



MPA
SINGAPORE

Exhaust Gas Cleaning System (Scrubber)

An Advisory for
Singapore-Registered
Ships



PREAMBLE

MARPOL Annex VI Regulation 14.1 states that the sulphur content of any fuel oil used on board ships shall not exceed 0.50% m/m on and after 1 January 2020 (for ships operating outside an emission control area¹). This is commonly referred to as the IMO 2020 fuel oil sulphur limit.

Furthermore, amendments to MARPOL Annex VI Regulation 14.1 to prohibit the carriage of fuel oil with sulphur content exceeding 0.50% m/m for use on board ships will come into force on 1 March 2020. This is commonly referred to as the “carriage ban” of non-compliant fuel oil. The ban would not apply to carriage of non-compliant fuel oil as cargo.

In summary, for ships operating outside an emission control area, the sulphur content of any fuel oil used on board ships shall not exceed 0.50% m/m from 1 January 2020 and the sulphur content of fuel oil used or carried for use on board a ship shall not exceed 0.50% m/m from 1 March 2020.

The above requirements would not apply to ships that use abatement technology as equivalent means of compliance, if approved by the flag Administration under MARPOL Annex VI Regulation 4. One such abatement technology is the exhaust gas cleaning system (scrubber).

For compliance with the IMO 2020 fuel oil sulphur limit, many Singapore-registered ships have been fitted with scrubbers. Many more are scheduled to be fitted with scrubbers in the coming months.

This advisory does not delve into the selection of scrubber types, makes or models. Nor does it touch upon the selection of shipyards. Instead, this advisory serves to share some observations and best practices during installation, and when the scrubber is put into operation.

The observations are mainly gathered from the shipboard inspections carried out in the course of our Flag State Control and Port State Control inspections. The best practices are gathered from the inputs and feedback provided by operators of Singapore-registered ships who had installed and operated scrubbers. These are shared so that operators of Singapore-registered ships may take them into consideration during the installation and subsequent operation of scrubbers.

The intent of this advisory is to help ensure the safe operation and pollution prevention of Singapore-registered ships. The choice of methodology for compliance with the IMO 2020 fuel oil sulphur limit remains the prerogative of each ship owner and operator.

¹ For ships operating within an emission control area, the sulphur content of fuel oil used on board ships shall not exceed 0.10% m/m since 1 January 2015. The emission control areas under MARPOL Annex VI Regulation 14 are the Baltic Sea area, the North Sea area, the North American Emission Control Area, and the United States Caribbean Sea Emission Control Area.

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INSTALLATION

Structure & Hull

Stability and Lightweight

When installing a scrubber on an existing ship, consideration should be given to the impact of the scrubber and its associated systems on the ship's lightship weight and vertical centre of gravity. In general, if in comparison with the approved stability information, a deviation from the lightship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 1% of subdivision length (L_s) is found or anticipated, an inclining test should be carried out and the stability booklets (final stability data, damage stability calculations, loading instruments, etc.) should be re-approved. Reference is made to SOLAS Chapter II-1 Part B-1 Regulation 5.

Volumetric Change and Gross Tonnage (GT)

For retrofitting of scrubber on existing ship where the enclosed superstructure is enlarged, recalculation of the ship's GT is required. Due to change in the ship's GT, a new International Tonnage Certificate would need to be issued. Other affected certificates with indication of the ship's GT such as Certificate of Class, applicable Statutory Certificates and Certificate of Registry are to be re-issued accordingly as well.

Longitudinal Strength

The location of a scrubber on a ship may have an effect on the ship's longitudinal strength. A scrubber that is installed at the aft section of the ship may increase the ship's hogging moment. As such, consideration should be given to an evaluation of the ship's longitudinal strength.

Strengthening and Structural Enforcement

For new ships under construction, the required structural supports for the scrubber would have been included in the design drawings and calculations. However, for existing ships to be installed with a scrubber, structural modification would normally be required for the additional space at the funnel for the scrubber and the additional exhaust piping. Ancillary support machinery for the scrubber systems may also require structural modifications and strength enhancement, where necessary. Attention should be paid to penetration of watertight bulkheads for piping works and electrical cables.



A bulk carrier retrofitted with enlarged funnel structure for scrubber

Machinery & Piping

Integration of Scrubber System with Existing Engine Room Systems

Installation of a scrubber on board involves integration of the scrubber system with the existing shipboard systems. This includes the exhaust piping system, the electrical power supply, the control and monitoring system and in some ships, the sea water system. Consideration should be given to system component compatibility such as piping and electrical cable connections, materials, ratings, etc. Also to be considered is whether the capacities of existing systems are able to support the scrubber system requirements, such as electrical power supply, sea water supply and fire-extinguishing systems.

