LNG transport capacity

COSCO shipping energy transportation company is the largest investment and operation platform for large LNG carriers in China. Through two subsidiaries (one is wholly owned by COSCO SHIPPING LNG Investment (Shanghai) Co.,Ltd. and 50% equity interest of CLNG), A total of 38 LNG vessels are invested, the designed capacity is 6.414 million cubic meters, and equivalent volume is about 3 million tons.

In service	NO.	capacity(million cubic meters)
21	6	0.147
	8	0.172
	7	0.174

In building	NO.	capacity(million cubic meters)
17	0	0.147
	10	0.172
	7	0.174



02

Status of Shanghai LNG transportation capacity



Status of Shanghai LNG transportation capacity

Shanghai LNG is a wholly owned subsidiary of COSCO shipping energy transportation co., LTD. It is specialized in the development and design of LNG transportation. This is the only company in China with the project management experience and performance in the whole process of construction and operation of large LNG carriers.

At present, it has 12 ships in service and 5 under construction, with a total capacity of 2.08 million m³ and a total deadweight of 1 million tons.

project	No. of ship	capacity m ³	Main propulsion type
MOBIL	4	172000	SSD+R system
APLNG	6	174000	DFDE
YAMAL ARC7	2	172000	DFDE+AZPOD



03

Energy conservation and emission reduction practice case report from Shanghai LNG



3.1 Case situation



"CESI GLADSTONE", a LNG carrier having 174,000 cubic meter and Dual fuel diesel-electric propulsion, belong to COSCO SHIPPING LNG Investment (Shanghai) Co.,Ltd. which is subsidiary of cosco shipping energy transportation company. The ship was put into service on October 31, 2016.

The ship is the first of six project vessels for sinopec's Australia APLNG transport project. Her completion not only marked the successful delivery of China's first Dual fuel diesel-electric (DFDE) membrane LNG carrier, but also won the title of the largest, most advanced and most environment friendly LNG ship independently designed and built in China.

3.2 ship's particulars

NAME: CESI GLADSTONE

DATE OF DELIVERY: 31/10/2016

Builder: Hudong-zhonghua shipbuilding group co., LTD

Cargo type: GTT NO 96; No. of Cargo hold: 4

length: 290m; Breadth: 45.8m; Depth: ≤ 27 m;

capacity : 175,000 cubic meters

The design draft: ≤ 11.8 m; Specific gravity of LNG= 0.47

Structure of the draft: the design draft+1m(at least), Specific gravity of LNG= 0.5

Speed: ≥ 19.5 kn (the design draft) with 21% offshore reserves

Cargo evaporation rate: $< 0.15\%$ /day

Displacement: ≤ 148000 tons

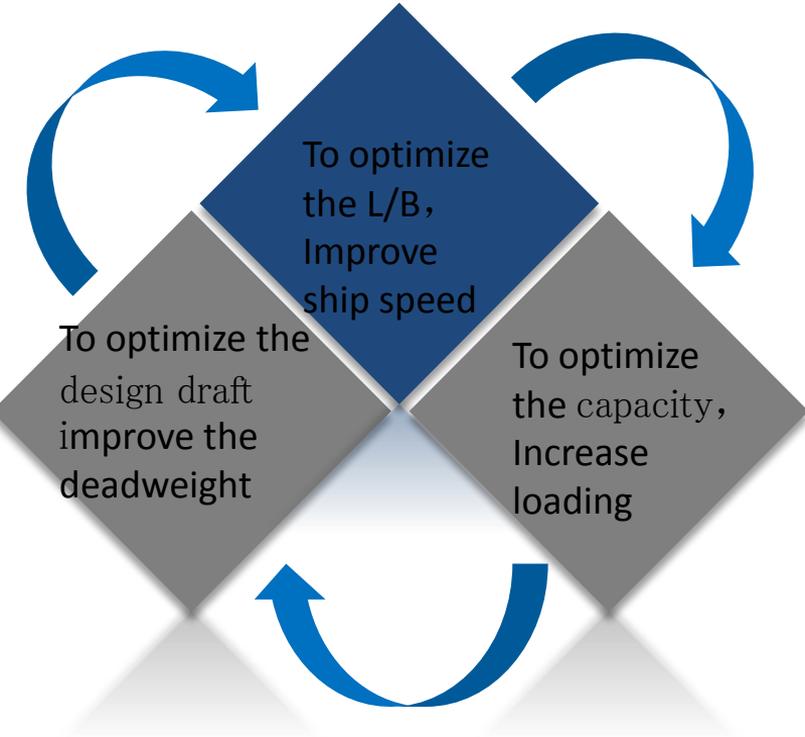
Main engine: Dual fuel diesel-electric (DFDE)

3.3 Energy saving and emission reduction measures

cargo hold optimization

Under series of project APLNG transportation (project AP carrier) , the 174,000 m³ LNG carrier , a new ship type based on Mobil project 172,000 m³ LNG carrier (project Mobil carrier), is optimized and designed by the company and hudong-zhonghua.

cargo hold optimization



Cargo hold	20°C (environment temperature) 100% capacity	20°C (environment temperature) 98.5% capacity
No.1	26200	25800
No.2	49300	48560
No.3	49300	48560
No.4	49300	48560
ALL capacity	174100	171480

3.3 Energy saving and emission reduction measures

Configuration of the main propulsion system

electrical propulsion system

Two engines, two oars and two rudders

Intelligent Control with Propulsion

power management system (PMS)

The LNG carrier propelled by DFDE mainly relies on the evaporated natural gas in the cargo hold for fuel during the voyage, so it does not need to use fuel oil any more. It not only saves fuel cost , but also makes the ship to obtain IMO Tier III emission compliance certificate , because of the characteristics of natural gas combustion emissions, which meets the requirement in one step.

