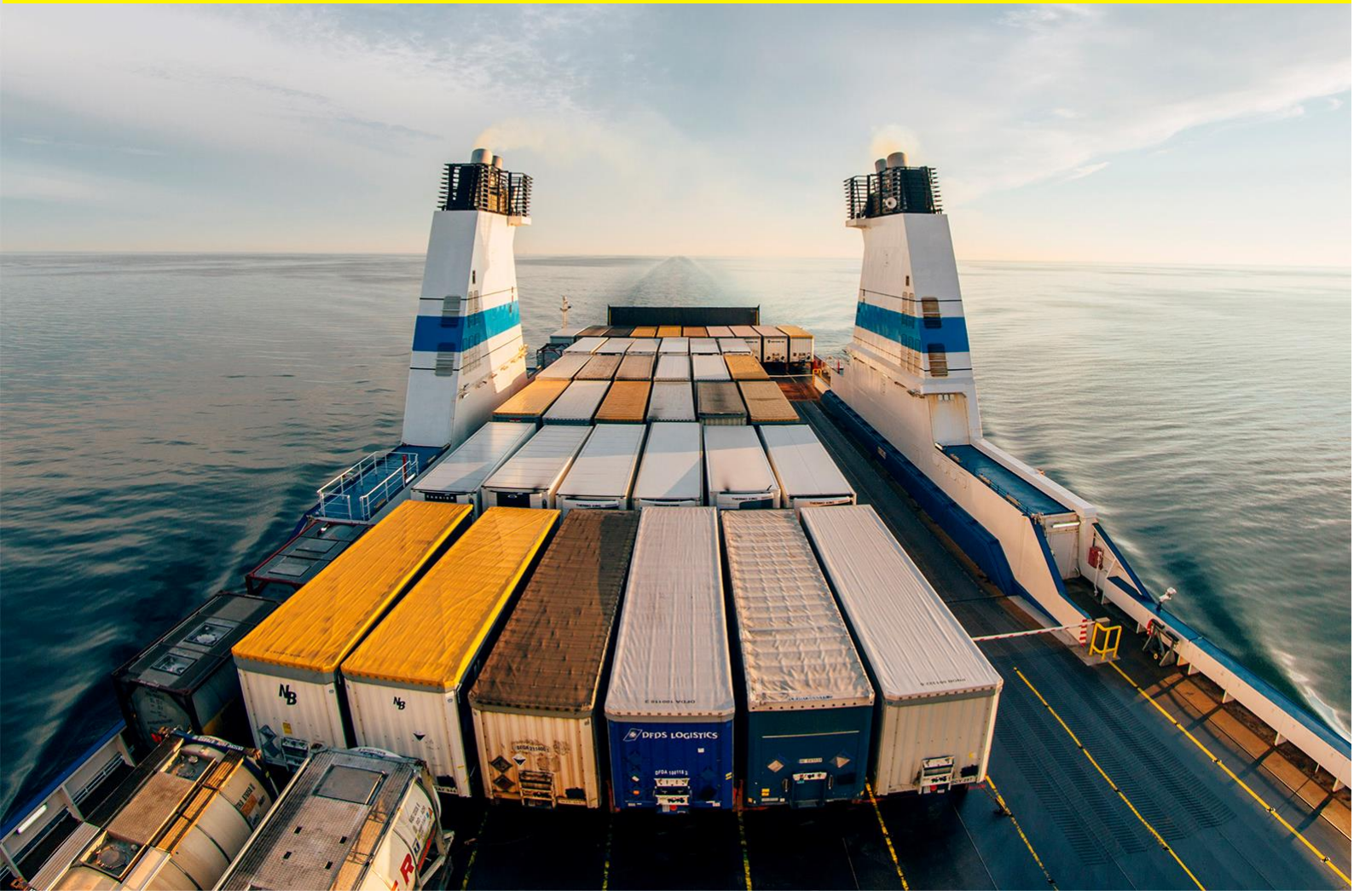
CompMon

Compliance monitoring pilot for Marpol Annex



Guidance for Procuring Sulphur Monitoring Services or Equipment

Finnish Transport Safety Agency

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POLICY AREA 'SHIP'

CompMon

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Compliance monitoring pilot for Marpol Annex VI

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Abstract

The scope of sub-activity 2.1 was to collect and summarize information regarding procurement of sulphur monitoring services or equipment to help other authorities that are planning to procure sulphur monitoring services or equipment. The information has been collected from procurement processes made by Finnish and Danish authorities and summarized in this document. The document does not focus neither on national or EU-legislation regarding public procurements nor the prices of services or equipment.

