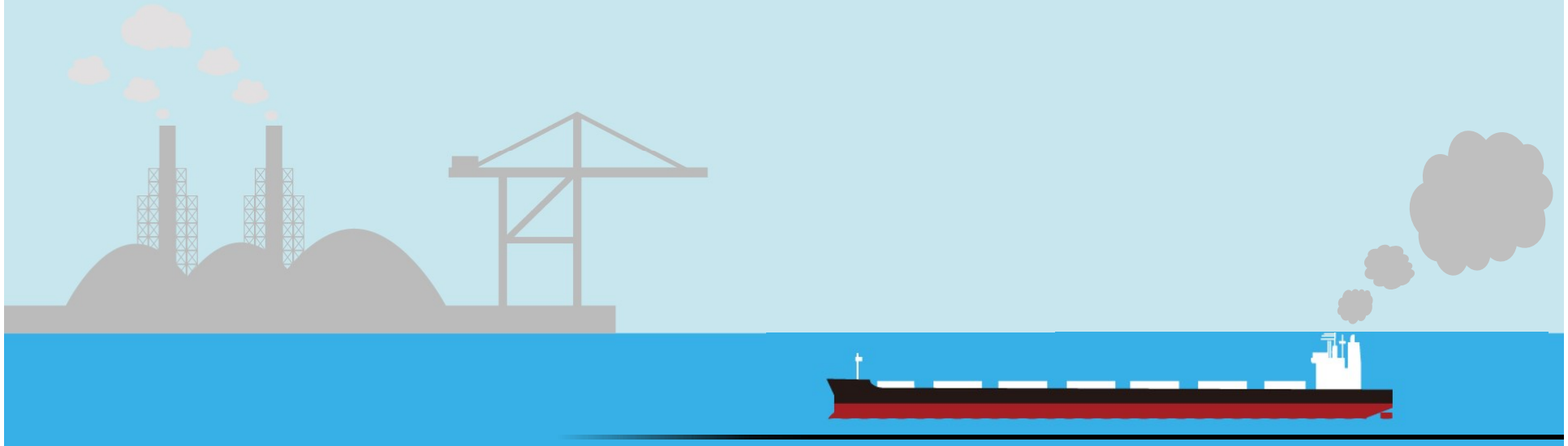
ClassNK

Outlines of EEXI regulation



EEDI Section of Marine GHG Certification Department

December 2021

Contents

1. Initial IMO Strategy on Reduction of GHG emissions from ships

2. Outlines of the EEXI regulation

3. Preparation for the EEXI regulation

The Initial IMO GHG Strategy

ClassNK

Initial IMO Strategy on Reduction of GHG emissions from ships (adopted on April 2018)

- ✓ The Initial IMO GHG Strategy including goals of reduction of GHG emissions from ships was adopted. It shall be reviewed every 5 years.
- ✓ First effort aimed at the GHG zero emissions from global sector without distinction between developed countries and developing countries.

Levels of ambition of the Initial Strategy

1. Vision (Final target)

■ Final target : GHG zero emissions at earliest in this century

2. Levels of ambition

■ Target of transportation efficiency (CO_2 emissions per transport work) compared to 2008;
At least 40% improvement by 2030, 70% improvement by 2050

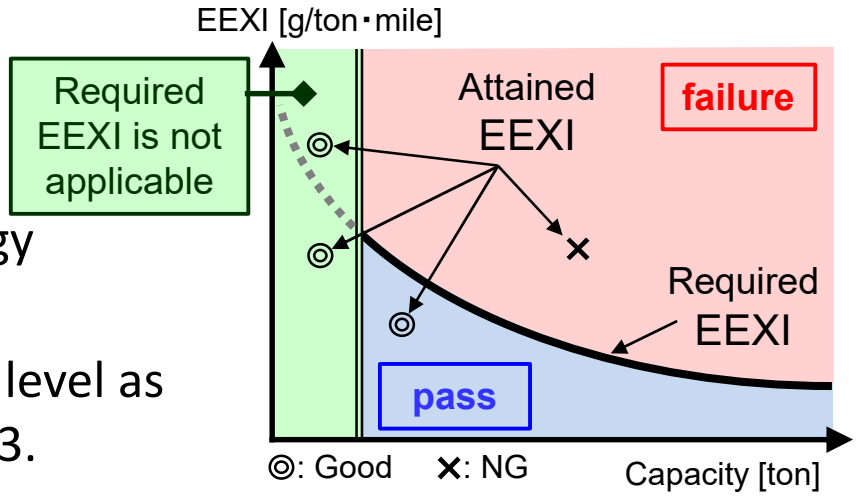
■ Target of total annual GHG emissions compared to 2008;
At least 50% reduction by 2050, effort for zero emissions at earliest in this century

MEPC 76 (June 2021)

The amendments to MARPOL Annex VI (MEPC.328(76)) were adopted at MEPC 76.

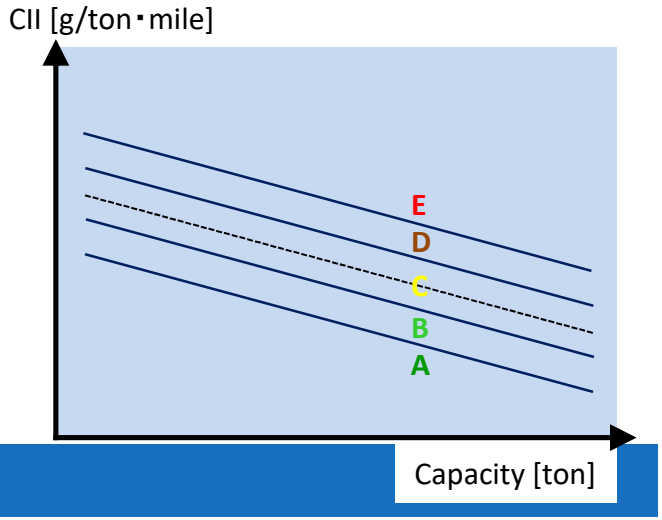
Technical approach (EEXI)

- Introduce the Energy Efficiency Existing Ship Index (EEXI) as the energy efficiency index for existing ship.
- The required EEXI is almost the same level as required EEDI for new ships as of 2023.



Operational approach (CII rating)

- Ship is rated on a scale of A to E based on the annual operational carbon intensity indicator (CII).
- A ship rated D for three consecutive years, or E, would have to submit a corrective action plan.



Contents

1. Initial IMO Strategy on Reduction of GHG emissions from ships

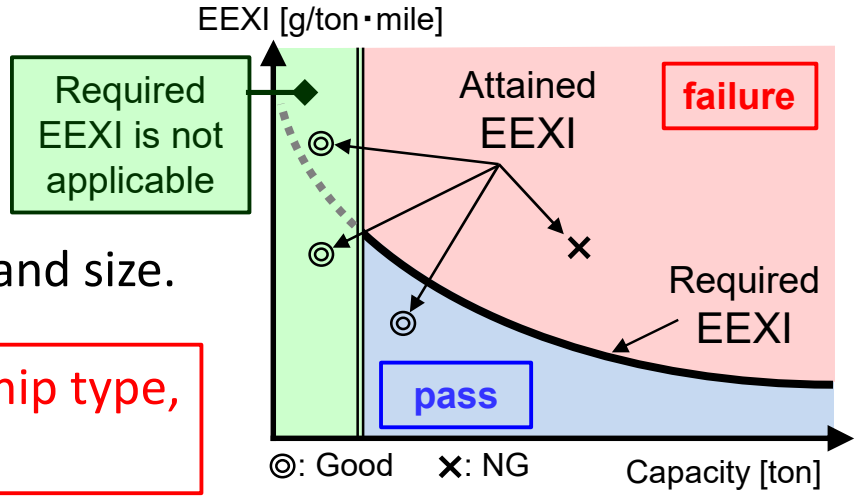
2. Outlines of the EEXI regulation

3. Preparation for the EEXI regulation

Outlines of the EEXI regulation

ClassNK

- **Attained EEXI**
  EEXI value is calculated by an individual ship.
- **Required EEXI**
  Required EEXI is specified for each ship type and size.



For ships with a certain size of specified ship type,
Attained EEXI ≦ Required EEXI

EEXI requirements shall apply to all ships of 400 GT and above which are engaged in the international voyages regardless of ship's delivery date, except the following ships as with the case of EEDI.

- Ships not propelled by mechanical means
- Platforms including FPSOs and FSUs and Drilling rigs, regardless of their propulsion
- Category A ships as defined in the Polar code
- Ships which have non-conventional propulsion such as diesel electric, turbine or hybrid propulsion system (except LNG carrier and cruise passenger ship)

Calculation formula of EEXI

ClassNK

■ EEXI is calculated by the same formula as EEDI.

EEXI [g/ton・mile]=

$$\frac{\left(\prod_{j=1}^{M} f_j\right)\left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}\right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE}\right) + \left\{\left(\prod_{j=1}^{M} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}\right) \cdot C_{FAE} \cdot SFC_{AE}\right\} - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}\right)}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot V_{ref}}$$

Concept formula

$$\text{EEXI [g/ton・mile]} = \frac{CO_2 \text{ Conversion factor} \times \text{SFC [g/kW・h]} \times \text{Engine Power [kW]}}{\text{Capacity [ton]} \times \text{EEXI Speed [knots]}}$$

CO_2 emissions (gram) from a ship when ship sail transport 1 (ton) cargo for 1 (nautical mile)

CO_2 Conversion factor（C_F）	C_F corresponds to the fuel used when determining SFC (DM grade: 3.206)
SFC	Fuel consumption at 75%MCR (M/E), at 50%MCR (A/E)
Engine Power	75% of the rated installed power (MCR) (In case of EPL, 83%MCR_{lim})
Capacity	Deadweight (For containerships, 70% of the deadweight)
EEXI Speed（V_{ref}）	Ship speed at 75%MCR under the draught condition corresponding to the capacity

Calculation formula of EEXI (Differences from EEDI)

