

EEDI Implementation

Paul McStay

Senior Environmental Specialist

Marine Product Development: Environment

5th December 2011

Regulatory text – Chapter 4 MARPOL Annex VI

- Regulation 19 – Application of EEDI
- Regulation 20 – Attained EEDI
- Regulation 21 – Required EEDI
- Regulation 22 – SEEMP
- Regulation 23 – Cooperation
- Appendix VIII – form of IEEC



EEDI Verification

Purpose of verification is to ensure that:



Two-stage verification process:

Pre-verification	Design stage (to demonstrate estimate of the design efficiency prior to construction)
Final Verification	At commissioning trial (to validate the EEDI and compliance before delivery)

- Details of calculation method is given in MEPC.1/Circ.681
- Details of verification method is given in MEPC.1/Circ.682.

Attained EEDI

- Use of de-rated engines
- More efficient engines
- Use of low-carbon fuels such as LNG and bio-diesel

- More efficient engines
- Optimised auxiliary machinery

- Waste heat recovery
- Shaft generators and other electrical energy efficient technologies
- Solar power

- Wind power
- Nuclear power

$$\begin{aligned}
 & \underbrace{\left(\prod_{j=1}^M f_j \right) \left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME} \cdot SFC_{ME} \right)}_{\text{Main engine(s)}} + \underbrace{\left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE} \right)}_{\text{Auxiliary engine(s)}} + \underbrace{\left(\left(\prod_{j=1}^M f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)} \right) C_{FAE} \cdot SFC_{AE} \right)}_{\text{Energy saving technologies (auxiliary power)}} - \underbrace{\left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME} \right)}_{\text{Energy saving technologies (main power)}} \\
 & \hline
 & \underbrace{f_i \cdot Capacity \cdot V_{ref} \cdot f_w}_{\text{Transport work}}
 \end{aligned}$$

- Increased capacity (DWT)
- Hydrodynamic/aerodynamic optimisation

Attained EEDI – main engine(s)

- Use of de-rated engines
- More efficient engines
- Use of low-carbon fuels such as LNG and bio-diesel

$$\left(\prod_{j=1}^M f_j \right) \left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME} \cdot SFC_{ME} \right)$$

$$0.75 \cdot MCR_{MEi} - P_{PTOi}$$

Shaft generator: will reduce CO2 but also reduce Vref

Advice clients to include SFC tolerance in pre-verification!

Attained EEDI– auxiliary engine(s)

- More efficient engines
- Optimised auxiliary machinery

$$(P_{AE} \cdot C_{FAE} \cdot SFC_{AE})$$


$$> 10000 \text{ kW}: \left(0.025 \cdot \sum_{i=1}^{nME} MCR_{ME(i)} \right) + 250 \quad < 10000 \text{ kW}: 0.05 \cdot \sum_{i=1}^{nME} MCR_{ME(i)}$$

P_{AE} “significantly different”: electric power tables excluding propulsion at V_{ref} conditions!

Attained EEDI – energy saving technologies (auxiliary power)

- Waste heat recovery
- Shaft generators and other electrical energy efficient technologies
- Solar power

$$\left(\left(\prod_{j=1}^M f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)} \right) C_{FAE} \cdot SFC_{AE} \right)$$

Shaft motor: will increase CO2 but also increase Vref

WHR or similar

Under discussion, for time being = 1 for WHR

Attained EEDI - energy saving technologies (main power)

- Wind power
- Nuclear power

$$\left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME} \right)$$

Attained EEDI – transport work

- Increased capacity (DWT)
- Hydrodynamic/aerodynamic optimisation

$$f_i \cdot Capacity \cdot V_{ref} \cdot f_w$$

Under discussion

DWT (or 65% DWT for
containership) or GT

Model test (pre-verif.) or speed
trial (final verif.)