The Danish Environmental Protection Agency published the first call for offers titled "Surveillance of sulphur emissions from ships in Danish waters" in January 2015. The Finnish Transport Safety Agency (Trafi) had a similar call in December 2015. In addition to these two procurement processes on remote monitoring services, Trafi had another call on acquisition of portable XRF-equipment on May 2016.

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1 Preparation of the tender material

Remote sensing of Sulphur emissions from ships for authority purposes is a relatively new thing and has been done only by few countries so far. Therefore, when an authority starts to prepare tender material it's important to allocate necessary resources for the job. Setting up a project organization with different specialists (finance, procurement law, IT etc.) may be the best choice for the best outcome. An authority organization won't most likely have all the know-how needed, so seeking external expertise or consultation may be necessary.

Since the field of remote sensing is still developing and local circumstances (geography, wind etc.) vary, determining the concept of remote monitoring cannot just be copied from something that someone else has done elsewhere. The technology aspect, what is available at the moment, can be solved by conducting a technical market survey. Another approach to find out possible solutions is to invite the service providers to present their products. Companies tend to be more than happy to do so.

An efficient remote monitoring network is often a combination of mobile and fixed monitoring platforms. With fixed platforms positioned along busiest shipping routes and harbors it's possible to gain a large number of measurements. The disadvantage with fixed platforms is that they provide no information about the actual compliance further at sea. Based on the experiences in the CompMon-project, some ships are compliant at ports, but at-sea observations indicate non-compliance at sea. Mobile monitoring is the only solution to detect compliance or non-compliance further away from the coastline.

When preparing the tender, one important selection that must be made is whether to split fixed monitoring and mobile monitoring to separate call for offers or to keep both deliverables in together in one call. On the authority´s perspective, the downside with splitting is that it doubles the related paperwork. On the other hand, by splitting it´s possible to get more offers.

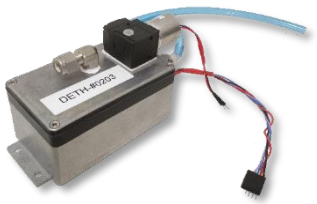
2 Remote sensing instruments and the XRF

Below short descriptions of measurement techniques that have been used on the CompMon-project:

2.1 The sniffer method (air sampling)

- In the sniffer method an air sample is analyzed inside the equipment.
- Direct contact with plume required
- The concentration ratio of SO2 and CO2 in the smoke is proportional to fuel sulfur content consumed in ship's engine.
- Wind direction and force sets the most significant limitations.
- Sniffer systems are based on standardized equipment for air quality monitoring based on infrared (CO2), UV fluorescence (SO2) and chemiluminescence (NOx).
- Requires ~500W power + possible air conditioning or heating
- Weight +60 kg

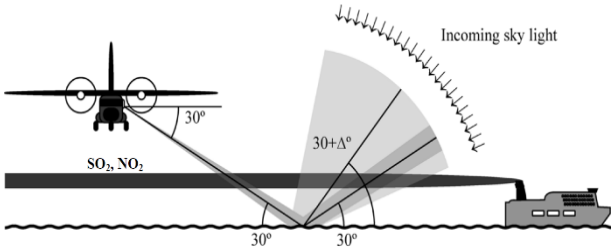
2.2 Mini sniffer



- Same principle as above, but with smaller electrochemical sensors.
- Advantages: small size, lower price and simple operating conditions.
- Disadvantages: sensitivity to the environmental conditions, high detection limit and cross sensitivities.
- High quality measurements require higher concentrations and longer exposure
- Low power consumption
- Weight 500g →

2.3 The Optical Method (DOAS)

- DOAS - Differential Optical Absorption Spectroscopy
- An optical sensor measures the concentration of SO2 and NO2 in the ship plume by spectroscopic analysis of reflected solar light that passes through the smoke
- The equipment automatically measures mass flow of SO2 and NO2 and combined with modelling of CO2 it can produce an estimate of the fuel sulphur content enough to differentiate between 1.0% and 0.1%.
- Requires sun light
- Distance to vessel max 1 km
- Requires ~200W power at minimum
- Weight 80 kg



2.4 The XRF

- Portable XRF-scanner for analyzing Sulphur content of fuel onboard instead of sending samples to laboratories.
- Fuel sample is placed on a designated sample cup for analysis
- Used by national Port State Control and Sulphur inspectors.
- Easy to use
- Good accuracy
- Weight 1,5 kg + accessories & case
- Multiple analyses with a single charge

2.5 Other instruments

AIS (Automatic Identification System) –data is used to identify vessels and to address a single measurement to a specific vessel. Therefore, platforms are equipped with an AIS-receiver.