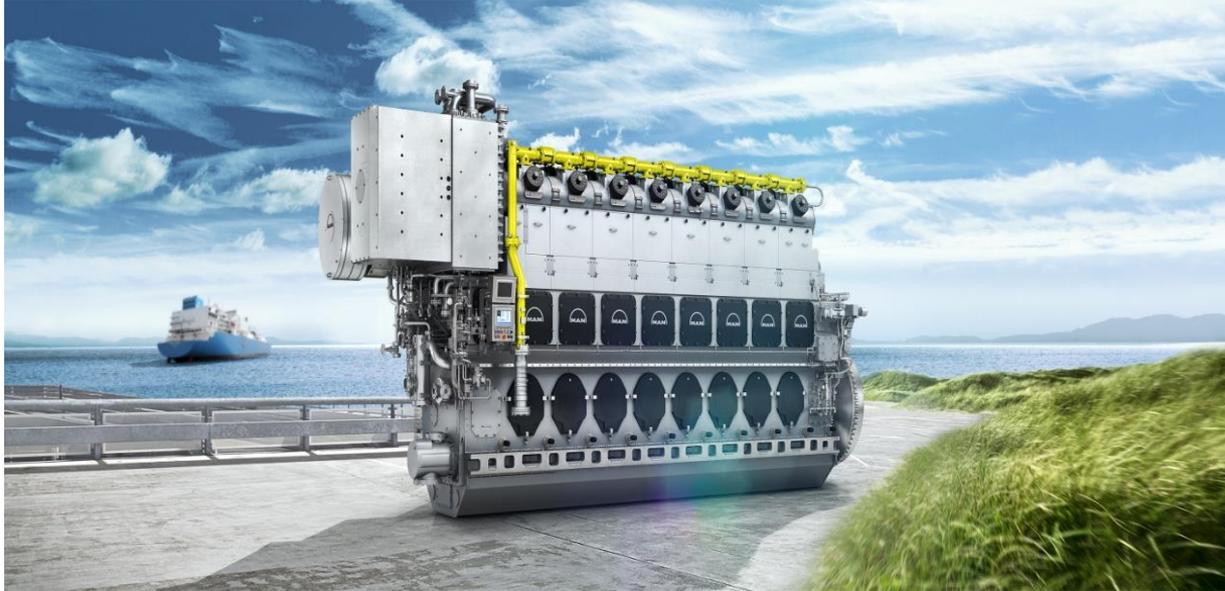
3.3 Energy saving and emission reduction measures

Main Generator Configuration

In 2012, DFDE propulsion LNG ships built by the three major Korean shipyards (Hyundai, Samsung and Daewoo) are equipped with four units of "three big and one small" or "two big and two small", namely THREE 12V+ONE 6L machines or TWO 12V+TWO 9L machines, the total number of cylinders is 42. However, there are some disadvantages and limitations in the technology and management of assembling two types of ship (V type and L type), especially the maintenance of V type has always been a difficult problem. The company actively explored and demonstrated with the shipyard and the main engine manufacturers, and finally decided to adopt a single in-line unit configuration scheme: FIVE 8L models, with the total number of cylinders reduced to 40. This innovative measure not only optimizes the unit configuration, which is conducive to maintenance and management, but also reduces the total installed power and achieves energy saving and emission reduction just like the saying "The little horse pulled the cart". What is important is that the full-load service speed of the ship remains at 19.5 knots after the ship type optimization without any reduction.

3.3 Energy saving and emission reduction measures

MAN 8L51/60DF diesel engine used in APLNG



3.3 Energy saving and emission reduction measures

Intelligent gas management system (GMS)

Due to the use of Dual fuel diesel–electric propulsion, in order to make full use of the Boil–Off Gas (BOG) in the LNG cargo hold, the company puts forward two BOG management concepts on the project AP ship:

The concept of "pure Natural vaporized gas achieves service speed" is that when the ship is fully loaded, it only USES Natural BOG vaporized from the cargo hold as energy to realize the service speed of 19.5 knots, so that it does not need to consume any LNG cargo and fuel oil during full load and full speed navigation.

The concept of "power management for BOG", That is the power management system in the BOG management mode can intelligently manage and adjust the power required by the ship's propulsion according to the amount of BOG in the cargo hold, so as to realize the sailing state of "how much BOG naturally evaporates and how fast the ship can drive".

