ClassNK

Global Sulphur Cap from 2020

ClassNK Machinery Department

13 November 2019

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1. SOx and PM regulations
2. Foresight for compliance
3. SOx scrubber
4. ClassNK activities

SOx and PM regulations (1/2)

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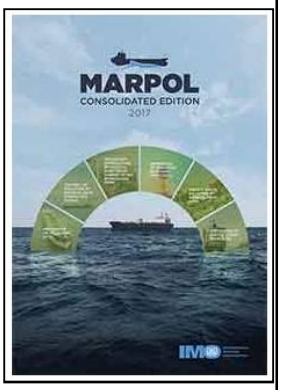
SOx and Particulate Matter (PM) (Regulation 14 of MARPOL Annex VI)

- ✓ Regulation for the sulphur content of any fuel oil used on-board ships
- ✓ Applicable to all ships regardless of ship size and intended service area

Equivalents (Regulation 4 of MARPOL Annex VI)

Equivalents such as SOx scrubber (Exhaust Gas Cleaning System: EGCS) can be used subject to the acceptance of the Flag Administration.



At MEPC 73 (Oct. 2018), amendments to MARPOL Annex VI for **a prohibition on the carriage of non-compliant fuel oil** for combustion purpose with a sulphur content exceeding 0.50% were adopted. (Enter into force: 1 March 2020)

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SOx and PM regulations (2/2)

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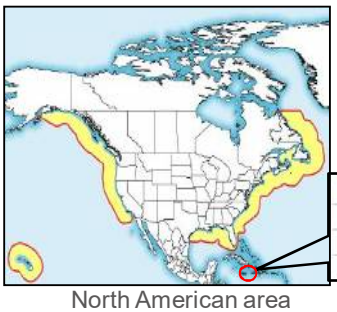
ECA: Emission Control area

North Sea area and Baltic Sea area



North American area

United States Caribbean Sea area

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1. SOx and PM regulations
2. **Foresight for compliance**
3. SOx scrubber
4. ClassNK activities

Available compliant options

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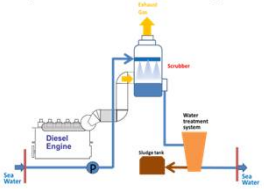
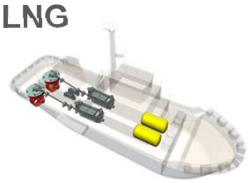
1. Compliant fuel oil	2.EGCS (SOx Scrubber)	3.Alternative fuels such as LNG
  Bunker Delivery Note		
＜Advantage＞ • No or little modifications to fuel system	＜Advantage＞ • Lower operating cost	＜Advantage＞ • Reduction of NOx and CO_2 as well
＜Disadvantage＞ • Higher fuel cost • Uncertainly of fuel quality	＜Disadvantage＞ • Higher installation cost • Installation space	＜Disadvantage＞ • Infrastructure for bunkering • Higher installation cost • Installation space

Trend for compliance

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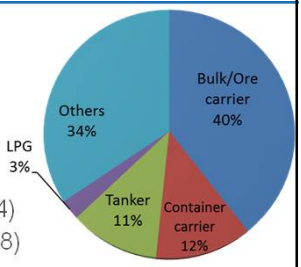
Compliant fuel oil

- Seems to become majority in 2020

EGCS installation ship

- Global (14 Oct. 2019)
  - Installed for 1,481ships (New ship: 417, Retrofit: 1,064)
  - Planned for 1,798 ships (New ship: 590, Retrofit: 1,208)

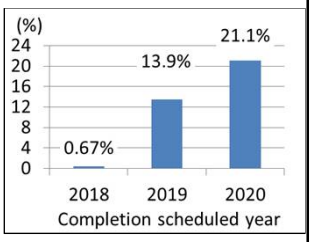
(Source: Clarkson Research Database)



NK ships installation projects
Ship type of 573 ships

- NK ships (31 Oct. 2019)
  - Installed for 172ships (New ship: 61 Retrofit: 111)
  - Planned for 401ships (New ship: 164, Retrofit: 237)

Open Loop	Hybrid	Unknown
ab. 81%	ab. 2%	ab. 17%



Proportion of NK ship planning EGCS installation

LNG fuelled ship

- Installed or ordered: ab. 220 ships (Jul. 2019)

(Source: Clarkson Research Database)

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EGCS (SOx Scrubber)

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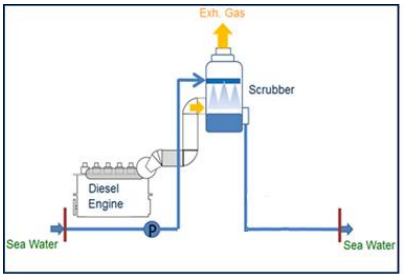
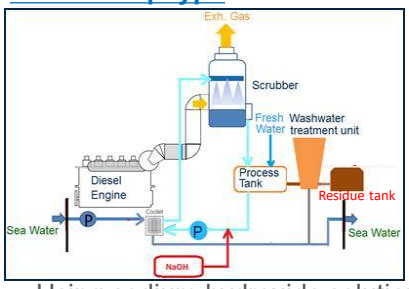
Open loop type