Identification of a plume emitter can not only be done based on AIS-data. AIS-data is combined with information of wind conditions. Platform can be equipped with a weather station or an external source eg. avionics or nearby weather station can be utilized. Other meteorological information like temperature and humidity are also recorded and can be used for quality evaluation.

3 Platforms

3.1 Fixed

- Port entrances, bridges, lighthouses, islands along shipping lanes
- Sniffers and DOAS
- Four main conditions for location selection:
  - distance to fairway
  - prevailing wind direction
  - power source
  - permit to install equipment
- Distance to fairway few hundred meters, but results can be obtained up to two kilometers in optimal wind conditions.
- Mixing of plumes, emitter identification

3.2 Aircraft

- Sniffers and DOAS
- Each plume to be physically reached → special flight pattern → sniffer flights cannot usually be combined with other type of tasks eg. oil pollution monitoring

- Distance to vessel from 200 up to 2000m
- Altitude 150-350 ft (sniffer), 600-1200 ft (DOAS), speed 100-120 kn
- Current sniffer sensors require 1-2 seconds exposure
- Possible to measure +10 vessels/hour in good conditions
- Aircrafts need to be certified
- Flight permits to fly low altitudes
- Mixing of plumes, emitter identification

3.3 Helicopter

- Mini-sniffers
- Sample is taken very close to the vessel combined with adequate sampling time makes it possible to gain high quality measurements
- Almost 100% emitter identification, hardly any mixing of plumes
- Altitude 100-150 ft, speed same as vessel´s
- Up to 15 vessels / hour
- Permits/qualifications/procedures to operate close to the ships

3.4 RPAS / UAV

- Mini-sniffers practically only sensor solution due lighter payload
- Testing has been made outside the CompMon-project.

3.5 Boat / vessel

- Sniffers
- Small boat is more agile compared to larger patrol vessel
- Small boat more sensitive to weather conditions
- Mixing of plumes, emitter identification

4 Reporting the measurements

Reporting the results to authorities can be done in several ways. The most important matter is that results are reported without significant delay so Port State Control or Sulphur inspectors can react as soon as possible to potential violations.

It is common that all measurements are reported and stored into a database which can be accessed by national inspectors through web browser. Also automatic alerts to inspectors of measurements that fulfill certain pre-set criteria (triggers) can be set. Format of these alert messages can be either SMS or e-mail. Practice has shown that since almost all inspectors use smartphones with e-mail application, the e-mail alert is preferred due the limitations of SMS-message length.

4.1 Time

Fixed platforms don’t usually have any significant delay in reporting; results are reported as soon as measurements are processed. If the platform is located further away at sea and no mobile data network is available, reporting can be done via satellite and in that case reporting intervals can be longer.

If mobile platforms operate beyond mobile data coverage, reporting is normally done soonest after the mission if not automatically after mobile network is reached. In such cases the reporting time seldom is longer than two hours. If observations require manual quality control, the time may be somewhat longer.

4.2 Format

On authority´s perspective the most essential data regarding an observation are vessel´s identification (IMO number, name), fuel sulphur content (FSC), destination,

time and position of the observation and quality of the measurement. This information fits a standard SMS-message of 160 characters and is normally enough for the authority´s representative to decide on need of further actions.

The database to which all observations are reported can have more detailed information concerning the observations. It will be useful to have an easy to use tool that can create summary reports and statistics based on different variables. With some reporting tools it is possible to create even animations when observations are combined with AIS-data.

4.3 Measurement accuracy and quality control

When evaluating the need of actions based on a remote sensing observation, the limitations regarding the accuracy should be noted. With sniffer´s relative uncertainty of 50-100% at 0.1 % Sulphur content level it is not practical to focus on the second decimal. To help PSC and Sulphur inspectors analyze the measurements different types of flagging systems have been developed. For example, an observation that is above the legal Sulphur limit even when the uncertainty is counted is given a red flag. This way the inspectors can focus on the most likely non-compliant vessels (red flags) and select those for onboard inspections or further reporting measures.