Ship's Emission Standards on Fuel Changeover in ECAs (SECAs)

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Abstract: MARPOL 73/78 is the main convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. MARPOL Annex VI outlines international requirements for vessel air emissions and pollution prevention. Under the terms of the convention, Undertaking Parties shall require ships of their administration and foreign ships in their waters to comply with these international air pollution prevention regulations. Upon entry into force of Annex VI to MARPOL on the 19 May 2005, the sulphur oxide (SOx) emissions from ships are controlled by setting a limit of 3.5% on the sulphur content of marine fuel oils. Furthermore, a limit of 1.0% on the sulphur content of marine fuel oil is apply in designated SOx Emission Control Areas (SECAs) and Emission Control (i.e. NA-ECA).

1 INTRODUCTION

From January 1st, 2015, the maximum sulphur content of fuel oil used within the MARPOL Annex VI Emission Control Areas (ECAs) will be 0.10%, unless using an approved alternative means for controlling sulphur emissions. In most cases, the fuel used will be low-sulphur distillate oil (LSDO). Many ships operating both inside and outside ECAs will changeover between LSDO and residual fuel oil (RFO) when entering and exiting ECAs.

ECA means to unite Sulphur Emission Control Areas (SECA) with incorporation of NOx emission as requirements. So far Emission Control Area means an area where the adoption of special mandatory measures for emissions from ships is required to prevent, reduce and control air pollution from SOx, NOx, and particulate matter and its attendant adverse impacts on human health and the environment. Emission Control Areas includes those listed in, or designated under regulations MARPOL ANNEX VI Reg. 13 and 14. As of 2011 there were four existing ECAs: the Baltic Sea, the North Sea, the North American ECA, including most of US and Canadian coast and the US Caribbean ECA. Other areas may be added via protocol defined in Annex VI as well. ECAs with nitrogen oxides thresholds are denoted as Nitrogen Oxide.

Two tables below show that sulphur limits for fuel in SECA and other sea areas:

Table1. Sulphur Limits for Fuel in SECA.

before 1 July 2010	1.50% m/m
between 1 July 2010 and 1 January 2015	1.00% m/m
after 1 January 2015	0.10% m/m

Table2. Sulphur Limits in Other Sea Areas

before 1 January 2012	4.50% m/m
between 1 January 2012 and 1 January 2020	3.50% m/m
after 1 January 2020	0.50% m/m

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In addition, the volume of low sulphur fuel oils in each tank as well as the date, time, and position of the ship when any fuel oil change over operation is completed prior to the entry into an ECA or commenced after exit from such an area, shall be recorded.

Table3. EU, CARB and Other Requirements for Changeover to MDO/MGO

2007	1st January	CARB	MDO Max 0.5% sulphur within 24 miles of California shore North
2008	1st January	EU	Max 0.1% sulphur for marine gas oils
2009	1st July	CARB	Marine gas oil (DMA) at or below sulfur; or 1.5% Marine diesel oil (DMB) at or below 0.5% sulphur
2010	1st January	EU	Max 0.1% sulphur bunker fuel in use at EU berths
		EU	Max 0.1% sulphur in all EU inland waterways
		CARB	Max 0.1%sulphur within 24 miles of California shore (Delayed)
2012	1st January	EU Ports	Max 0.1% sulphur bunker fuel in use by Greek ferries at Greek
2012	1st August	CARB	Limit marine gas oil to 1% sulfur / MDO still remain at Max 0.5%
2014	1st January	CARB	Max 0.1%sulphur marine gas oil (DMA) or diesel oil (DMB) within 24 miles of California shore

2 CHANGEOVER PROCEDURES

Change-over between heavy fuel oil grades is standard practice and therefore is changed over from heavy fuel oil to marine diesel oil in connection with e.g. dry-dockings. Change-over from heavy fuel oil to marine gas oil is however completely different and clearly not common standard. If gas oil is mixed in while the fuel temperature is still very high, there is a high probability of gassing in the fuel oil service system with subsequent loss of power. It should be acknowledged that the frequency and timing of such change-over may increase and become far more essential upon entry into force of SECA's. Additionally, the time, ship's positions at the start and completion of change-over must be recorded in a logbook (e.g. ER logbook), changeover operation, together with details of the tanks involved and fuel used need to be recorded as well. It can be anticipated that the same will be applicable with respect to the EU proposal upon entry into force. Description of procedures on keeping set limits of sulphur with entrance in SECA(s) ECA and CARB Areas are as follows.

