March 2018 Development Paper

MariEMS Learning Material

This is the 20th compilation by Professor Dr Reza Ziarati on the work of the EU funded Erasmus + MariEMS' partners and material extracted from the IMO TTT Course. The material is composed from Chapter 19 of the learning material. Readers are also advised to refer to the papers on IdealPort and IdealShip projects led by C4FF and published by MariFuture.

20. Ship In-Port Operational Energy Efficiency Measures

20.1 Introduction

When the ship arrives at a port, there are some limited scope for the ship to reduce its fuel consumption while at anchor or at berth. Despite the fact that such reduction in fuel consumption may not have significant impact on a ship's overall annual fuel consumption; the impact on port air quality could be significant. Therefore the question "if ship-board staff could do anything to support a more efficient ship-in-port operation" is main topic of this section.

A number of measures could be identified that if implemented would reduce fuel consumption for the benefit of ship's energy efficiency and port air quality. These measures are analysed by assuming that ship will not be connected to shore power or a major switch in terms of fuel type will not take place as these changes may make some of the arguments put forward herein redundant.

The aspects covered in this section are simple day to day ship-board operational measures that can be undertaken by all ships. In fact, some of them could be implemented also by harbour and port support vessels. The main ship-board systems working when ship is at anchor or at berth include:

- Auxiliary machinery and equipment
- Diesel generators,
- Boilers

Additionally and on some ships, cargo handling equipment may be in operation that would provide extra opportunities and further measures for energy saving. However, in this section, the above three items are only investigated.

20.2 Operation of Auxiliary Machinery

The ship's diesel generators operate in port in order to produce electricity for operation of a large number of machinery and systems in engine room, deck and accommodation areas. Amongst them are the engine room auxiliary machinery like fans, pumps and other devices. On the accommodation side, the need for lighting, HVAC and galleys exists in port. In order to save energy and reduce emissions, auxiliary machinery utilisation in port should be minimised with consideration for safety.

There are practical evidences showing that such machinery are normally over-utilised in ports. Ship staff may follow the same processes as sea-going condition and keep the machinery running in the same way as during sea going conditions. This could also be considered as a way of avoiding additional processes, remain ready to leave the port without the need to re-start some of the machinery and for simple reasons that the company may not have plans and procedures on how the port operations with regard to machinery utilisation need to be handled.

This should not be the case and it can be changed via specific planning for the engine room machinery operations for at-berth/at-anchor operation to ensure energy efficiency while safety is

taken into account. The main aim of the plan will be to save energy via switching off the unnecessary machinery. As examples, the following may be undertaken:

- Minimising the number of running auxiliary machinery based on port operation requirements. There are a large number of pumps on board such as sea water cooling pumps, steering pumps, engine water circulating pumps, engine lubricating oil pumps, etc. All these need to be investigated and a plan for their port-operation should be devised based on port requirements.
- Minimising the number of A/C units operated or switch them off when conditions permit.
- The number of engine ventilation fans should be reduced in port or brought to slower speed. Since main engine(s) is not working in ports, there is no need to run all the engine room ventilation fans.
- The fuel treatment machinery need to be reviewed if they all needed to run in the same way as sea-going condition in view of the significant reduction of ship fuel consumption because of main engine being switched off.
- Minimisation of use of compressed air and its use where required. Compressed air is an expensive commodity and for example should not be used for ventilation purposes.

As indicated, these measures will provide less demand for electric generation and thus will lead to reduced fuel consumption. Additionally, the machinery run hours will reduce and this will be beneficial from maintenance point of view.

There are opportunities for reduction of energy needed in the accommodation area when in port. Although these measures are applicable to sea going conditions as well, it will be more effective under port condition. Some aspects include:

- **Lighting system:** The lights in spaces when not in use can be switched off and deck lighting during day hours can be avoided.
- **Galleys:** The galley area also provides some opportunities. For example lighting and electric equipment can be switched off after use.
- **Deck lighting:** No need for lighting during day time.

These measures also help to reduce demand for electric power.

