



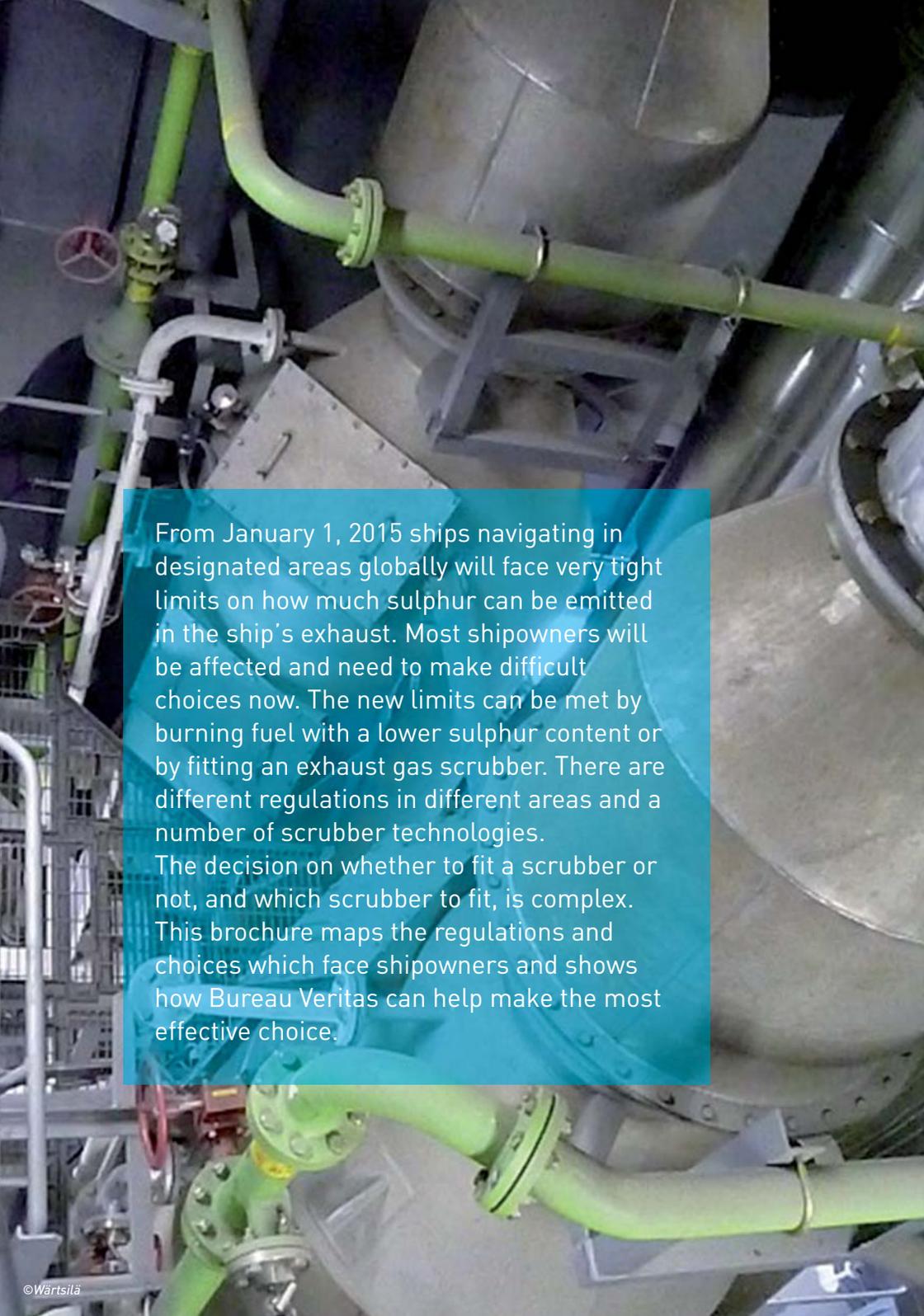
Exhaust Scrubbers

What you need to know



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A photograph of a ship's engine room, showing various pipes, valves, and machinery. The pipes are painted in shades of green and yellow. A teal semi-transparent box is overlaid on the center of the image, containing white text. The background shows a complex network of pipes and mechanical components, including a large cylindrical tank and various valves with handwheels.

