
Introduction

Gas Trade Review is a publication in which the shipping and contractual issues relevant to the global LNG trade and the European pipeline trade with natural gas are analyzed.

In this edition, you can read about the following topics:

**- The Implications Of The Houthi Rebels' Attacks In The Red Sea On The LNG Exports From The Middle East To Europe**

**- Price Revision In The Long-Term LNG Supply Contracts**

**- Application Of The EEXI Requirements To Steam Turbine LNG Carriers**

**- How EEXI And CII Regulations Could Affect The Steam Turbine LNG Carriers**

If you have any comments about the matters reviewed in this edition, please address them to **editor@commoditylaw.eu**

# The Implications Of The Houthi Rebels' Attacks In The Red Sea On The LNG Exports From The Middle East To Europe

**by Vlad Cioarec, International Trade Consultant**

The missile attacks by the Yemen's Houthi rebel group on the cargo ships passing through the Bab el-Mandeb Strait and the Southern Red Sea have forced the LNG suppliers from the Middle East, QatarEnergy LNG and Abu Dhabi National Oil Company, to use an alternative route for the transportation of LNG via the Cape of Good Hope.

The use of the alternative route will extend considerably the time spent by the LNG carriers on the laden and ballast voyages which in turn will affect the delivery schedules at the European LNG terminals. In the Ex Ship sale contracts, any circumstances relating to the transportation of the LNG which affect the ability of the seller to deliver the LNG cargoes at the receiving terminal during the scheduled periods such as acts of war (whether declared or undeclared), hostilities, acts of piracy or the acts of terrorists[1], represent an event of Force Majeure.

The Ex Ship sale contract forms provide that if the seller's obligation to deliver the LNG cargoes during the scheduled periods is prevented or delayed by an occurrence of an event of Force Majeure, the seller may claim Force Majeure by giving notice of such Force Majeure to the buyer.

The Force Majeure notice should include the information available about the circumstances (i.e. the security risks in the Southern Red Sea) and a statement of the steps and time believed necessary to remedy the event or circumstances of Force Majeure[2] (i.e. the alternative route and the time necessary to transport the LNG via the alternative route).

The contracting parties will have to re-schedule the delivery of the LNG cargoes and agree on a new date and time for berthing the vessel(s) on the route to the receiving terminal. Then after taking into consideration the time spent by the LNG carriers on the laden and ballast voyages, the sellers can propose to buyers a revision of the scheduled unloading windows for the LNG cargoes to be delivered from now on.

Re-scheduling of the current deliveries (the LNG cargoes on the route to the receiving terminals) will cause additional operational costs for both the sellers and buyers. The buyers will incur extra costs for the regasification terminal capacity not used and for the re-liquefaction of the boil-off gas generated by the LNG in the storage tanks during the additional period spent by the LNG carriers on the laden voyage(s). In this regard, the Force Majeure clause of the long-term Ex-Ship Sales Agreements provides that in the event that the seller's obligation to deliver the LNG cargoes is delayed by an occurrence of an event of Force Majeure, the seller shall be relieved from liability and shall not be liable to the buyer for any loss incurred due to delay in delivery[3].

If the use of the alternative maritime route via the Cape of Good Hope will be necessary for a longer period, then it will be necessary to re-schedule not only the cargoes on the route and the cargoes to be delivered in February and March, but the entire Annual Delivery Program.

## Who Bears The Additional Transportation Costs

The use of the alternative maritime route via the Cape of Good Hope will extend considerably the voyage distance and time from the Middle East to Europe.

On the original route via the Bab el-Mandeb Strait, the Red Sea and the Suez Canal, the Q-Max and Q-Flex LNG carriers used by QatarEnergy could have transported the LNG cargoes from Ras

---

1 In QatarEnergy LNG contracts, such events of Force Majeure are referred to as “Adverse Security and Safety Conditions” and defined as security and safety risks which prevent an LNG vessel from proceeding on the usual route due to the prevailing security conditions.