Electrical Load

The addition of a scrubber system on board will increase the operational power requirements of the ship and consequently, the ship's fuel consumption. The electrical load is primarily to power the washwater pumps. Aside from that, there are also power requirements for sludge removal, alkaline dosing (closed-loop mode), induced draft fans and control and monitoring systems.

New ships can be designed with generators able to accept the scrubber loads as part of normal operating conditions. However, for retrofit installations, these loads can be more than the surplus electrical capacity available in an existing ship's electrical power system and may require the addition of a separate generator.

An electrical load analysis will help to determine if the ship's existing power plant has adequate capacity for the additional power demand of the scrubber. The evaluation is to consider various operational modes of the ship, including normal sea going, manoeuvring and cargo loading/offloading. Reference is to be made to SOLAS Chapter II-1 Regulation 41.

It is advisable to engage and seek the advice of the classification society on evaluation of the electrical load analysis and if an additional generator is required, as well as whether the ship's attained Energy Efficiency Design Index (EEDI) is affected. A ship's attained EEDI may be affected due to changes in the ship's auxiliary engine power² and capacity. Reference is to be made to IMO Resolution MEPC.308(73) – *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships*.

Exhaust Backpressure and NOx Code Compliance

It is important that the backpressure imparted by the scrubber on the exhaust does not adversely affect engine operation. Backpressure can be caused by undersized scrubbers, poor exhaust piping configuration, cooling and slowing down of exhaust gas, failure of engine load signal matching with the washwater flow rate adjustment, and other design issues.

Increase of exhaust backpressure may result in additional fuel consumption due to lower turbocharger efficiency, increased component temperatures, and cause increased wear.

² The auxiliary engine power is defined as the required auxiliary engine power to supply **normal maximum sea load** including necessary power for propulsion machinery/systems and accommodation, e.g. main engine pumps, navigational systems and equipment and living on board, but excluding the power not for propulsion machinery/systems, e.g. thrusters, cargo pumps, cargo gear, ballast pumps, maintaining cargo, under a specified condition.

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Emission of Nitrogen Oxides (NO_x) may also be increased due to the backpressure. Diesel engines, which operate outside the exhaust backpressure limits detailed in the approved engine NO_x technical file, may invalidate the emissions certification and will require a re-approval of the engine NO_x certification. It is advisable that the backpressure measurement be confirmed after the scrubber installation to ensure that it is within the approved range of the engine NO_x technical file. It is important to check during the trial run at manoeuvring speed to see the reaction of the scrubber system and effect of the sudden backpressure changes.

It is common that on a scrubber connected to multiple engines and boilers, extractor fans are provided on the scrubber outlet to the exhaust pipe to lower the pressure in the scrubber and thereby prevent excessive backpressure in the system. This will also help to prevent higher backpressure from one engine or boiler affecting the other interconnected fuel burning units. In view of this, it is advisable that the impact of a scrubber fan failure on the safe operation of the fuel burning units should be carefully considered.



Exhaust gas extractor fans to reduce backpressure

Exhaust Piping

For retrofit cases, in case the outlet of the exhaust pipe is changed from its original location, it is important to ensure that the end of the exhaust pipe must not affect the accommodation area. It is normally not necessary to change the material of the exhaust duct between the engine/boiler to the scrubber. However, the exhaust gas coming out from a scrubber may have a high relative humidity if the exhaust gas temperature is not kept above the dew point. In view of that, it is advisable to consider highly corrosion-resistant materials such as stainless steel for the exhaust duct and systems downstream of a scrubber.



Interior of an exhaust gas bypass damper

INSTALLATION

Washwater Piping

Glass Reinforced Epoxy (GRE) pipes are commonly used for the scrubber washwater discharge piping, due to the strong acidity of the scrubber washwater. This GRE pipe being used must be an approved type for use in machinery spaces. GRE piping is lightweight, which makes it easier to handle during retrofits, but its reduced rigidity means GRE piping requires more support and has a larger bend radius than its size equivalent in steel.



Scrubber washwater discharge GRE pipe fitted in an engine room



Close up view of a GRE pipe section

The relevant classification rules should be followed, e.g. use of steel transition pieces, fitted with suitable closing devices where GRE piping passes through watertight bulkheads. GRE piping close to the scrubber must also be protected from exposure to hot exhaust gases.

For open-loop scrubbers, overboard discharge fittings for the washwater will need to be installed. Valves should be rubber-lined butterfly type or of suitable stainless steel grade. The stub pipe between overboard discharge valves and the side shell need to be of metallic material as normally required by class rules. This stub pipe may be subjected to the severe corrosive nature of the washwater. It is advisable to consider piping with increased wall thickness and as for material, carbon steel with plastic lining or high-grade stainless steel as material for the overboard stub pipe may be considered.