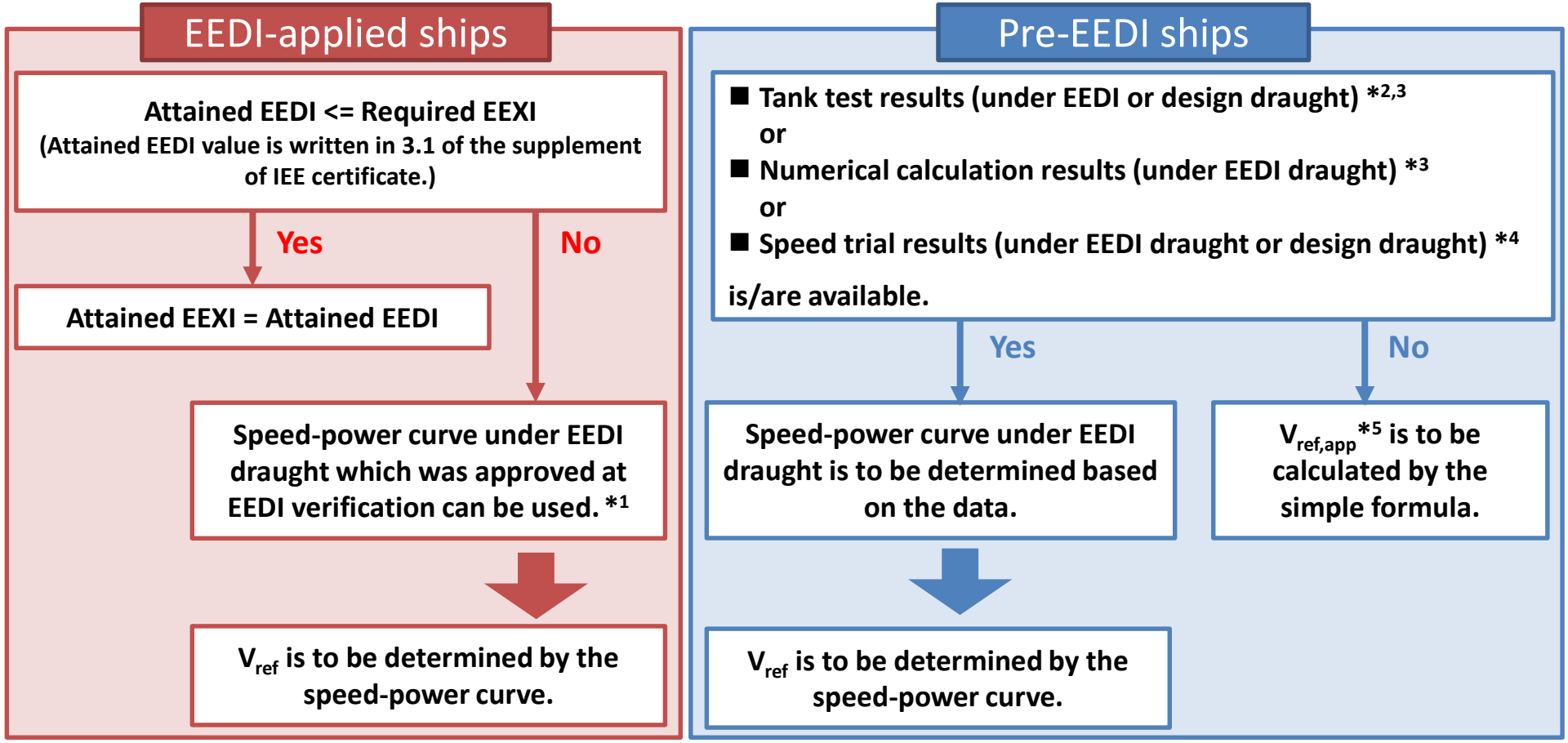
■ **The formula of EEXI is the same as EEDI, but some parameters' definitions are different.**

Concept formula

$$\text{EEXI [g/ton·mile]} = \frac{\text{CO2 Conversion factor x SFC [g/kW·h] x Engine Power [kW]}}{\text{Capacity [ton] x EEXI Speed (Vref) [knot]}}$$

SFC	Fuel consumption at 75%MCR (M/E), at 50%MCR (A/E) specified in NOx technical file • **In cases where the installed engines don't have NOx technical file, approximated default values including margin, SFC_{app} (i.e. M/E: 190 g/kW·h, A/E: 215 g/kW·h), are available.** • **In cases where the NOx regulation doesn't apply to the propulsion system (e.g. steam turbine, etc.), SFC specified by the manufacturer or confirmed by the verifier is available.**
Engine Power (P_{ME})	75% of the rated installed power (MCR) (In cases where the propulsion system is diesel electric or steam turbine, P_{ME} is 83% of MPP or MCR.) • **In cases where EPL is installed, P_{ME} is 83% of the limited installed power (MCR_{lim}).**
V_{ref}	Ship speed at P_{ME} and under the maximum summer load draught (for container ships, under 70%DWT draught.) • **In cases where both of tank test results and speed trial results are not available, an approximated ship speed including margin, $V_{ref,app}$ is to be calculated by the simple formula. The parameters of this formula are ship type, DWT, and MCR.**

Methods for obtaining V_{ref}



*1 The approved speed-power curve is available without any corrections.

*2 The tank test results can be corrected/calibrated by numerical calculation such as CFD, etc.

*3 In case of using numerical calculations, estimation process and methodology of the power curves are to be submitted. (It should include documentation on consistency with the defined quality standards and the verification of the numerical setup with parent hull or the reference set of comparable ships.)

*4 The sea conditions and ship speed should have been measured in accordance with ISO 15016:2002 or the equivalent and the measured ship speed was calibrated, if necessary, by taking into account the effects of wind, tide, waves, etc. If the speed trial was carried out under design draught, the ship speed shall be calibrated under EEDI draught by using Admiralty Coefficient, etc.

*5 $V_{ref,app}$ is an approximated ship speed obtained by a certain correction applies to the average ship speed of each ship type and size (including margin).

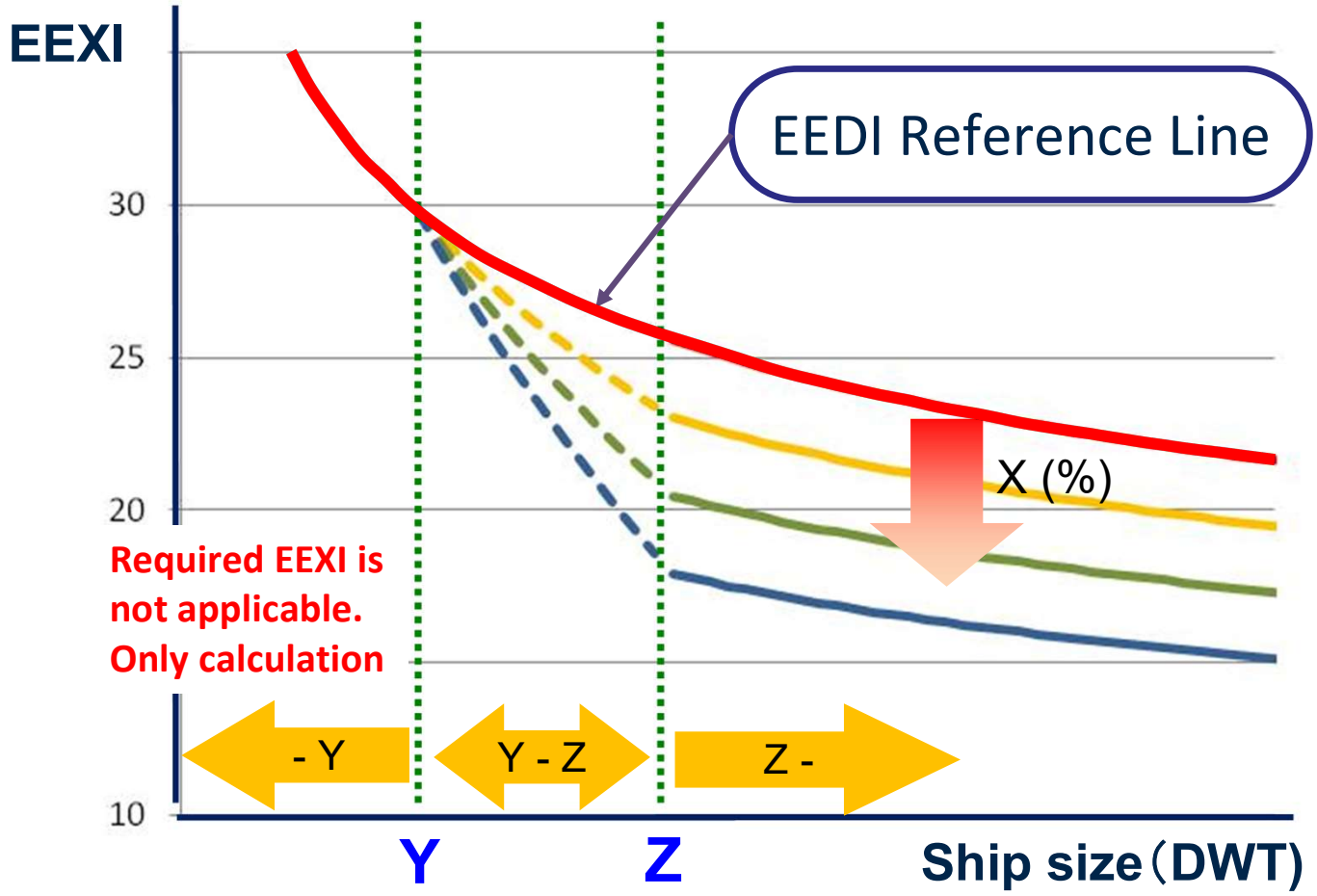
Application of EEXI

The "calculation of EEXI (Attained EEXI)" and "conformity to required value (Required EEXI)" shall apply to the following ship type and size as with the case of EEDI.