2 See GIIGNL Master Ex-Ship LNG Sales Agreement form.

3 See BP Standard Form MSA (DES) 2019 Edition.

Laffan LNG Terminal, in Qatar to South Hook LNG Terminal in United Kingdom on approximately 18 days.
On the alternative maritime route via the Cape of Good Hope, the LNG carriers have to sail over a distance of 10,824 nautical miles. At a speed of 14 knots, the time necessary to perform such voyage would be 32 days.
In the case of the LNG cargoes which have to be delivered by QatarEnergy to Adriatic LNG Terminal, the things are much worst.
On the original route via the Bab el-Mandeb Strait, the Red Sea and the Suez Canal, the Q-Max and Q-Flex LNG carriers used by QatarEnergy had to transport the LNG cargoes from Ras Laffan LNG Terminal, in Qatar to Adriatic LNG LNG Terminal in Italy over a distance of 4,438 nautical miles. At a speed of 14 knots, the time necessary to perform such voyage was approximately 13 days.
On the alternative maritime route via the Cape of Good Hope, the LNG carriers have to sail over a distance of 11,669 nautical miles. At a speed of 14 knots, the time necessary to perform such voyage would be 34 days and 18 hours.
The LNG deliveries by Abu Dhabi National Oil Company to the Elbehafen floating LNG terminal in Brunsbüttel, Germany would also be affected.
On the original route via the Bab el-Mandeb Strait, the Red Sea and the Suez Canal, the LNG cargoes were transported from Das Island LNG Terminal to the Elbehafen floating LNG terminal in Brunsbüttel over a distance of 6,493 nautical miles. At a speed of 14 knots, the time necessary to perform such voyage was approximately 19 days and 8 hours.
On the alternative maritime route via the Cape of Good Hope, the LNG carriers have to sail over a distance of 11,226 nautical miles. At a speed of 14 knots, the time necessary to perform such voyage would be 33 days and 10 hours.
The use of the alternative maritime route via the Cape of Good Hope will increase the bunker fuel consumption of the LNG carriers on both the laden and ballast voyages. As a result, in the case of LNG carriers operated under time charters that use the boil-off gas as fuel, the charterers might have to reconsider which type of fuel can be used.
In LNG time charterparties for these types of LNG carriers, the fuel consumption is calculated taking into consideration not only the fuel oil and marine diesel oil consumption but also the LNG cargo loss through boil-off.
ShellLNGTime 1 (Shell LNG Time Charter Party form) provides that for the purpose of calculation of the fuel consumption for a voyage, the term “fuel” is used to refer to its two components, the fuel oil and boil-off gas, measured in metric tonnes of Fuel Oil Equivalent. The Clause 6(a) of Appendix C of ShellLNGTime 1 has the following provisions:

*“The actual fuel consumption on a Voyage shall [...] be the sum of,*
*(i) the fuel oil consumed during the Voyage (expressed in tonnes) [...]; and*
*(ii) the fuel equivalent of the total volume of cargo lost as Boil-Off during the Voyage (expressed in tonnes of Fuel Oil Equivalent) […].”*

It is obvious that the amount of boil-off gas generated by the LNG cargoes on the alternative maritime route via the Cape of Good Hope will exceed the Boil-Off Cap stated in charterparties based on the voyage time on the original route via the Bab el-Mandeb Strait, the Red Sea and the Suez Canal. In charterparties, the excess boil-off consumed on the alternative route shall be for the charterers' account. The Clause 23 paragraph (b) of BIMCO GIIGNL LNGVOY (BIMCO and GIIGNL LNG Voyage Charter Party form) stipulates expressly that the excess boil-off lost in the event of delays occurred due to war risks shall not count towards the Boil-Off Cap and therefore, the shipowners shall have no responsibility to compensate the charterers for the use of such excess boil-off gas as propulsive fuel.

Furthermore, BIMCO War Risks Clause 2013 paragraph (d), which is incorporated in BIMCO GIIGNL LNGVOY, has the following provisions:

*"If at any stage of the voyage after the loading of the cargo commences, it appears that, in the reasonable judgement of the Master and/or the Owners, the Vessel, cargo, crew or other persons on board the Vessel may be exposed to War Risks on any part of the route (including any canal or waterway) which is normally and customarily used in a voyage of the nature contracted for, and there is another longer route to the Discharging Port, the Owners shall give notice to the Charterers that this route will be taken. In this event the Owners shall be entitled, if the total extra distance exceeds 100 miles, to additional freight which shall be the same percentage of the freight contracted for as the percentage which the extra distance represents to the distance of the normal and customary route."*

In the spot sales, the LNG suppliers and traders who deliver the LNG cargoes on Ex Ship basis at receiving terminals could recover the extra expenses from the buyers after delivery, by including the additional transportation costs in the invoice sent to the buyers.