Please see Case Study 2.

INSTALLATION

Location of Overboard Discharge and Hull Protection

For open-loop scrubber installation, it is important to ensure that the washwater overboard discharge point is located below the water surface aft of the engine room, to prevent the discharged washwater from being sucked and re-circulated into the engine room sea chest, which may lead to corrosion of piping and fittings of other engine room sea water systems.



GRE pipe to overboard discharge.

Accessibility for Maintenance

One practical point to take into consideration during the installation of a scrubber is the accessibility for maintenance work during operations. Suitable space should be factored in to accommodate periodic maintenance and repair. For scrubber installation on open deck, protection from the weather elements for crew doing maintenance needs to be considered.

INSTALLATION

Fire Protection

Fire Detection System

The majority of scrubber installation involve having the scrubber within the engine room. For new built vessels, the fire protection arrangements for the scrubber compartment would likely to have been integral with the engine room.

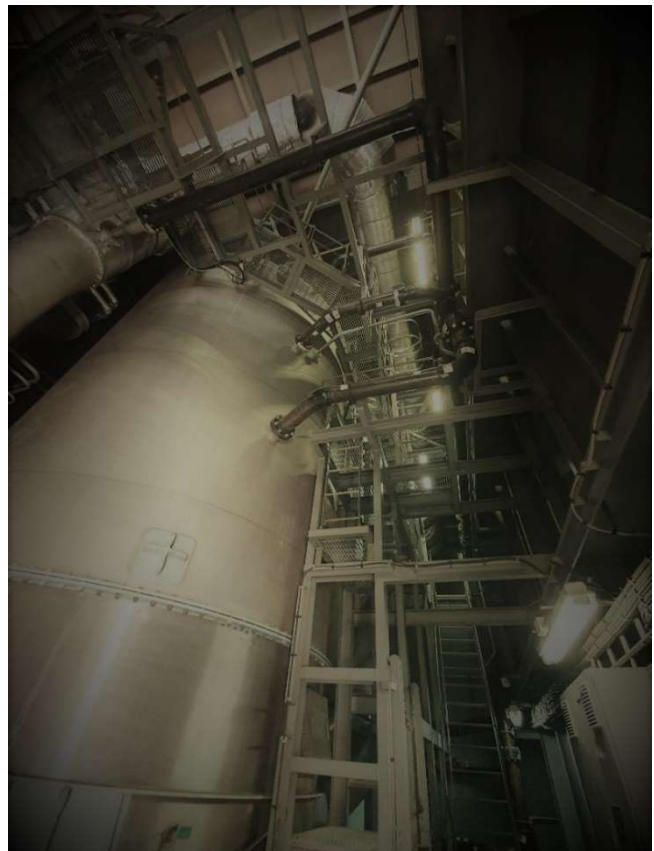
However, for retrofit cases, consideration would be required for extension of the existing fire detection system or a new separate fire detection system itself, for the additional scrubber compartment.

Fixed Fire-extinguishing System and Portable Fire-fighting Appliances

Similar to the fire detection system, for retrofit cases, consideration would be required for extension of the existing fixed-fire extinguishing system for the additional scrubber compartment. Calculations would need to be carried out by the shipyard/class and the capacity of the existing fixed fire-extinguishing system may need to be increased. For example, if the ship was using fixed CO₂ fire-extinguishing system, such works would involve increasing the number of CO₂ bottles and extending the CO₂ piping and nozzles into the scrubber compartment.

Aside from the fixed system, portable extinguishers, fire hydrants, hoses and nozzles would also need to be provided. Where ventilation flaps/dampers are fitted to the scrubber casing, remote closing arrangements should be provided. Please see SOLAS Chapter II-2 Regulation 10.

The Fire/Safety Control Plan needs to be re-approved. Please see Case Study 1.



A retrofitted scrubber tower machinery space without fire detection nor fixed fire-extinguishing system.

Escape route

The scrubber is a piece of machinery, and in most cases, installed at the funnel casing. Unlike simple exhaust ducting, the scrubber as a piece of machinery requires occasional maintenance by the ship crew. As such, aside from access for maintenance, it is advisable that consideration be given to the escape route/pathway for crew in case of emergency.

Please see SOLAS Chapter II-2 Regulation 13.4.