Type of ship	Calculation of Attained EEXI	Conformity to Required EEXI
Bulk carrier	400 GT and above	10,000 DWT and above
Gas carrier	400 GT and above	2,000 DWT and above
Tanker	400 GT and above	4,000 DWT and above
Containership	400 GT and above	10,000 DWT and above
General cargo ship	400 GT and above	3,000 DWT and above
Refrigerated cargo carrier	400 GT and above	3,000 DWT and above
Combination carrier	400 GT and above	4,000 DWT and above
Ro-ro cargo ship (Vehicle carrier)	400 GT and above	10,000 DWT and above
Ro-ro cargo ship	400 GT and above	1,000 DWT and above
Ro-ro passenger ship	400 GT and above	250 DWT and above
LNG carrier	400 GT and above	10,000 DWT and above
Cruise passenger ship (non-conventional)	400 GT and above	25,000 GT and above

Required EEXI (1/5)

$$\text{Required EEXI} = \left(1 - \frac{X}{100}\right) \times \text{EEDI Reference Line}$$

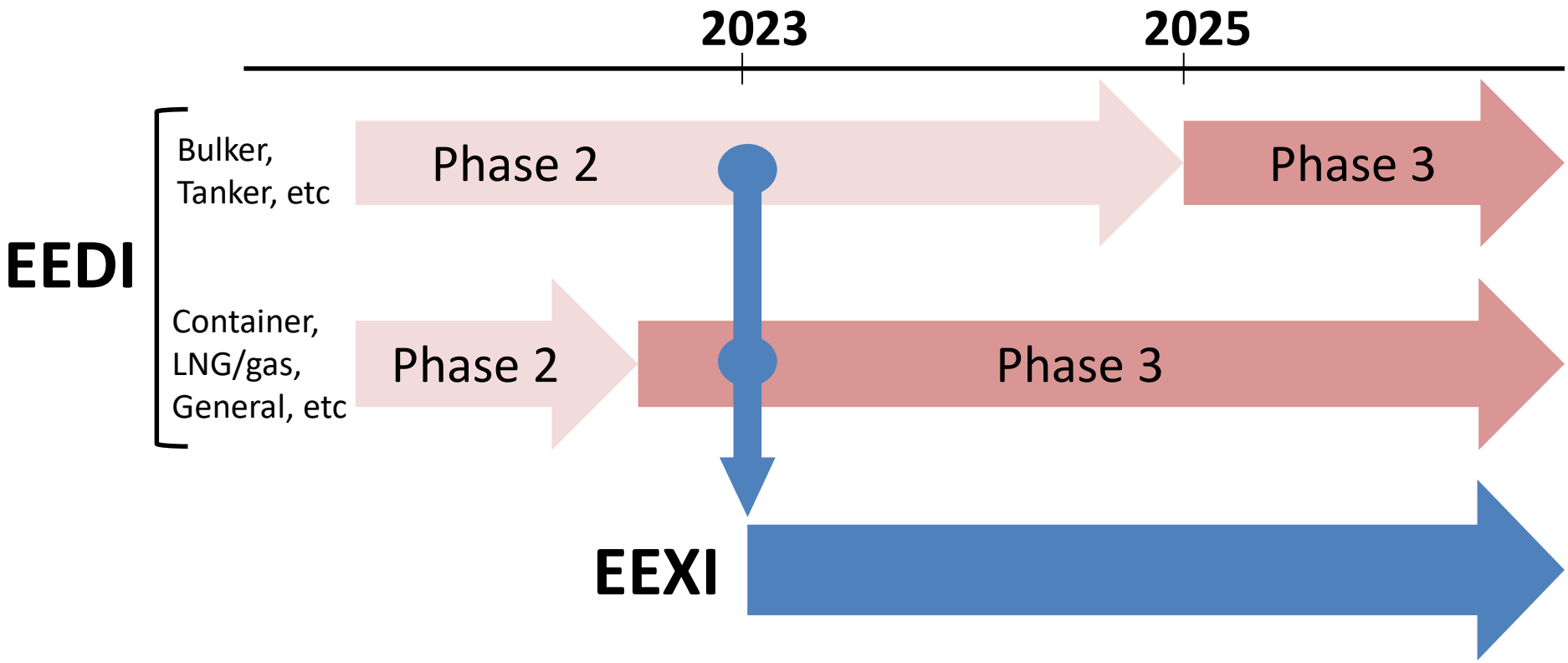


Reduction factor (X) depends on ship type and size

Y, Z value depends on ship type

Required EEXI (2/5)

Almost the same level as required EEDI for new ships as of 2023*



*However, very large tanker and bulk carrier, small and middle containership, Ro-ro cargo ship and Ro-ro passenger ship are relaxed for technical difficulty to improve the efficiency.

Required EEXI (3/5)

EEDI Reference Line

✓ Required EEXI is set based on the EEDI reference line

Type of ship		Reference Line
Bulk carrier	DWT ≤ 279,000	$961.79 \times DWT^{-0.477}$
	DWT > 279,000	$961.79 \times 279{,}000^{-0.477}$
Gas carrier		$1120.00 \times DWT^{-0.456}$
Tanker		$1218.80 \times DWT^{-0.488}$
Containership		$174.22 \times DWT^{-0.201}$
General cargo ship		$107.48 \times DWT^{-0.216}$
Refrigerated cargo carrier		$227.01 \times DWT^{-0.244}$
Combination carrier		$1219.00 \times DWT^{-0.488}$
Ro-ro cargo ship (vehicle carrier)	DWT/GT < 0.3	$(DWT/GT)^{-0.7} \times 780.36 \times DWT^{-0.471}$
	DWT/GT ≥ 0.3	$1812.63 \times DWT^{-0.471}$
Ro-ro cargo ship	DWT ≤ 17,000	$1686.17 \times DWT^{-0.498}$
	DWT > 17,000	$1686.17 \times 17{,}000^{-0.498}$
Ro-ro passenger ship	DWT ≤ 10,000	$902.59 \times DWT^{-0.381}$
	DWT > 10,000	$902.59 \times 10{,}000^{-0.381}$
LNG carrier		$2253.7 \times DWT^{-0.474}$
Cruise passenger ship having non-conventional propulsion		$170.84 \times GT^{-0.214}$

Required EEXI (4/5)

ClassNK

Type of ship	Size	Reduction factor（X）%
Bulk carrier	200,000 DWT and above	15
	20,000 - 200,000 DWT	20
	10,000 - 20,000 DWT	0 - 20 *
Gas carrier	15,000 DWT and above	30
	10,000 - 15,000 DWT	20
	2,000 - 10,000 DWT	0 - 20 *
Tanker	200,000 DWT and above	15
	20,000 - 200,000 DWT	20
	4,000 - 20,000 DWT	0 - 20 *
Containership	200,000 DWT and above	50
	120,000 - 200,000 DWT	45
	80,000 - 120,000 DWT	35
	40,000 - 80,000 DWT	30
	15,000 - 40,000 DWT	20
	10,000 - 15,000 DWT	0 - 20 *

* Reduction factor to be linearly interpolated between the two values dependent upon ship size.

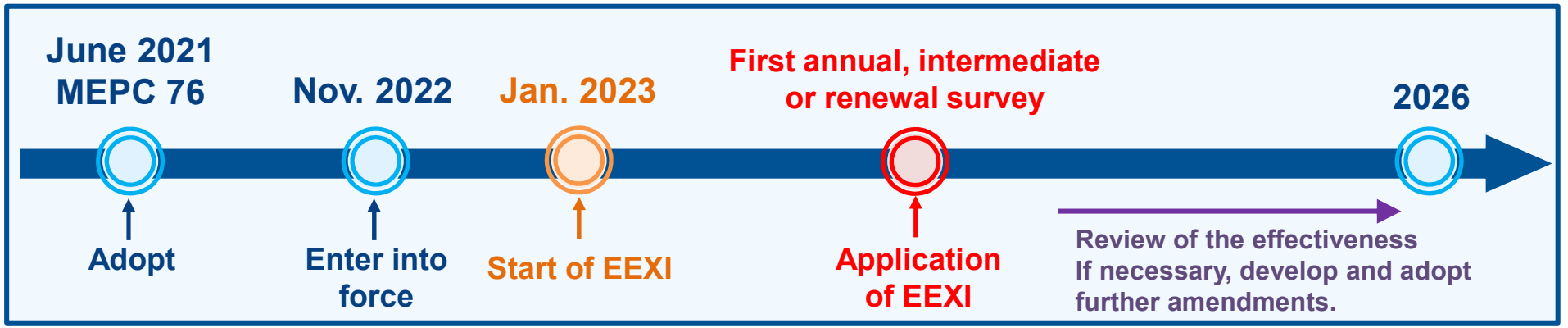
Required EEXI (5/5)

ClassNK

Type of ship	Size	Reduction factor（X）%
General cargo ship	15,000 DWT and above	30
	3,000 - 15,000 DWT	0 - 30 *
Refrigerated cargo carrier	5,000 DWT and above	15
	3,000 - 5,000 DWT	0 - 15 *
Combination carrier	20,000 DWT and above	20
	4,000 - 20,000 DWT	0 - 20 *
Ro-ro cargo ship (vehicle carrier)	10,000 DWT and above	15
Ro-ro cargo ship	2,000 DWT and above	5
	1,000 - 2,000 DWT	0 - 5 *
Ro-ro passenger ship	1,000 DWT and above	5
	250 - 1,000 DWT	0 - 5 *
LNG carrier	10,000 DWT and above	30
Cruise passenger ship having non-conventional propulsion	85,000 GT and above	30
	25,000 - 85,000 GT	0 - 30 *

* Reduction factor to be linearly interpolated between the two values dependent upon ship size.

Timeline of EEXI regulation



■ Timing of EEXI application

- ✓ The amendments to MARPOL ANNEX VI will enter into force on 1 November 2022.
- ✓ EEXI requirements will start from **1st January 2023**.
- ✓ The EEXI verification shall take place at the following timing.

Ships delivered before 1 January 2023	First annual, intermediate or renewal survey of the International Air Pollution Certificate (IAPP Certificate), whichever is the first, on or after 1 January 2023
Ships delivered on or after 1 January 2023	Initial survey of the International Energy Efficiency Certificate (IEE Certificate)

Relevant guidelines of EEXI

ClassNK

■ The relevant guidelines of EEXI were adopted at MEPC 76 (June 2021)

GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED EEXI (MEPC.333(76))	• The detailed calculation method of the attained EEXI is provided. • Only parameters different from the EEDI Calculation Guidelines are prescribed.
GUIDELINES ON SURVEY AND CERTIFICATION OF THE ATTAINED EEXI (MEPC.334(76))	• The details of survey and certification of the attained EEXI is provided. • The content of EEXI Technical File and additional information for EEXI verification are prescribed.
GUIDELINES ON THE SHAFT / ENGINE POWER LIMITATION SYSTEM AND USE OF A POWER RESERVE (MEPC.335(76))	• Technical and operational conditions that the SHaPoLi / EPL system should satisfy in complying with the EEXI requirements and in using a power reserve are provided. • The contents to be included in the Onboard Management Manual（OMM）are prescribed.