From January 1, 2015 ships navigating in designated areas globally will face very tight limits on how much sulphur can be emitted in the ship's exhaust. Most shipowners will be affected and need to make difficult choices now. The new limits can be met by burning fuel with a lower sulphur content or by fitting an exhaust gas scrubber. There are different regulations in different areas and a number of scrubber technologies.

The decision on whether to fit a scrubber or not, and which scrubber to fit, is complex. This brochure maps the regulations and choices which face shipowners and shows how Bureau Veritas can help make the most effective choice.

What are the rules?



The International Maritime Organization (IMO) Annex VI of MARPOL 73/78 stipulates the regulations for exhaust gas emissions (NO_x, SO_x, PM and CO₂). The full text is available at www.imo.org



The European Commission has published Directive 2012/33/EU amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels. <http://eur-lex-europa.eu>



Other regulations on emissions reduction include EC Directive 2005/33, California Air Resources Board (CARB), the US EPA, and local jurisdictions such as port administrations. www.ecfr.gov www.arb.ca.gov

In simple terms, ships in IMO-designated Emission Control Areas (ECAs) and Sulphur Emission Control Areas (SECAs) can only burn fuel with a sulphur content less than 0.1% mass per mass from January 1, 2015. There is currently a designated ECA around the US coastline and parts of the Caribbean Sea and a SECA around The North Sea and the Baltic. There is currently a 0.1% limit in EU ports and around the Californian coastline. A global limit of 0.5% will apply to most ship types from 2020.

The IMO MARPOL regulations, the EU regulations and the US EPA regulations are aligned except on some points of detail. They all allow for equivalents and so permit the use of Exhaust Gas Cleaning Systems (EGCS), which are called scrubbers. They have to achieve the same limits on Sulphur Dioxide (SO_x) content of the exhaust whatever fuel is burnt as if the ship was burning fuel with a sulphur content less than 0.1%. Each scrubber also has to be approved as an equivalent by the flag administration of the vessel so some different flag state requirements may apply.

The Californian regulations do not permit such an equivalent.

What can Bureau Veritas do to help?

Bureau Veritas has the advantage of wide experience with many different ship types and trades. Scrubber technology is in its infancy and experience in service is limited. Flag states, port states and equipment manufacturers only see part of the picture. That makes the wider experience of class extra valuable when considering scrubber fitment.



Your choices?

The biggest decision is whether to fit a scrubber or not. It is a trade-off which depends on the individual economic and operational specifics of each ship and trade. Fit the scrubber and the ship can continue to burn heavy fuel which is usually going to be both cheaper and more readily available. However fitting a scrubber involves significant capital expenditure, crew training costs and ongoing costs in energy use, maintenance and possibly waste removal. Bureau Veritas' expert teams can make a careful case specific analysis of each ship and trade to guide that crucial decision.

Bureau Veritas can help you with:

- The initial analysis of if a scrubber makes sense for their ship and trade or not.
- The choice of scrubber system.
- Type approval of a Scheme A system.
- System and monitoring approval of a Scheme B system.
- Checking and approving the effect of the ship specific issues.
- Maintaining class after a retrofit.
- Maintaining or changing specific environmental notations such as CLEANSHIP.
- Allocation of a new additional notation EGCS-SCRUBBER.

The full requirements for documentation to be submitted for a scrubber newbuilding or retrofit and the tests required are available online at www.veristar.com

Scheme A and B approval

The IMO EGCS guidelines detail the requirements for the testing, survey, certification and verification of scrubbers to ensure that they will produce emissions levels equivalent to the fuel sulphur content limits specified and are applicable to all fuel oil machinery installed onboard ships.

The Guidelines provide specific requirements for measuring the sulphur content in the exhaust gas and monitoring wash water discharge quality, including pH changes and contaminant levels.



There are two compliance options described in the Guidelines:

Scheme A

Type Approval: demands a significant testing and approval process resulting in a Type Approval.