Case Study 1

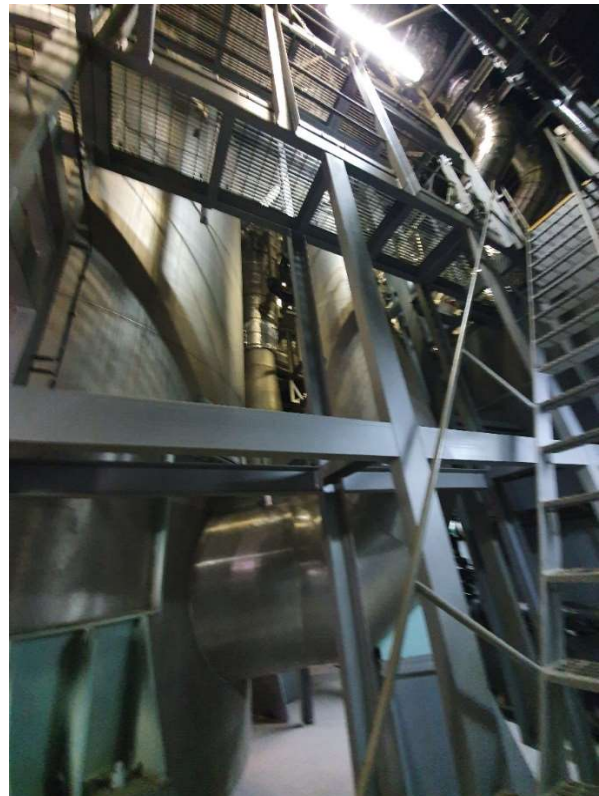
Installation of Scrubber Casing without Fire Detection nor Fire-fighting Arrangement

While this may not be an issue for new built ships, provision of a fire detection system and fire-fighting arrangement need to be taken into consideration for scrubber retrofit on existing ships. At present, there is a rush for scrubber retrofit on existing ships. Hence, there is a long lead time in some cases. In order to reduce the turn-around time, pre-fabrication of components including the additional enclosed structural casing for the scrubber, is common.

However, it was observed during our Port State Control inspections on board that there are retrofitted installations without any provision of fire detection systems nor fire-fighting arrangements. Some photos to illustrate the absence of such provisions are appended for information.



Top of scrubber tower and deckhead, without any fire detectors nor fixed fire-extinguishing arrangement



Another scrubber tower machinery space without fire detection, fixed fire-extinguishing system or portable fire extinguishers

In this instance, the owners were advised to consult Class and Flag Administrations so that the appropriate corrective actions could be taken.

Modifications to provide new or extend the existing fire detection system and fixed fire-extinguishing system to the additional space would be costly, time-consuming and disruptive to the ship's operations. As such, it is advisable to consider this aspect in the design and planning stage.

Case Study 2

Reported Failure of Washwater Piping and Flooding of Engine Room

A one-minute video recently surfaced in social media with the title "Ship scrubber system failure causes flooding of Engine Room". The video showed copious amount of water cascading down from the deck head of the engine room onto the main engine platform. There were alarms sounding in the background and the crew could be seen rushing about trying to address the situation. No further details were provided as to the name of the ship nor the date and time of this occurrence; hence, the authenticity of this video could not be verified.

Nevertheless, it is indeed very plausible that such a failure may occur on board ships fitted with scrubbers. There was no indication of the ship's operational status at the time of the incident in the video. However, should such a failure of the scrubber or pipework integrity occur while the main engine or boiler is running, it is possible that aside from the danger of being flooded, the engine room may also be inundated with exhaust gas as well, making it very difficult for the crew to respond. Furthermore, should such a failure occur while the ship is manoeuvring in heavy traffic, a hazardous navigational situation would quickly develop. It is imperative that the structural integrity of the scrubber and associated pipework is constantly checked for signs of leakage or corrosion.



Source: Video posted by Marine Republic in YouTube

Aside from the video, there are also reports of scrubber corrosion repairs being required less than six months after installation. In view of the acidic nature of the scrubber washwater, correct material selection for the scrubber body, pipework, components and accessories, together with good installation workmanship are critical to avoid subsequent safety issues.

Unlike an inert gas scrubber on an oil tanker, which is only put into operation during cargo discharging operation or occasional top-up/inerting of cargo tanks, the SO_x scrubber is expected to be in operation 24/7 most of the time, except for the open-loop type when the ship is in ports that prohibit the discharges from such scrubbers. A non-exhaustive list of best practices and considerations to ensure safe operation and pollution prevention when operating the SO_x scrubbers is appended in the following paragraphs. These are based on the experience of SRS operators who have operated scrubbers for ships calling into Sulphur Emissions Control Areas and those who have started to test and use scrubbers recently for the upcoming IMO 2020 regulation, coupled with observations from our inspections on board.