EEXI Technical File

1.1 General information

Shipowner	XXX Shipping Line
Shipbuilder	XXX Shipbuilding Company
Hull no.	12345
IMO no.	94112XX
Ship type	Bulk carrier

1.2 Principal particulars

Length overall	250.0 m
Length between perpendiculars	240.0 m
Breadth, moulded	40.0 m
Depth, moulded	20.0 m
Summer load line draught, moulded	14.0 m
Deadweight at summer load line draught	150,000 tons

1.3 Main engine

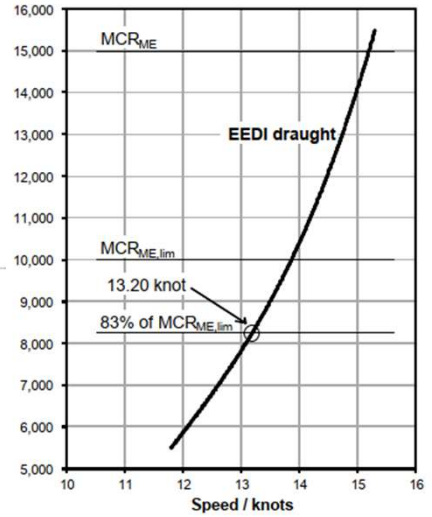
Manufacturer	XXX Industries
Type	6J70A
Maximum continuous rating (MCR_{ME})	15,000 kW x 80 rpm
Limited maximum continuous rating with the Engine Power Limitation installed ($MCR_{ME,lim}$)	9,940 kW x 72 rpm
SFC at 75% of MCR_{ME} or 83% of $MCR_{ME,lim}$	166.5 g/kWh
Number of sets	1
Fuel type	Diesel Oil

1.4 Auxiliary engine

Manufacturer	XXX Industries
Type	5J-200
Maximum continuous rating (MCR_{AE})	600 kW x 900 rpm
SFC at 50% MCR_{AE}	220.0 g/kWh
Number of sets	3
Fuel type	Diesel Oil

1.5 Ship speed

Ship speed (V_{ref}) (with the Engine Power Limitation installed)	13.20 knots



6.8 Calculated value of attained EEXI

$$EEXI = \frac{(\prod_{j=1}^{M} f_j)(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}) + (P_{AE} \cdot C_{FAE} \cdot SFC_{AE})}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

$$+ \frac{\{(\prod_{j=1}^{M} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}) \cdot C_{FAE} \cdot SFC_{AE}\}}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

$$- \frac{(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME})}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

$$= \frac{1 \times (8250 \times 3.206 \times 166.5) + (625 \times 3.206 \times 220.0) + 0 - 0}{1 \times 1 \times 1 \times 150000 \times 1 \times 13.20 \times 1}$$

$$= 2.41\ (g - CO_2/ton \cdot mile)$$

attained EEXI: 2.41 g-CO_2/ton mile

Contents of EEXI Technical File

DWT/GT, Principal particulars of M/E and A/E (e.g. type, MCR, SFC, etc.), MCR_{lim} in case of installing EPL, Ship Speed (i.e. V_{ref}), Estimated speed-power curve(s), Principal particulars and schematic figure of propulsion system and electric power supply system, Estimation process of speed-power curve(s), Description of energy saving equipment(s), Calculation of attained EEXI, (For LNG carrier, relevant information of propulsion system, LNG cargo tank, etc.)

Contents

1. Initial IMO Strategy on Reduction of GHG emissions from ships

2. Outlines of the EEXI regulation

3. Preparation for the EEXI regulation

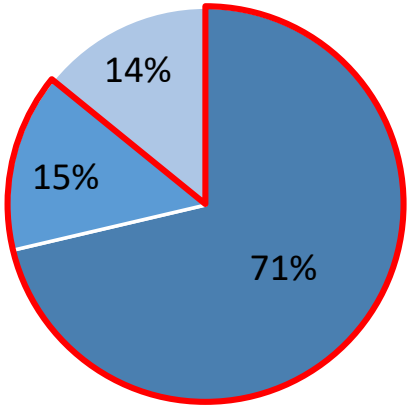
Status of compliance with EEXI on NK classed ship

Number of ships subjected to EEXI	7,200 ships
✓ Non EEDI ship	5,300 ships
✓ EEDI ship (not comply with EEXI)	750 ships
✓ EEDI ship (comply with EEXI)	1,150 ships

Action needed:
6,050 ships (84%)

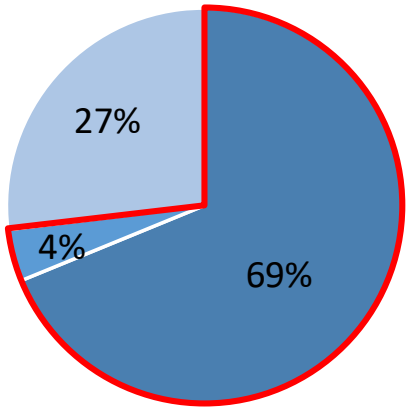
No action needed:
1,150 ships (16%)