Under discussion

Required EEDI - Reference lines

Reference line value = $a \times b^c$			
Ship type (as defined in MARPOL Annex VI Chapter 4, Regulation 2)	a	b	c
Bulk carrier	961.79	DWT of the ship	0.477
Gas tanker	1120.00	DWT of the ship	0.456
Tanker	1218.80	DWT of the ship	0.488
Containership	174.22	DWT of the ship	0.201
General cargo ship	107.48	DWT of the ship	0.216
Refrigerated cargo carrier	227.01	DWT of the ship	0.244
Combination carrier	1219.00	DWT of the ship	0.488

Reference Lines – Industry Discussion

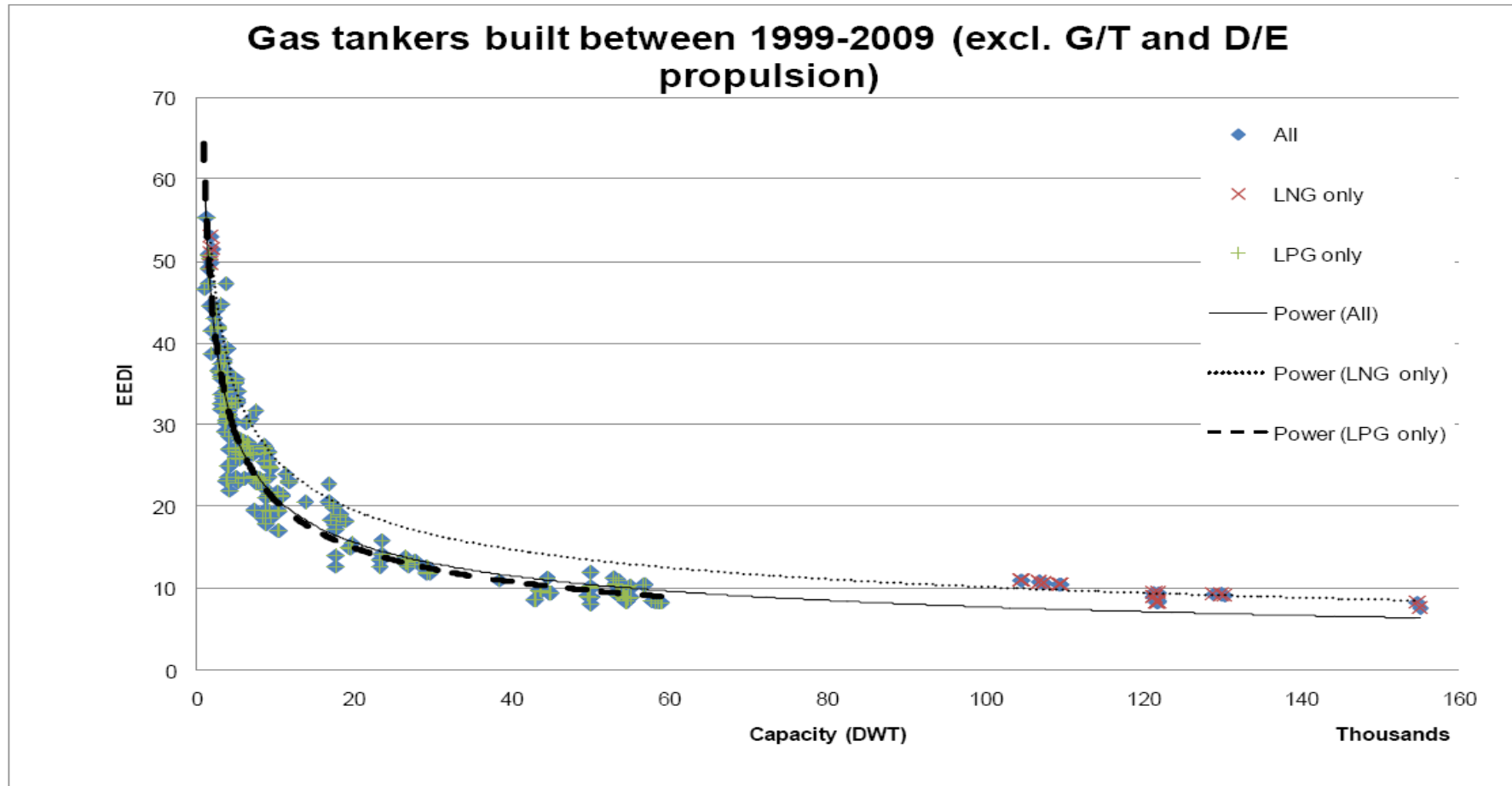


Issues with reference lines for certain ship types:

- Number of submissions to IMO in relation to discrepancies in the adopted reference lines
- Most notable:
 - MEPC.62/6/13 correction factors for reference lines affecting parcel tankers;
 - MEPC.62/6/20 Gas carriers – out of 354 vessels, 29 LNG and 325 LPG. Reference lines are biased towards denser cargoes of LPG (butane/propane)
- IMO has agreed to review these issues but uncertain whether any action will be taken.