Safety and Pollution Prevention Systems

Water Level Sensors, Overboard Valve Inter-lock and Local/Remote Selection

Much has been said with regard to the risk of scrubber flooding, with potential overflow of water down the exhaust pipe, resulting in damage to the attached engine and/or boiler. It has been estimated that it only takes minutes to fill up the whole volume of a scrubber body for a U-type scrubber while it takes even lesser time for an I-type scrubber.

The scrubber safety system should be designed to mitigate this risk. Components of the scrubber safety system that should mitigate this risk include high water level alarm, automatic cut-off of the water supply to the scrubber and opening of the exhaust bypass (if fitted). Some scrubber safety systems also incorporate two independent and hardwire connected high water level switch design.

In most open-loop systems, the overboard discharge valve is fitted with an interlock with the seawater pump. If the overboard valve is closed, the seawater pump cannot be started.

It is important that the crew periodically and diligently carry out tests of the high water level alarms and auto-stop function of water supply.

One important and practical point to note is that with some scrubber systems, there is an option of “Local” or “Remote” operation of water pumps or sealing fans. This is to allow for manual starting of the pumps/fans when required. However, if the selection is left on “Local”, the pumps/fans will not auto-stop when triggered by the safety systems, for example due to high water level in the scrubber.

Please see Case Study 3 for an example of a catastrophic failure of safety system and the extensive damages caused.

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Dampers

There have been reports of high temperature in the scrubber, even when the scrubber is not in operation and bypassed. This was subsequently identified to be due to leakage of the bypass dampers or defects in the sealing air system. Such a situation may result in fire/damage to scrubber components and material, if left unchecked. It is advisable to operate the exhaust gas dampers weekly in order to prevent seizure.

Power Supply

Power supply shortage/disruption during scrubber operation, can result in serious consequences, especially during manoeuvring or cargo operations. Regular checks and servicing should be carried out for the power management system, electrical power protection, automation and control system, switchboard and distribution boards, and control panel.



Exhaust gas damper actuators

Corrosion and Leakages

The basic operational concept of an SO_x wet scrubber involves the mixing of water and sulphur from the exhaust gas. Naturally, this results in a corrosive environment within the scrubber tower and associated pipework. With this, comes the risk of water flooding and escape of exhaust gas into the engine room.



Interior of a scrubber tower with nozzles and demister

A failure of the water piping may flood the engine room within a short period of time. For ships operating under Unmanned Machinery Space (UMS), by the time the duty engineer responds and reaches the engine room after receiving the bilge alarm, the engine room bottom platform may have been flooded.

Regular inspection of the scrubber tower internal structure and early detection of pipework leaks are advisable. Crew should ensure that the emergency bilge suction pumps are always

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in working condition. Additional bilge alarm/flood alarm connected to auto-shutdown of the scrubber and the washwater pumps should be considered. Manual emergency stops should be placed in the Engine Control Room, on the Bridge and on the scrubber panel for manual shut down when required.

In-line Scrubbers and Running Dry

Maker's Recommendation and Switchover Procedures

A number of ships are fitted with in-line scrubber systems that are usually designed in a compact form to save space. This is useful in smaller vessels and in retrofit cases. In most cases, the design directs the exhaust gas to enter from the bottom of the scrubber tower without a bypass arrangement. In such a configuration where a bypass arrangement is not provided, the scrubber would need to run dry in situations where scrubbing is not allowed such as in ports that prohibit open-loop scrubber washwater discharge. It is important to ensure that the material and construction of the scrubber can withstand the high temperature exhaust gas flowing through when running dry.

Maker's recommendation and procedures for changing over between scrubbers in operation and running dry should be adhered to.

Soot Fire

It is advisable to establish a regular inspection schedule of the scrubber internals, and cleaning of the internal components such as packing or demisters to prevent blockage and accumulation of soot. Such accumulation of soot may carry a risk of soot fire when the scrubber is run dry. Crew should ensure that fixed cleaning arrangements (water or steam, where fitted) are working properly and utilised regularly. Such cleaning should be carried out as per the manufacturer's guidance. The crew should also consider flushing the scrubber for a prolonged period after each scrubber operation to wash down soot, bearing in mind washwater discharge standards in case of open-loop scrubbers.



Demister section that is prone to soot build up when scrubber is run dry

Critical Spares

The scrubber is a critical piece of machinery, whereby its failure may affect the ship's operations. As such, it is recommended to carry on board the necessary spare parts as recommended by the manufacturer, in order to avoid costly downtime when such spare parts are required.

Open-loop Scrubber Discharges

Prohibition of Discharges from Open-loop Scrubber

Ships may be fitted with a scrubber as an equivalent arrangement in order to comply with the IMO 2020 requirements. The most common type of scrubber is the open-loop scrubber. It uses seawater to wash and remove the sulphur oxide from the exhaust gas, and thereafter this wash water is discharged overboard. While open-loop scrubbers may comply with the IMO EGCS Guidelines (MEPC.259(68)), the Guidelines stipulate only four threshold limits on the wash water discharge of scrubbers, namely, pH, PAH (Polycyclic Aromatic Hydrocarbon), Turbidity and Nitrates. The Guidelines currently do not specify a threshold limit for heavy metals.