Bulk carrier



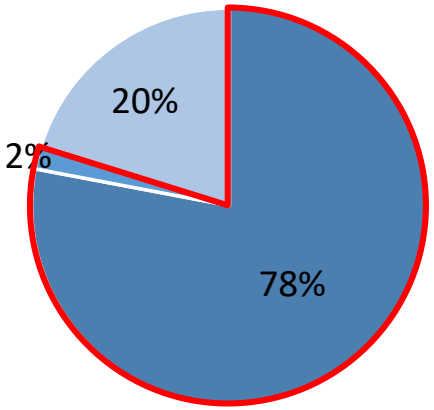
Action needed: 86%

Tanker



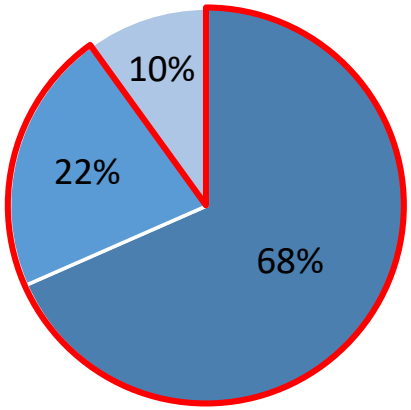
Action needed: 73%

Containership

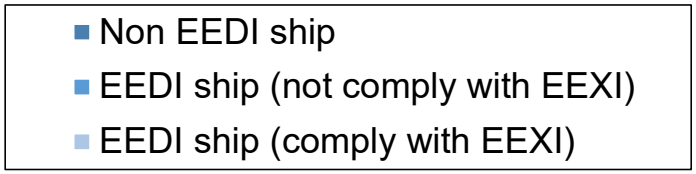


Action needed: 80%

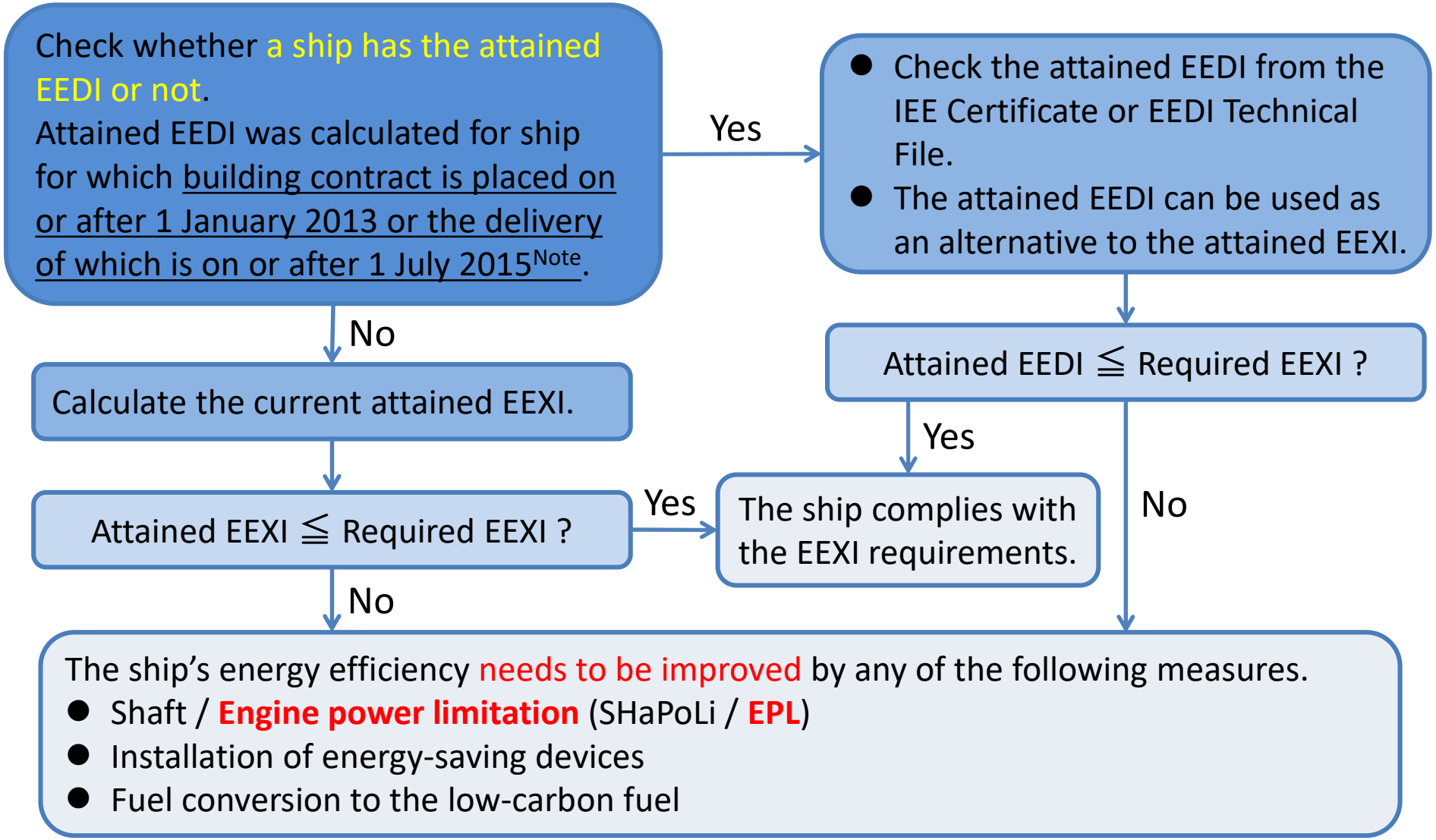
Gas carrier



Action needed: 90%

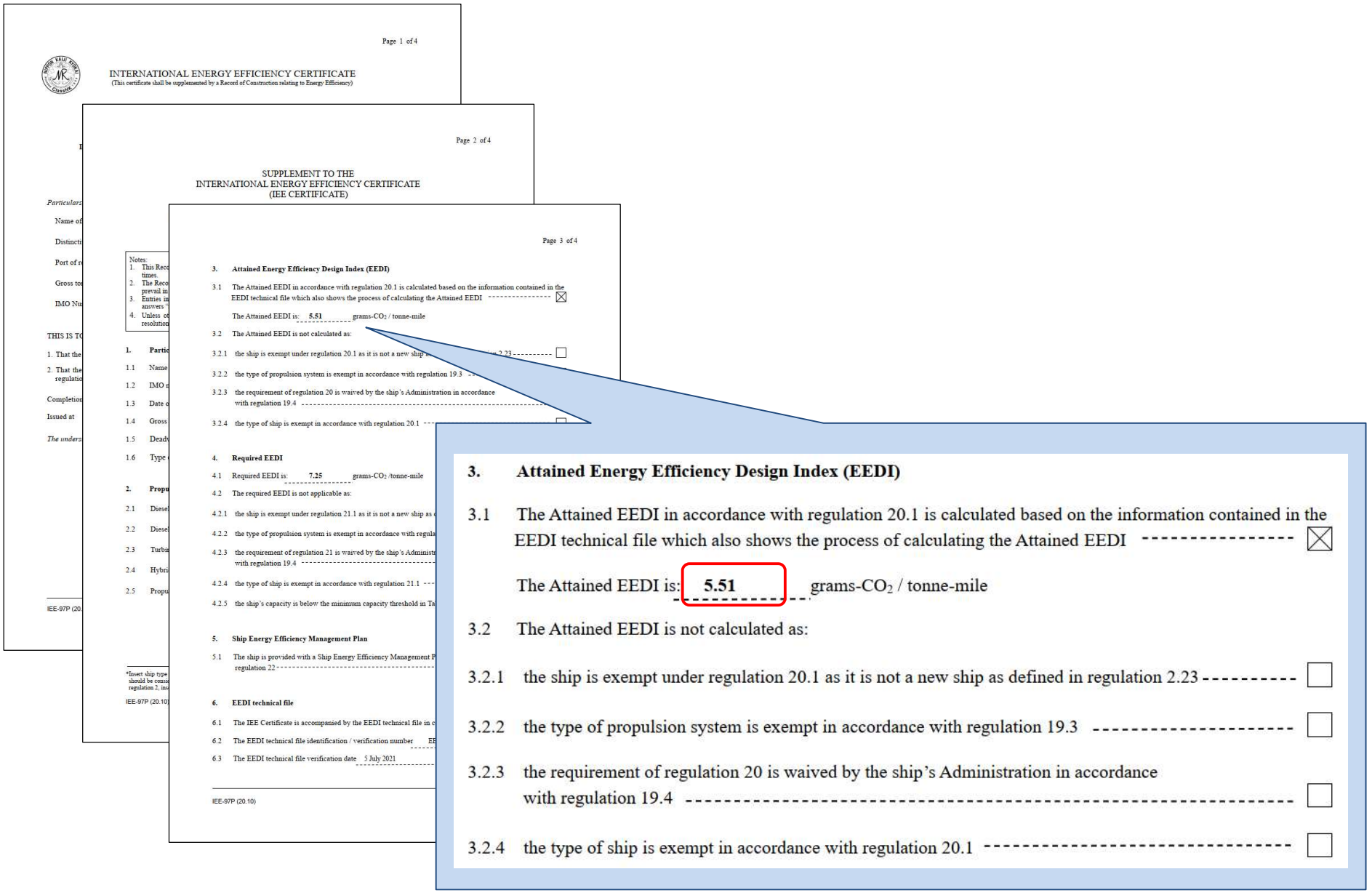


Flow chart of EEXI application



Note : In case of LNG carrier and Cruise passenger ship, building contract is placed on or after 1 September 2015 or the delivery of which is on or after 1 September 2019.

Example of an IEE Certificate



3. Attained Energy Efficiency Design Index (EEDI)

3.1 The Attained EEDI in accordance with regulation 20.1 is calculated based on the information contained in the EEDI technical file which also shows the process of calculating the Attained EEDI ☒

The Attained EEDI is: **5.51** grams-CO_2 / tonne-mile

3.2 The Attained EEDI is not calculated as:

3.2.1 the ship is exempt under regulation 20.1 as it is not a new ship as defined in regulation 2.23 ☐

3.2.2 the type of propulsion system is exempt in accordance with regulation 19.3 ☐

3.2.3 the requirement of regulation 20 is waived by the ship's Administration in accordance with regulation 19.4 ☐

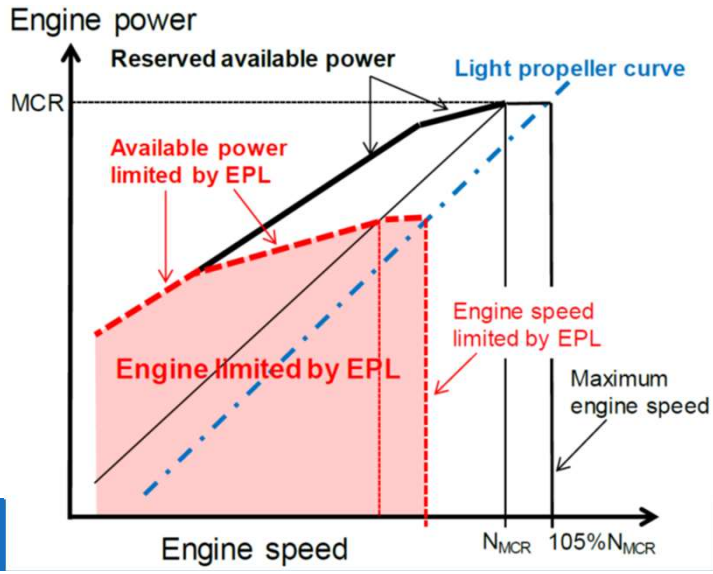
3.2.4 the type of ship is exempt in accordance with regulation 20.1 ☐

Engine Power Limitation (EPL)

■ What is Engine Power Limitation (EPL) ?

- ✓ Engine Power Limitation (EPL) is a system to improve a ship's energy efficiency by limiting the ship's engine power within the optimum engine setting. As a result, the ship speed will be limited.
- ✓ EPL consists of a simple device which can easily limit the maximum engine power by adjusting a fuel index limiter on the engine control system without retrofitting a complicated system within the current regulatory framework.
- ✓ EPL can be easily installed in a short time during a port without updating EIAPP certificate and the NOx technical file.
- ✓ EPL can be released in the adverse weather conditions. Therefore, the limited engine power does not have to meet the minimum power requirement.

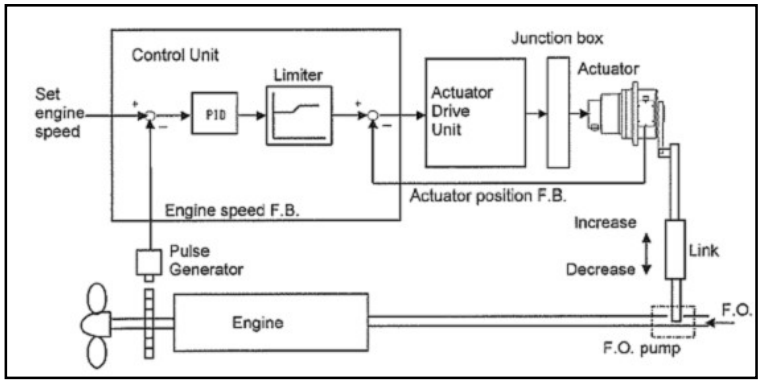
EPL can be utilized as one of the effective measures to improve energy efficiency of existing ships in terms of EEXI.

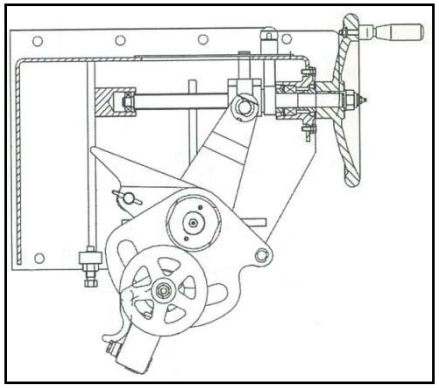


Installation procedure of EPL (1/2)

Mechanically driven type engine such as old engine type

1. Changing a set of governor's fuel index limiter
2. Adjusting the Mechanical Stop Screw
3. Sealing the Mechanical Stop Screw by wire and so on (confirmed at class survey and PSC)