In the case of LNG cargoes delivered on Ex Ship basis under long-term sales contracts, the contract price formula is based on the costs of transportation via the Bab el-Mandeb Strait, the Red Sea and the Suez Canal. For the time being, QatarEnergy LNG and Abu Dhabi National Oil Company may have to bear the additional transportation costs but if the situation in the Southern Red Sea will persist in the future, they can request a revision of the existing price formula which is based on the costs of transportation via the Bab el-Mandeb Strait, the Red Sea and the Suez Canal.

# Price Revision In The Long-Term LNG Supply Contracts

**by Vlad Cioarec, International Trade Consultant**

The long-term LNG SPAs typically include a price review clause which provides that in certain circumstances, such as a substantial change of economic circumstances in the buyer's market, a contracting party may request the revision of the contract price formula. The party requesting the price revision must give a notice for price review to the other party, mentioning the reasons for such request. If the contracting parties agree on the terms of the price revision within the time limit provided for in the supply contract, the revised contract price shall apply from the date of the price review notice until either the date of the next price revision provided for in the supply contract or, if there will be no further price revision, until the end of the supply period provided for in the supply contract. Thus it shall apply to all LNG cargoes delivered under the supply contract on or after the date of the price review notice.

Until the price revision is agreed by the contracting parties, the price of each cargo delivered, from the date of the price review notice until the date when the price revision is agreed, can be determined on a provisional basis using the existing price formula.

After the price revision is agreed, the contracting parties shall calculate the difference between the revised price and the price provisionally applied to the LNG cargoes delivered from the date of the price review notice and such difference shall be paid by the contracting party from which it is due.

If the contracting parties cannot reach an agreement on the terms of the price revision within the time limit provided for in the LNG supply contract (usually stipulated as six months after the date of the price review notice), the LNG supply contracts stipulate that they have the right to settle the dispute by arbitration.

An example of such case was the US law case **Gas Natural Aprovisionamientos, SDG, S.A. v. Atlantic LNG Company of Trinidad and Tobago**[1]**.** In that case Atlantic LNG Company of Trinidad and Tobago concluded in the year 1995 a long-term LNG supply contract with the Spanish gas supplier Gas Natural Aprovisionamientos for the period between 1999 and 2019. The LNG cargoes were to be delivered FOB basis at Atlantic LNG terminal in Point Fortin, Trinidad and Tobago.

The contract price formula consisted of a Spanish base price and multiplier indexed quarterly to the European prices of oil products. The contract price formula was agreed based on the assumption that the LNG cargoes will be delivered and sold in the Spanish market.

However, after the conclusion of the LNG supply contract in 1995, the Spanish gas market was substantially liberalized and the Spanish gas price decreased. The unexpected decrease of the gas price in the Spanish market has not been proportionate to the change in the value of the oil price index in the contract price formula.

Although the liberalization of the Spanish gas market was foreseen by the contracting parties in 1995, they expected that the contract price formula would allow the contract price to increase proportionally with the increase of the natural gas price in Spain. That did not happen. There was a substantial difference between the expected and the actual prices at which Gas Natural Aprovisionamientos re-sold the gas from the LNG cargoes.

The LNG supply contract had a “price reopener clause” which stipulated that in the event of a substantial change of economic circumstances in the Spanish gas market compared to what was reasonably expected at the time the contract was concluded, either party to the contract could notify the other to request a revision of the contract price provisions. The revised contract price had to