2.1 Person In-Charge and Company's General Standards

The Person In-charge for the Fuel Changeover operation shall be the 1st Asst. Engineer. He shall assure that safety in the changeover operation is observed to prevent any untoward incidents during the changeover operations. Appointment of Person In-charge shall be reflected to the Fuel Changeover Operation Designation of In-charge Personnel. Generally, the Company requires that planning for changeover of fuel oil shall be made at least 7-days prior to entry depending on the result of onboard calculation. Please note that the higher the sulphur content of both HSFO and LSFO, the longer the changeover operation will take be attained. These factors affecting the changeover process will be explained as follows: (1) Sulphur content: The higher the initial sulphur level, the longer the change-over time will be. As well, the higher the LSFO sulphur level, the longer the change-over time. (2) Total fuel consumption rate: The higher the consumption, the lower the changeover time will be. The complexity is related to selecting the appropriate consumption in the period the change-over takes place (could involve port stay where main engine consumption is negligible but auxiliary engine and boiler consumption is high). In some cases, boilers are fed by the settling tank, and this contributes only to draining of the settling tank and not to the direct reduction of the service tank sulphur level. (3) Total volume in the fuel oil system: The larger the total volume in the settling tank and associated piping to be blended (diluted), the longer the change-over time. The larger the total volume in the service tank and associated piping to be blended (diluted), the longer the change- over time. (4) Separator(s) capacity: If the service tank is dropped to 25% level, then the separator capacity is often increased until the service tank is full (remembering to take into consideration the water, cat fines, and sediment levels in the LSFO to be treated). However, when the service tank is full, it is recommended that as far as practicable, the separator capacity is set equivalent to the total consumption. One reason is that a constant backflow to the service tank will re-circulate fuel and increase the sulphur level in the settling tank and subsequently the service tank. This effect will be particularly evident when the LSFO sulphur level approaches the target of 1.00% maximum limit. (5) Fuel transfer pump(s) capacity: Provided the piping arrangement facilitates stripping of the service tank, the transfer pump capacity will affect the time needed to drain it. Similarly, the pump capacity will have impact on the time needed to charge the settling tank after stripping.

2.2 Acceptable Methods of Fuel Oil Changeover Operations

2.2.1 Natural Changeover Operation for Entering ECA (SECA)

The number of days to start the changeover operation mainly depends on the sulphur concentration of HSFO in use and the sulphur concentration of LSFO available onboard. It is comprehended that the time of operation is expected to be quite long and required LSFO to be consumed to replenish the fuel system is considerably huge. The following Figure 1 show the change-over time.