20.3 Use of Auxiliary Engines

In ports, many ship staff run two auxiliary engines (diesel generators) in parallel to safeguard security of electric power supply. This is not needed for most of normal berth activities or when at anchor. When two engines operate in parallel, each run at very low loads thus give higher pollutant levels, consume more energy (they operate less efficiently) and the operation mode not good for engine components and maintenance.

Therefore, it is best practice if unnecessary cases of operation of two diesel generators can be minimised. This would equally reduce air pollutants to port as well.

To do this safely, the communication between deck department and engine department is crucial. If such communications are effective, then the engine room control engineers could pre-plan diesel generator operations in ports.

20.4 Operation of Boilers in Port

Boilers form a major part of ship-board energy consumption in ports in particular for certain types of ships such as oil tankers. Although boilers emit less harmful emissions than diesel engines (e.g. less NOx), nevertheless the control of their energy use will be beneficial for the port area emissions. This is the case as the ship auxiliary boilers mostly operate at low loads while in port. At low loads, the energy efficiency reduces and emissions factors increase that is not helpful.
The following ship board measures could potentially reduce the usage of boilers in ports:

- Use of parallel operation of two boilers should be avoided. This not only improves the efficiency of the working boiler but also gets rid of electrical requirements for the second auxiliary boiler.
- Planning and optimisation of cargo discharge operation is another area if it relies on steam driven cargo pumps (e.g. larger oil tankers). In some of the ships, there may be provisions for a mix of electric and steam driven pumps. Proper planning could be done to avoid excessive use of boilers.
- Plan and optimise ballast operation if it relies on steam driven ballast pumps. In many ships, the ballast pumps are now electric driven or a mix of steam and electric drives are used for this purpose.
- All aspects covered in relation to steam system maintenance on reducing the ship-board steam demand will also help the port operation. In other words, steam users need to be investigated and their operations decided based on port requirements.

In some ships such as oil tankers, auxiliary boilers may be used for inert gas generation (IGG). The whole process of generating inert gas and its use can be part of optimisation; as for inner gas generation, the boiler would normally run at very low load (normally a dedicated IGG system is used to avoid use of large boilers).

20.5 Ship Operational Efficiency Measures

The IMO commissioned study on ship-port interface [MEPC 68/INF.16] was discussed in detail in Section 3 of this module, also provide a list of operational measures as shown in Figure 20.5.1.

	Applicable Emission Source	Retrofitable?	Applicable Operational Modes	NOx	PM	SOx	HC	Energy Consumption
Ship Operational Efficencies								
Vessel Speed Reduction/Slow Steaming	All	Y	STM	↓ cbc	↓ cbc	↓ cbc	↓ cbc	↓ cbc
Optimization of Ship Reefer Systems	All	Y	All	↓ cbc	↓ cbc	↓ cbc	↓ cbc	↓ cbc
Optimization of Ship Systems	A	Y	All	↓ cbc	↓ cbc	↓ cbc	↓ cbc	↓ cbc
Optimization of Fleet Sizing to Maximize Vessel Efficienc	All	Y	All	↓ cbc	↓ cbc	↓ cbc	↓ cbc	↓ cbc

Figure 20.5.1 – Summary of ship operational measures [MEPC 68/INF.16]

Of the measures listed above, the optimisation of ship reefer system and other cargo conditioning systems need to be also considered as a case by case basis.

20.6 References and further reading

The following list provides references for this section and additional publications that may be used for more in-depth study of topics covered in this section:

1. "IMO train the trainer course material", developed by WMU, 2013.

http://www.imo.org/en/ourwork/environment/pollutionprevention/airpollution/pages/imo-train-the-trainer-course.aspx Viewed Nov 2016.

2. MEPC 68/INF.16, "Study of emission control and energy efficiency measures for ships in the port area", MEPC 68/INF.16, 4 March 2015, report prepared by Starcrest Consulting Group, LLC CE Delft and Civic Exchange. Viewed Nov 2016.

3. ICCT December 2012, "Workshop brief: Technologies and operational strategies for best practices in port clean air programs" A report prepared for the International Workshop on Reducing Air Emissions from Shipping, Shanghai, China, December, 2012. Viewed Nov 2016.