Due to environmental and socio-economic reasons, along with other considerations, some coastal states and ports have prohibited the discharge of washwater from open-loop scrubbers in their waters. When operating in these waters, ships fitted with open-loop scrubbers should switch over to compliant fuel oil, and ships fitted with hybrid scrubbers should switch to the closed-loop mode of operation or use compliant fuel oil.

UNCLOS³ Article 195; *In taking measures to prevent, reduce and control pollution of the marine environment, States shall act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another.*

A non-exhaustive list of ports that have prohibited the discharge of scrubber wash water can be found on this [webpage](#)

Changeover Procedure

For ships operating to ports, which prohibit the discharges from open-loop scrubbers, it is advisable that such ships, fitted with either open-loop scrubbers or hybrid scrubbers, to establish appropriate changeover procedures to either compliant fuel oil or to closed-loop mode respectively. The changeover procedure for open-loop scrubber should take into consideration the amount of time required to flush through the fuel oil system with compliant fuel before the scrubber is shut down. The changeover should also be carried out at an appropriate location and distance away from busy waterways in order to ensure navigational safety. Such procedures should form part of the ship's safety management system (SMS).

³ United Nations Convention on the Law of the Sea

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Carriage of Compliant Fuel

If the scrubber fails and cannot be put back into a compliant condition within one hour, the ship should changeover to compliant fuel oil. Operators should consider having some quantity of compliant fuel on board as determined by the company's SMS that could be used during the period of a scrubber malfunction.

The failure should also be properly reported in the EGCS Record Book. The reason for a failure could be due to a myriad of reasons, for example a control system error or a failure of a monitoring instrument, where the system malfunction cannot be rectified.

If the ship does not have sufficient amount of compliant fuel oil on board, the ship should communicate a proposed course of action to the relevant authorities (the ship's flag administration, the destination port authorities and the coastal state authorities if applicable), in order to bunker compliant fuel oil or carry out repair works at the earliest opportunity. The authorities need to approve the proposed course of action.

Handling of Alkali Solution



Caustic soda storage tank onboard a ship.

In order to achieve the required SO₂ reduction and neutralization from the exhaust gas in a closed loop or hybrid type scrubber, a certain alkalinity is to be maintained in the washwater in accordance to manufacturer's recommendation.

Alkali solution, usually caustic soda (NaOH) is usually fed to the suction side of the scrubbing water pump via an alkali feed injection module, where the feed will be constantly monitored and adjusted automatically according to the scrubber load requirement.

NaOH is a hazardous substance. Handling of the solution must strictly follow the Material Safety Data Sheet (MSDS). Crew must take special care when handling NaOH solution during bunkering or doing maintenance. Crew

should always wear goggles, gloves, and protective clothing when handling caustic soda. Working area should always be well illuminated and ventilated. Should the substance comes into contact with the crew, contaminated clothing must be removed immediately to avoid chemical burns and first aid administered immediately. Any spills must be cleaned up immediately.



IBC tanks used for storing scrubber residue

Scrubber Residue

For ships using scrubbers in a closed-loop mode, the residue, which is separated from the washwater, is not allowed to be incinerated on board the ship as prohibited under MARPOL Annex VI Regulation 16.2.6. Such residue would need to be retained on board for subsequent disposal to port reception facilities.

Operators with ships installed with closed-loop scrubbers or hybrid scrubbers operating in closed-loop mode would need to consider the logistical arrangements for port reception facilities for the separated residue.

For disposal of scrubber residue in Singapore port, please refer to Port Marine Circular No.11 of 2019.

Crew Competency

Aside from the hardware and control systems, the competency of crew is also crucial in order to avoid incorrect operation of the scrubber system, and to ensure safety of ship, crew and the environment. Operators should arrange for ship crew to learn about the critical components, understand their functions and how to operate the system.

Some best practices include simple steps such as posting key operating instructions near to control panels. Other best practices include arranging for all crew to receive refresher training at periodical intervals and ensuring participation of the crew in the maintenance activities by maker's engineers in order to ensure that they know the system and what to do in case of a malfunction.

Case Study 3

Loss of Propulsion due to Scrubber Safety System Failure

A fully laden Capesize bulk carrier fitted with an in-line open-loop scrubber was departing Singapore and entering the Traffic Separation Scheme, when several critical alarms were activated in the engine room. The alarms included the exhaust gas high temperature alarm for the auxiliary engine and exhaust gas deviation alarm for the main engine.