3.3 Energy saving and emission reduction measures

Innovation and highlights

CESI GLADSTONE independently designed and built in China is the first DFDE membrane LNG carrier.

CESI GLADSTONE is still the largest (174,000 cubic meters) and fastest (full load over 19.5 knots) LNG carrier built in China.

CESI GLADSTONE is the first LNG ship in China and the second LNG ship in the world that adopts a single in-line main generator set (the first LNG ship was built by STX of Korea in April 2010, only one LNG ship was built), which broke through the conventional configuration mode on DFDE LNG ships in three major Korean shipyards (hyundai, samsung and daewoo).

CESI GLADSTONE is the first LNG carrier that fully adopts the design concept of "pure BOG full load and full speed voyage" and the first intelligent LNG carrier that adopts "Management for BOG".

Fuel Sharing Mode for the first time

Nature BOG - Only + Load off-set (功率补偿)

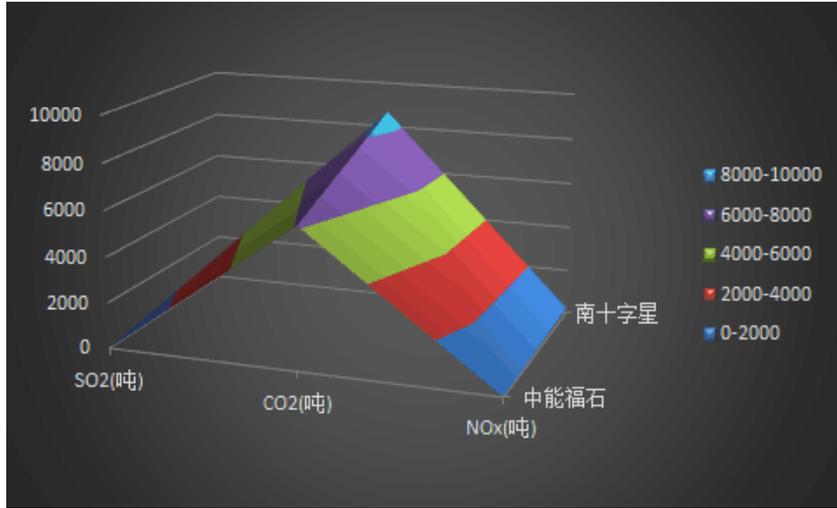
3.4 Ship energy consumption comparison

CESI GLADSTONE VS “SOUTHERN CROSS”

CESI GLADSTONE and “SOUTHERN CROSS” belong to Australian project gaogeng and project APLNG respectively. Both of them are invested (joint venture) by Shanghai LNG, and they are in normal operation, with similar shipping routes and conditions

3.4 Ship energy consumption comparison

CESI GLADSTONE VS “SOUTHERN CROSS”



The monthly energy consumption of the two are 3982.9617 tons and 3943.7832 tons of standard coal respectively, with little difference. However, in terms of pollutant emission, the southern cross discharged 167.22 tons of SO₂ (sulfur dioxide), 8,672.466 tons of CO₂ and 242.469 tons of NO_x (nitrogen oxide). The pollutant emission of CESI GLADSTONE is 6.846 tons of SO₂, 6111.0326 tons of CO₂ and 9.9267 tons of NO_x. It can be seen that being similarly LNG carrier of 170,000 cubic meters and under similar shipping routes and conditions, CESI GLADSTONE is superior in pollutant emission, which is equipped with dual fuel engines and put clean energy BOG (evaporated natural gas) as the main fuel.

3.5 Data statistical analysis

In 2017, “CESI GLADSTONE” completed 13 voyages in the whole year, and transport about 2.145 million cubic meters of LNG. The total consumption of LNG cargo evaporated gas (natural gas) was 29,810 tons, which was converted into diesel fuel of 34,877 tons.

According to the calculation of MAN, the CO₂ produced by a ton of diesel fuel being fully burned is about : 3.2 tons, a ton of natural gas combustion of CO₂ is about: 2.75 tons, if use diesel emissions of CO₂ a year is about: 111600 tons, however, the annual CO₂ emission of natural gas is about 81,977 tons, which reduces about 29,600 tons of CO₂ emissions. The annual CO₂ emission reduction of six ships is about 177,700 tons, which has obvious effect on preventing greenhouse gas emissions.

3.5 Data statistical analysis

According to the actual ship test in hudong-zhonghua, when the dual-fuel diesel engine uses LNG cargo vaporized gas as fuel, the nitrogen oxide emission effect is obvious, which fully meets the emission requirements of Tier III:

Tier III index: 2.6g/ KWH while the actual ship test of project APLNG is only 2.1g/ KWH

If diesel is used as fuel, it can only meet the emission requirements of Tier II:

Tier II index: 10.5g/ KWH ,the test results generally reach 10.0g/ KWH actually

As a result, the nitrogen oxide emissions from the project APLNG are only 21% of conventional ships, with a significant reduction in nitrogen oxide emissions.

Because natural gas fuel contains almost no sulfur, its emissions are almost zero. Liquid oil fuel, even low sulfur fuel contains some sulfur components, can not completely eliminate sulfur emissions

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Thank you