- Using seawater as wash water
- One through use of seawater

Closed loop type



- Using sodium hydroxide solution with recirculation

➡ Operation with no discharge overboard is possible

Operation Cost of NaOH, deliver the residue ashore

Hybrid type

- Combined type where the above two type can be switched between
- A low cost of operation without NaOH for the open-loop type as possible
- Operation without discharge in areas where washwater discharge is prohibited

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Key points for SOx scrubber retrofitting (1/5)

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✓ **Machinery**

Arrangement of equipment:

- Huge size of equipment: Need for spaces
  Discussion with scrubber maker and engineering company

Special pipe material:

- Resistance against corrosion: SUS pipe, GRE pipe (type approved)
  GRE: Glassfiber Reinforced Epoxy
- Remote ship side valve for GRE piping (washing water discharge)

Back pressure on engines:

- Increase of the pressure → Suitable to the engine design?
- NOx regulation: Limited the pressure in NOx technical file

Boiler:

- Example: Engine/boiler common exhaust gas piping
- Misfiring on boiler: By engine back pressure
- Measures: Forced draft fan, Damper

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Key points for SOx scrubber retrofitting (2/5)

✓ **Machinery**

Sea chest:
- Add/Enlarge sea chests for the intake of washing water
- Majority: To add sea chests exclusive for scrubbers

Electric power capacity:
- Replace/Add generators and generator engines as necessary
- NOx Tier III applied for the engine (only for operation in ECA)
- Example: App. 320kW added (@VLCC)

Short-circuit current:
- Increase of short-circuit current: By additional equipment
- Circuit breaker(ACB/MCCB): Capacity checking

Key points for SOx scrubber retrofitting (3/5)

✓ **Hull**

Increase of lightweight(L/W):
- Revision: Stability information, Loading manual, Damage stability calculation, Loading/Stability computer
- Inclining test: 2% difference on L/W, 1% difference on LCG* (Ls basis)
  LCG: Longitudinal Centre of Gravity
- Navigation Bridge Visibility: To be confirmed

Increase of gross tonnage(GT):
- Reissue: Tonnage certificate,
  other statutory certificates
  (because of GT described)
- Reissue (as requested):
  PC/UMS Documentation,
  Suez Canal tonnage cert.

Source: Alfa Laval HP

Key points for SOx scrubber retrofitting (4/5)

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✓ **Hull**

Hull structure:
- Reinforcement: Enlarged funnel, Scrubber installation

Fire protection:
- Fire protection: For the spaces adjacent to the installed space
- Fire damper: On the ventilating facility

Equipment number:
- Anchor, Chain, Rope: Changed (when the number increased)

Hull painting:
- Strong acidity of discharging water (washing water)

Life Saving / Navigation Equipment:
- Obstruction of Navigation Light
- Access to lifeboat

Key points for SOx scrubber retrofitting (5/5)

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✓ **EEDI**

EEDI calculation:
- EEDI application: Jan. 2013 on the contract date basis
- EEDI value worse: By deadweight decreased (L/W increased)

$$\text{EEDI} = \frac{\text{Output} \times \text{Fuel Oil Cosumption} \times \text{CO2 factor}}{\textbf{Deadweight} \times \text{Ship speed}}$$

- Major conversion → EEDI recertification
- Example: 1% deadweight decrease = 1% EEDI worse
  → EEDI compliance is not so difficult

✓ **Fire fighting**

Fixed fire fighting system:
- Enlarged engine casing → Capacity (CO_2, Foam, Water-spray)
- SOx scrubber room → portable fire-extinguisher, fire detector

Outlines of IMO Guidelines

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Exhaust gas criteria

Fuel oil sulphur content limit (% m/m)	SO_2(ppm) / CO_2 (%v/v)
0.50	21.7
0.10	4.3

Reference: Website of Alfa Laval
Example of scrubber

Reference: Website of SICK
Example of ex. Gas monitoring system

Approval Scheme

Scheme A
- Approval of EGC unit
- Continuous onboard monitoring of operating parameters

Scheme B
- Approval of exhaust gas monitoring system
- Continuous onboard monitoring of SO_2 & CO_2

Almost all cases, Scheme B is selected

Washwater discharge criteria

✓ Items to be continuously monitored and recorded
- pH
- PAH (polycyclic aromatic hydrocarbons)
- Turbidity
- Temperature

✓ Washwater analysis for nitrates concentration
(The analysis result is to be confirmed at ***Installation survey*** and ***Renewal survey***)

Phenanthrene
(a kind of PAH)

Approval of SOx Scrubber

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Equivalents (Regulation 4 of MARPOL Annex VI)

✓ The Flag Administration may allow the use of an equivalent.
Applicable requirements: EGCS Guidelines (Resolution MEPC.259(68))

General approval procedure:

NK: Contact the Flag Administration
↓
Flag: Instruction of examination/approval work to Class
↓
NK: Confirmation of compliance with the guidelines
Report the result to the Flag Administration
↓
Flag: SOx scrubber approval (as an equivalent)
↓
NK: Issuance of IAPP certificate
Flag: Communicate to IMO for circulation to the relevant parties

< Main contents >
- Approval Scheme
- Exhaust gas limit
- Discharge water criteria
- Onboard documents, etc.