Within a few minutes of the alarms, the vessel's main engine shut down and the vessel was no longer under command. The Master immediately reported the incident to Singapore's Port Operations Control Centre and requested for tug assistance. Fortunately, there was no other ship close enough within the vicinity of the stricken vessel to pose an immediate collision hazard. Tug assistance was rendered and the stricken vessel was towed back to Singapore port waters where she anchored for repairs.

Singapore's Port State Control Officer (PSCO) boarded the vessel subsequently to carry out an inspection in order to ascertain the cause of the incident. Based on the PSCO's inspection findings and discussion with the vessel's Chief Engineer, the suspected causal factors for the incident and sequence of failure were as follows:

- It was suspected that the volume of water spray did not adjust accordingly and automatically when the main engine load changes during manoeuvring. This may have led to water accumulation in the scrubber.
- It was also suspected that the drain valves were not completely opened and/or that drain lines were choked. This could have restricted the flow of washwater overboard.



High level sensors



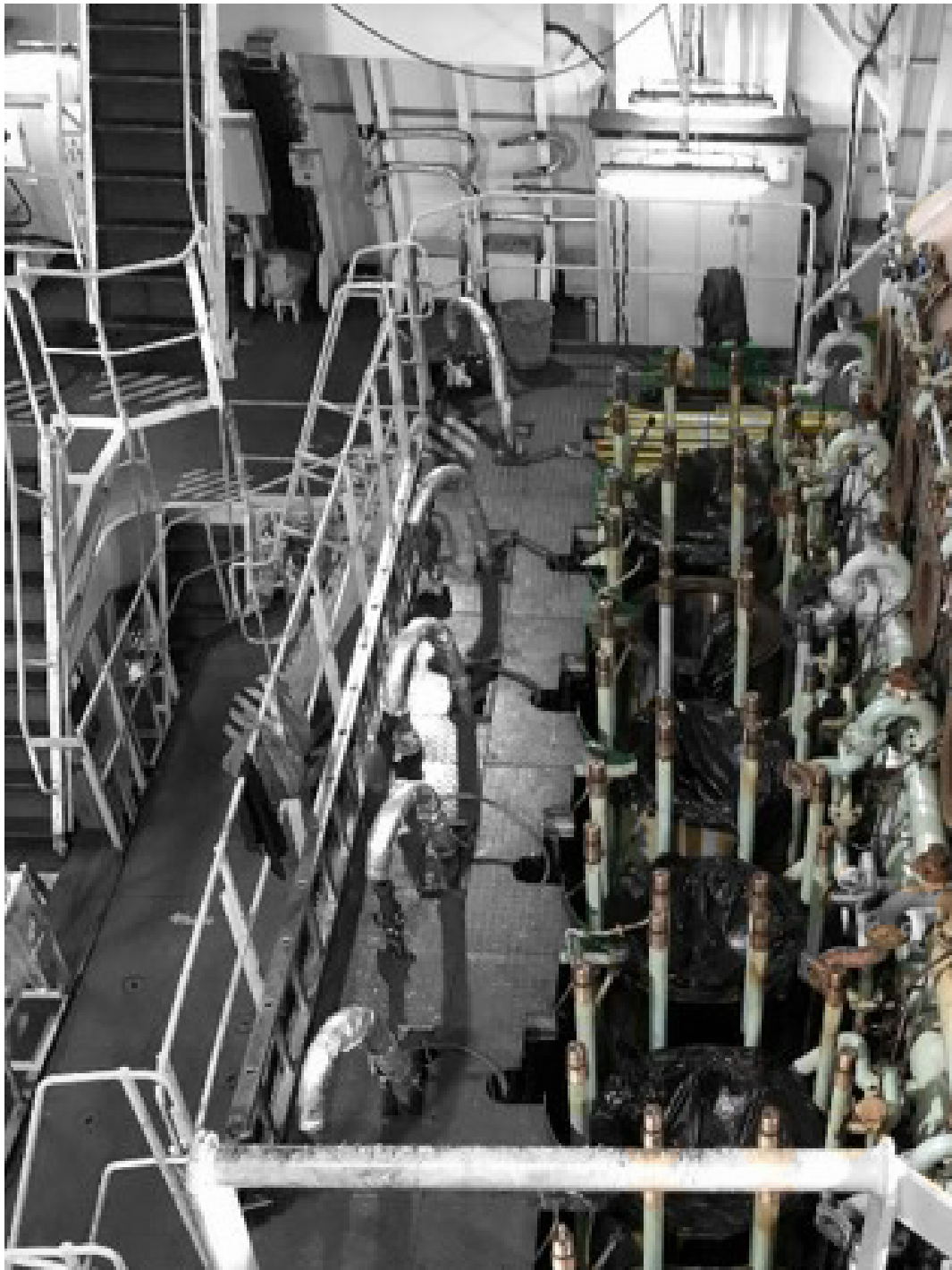
- The overboard valve could have been closed.
- The high water level sensors that were part of the scrubber safety system and supposed to automatically stop the washwater pumps, did not activate when the high water level was reached.
- The seawater pumps continued to supply seawater to the scrubber unit causing washwater to overflow from the scrubber space into the main and auxiliary engines through the exhaust piping.