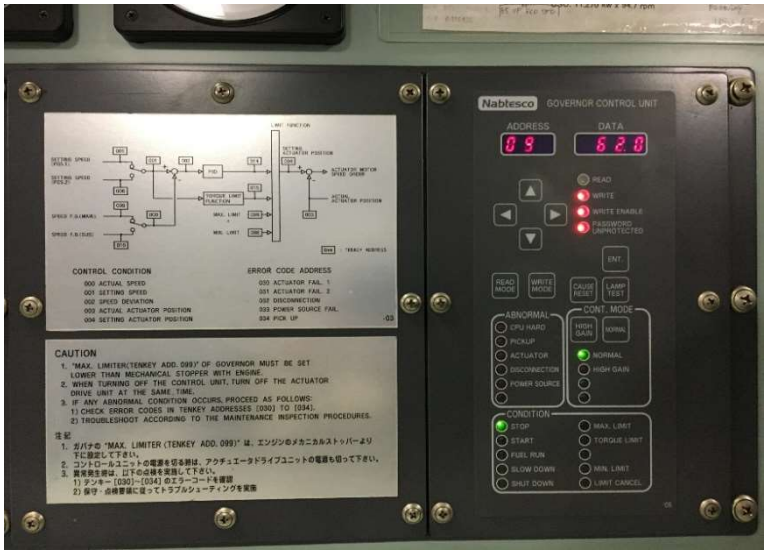


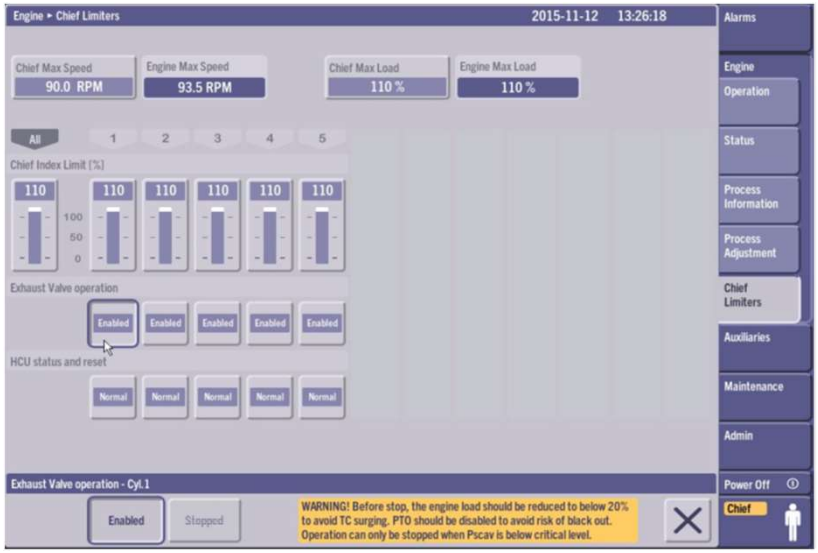
Installation procedure of EPL (2/2)

Electronically controlled type engine such as new engine type

1. Changing a set of governor's fuel index limiter

   (In case of MAN B&W engines, setting the fuel index limit in Chief Limiters)

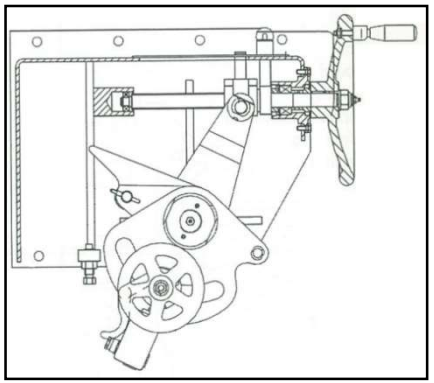


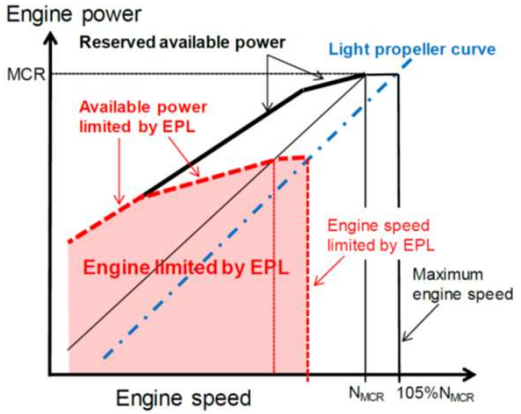


Source: MAN Energy Solutions

Since the electronically controlled type engine is not physically sealed unlike the mechanical driven type engine, it is confirmed that the EPL had not been released without permission since the last confirmation by checking the data recorded in the data logging program.

Principal requirements of EPL





Principal requirements

- The available power is to be limited by locking fuel index.
- EPL cannot be released without permission from the ship master or the officer in charge of navigational watch (OICNW).
- If EPL is un-limited due to the purpose of securing the safety of a ship or saving life at sea, the reason and relevant information are to be recorded in Onboard Management Manual (OMM).
- EPL system (or each sub system) should be tamper-proof.
- EPL system should be accompanied by OMM for EPL that should be on board the ship for inspection.

Contents of OMM

Original MCR (kW x rpm), MCR after installing EPL: MCR_{lim} (kW x rpm), Technical description of EPL system, Sealing method (mechanically controlled engine), Locking and monitoring method (electronically controlled engine), Procedures and methods for releasing EPL, Time required for un-limiting EPL, Procedures for survey by the Administration/RO, Procedure for the report on release of EPL, Administrator of the EPL system, etc.

Acceptable conditions of un-limiting EPL

The un-limiting EPL is only allowed for the purpose of securing the safety of a ship or saving life at sea, consistent with regulation 3.1 of MARPOL Annex VI.

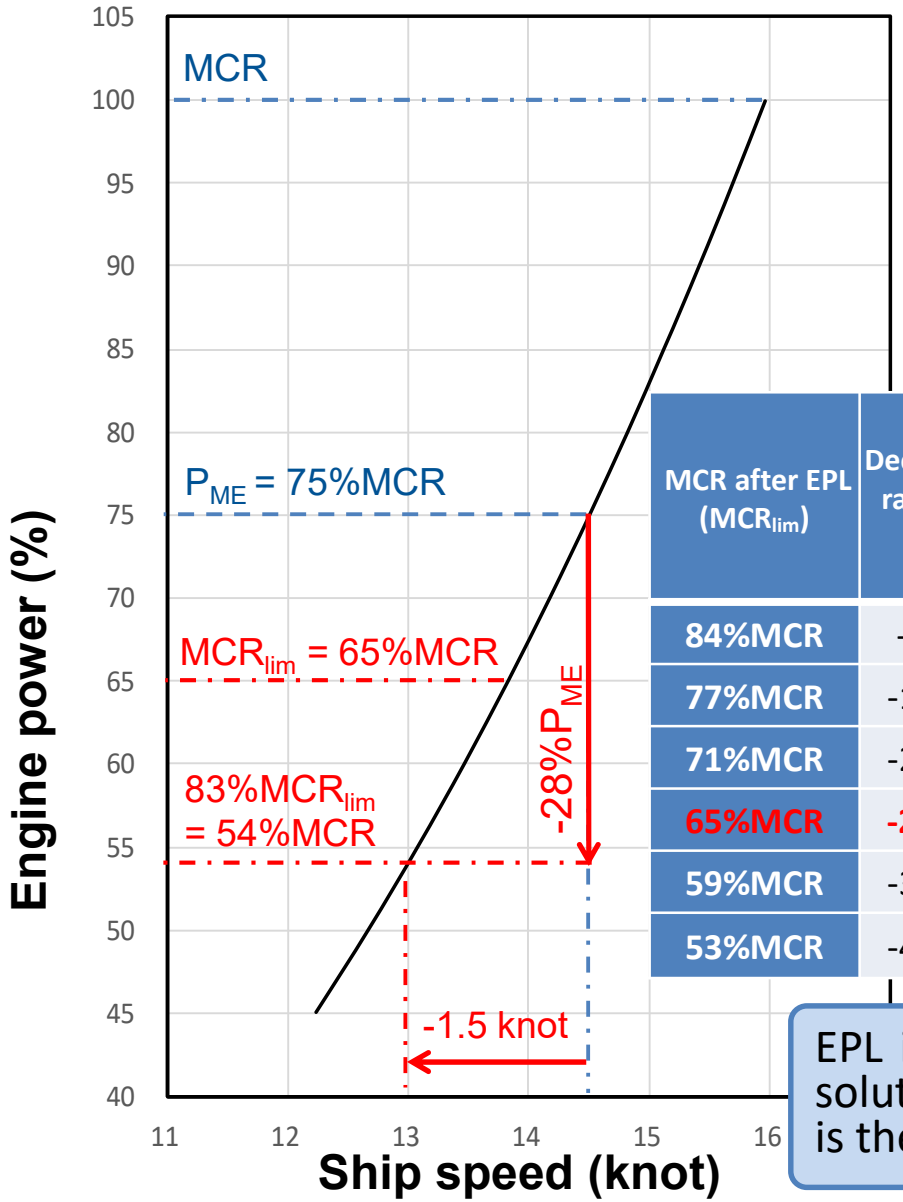
Examples)

- Operating in adverse weather and ice-infested waters, or avoidance voyaging in such areas
- Participation in search and rescue operations
- Avoidance of pirates
- Engine maintenance (e.g. removing soot, etc.)

Necessary procedures in cases where EPL is un-limited

- Recording the status in OMM (e.g. reason of the un-limiting, ship speed, maximum un-limited power, beaufort number and wave height, position and timestamp, etc.)
- Notifying Administration or RO
- Reactivating/Replacing EPL system immediately after the risks have been prevented
- Confirmation of the reactivated/replaced EPL system by Administration or RO（Remote confirmation may be acceptable.）

Example of improvement of EEXI by EPL



EEXI after EPL [g/ton·mile] =

$$\frac{\text{Conversion Factor} \times \text{SFC} \times \textbf{Engine Power (83\% MCR}_{lim}\textbf{)}}{\text{Capacity} \times \textbf{Ship Speed at 83\%MCR}_{lim}}$$