Reference Lines – Gas Tankers Example

Total count: 354, LNG count: 29 (8.2%), LPG count: 325 (91.8%)



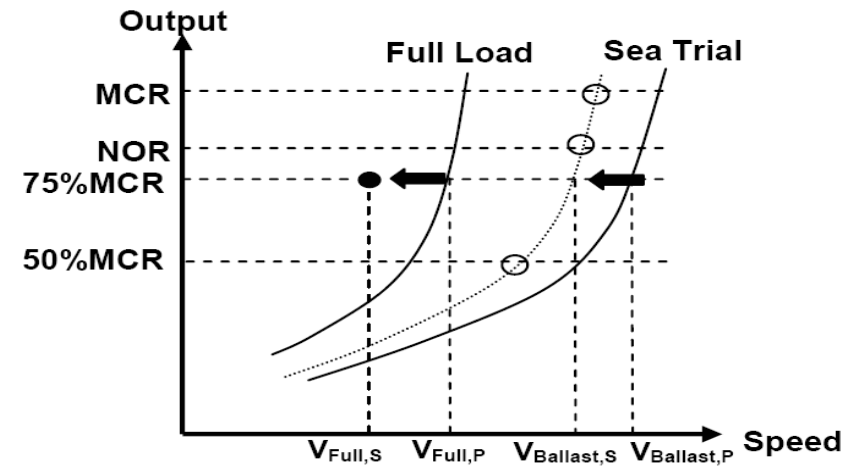
Speed Trials

Considerations:

- Purpose is to validate V_{ref} at 75% MCR!
- Can be part of normal sea trials procedure
- Required for each ship, not just lead ship
- Speed / power analysis should be acceptable to IMO requirements:

“more than two points of which range includes the 75% of MCR power,...”

- ISO 15016:2002 or equivalent !!!
- Speed trial plan should cover: vessel condition; course layout; number/order of runs; environmental limits; conduct; data measurement, calibration and accuracy.....etc



EEDI impact on manoeuvrability

- **Tendency at the moment: reduce speed (and installed power).**

Example: VLCC designed for 14.5 knots, 15MW main engine, ~30% EEDI reduction. Pre-EEDI: 25MW, designed for 16.5 knots

- **Will EEDI impact (or outlaw) twin screw design?**

Example, Stena V-Max design, 2x15,795 kW engines, 16.0 knots design speed

- **Typically, power reserves are used:**

For redundancy and safety

To allow engine maintenance whilst sailing without interruption in service

For manoeuvring in adverse conditions without tugs

To maintain schedules

For hotel and accommodation services (passenger/cruise)

- **IMO Guidelines will look to address minimum power**

Should safety related matters concerning manoeuvrability be addressed within energy efficiency regulation?

EEDI – What are the Challenges?

- Ensuring accuracy of data
 - Speed trial conduct
 - Discrepancy between results
 - Core model data used in assessment of EEDI
 - Data tolerances used in pre-verification of EEDI
- Tank test issues
 - Tank test/model test validation
- Standardisation / consistency
 - Speed Trial - number of points and equivalency for sister ships
 - Integrity and appropriateness of ISO 15016:2002 (what about NSMB, BSRA, Shipyard methods?)
 - Industry concerns vs commercial pressures



IMO and ongoing work

- Intersessional WG scheduled in January 2012
- Further improving of guidelines, with a view of finalisation at MEPC 63
- JIWG in November agreed to hand remit for looking at guidelines on tank test and speed trial to ITTC
- EEDI frameworks for ship types, sizes and propulsion systems not currently covered
- Draft interim Guidelines for determining minimum propulsion power and speed to enable safe manoeuvring in adverse weather conditions
- Other guidelines or supporting documents (correction factors, fw)
- Considering the EEDI reduction rates for larger tankers and bulk carriers



Any questions?