Scheme B

Continuous Emissions Monitoring: requires the use of sophisticated emissions monitoring equipment.

Scheme A & B are statutory approvals. Class Societies have to provide unit approval after manufacturer's request, approval of ship specific installation, independent verification (Class Type Approval) and verification of performance.

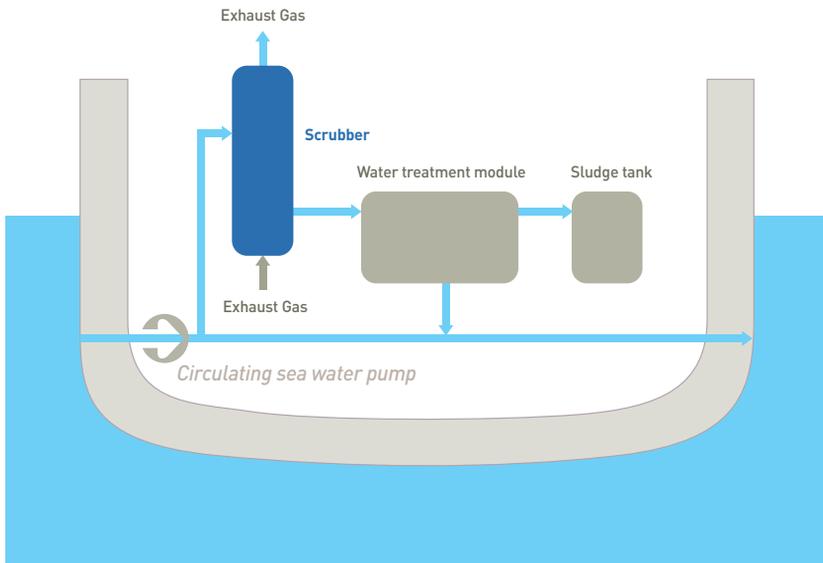
Note that according to the revised EU Sulphur Directive, ships using alternative emission abatement methods shall continuously achieve reductions of SO_x emissions that are at least equivalent to the reductions that would be achieved by using compliant marine fuels. According to EMSA, this reference to continuously achieving reduction of SO_x emissions means that Scheme A cannot be used in practice. Shipowners whose ships are intended to operate in European waters have to opt for Scheme B with continuous monitoring of CO₂ and SO_x emissions.

What types of scrubber are there?

The regulations don't say what a scrubber must be, they simply set the outcome requirements it must deliver. So owners are free to design and fit their own systems, and equipment manufacturers have come up with a number of different technological solutions. These divide into three main types: open loop; closed loop and dry systems. The IMO regulations also distinguish between two types of approval: Scheme A which is a type approval and Scheme B which is based on continuous monitoring.

Open loop system

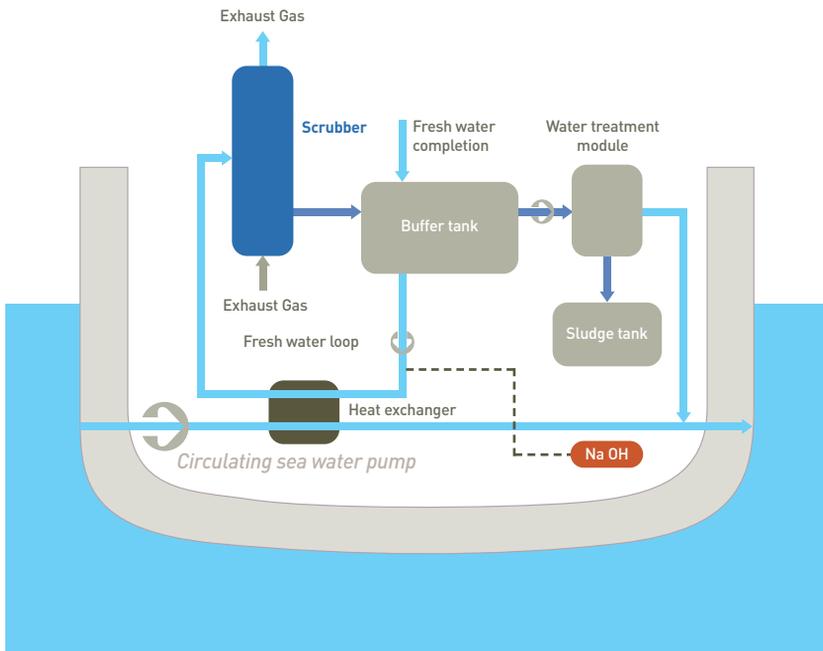
An open loop system uses ambient seawater for exhaust gas scrubbing. The sea water is filtered for heavy metals and particulate matter and then discharged into the sea containing all the sulphur cleaned from the exhaust. These are simpler systems and do not require large amounts of waste storage and handling on board but there are issues of water intake quality and more importantly some ports and areas may not permit the discharge of the waste water containing sulphur.