NK's work for confirmation of compliance

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① Approval of statutory documents, test procedures, etc.

↓

②Survey for operation test, etc. (including washwater sampling)

↓

③ Receipt test results including nitrate analysis to NK
(For nitrate analysis, it takes 1 ~ 2 weeks.)

↓

④ Report to the Flag Administration for approval

In case ①~④ cannot be completed by the delivery/ leaving the dock, a request for exemption by the flag Administration may be required.

Status of Approval at Installation Completion (NK vessels)

Status of Approval	New vessel	Retrofit
All completed	75%	1%
Not completed -Only ① completed-	0%	21%
Not completed -Only ①&② completed-	11%	62%
Not completed -Due to trouble in ②-	14%	16%

Case example at EGCS installation

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Trouble during scrubber operation test

- Failure relating to the measurement of exhaust gas
  - Calibration for the exhaust gas monitoring system could not be carried out accurately due to the leak from the sampling line.
- Failure relating to the measurement of washwater
  - Flow meter in the measurement system could not be operated.
  - PAH values could not be measured accurately due to insufficient cleaning, air bubble, etc.
- Failure relating to software
  - Measurement values could not be recorded to the recording devices appropriately.
  - Measurements values could not be output.

IMO discussions

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Guidance for EGCS malfunction and failure MEPC 74 (May 2019)

Adopted the guidance for shipowner, Administrations, PSC, etc. on how to address scrubber malfunction, failure, etc. (MEPC.1/Circ.883)

- **Short-term temporary emission exceedance due to the system response;**

  Transitory periods and isolated spikes are not to be considered as a breach.

- **System malfunction not rectified within one hour;**

  Changeover to compliant fuel oil and report to the flag and port State's.

- **Failure of single monitoring instrument;**

  It is indication of the ongoing compliance in the case of followings:

  ✓ EGCS is running on a fuel oil with a constant sulphur content and at constant washwater engine load ratio; and

  ✓ the other parameters are continuing at the normal levels.

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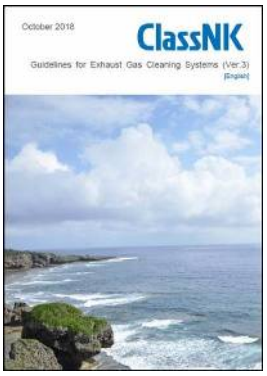
Providing Supports with the 2020 Sulphur CAP

Guidelines for Exhaust Gas Cleaning Systems

Providing the information of the introduction of EGCS including safety requirements for installation of EGCS, Class Notation and Local regulations.

Guidelines for Exhaust Gas Cleaning Systems (Ver.3) (Oct. 2018)

[Contents]



Providing Supports with the 2020 Sulphur CAP

Planning for Change to Compliant Fuel Oil

- **Sample of ship implementation plans (SIP)**
  ClassNK has developed *Sample form of SIP with sample of description.*

- **Appraisal of implementation plans** Examined
  ClassNK offers the Appraisal Service for examination of SIP developed by ship side on voluntary basis.

- **Appraisal facts of fuel oil tank cleanings, etc.** Statement
  ClassNK offers the Appraisal Service relating to change to compliant fuel oils (e.g. such as fuel oil tank cleaning before bunkering compliant fuel oils, etc.)

For detail including application process and other services, please refer to the “SOx・PM regulations” page on of our website.

URL: http://www.classnk.or.jp/hp/en/activities/statutory/soxpm/index.html

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Guidance for use of Compliant Fuel Oil

- Focused on the five fuel properties, Compatibility, Low viscosity, Cold flow properties, Cat-fines, and Ignition/Combustion quality.
- Wrapped up the potential changes and potential risks associated with the five properties, and reviewed mitigation measures against these risks.

Guidance for onboard use of Compliant Fuel Oil with SOx regulation from 2020 (Mar. 2019)

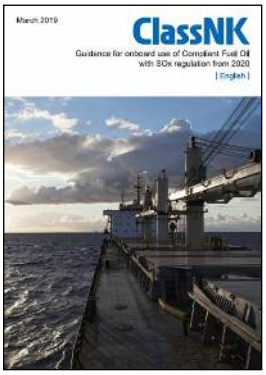
[Contents]

Chapter 1: Outline of SOx regulations applied from 2020

Chapter 2: Compliant Fuel Oil from 2020

Chapter 3: How to use compliant fuel oil on board in safe

- Mitigation measures for five potential implications



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Booklet for ship crew members

For crew members, providing the information focusing on the "**compatibility**" and "**cold flow properties**" of compliant fuels as well as the risks related to the changing over to compliant fuel oils and the measures necessary to mitigate such risks.

Precautions concerning change-over to 0.50% sulphur compliant fuel oils (Sep. 2019)

[Contents]

Chapter 1: Risks associated with the changing over to compliant fuel oils

Chapter 2: Measures for changing over to compliant fuel oils

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