1 SDNY 2008

allow the buyer “to achieve a reasonable rate of return” on the LNG delivered by the seller under conditions of “sound marketing practices and efficient operations”.
The LNG supply contract prohibited the contracting parties to submit a request for price revision earlier than twelve months following the date of the first cargo delivery. It also prohibited a contracting party to request a further revision of the contract price to become effective at a date which was earlier then three years after the date on which such party had last requested a price revision.
The LNG supply contract provided that in the event that the contracting parties could not reach an agreement on the terms of the price revision within six months from the date of the price revision notice, they had the right to request the settlement of the dispute by arbitration.
After a year from the commencement of the LNG deliveries, the buyer sought to obtain a lower price adjustment due to the low prices at which the gas from the LNG cargoes was re-sold in Spain. Unable to obtain a lower price, since October 2002 the buyer re-sold the LNG on the higher-priced US market (in New England).
The seller contended that the re-sale of LNG in the US market was a substantial change of economic circumstances and on 21 April 2005, sent a notice to buyer requesting an upward revision of the contract price formula to reflect the price of the natural gas in the US market. Because the seller and buyer were unable to agree a new price formula, on 21 October 2005, the seller requested the settlement of the dispute by arbitration. The seller claimed that after October 2002, when the buyer started to re-sell the LNG in the US market (in New England), the US market became the “buyer's end user market” and therefore, the contract price formula had to take into consideration the price of the natural gas in the US market.
The arbitration panel held that the contract requirements for requesting the price revision had been fulfilled, because there was a substantial difference between the expected and the actual prices, that difference occurred consistently over a meaningful time period and was reasonably anticipated to persist. The substantial difference between the expected and the actual prices over a three years' period (between 21 April 2005, the date of the price review notice and December 2007, when the arbitration proceedings were held) was considered a substantial change of economic circumstances.
The arbitration panel decided that for the purpose of price revision, the buyer's end user market was either Spain or United States (New England) depending on where the LNG was ultimately delivered and that the revised price formula had to be constructed with terms that could be adaptable depending on the buyer's end user market at the time. Therefore, the arbitration panel maintained the contract price formula designed for the Spanish market (with the Spanish base price), but it added to it “a New England Market Adjustment factor”.
The revised price formula became effective from 21 April 2005, the date of the price review notice.
As a result of the contract price recalculation, the seller, Atlantic LNG Company, had to pay over USD 70 million to buyer as the price difference for LNG cargoes delivered between 21 April 2005 and 31 December 2007[2].
The arbitral tribunal declined to impose interest on the recalculated price for that period of time for that period of time, in the absence of contractual provisions covering this matter. Therefore, the LNG supply contracts should stipulate whether the price difference resulting from the contract price revision is to be payable with interest or not.
It should also stipulate how the fees and expenses due to the arbitral tribunal will be shared by the contracting parties and who shall bear the liability for the costs of legal representation in the arbitration proceedings. The art. 42 of the UNCITRAL Arbitration Rules provides that:

*“1. The costs of the arbitration shall in principle be borne by the unsuccessful party or parties. However, the arbitral tribunal may apportion each of such costs between the parties if it determines that apportionment is reasonable, taking into account the circumstances of the case.*

2 The date of the final award was 17 January 2008.

*2. The arbitral tribunal shall in the final award or, if it deems appropriate, in any other award, determine any amount that a party may have to pay to another party as a result of the decision on allocation of costs.”*

The parties can stipulate in the contract arbitration clause that each party shall bear its own costs relating to the arbitration (i.e. the costs of legal representation) and that the parties shall share equally all fees and expenses incurred by the arbitrators.

# Application Of The EEXI Requirements To Steam Turbine LNG Carriers

**by Vlad Cioarec, International Trade Consultant**

Starting from 2011, the IMO has introduced in MARPOL Annex VI a series of technical and operational measures to improve the energy efficiency of ships and reduce the amount of $CO_2$ emissions from international shipping.
In 2011, the IMO has introduced in MARPOL Annex VI the Energy Efficiency Design Index (EEDI) which requires a minimum energy efficiency level for new ships. EEDI is a measure of the ship's energy efficiency which is expressed in grams of $CO_2$ per ship's capacity mile (in case of LNG carriers, tonne mile), in function of the ship type and size. The lower a ship's EEDI, the more energy efficient it is and the less negative is its impact on the environment.
In 2021, the IMO has introduced in MARPOL Annex VI the Energy Efficiency Existing Ship Index (EEXI) which requires a minimum energy efficiency level for existing ships. EEXI is EEDI for the existing ships. The EEXI requirements came into force on 1 November 2022. All LNG carriers with a gross tonnage of 400 tonnes and above were asked to calculate their Attained EEXI.
In the case of the steam turbine LNG carriers, the Attained EEXI is calculated by a formula which takes into account the following parameters[1]:

- $\mathbf{MCR_{SteamTurbine}}$ is the maximum continuous rated power of steam turbines based on the rated installed power of each steam turbine.
In the case of LNG carriers of 10,000 DWT and above, the value of the Attained EEXI has to be utmost equal to or less than that of the Required EEXI for LNG carriers which sets a minimum energy efficiency level for LNG carriers.
The Required EEXI for LNG carriers is calculated based on a 30% reduction factor applicable to the reference line value set for LNG carriers. If the value of the Attained EEXI exceeds the Required EEXI, the ship does not comply with the EEXI requirements.
In order to comply with the Required EEXI for LNG carriers, the power of the steam turbines ($\mathbf{MCR_{SteamTurbine}}$) can be reduced by installing a shaft power limitation system.
In the cases where a shaft power limitation system is installed, the installed power limited by the shaft power limitation system is stated as $\mathbf{MCR_{SteamTurbine,lim}}$.
When calculating the acceptable limited power ($\mathbf{MCR_{SteamTurbine,lim}}$), a reduction factor is applied to $\mathbf{MCR_{SteamTurbine}}$ until the Attained EEXI shall be equal to or less than the Required EEXI for LNG carriers.

- $\mathbf{P_{ME(i)}}$ is the power of main engines[2], i.e. the steam turbines output. It is calculated as 83% of the rated installed power ($\mathbf{MCR_{SteamTurbine}}$) of each steam turbine (i):

$$\mathbf{P_{ME(i)} = 0.83 \times MCR_{SteamTurbine}}$$

In the cases where a shaft power limitation system is installed, $\mathbf{P_{ME(i)}}$ is calculated as 83% of the limited installed power ($\mathbf{MCR_{SteamTurbine,lim}}$) of each steam turbine:

$$\mathbf{P_{ME\_lim} = 0.83 \times MCR_{SteamTurbine,lim}}$$

1 See Resolution MEPC.350(78) – “2022 Guidelines On The Method Of Calculation Of The Attained Energy Efficiency Existing Ship Index (EEXI)”
2 The subscript ME(i) refers to the main engines.

In the cases where shaft generators are installed to steam turbines, the power of the shaft generators ($\mathbf{P_{PTO(i)}}$) has to be taken into consideration for the calculation of $\mathbf{P_{ME}}$ value. In such case

$$\mathbf{P_{ME(i)} = 0.83 \times (MCR_{SteamTurbine} - P_{PTO(i)})}$$

If a shaft power limitation system is installed, the formula is:

$$\mathbf{P_{ME(i)} = 0.83 \times (MCR_{SteamTurbine,lim} - P_{PTO(i)})}$$

The power of shaft generators is calculated as 83% of the rated electrical output power of each shaft generator[3].

- $\mathbf{P_{ME\_revised}}$

The excessive power from the combustion of the excessive natural boil-off gas in the boilers to avoid the release into the atmosphere can be deducted from $\mathbf{P_{ME(i)}}$. The new power value is stated as $\mathbf{P_{ME\_revised}}$ and is calculated with the formula:

$$\mathbf{P_{ME\_revised} = 0.83 \times (MCR_{SteamTurbine,lim} - P_{Excessive})}$$

where:

$\mathbf{P_{Excessive}}$ is the excessive power from the combustion of the excessive natural boil-off gas in the boilers to avoid the release into the atmosphere. It is calculated as the difference between the nominal power generated by consuming all boil-off gas from the cargo tanks ($\mathbf{P_{BOG}}$) and $\mathbf{MCR_{SteamTurbine,lim}}$[4].

$$\mathbf{P_{Excessive} = P_{BOG} - MCR_{SteamTurbine,lim}}$$

- **Ship's Capacity –** for LNG carriers is the ship's Deadweight at summer load draft.

- $\mathbf{V_{ref}}$ is the ship's reference speed at 83% of $MCR_{SteamTurbine}$ or at 83% of $MCR_{SteamTurbine,lim}$[5]

- $\mathbf{SFC_{SteamTurbine}}$ is the certified specific fuel consumption of the steam turbines. In case of the power limitation by a shaft power limitation system, the specific fuel consumption is taken at $\mathbf{P_{ME\_lim}}$[6]

- $\mathbf{C_F}$ is the conversion factor between the fuel consumption and $CO_2$ emission.