Closed loop system

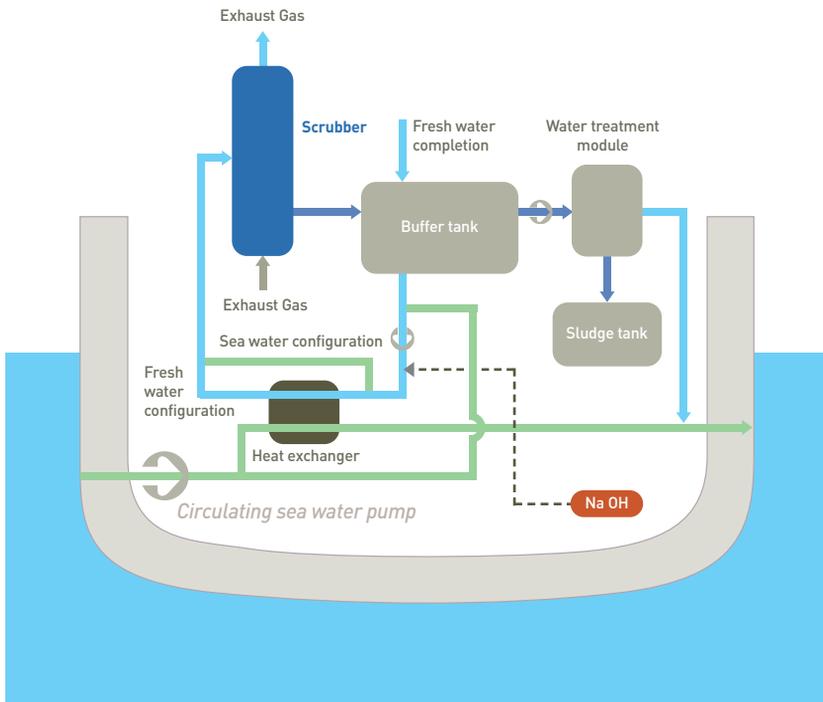
A closed loop system uses fresh water that is chemically treated usually by caustic soda injection to effect scrubbing. Most of the scrubbing agent is re-circulated with only minimal water intake and effluent discharge. These systems avoid the issues of waste water discharge but are more complex, more costly to run, and create waste storage and handling issues on board.

A variation on the closed loop system is a hybrid system which can operate as an open loop system while outside special areas.



Hybrid scrubbers

A combination of closed and open loop scrubber in order to offer only the advantages of both solutions through flexibility. It can operate as an open loop system while outside special area.



How big a job is installation?

The retrofitting of a scrubber system is complex and includes at least the following work onboard the ship:



Removal of:

- Funnel structure
- Deck platforms and ladder
- Exhaust gas pipes

Installation of:

- Deck extension, pillars, ladder and platforms
- Sludge tank (internal structure tank)
- Fresh water circulation tank (closed loop or hybrid system)
- NaOH safety measures and tank (closed loop or hybrid system)
- Scrubber itself
- Exhaust gas pipes, scrubber water pipes
- Funnel top structure

Frequently Asked Questions

1

Specific rules

What do the flag administration and the ports to be visited permit? This governs the initial choice of scrubber system.