Wash water accumulated in this space and overflowed from scrubber space back to exhaust piping

Case Study 3

The incident caused severe damages to the main and auxiliary engine components, affecting the turbochargers, cylinder heads, pistons and liners. The crankshaft bearings were also removed for inspection. The vessel stayed in port to complete the repairs and subsequently departed around three weeks later.

This incident highlighted the importance of maintaining the automation and safety system of the scrubber in good working order and are frequently tested, as failure may result in serious consequences.



All cylinders of the main engine were found opened up during the PSC inspection

Carriage Ban and Use of High Sulphur Fuel Oil for Commissioning Test of Scrubbers

From 1 March 2020, ships will be prohibited from carrying fuel oil with sulphur content exceeding 0.50% m/m for use on board (commonly referred to as the “carriage ban”).

Prior to entering a yard for scrubber retrofitting after 1 March 2020, a ship is not allowed to carry high sulphur fuel due to the carriage ban. A ship in the yard undergoing the scrubber installation will not be affected by the carriage ban as the ship is under repairs/survey/retrofit and not in operation.

After the scrubber has been installed, the carriage ban does not apply to the ship. However, the ship has to **use** low sulphur fuel oil for its operations until the scrubber commissioning is satisfactorily completed by the ship’s classification society and an updated International Air Pollution Prevention (IAPP) Certificate with Supplement is issued.

Ships may be required to use high sulphur fuel oil for the commissioning of the scrubber. In such cases, the ship owner is requested to seek MPA’s approval. The ship owner is required to submit detailed information on the scrubber commissioning schedule and maintain fuel oil consumption record for any third party / PSC inspection. After assessing the application, MPA may grant an in-principle approval for the ship to use high sulphur fuel oil, specifically for the purpose of commissioning of the scrubber only.

Reference is made to IMO Resolution MEPC.321(74) – 2019 Guidelines for Port State Control under MARPOL Annex VI Chapter 3 Clause 2.2.1.1 – “2.2.1 On ships equipped with equivalent means of compliance, the PSCO will look at evidence that the ship has received an appropriate approval for any installed equivalent means (approved, under trial or being commissioned)”.

Shipboard Incineration of Sludge Generated from the Purification of High Sulphur Fuel Oil

Sludge generated from the purification of high sulphur fuel oil may be incinerated on board in an approved incinerator. Where the boiler is approved for sludge burning, this high sulphur fuel oil sludge can also be consumed in a boiler that is connected to a scrubber. Consumption of sludge in the boiler shall not take place when the vessel is inside ports, harbours and estuaries (MARPOL Annex VI Regulation 16.4).

However, this high sulphur fuel oil sludge shall not be consumed inside a boiler not connected to a scrubber. MARPOL Annex VI Reg 2 defines fuel oil as “any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including gas, distillate and residual fuels.” Steam generated from boilers is for operation on board a ship. As such, unlike an incinerator, any fuel consumed in the boiler should be in compliance with MARPOL Annex VI Regulation 14.

REFERENCES

Practical Considerations for the Installation of Exhaust Gas Cleaning Systems
American Bureau of Shipping

Understanding Exhaust Gas Treatment Systems – Guidance for ship owners and operators
Lloyd's Register

Exhaust Gas Cleaning Systems Technical Information – for ship owners and surveyors
Korean Register

IMO Resolution MEPC.259(68) – 2015 Guidelines for Exhaust Gas Cleaning Systems [\(link\)](#)
IMO

IMO Circular MEPC.1/Circ.883 – Guidance on indication of ongoing compliance in the case of the failure of a single monitoring instrument, and recommended actions to take if the Exhaust Gas Cleaning System (EGCS) fails to meet the provisions of the 2015 EGCS Guidelines (Resolution MEPC.259(68)) [\(link\)](#)
IMO

IMO Resolution MEPC.308(73) – 2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships [\(link\)](#)
IMO

Port Marine Circular No.11 of 2019 [\(link\)](#)
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Observations from MPA's PSC and FSC Officers
MPA

Inputs, advice, information and feedback from Singapore-registered ship operators
Industry

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