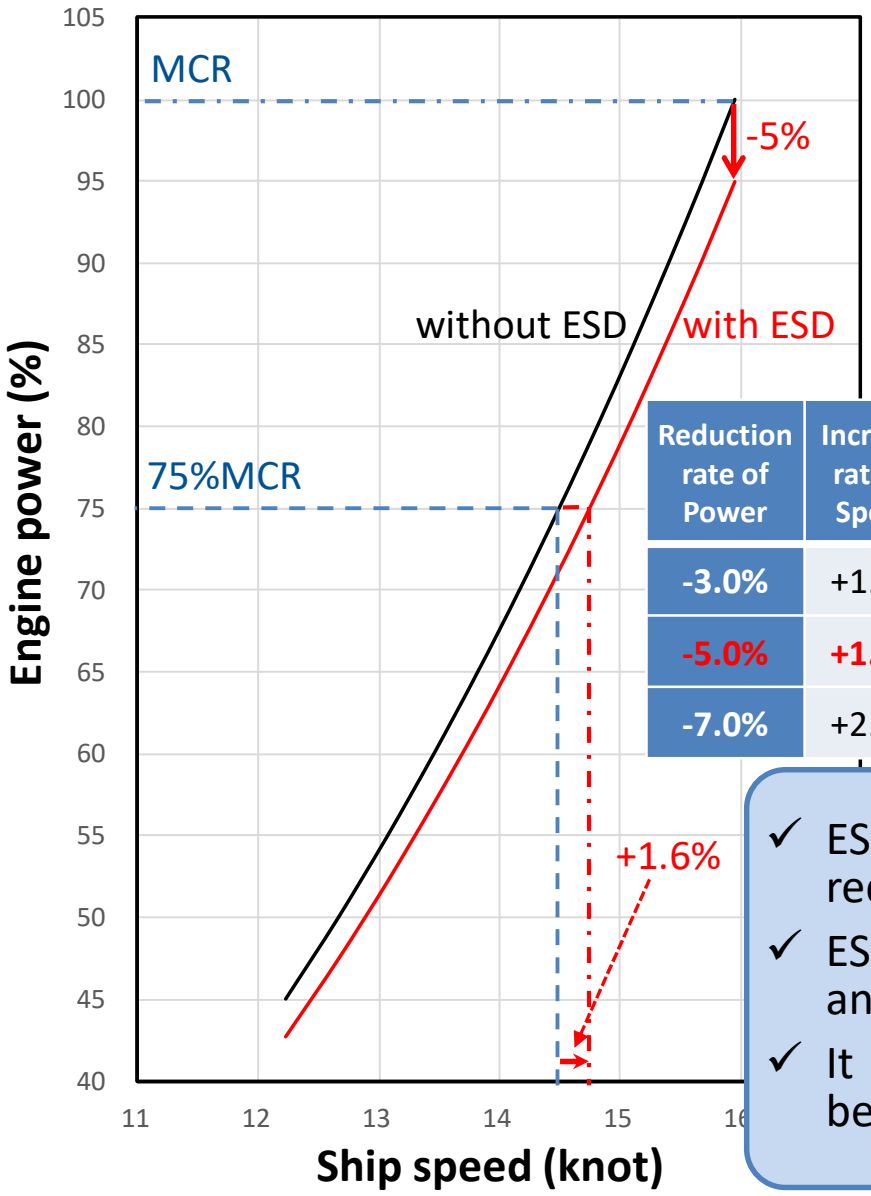
Power $\propto$ Speed^3 ➡ **EEXI $\propto$ Speed^2**

Speed $\propto$ Power$^{1/3}$ ➡ **EEXI $\propto$ Power$^{2/3}$**

MCR after EPL (MCR_{lim})	Decrease rate of P_{ME}	Decrease rate of Speed	Original Speed (V_{ref} at 75%MCR) [knot]	Speed after EPL (V_{ref} at 83%MCR_{lim}) [knot]	Decrease of Speed (ΔV) [knot]	Improvement rate of EEXI
84%MCR	-7%	-3%	14.5	14.1	-0.4	+5%
77%MCR	-15%	-5%	14.5	13.8	-0.7	+10%
71%MCR	-22%	-8%	14.5	13.4	-1.1	+15%
65%MCR	**-28%**	**-11%**	**14.5**	**13.0**	**-1.5**	**+20%**
59%MCR	-35%	-13%	14.5	12.6	-1.9	+25%
53%MCR	-41%	-16%	14.5	12.1	-2.4	+30%

EPL is a highly effective measure and a cost-effective solution to improve the ship's attained EEXI. Thus, EPL is the most effective measure for EEXI improvement.

Example of improvement of EEXI by Energy Saving Device (ESD)

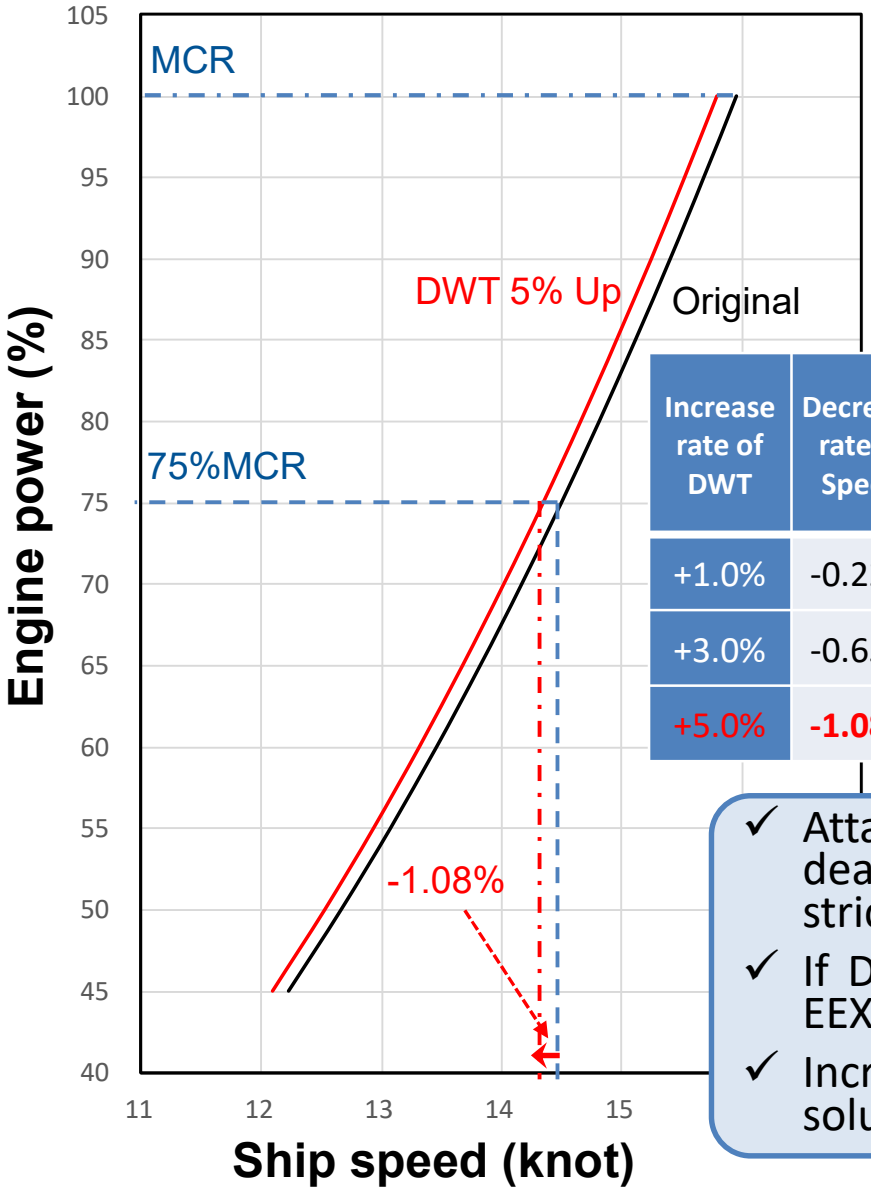


$$EEXI\ [g/ton \cdot mile] = \frac{\text{Conversion Factor} \times SFC \times \underset{\text{No change (Fixed)}}{\text{Engine Power (75\%MCR)}}}{\text{Capacity} \times \underset{\text{Reflect the effect of ESD}}{\text{Ship Speed at 75\%MCR}}}$$

Reduction rate of Power	Increase rate of Speed	Speed without ESD (V_{ref} at 75%MCR) [Knot]	Speed with ESD (V_{ref} at 75%MCR) [Knot]	Increase Speed [knot]	Improvement rate of EEXI
-3.0%	+1.0%	14.50	14.64	+0.14	+1.0%
-5.0%	**+1.6%**	**14.50**	**14.74**	**+0.24**	**+1.6%**
-7.0%	+2.3%	14.50	14.83	+0.33	+2.3%

- ✓ ESD affects ship's performance and generally reduces required engine power about 3-7% on seagoing.
- ✓ ESD reflects only ship speed on the EEXI calculation and the attained EEXI is improved by only 1-3%.
- ✓ It is more effective to install ESD along with EPL because ESD cannot improve the EEXI significantly.

Example of improvement of EEXI by increasing deadweight



$$\text{EEXI [g/ton·mile]} = \frac{\text{Conversion Factor} \times \text{SFC} \times \text{Engine Power (75\%MCR)}}{\text{Capacity (DWT)} \times \text{Ship Speed at 75\%MCR}}$$

No change (Fixed)

Speed $\propto$ DWT$^{-2/9}$

Increase rate of DWT	Decrease rate of Speed	Improvement rate of attained EEXI	Decrease rate of required EEXI (Bulk carrier)	Decrease rate of required EEXI (Tanker)	Actual improvement rate (Bulk carrier)	Actual improvement rate (Tanker)
+1.0%	-0.22%	+0.77%	-0.47%	-0.48%	+0.30%	+0.29%
+3.0%	-0.65%	+2.27%	-1.40%	-1.43%	+0.87%	+0.84%
+5.0%	**-1.08%**	**+3.72%**	**-2.30%**	**-2.35%**	**+1.42%**	**+1.37%**