Based on the above-mentioned parameters, the formula for the calculation of the Attained EEXI of the steam turbine LNG carriers is[7]:

3 See Resolution MEPC.364(79) – "2022 Guidelines On The Method Of Calculation Of The Attained Energy Efficiency Design Index (EEDI) For New Ships".
4 See IACS Recommendation No.172 – "EEXI Implementation Guidelines".
5 For the parameters to be used for the calculation of $V_{ref}$ see Resolution MEPC.350(78) – "2022 Guidelines On The Method Of Calculation Of The Attained Energy Efficiency Existing Ship Index (EEXI)" and IACS Recommendation No.172 – "EEXI Implementation Guidelines".
6 See Resolution MEPC.351(78) – "2022 Guidelines On Survey And Certification Of The Attained Energy Efficiency Existing Ship Index (EEXI)"
7 See IACS Recommendation No.172 – "EEXI Implementation Guidelines".

$$Attained\ EEXI = \frac{P_{ME} \cdot SFC_{Steam\ Turbine} \cdot C_F}{DWT \cdot V_{ref}}$$

In case of the shaft power limitation of $P_{ME}$ and after the deduction of the power from the combustion of the excessive natural boil-off gas (**$P_{Excessive}$**), **$P_{ME\_revised}$** shall be used in the formula for the calculation of the Attained EEXI.

In 2023, the LNG carriers of 10,000 DWT and above were subject to a survey by their Administration to verify whether their Attained EEXI were calculated in accordance with the requirements in the Regulation 23 of MARPOL Annex VI and EEXI Calculation Guidelines (Resolution MEPC.350(78)).

## How EEXI And CII Regulations Could Affect The Steam Turbine LNG Carriers

**by Vlad Cioarec, International Trade Consultant**

The conventional steam turbine propulsion systems installed on board the LNG carriers built in the 1970s, 1980s, 1990s, 2000s and early 2010s were designed not on fuel efficiency considerations but to use the boil-off gas generated by the LNG cargoes as fuel, taking into consideration a daily rate of boil-off gas of 0.15% based on the LNG tank insulation technology available at the time of the ships' building.

Following the technological innovations in the tank insulation and ship propulsion systems over the last ten years, the conventional steam turbines became the least efficient propulsion systems in the global LNG fleet. The LNG carriers powered by conventional steam turbines have the highest fuel consumption and generate the highest $CO_2$ emissions per ton of all types of LNG carriers.

In 2021, the IMO's Marine Environment Protection Committee has included in MARPOL Annex VI the Energy Efficiency Existing Ship Index (EEXI) regulation which requires a minimum energy efficiency level (expressed in grams of $CO_2$ per tonne mile) for existing ships in function of the ship's type and size. The Required EEXI for LNG carriers provides a minimum energy efficiency level based on a 30% reduction factor applicable to the reference line value set for the LNG carriers.

In order to comply with the EEXI requirements, the value of the Attained EEXI of LNG carriers of 10,000 DWT and above must be utmost equal to or less than that of the Required EEXI for LNG carriers.

In the case of the conventional steam turbine LNG carriers this would involve the installation of a shaft power limitation system to reduce the shaft power of the propeller shaft. This will reduce the speed of the conventional steam turbine LNG carriers, increasing the voyage time and the LNG cargo loss through boil-off. So, the actual effect of the technical measure recommended by the IMO's Marine Environment Protection Committee to ship operators to comply with the Required EEXI is that the conventional steam turbine LNG carriers have to sail at slower speeds than before, spend more time on the voyages, consume even more LNG cargo as fuel and thereby, generate even higher emissions of $CO_2$ than before.

Another consequence of the speed reduction by the shaft power limitation could be that part of the naturally generated boil-off gas can no longer be used for propulsion and has to be burned in the Gas Combustion Unit to avoid the release of gas into the atmosphere.

In addition to the EEXI regulation, the IMO's Marine Environment Protection Committee has introduced in MARPOL Annex VI the ship operators' obligation to report to the ship's Administration data with regard to the annual fuel oil consumption (based on the daily fuel oil consumption data), the distance travelled in nautical miles and time (hours) spent on voyages. It has also introduced an operational performance indicator named “Carbon Intensity Indicator” (CII) by which it is possible to measure the carbon intensity of a ship in the course of a year[1].