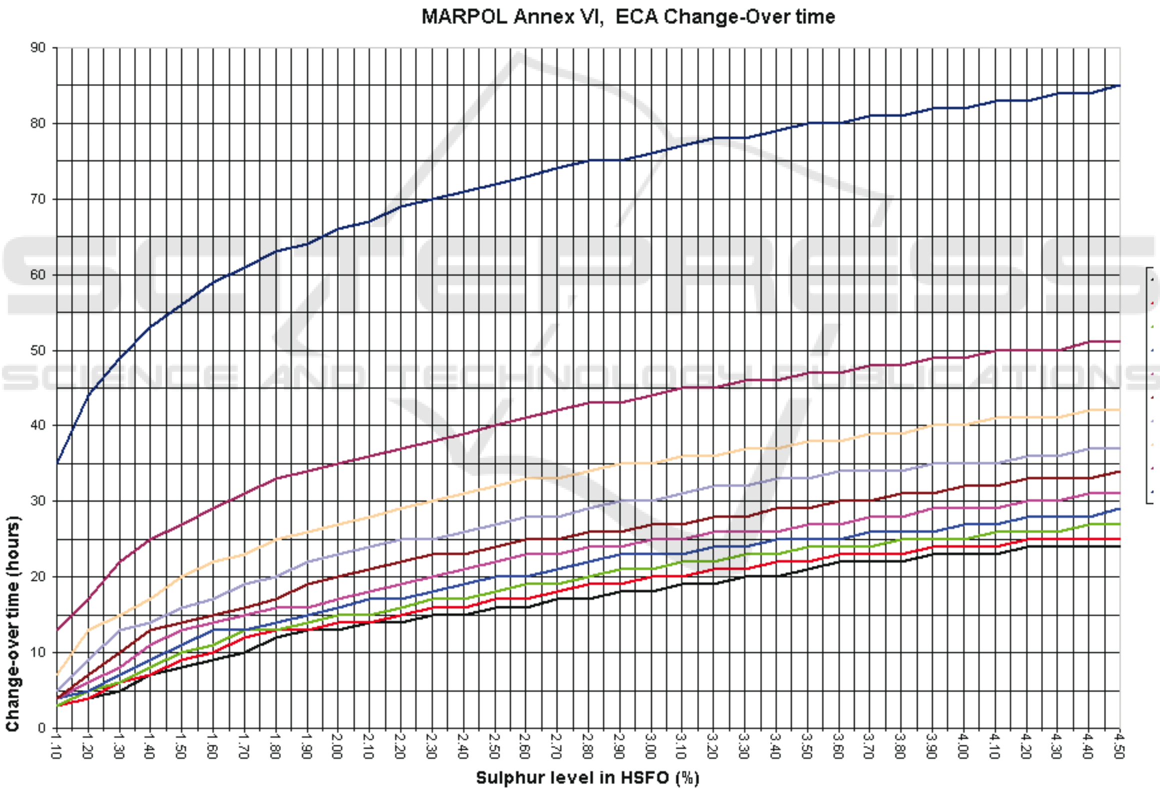

Figure 1: Graph of Change-over Time for natural changeover method.

2.2.2 Forced Changeover Operation for Entering ECA (SECA)

Before passing borderline of SECA / ECA, Settling Tank should be drained in one of F.O. Storage Tanks available using either the shifter pump or by draining it manually to the FO Overflow tank. However, the number of hours required to changeover the fuel oil prior to entering SECA/ECA also depends on the sulphur content of HSFO and LSFO to be used during the changeover. This operation is initiated by draining the HSFO inside the FO Settling tank and then refilled with LSFO. The starting point of fuel changeover shall be decided once the FO purifier has been put into operation to shift the LSFO from FO Settling Tank into FO Service Tank. It is therefore essential that the "time required for draining the FO Settling Tank" and the "most minimum quantity of HSFO that can be attained" shall be comprehended in advance. These factors depend on piping arrangements of each ship. If vessel is fitted with large drain line connecting the FO Settling tank going to FO overflow (or FO storage tank), use this to expedite the draining of HSFO. For the draining of FO Service tank, please take care to keep a quantity equivalent to operating the M/E for 8hrs at 85%MCR.

Date, time and position of the ship on commencement of changeover, completion of changeover and at the point of entry into ECA/SECA, remaining quantity from FO Settling Tank, FO Service Tank, and all LSFO Storage Tanks onboard shall be recorded in the log book. In ECR make sure that all tank indicators for designated LSFO and HSFO to be marked accordingly to avoid mistakes in the changeover operation. Furthermore, all HSFO Tank valves to be closed completely and locked when the changeover operation is completed to avoid contamination of fuel oil while ship is operating within SECA/ECA. All relevant valves shall be marked accordingly in the ECR for guidance during changeover during entry and upon exit from emission controlled area.

After leaving the SECA / ECA area the fuel system can be switched back to normal HSFO but particular attention shall be paid to the ship's position when changing over to HSFO to ensure that changeover took place when vessel is already outside the borderline of emission controlled area.

3 CONCLUSION

Air pollution caused by ships is severe in recent years in accordance with IMO GPG Study of 2014. SOx and NOx emissions account for 15% and 13% respectively which are caused by global shipping industry from 2007 to 2012. It indicates that the shipping pollution is a serious problem and needs to take necessary measures to improve it. Port's air quality will be affected due to the ships' air pollution, therefore, MPEC that belongs to IMO set up four ECAs. The North American ECA has had obvious improvement through various measures, including taking samples frequently for checking, imposing punishment for the disqualified check, supervising the fuel's quality, efficient division-cooperation system and so on. So far China has set up ECA to fight against air pollution and achieved the preliminary effects. However, there are a series of problems, e.g. inadequate supervision, while carrying out specific measures. China can draw lessons from the North American ECA which can further improve our air pollution and protect human beings' health and accelerate shipping technology.

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