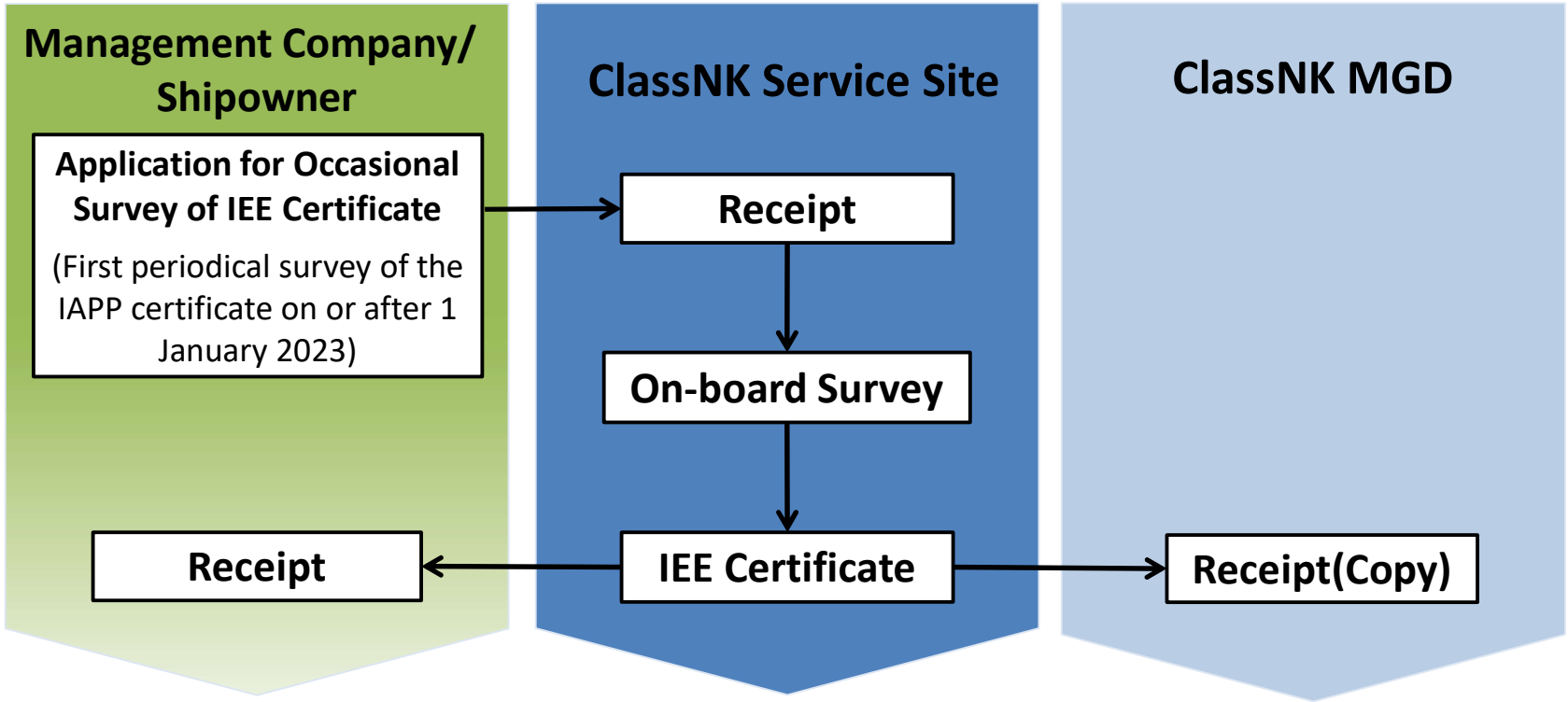
- ✓ Attained EEXI can be improved by increasing deadweight. However, Required EEXI becomes more stricter simultaneously.
- ✓ If Deadweight is increased by 5%, the actual gain of EEXI becomes about 1.4%.
- ✓ Increasing deadweight may not be a cost-effective solution to improve the ship's attained EEXI.

Flow of EEXI Verification Process (1/2)

Flow of EEXI Verification Process

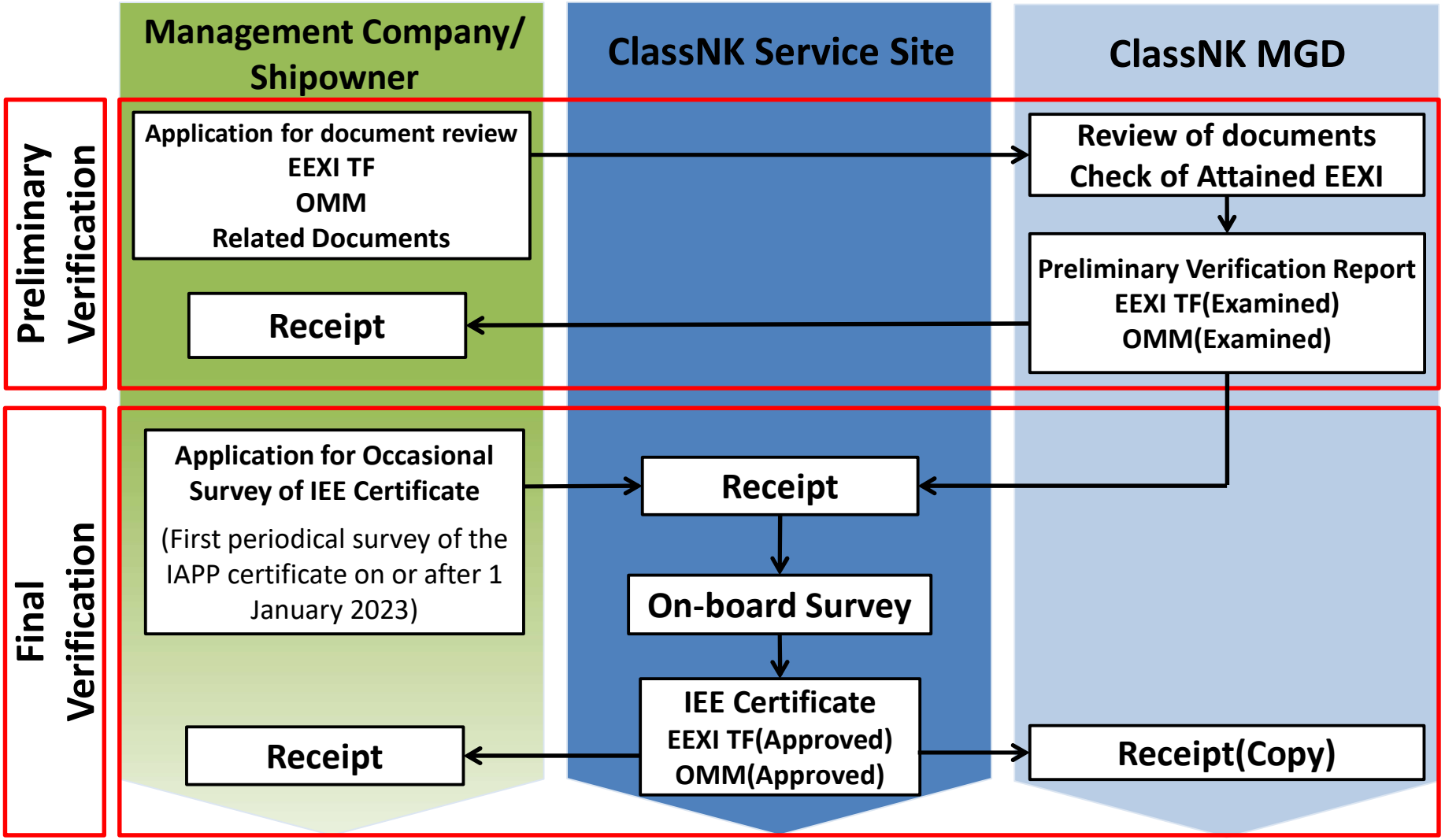
1. Achieve their Required EEXI by their Attained EEDI
2. Other cases

1. Achieve their Required EEXI by their Attained EEDI



Flow of EEXI Verification Process (2/2)

2. Other cases



Points of attention for EEXI (1/2)

EEXI Calculation

- Documents on **V_{ref}** and **SFC** are required for EEXI calculation.
- EEXI value can be conservatively calculated by using the ship speed given by simple formula and the default value of SFC. However, calculation of accurate EEXI counts to minimize the ship's operation.
- Calculation of accurate EEXI requires the documents on **speed-power curve and tank test result** provided by mother shipyard and **SFC (recorded at NOx measurement)** provided by engine manufacturer.

Engine Power Limitation (EPL)

- **EEXI assessment beforehand is important** to find the impact on ship's operation as **ship's maximum speed will be reduced** due to EPL.
- Installation of log recording device may be required due to EPL.
- **Preparing beforehand** is recommended to avoid **congestion of EPL works** as EEXI regulation applies to the existing ships all over the world.

Points of attention for EEXI (2/2)

EEXI verification by Class

- **Class approval** of EEXI technical file and EPL onboard management manual is required.
- **Some time is needed for review** to confirm the evidence of speed-power curve if ship's speed is calculated by speed-power curve.
- Drawing approval and onboard inspection by class **before 1st January 2023 is possible** although EEXI regulation will take place at the first annual, intermediate or renewal survey of IAPP Certificate on or after 1st January 2023.

Cost for conformation to EEXI regulation

- Fee for making EEXI technical file and EPL onboard management manual
- Fee for data of speed-power curve, tank test result, SFC
- Fee for EPL setting
- Fee for EEXI verification by class (drawing approval, onboard inspection, issuance of new IEE certificate)

Inquiry contact

EEDI Section, Marine GHG Certification Department

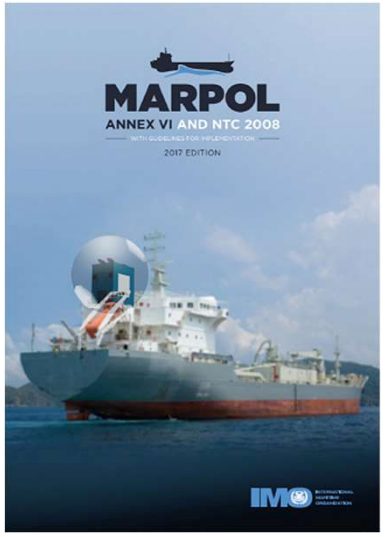
NIPPON KAIJI KYOKAI (ClassNK)

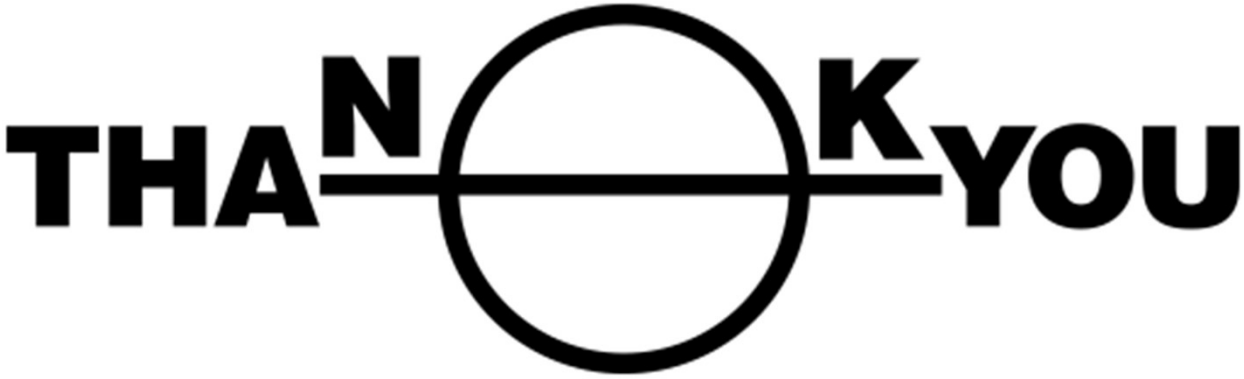
Administration Center

4-7, Kioi-Cho, Chiyoda-Ku, Tokyo 102-8567

Japan

E-mail : eedi@classnk.or.jp





for your kind attention

ClassNK

A World Leader in Ship Classification.