This regulation requires that, on the basis of the annual fuel consumption data, the distance travelled and the time spent on voyages, after the end of the calendar year 2023 and after the end of each following calendar year, each ship of 5,000 gross tonnage and above to calculate the attained annual operational CII over a 12-month period from 1 January to 31 December for the preceding calendar year.

The attained annual operational CII of individual ships has to be calculated as the ratio of the total mass of $CO_2$ emitted to the total transport work undertaken in a given calendar year[2].

---

1 See Regulation 28 of MARPOL Annex VI.

2 See Resolution MEPC.352 (78) – “2022 Guidelines on Operational Carbon Intensity Indicators and the Calculation Methods (CII Guidelines, G1)”

The **total mass of $CO_2$** is the sum of $CO_2$ emissions (in grams) **from all the fuel consumed** on board a ship in a given calendar year. According to the Regulation 2.1.14 of MARPOL Annex VI, the fuel oil consumption data that has to be reported to the ship's Administration should include the consumption data with regard to any fuel used for propulsion, including gas, distillate or residual fuels. Therefore, the LNG carriers using the boil-off gas as fuel should report the mass equivalent of the LNG volume consumed less the nitrogen mass content because the nitrogen does not contribute to $CO_2$ emissions.

The **total transport work** is calculated as the product of the ship's capacity (in the case of LNG carriers, the ship's DWT) and the distance travelled in nautical miles in a given calendar year.

Within three months after the end of each calendar year, starting from this year, each ship has to report to its Administration the attained annual operational CII.

Regulation 6.6 of MARPOL Annex VI stipulates that the ship's Administration shall verify whether the attained annual operational CII is truly based on the fuel consumption data, distance travelled and time spent on voyages and, based on the verified attained annual operational CII and predetermined rating boundaries, shall assign an operational carbon intensity rating to the ship from among five grades, A, B, C, D and E, with A indicating a major superior performance level, B – minor superior performance level, C – moderate performance level, D – minor inferior performance level and E – inferior performance level.

The rating boundaries are set based on the distribution of the attained annual operational CII of the ships of the type concerned (such as the LNG carriers) in the year concerned (e.g. 2023) on the operational energy efficiency performance rating scale[3].

The operational carbon intensity rating is assigned by comparing the attained annual operational CII of a ship with the boundary values on the operational energy efficiency performance rating scale for the ships of the type concerned. The middle point of rating level C shall be the value equivalent to the required annual operational CII[4]. The rating A is for the least carbon intensive ships, while the rating E is for the most carbon intensive ships.

Currently, the conventional steam turbine LNG carriers represent around one third of the existing fleet of LNG carriers, but in the coming years more and more modern LNG carrier newbuilds are expected to enter into service. These ships feature higher transport capacity, lower boil-off rates, enhanced propeller efficiency and more fuel-efficient engines with lower $CO_2$ emissions.

The modern LNG carriers will change the CII rating boundaries and the conventional steam turbine LNG carriers will not be able to achieve the required annual operational CII. The options of the conventional steam turbine LNG carriers' owners will be either to scrap these ships or upgrade them by replacing the steam turbines with modern dual-fuel engines such as WinGD's X-DF 2.0 engines (the second generation of X-DF dual-fuel two-stroke engines) or MAN B&W ME-GI or ME-GA dual-fuel two-stroke engines.

Some shipowners are already considering the retrofit options. An example is Nippon Yusen Kabushiki Kaisha (NYK) Line who intends to replace the steam turbines of their LNG carriers with WinGD's X-DF dual-fuel two-stroke engines.

The modern dual-fuel engines generate more power than the steam turbines with significantly less gas and fuel oil consumption and $CO_2$ emissions. The retrofitted LNG carriers will be able to sail at higher speeds and spend less time on voyages.

This measure will enable the shipowners to reduce the operational costs and extend the operational lifetime of older LNG carriers.

3 See Resolution MEPC.354(78) – “2022 Guidelines On The Operational Carbon Intensity Rating Of Ships (CII Rating Guidelines, G4)”

4 See Regulation 28.6 of MARPOL Annex VI.