> *Check if the local regulation allows any discharge in Port area or vicinity. Contact your local Bureau Veritas office for more information.*

2

Capacity and number of scrubbers

How many units will be needed and which engines/auxiliaries/boilers will they serve? What capacity is needed and how will shared scrubbers operate in different modes?

> *Contact your engine manufacturer and local Bureau Veritas office for early acknowledgement of common scrubber, as Bureau Veritas has specific additional requirements for that typical arrangement.*

3

Redundancy Except where low sulphur fuel oil can be used in case of failure of the scrubber, redundancy must be provided. Is a risk analysis of failure required?

> *There is no straight requirement for redundancy of scrubbers as this is not a matter of safety, however it is required that the scrubber will have full efficiency within SECA/ECA areas on the full load range, otherwise an alternative way of fulfilling SOx requirement must be made available onboard. Check also local regulation such as CARB about the acceptance of scrubber as an alternative to low sulphur fuels.*

4

Retrofitting scrubbers Is there enough space in the engine room casing/funnel to accommodate the exhaust gas scrubber, scrubbing water pumping/piping system and effluent handling?

If installed externally, the increase of the wind surface area has to be considered. In case of close loop scrubber systems, provisions are to be made for the storage and distribution of caustic soda. What effect does a heavy scrubber installed high in the ship have on the stability, deadweight and heel? Do the materials proposed take into account the acidity of the wash water?

> *Check with your local Bureau Veritas office the initial design and new arrangement for compliance with our Rules, specifically on stability, intact and damage. The extra power needed for running the scrubber will have to be taken into consideration, from a consumption and electric balance point of view.*

5

Knock on effects on existing systems and structure

Is electrical power sufficient? Is seawater pumping capacity sufficient? Will the back pressure on the engines be affected? How will acidic condensates be dealt with?

> *This is to be taken into account at the earliest stage.*

6

Sharing scrubbers Will you have one system for all the engines or individual units? What about the potential backflow of exhaust gas from engines to the exhaust gas duct of another device which is not in operation? That may pose safety issues. What about increased back pressure when two or more combustion devices are combined having different exhaust gas flow rates, temperatures and pressure? Can the common scrubber operate effectively at any flow rate over the entire range of exhaust gas of the different combinations of the combustion devices?
 > *Contact your local Bureau Veritas office for early acknowledgement of common scrubber, as we have specific additional requirements for that typical arrangement.*

7

Additional requirements

Are there maintenance and inspection additional specific requirements?

> *The Planned Maintenance Scheme must be updated to cover the additional maintenance and inspection required for exhaust gas scrubbers, pumping systems and piping. Access to the equipment including inspection manholes is to be provided*

8

SCRs and NOx What about compatibility of SCRs/NOx emissions reduction technologies?
 > *Where an SCR unit is installed to fulfil NOx emission Tier III regulations, compatibility between the scrubber and SCR systems is to be ascertained, especially the temperature at the scrubber outlet vs. temperature required at the SCR inlet.*

9

Training

Is there a need for a specific training?
 > *Crew training for the safe operation of the scrubber and handling of corrosive chemicals and waste water has to be provided.*

10

NaOH What is the impact on safety from using caustic soda onboard?

> *Reference Safety Data Sheet is giving the basic requirement for handling NaOH with care. The storage must be carefully addressed, as NaOH is extremely corrosive, so specific appropriate coating shall be considered for the storage capacity.*

11

Documentation Concerning type approval or approval under Scheme B, what shall be provided?

> *Type-approved scrubbers require a specific system technical manual which must meet the requirements and be carried on board. Scheme B scrubbers do not require type approval; instead the monitoring equipment fitted must be approved by the administration. There has to be a scrubber record book or logging system, a record of daily checks on the monitoring system and each system also requires a technical manual in a specific format. An On-Board Monitoring Manual is also required for each scrubber and each ship must have an approved SOx Emissions Compliance Plan (SECP).*

12

Specific cases Are there any specific inspection and survey?

> *All the new equipment will be subject to regular class, flag and port state inspection and survey.*



Move Forward with Confidence

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