Demo Project

Appendix 14b - Verification report

Version 2004-02-23

Summary

The emissions by Bro Atland the 17th-18th December 2003 that can be verified and reported to a potential EU Registry are 1159 kg SO2. The emissions were successfully measured and verified, the reported uncertainty and reviewed uncertainty calculations are within 5%. The final verification reporting from this test (with the limited scope) is an Audit report (attached to this report). The method of measuring engine load to calculate fuel consumption and the related SO_2 emissions is feasible.

Table of contents

1 Bro Atland – Planning, execution and completion

The scope in this test was to simulate a full scale Review as far as possible considering the scope of the Demo Project. However, since the ship owners are not producing emission reports the audit assertions will be used solely on the data received from the monitoring equipment and site visit observations.

1.1 Planning verification on Bro Atland

1.1.1 General risk assessment

General risk assessment performed based on the knowledge obtained during Demo Project Phase 1. Emphasis was put on the monitoring equipment and data generation. Key risks identified and evaluated as significant:

- Disruptions in the continuous monitoring or logging (equipment difficulties)
- Monitoring of fuel consumption, fluid meter
- Monitoring of the “correct” engine effect

- Monitoring of which tank of fuel, with corresponding sulphur content, that was used which time
- The existing internal controls and possibility to perform additional internal controls
- Position and time reporting

1.1.2 Materiality

Materiality is a key issue for the verification. The materiality is normally defined in the rules for each emission trading system set up. Since no rules so far are set for a future trading system we have assumed an overall materiality level on 10 % (95%-confidance interval) for the reported SO_2-emissions/reductions. This materiality level is in line with (or somewhat more demanding than) the level for corresponding market-based instruments for land-based sources[1]. This results in that factors or parameters that has the ability to influence the reported emissions/reductions with at least a couple of percentage has to be reviewed more thoroughly. The possibility to influence can be a result of statistical & systematic uncertainties (human errors) in the monitoring process as well as non-functioning monitoring equipment. Statistical uncertainty from factors (taken from Chapter 6 and 7 of the Phase 1 draft report) to be considered as possible to influence materiality for the Bro Atland monitoring test is:

- Turbo speed (rpm, mA converted to mV)
- P (kWh) from turbo speed
- GFUEL from (P (kWh))
- GFUEL from fluid meters l/h
- Fuel sulphur content (analysis and fuel/tank)
- Position
- Time

[1] The Swedish NO_x-system, Ontario emission trading system

1.1.3 Scope and sample selection

The scope is based on the verification instructions in chapter 13 of the Phase 1 draft report and the uncertainty risks identified in this report. Main focus has been on monitoring equipment and data collection, but time and geographical parameters has also been covered.

In a future emissions trading scheme the emissions/emission reductions will probably be reported annually. In this case the verification will start with the selection of a number of samples to review in detail. In Phase 2b of the Demo Project the reported emissions/emission reductions cover only a couple of days. In this case the samples cover more or less the whole reporting period and all the underlying parameters.

1.1.4 Assessment of the Control Environment

The main control environment to be checked in the Bro Atland case is the control environment of the persons and equipment involved in the monitoring and also the consumed fuels sulphur content. Consequently the verification will focus mainly on the control environment of IVL and only to some extent of Broström and the vessel Bro Atland.

Some questions regarding the control environment of already implemented systems, like: Safety Management System, Quality Management System, Environmental Management System, etc have been put to the Ship Owners (since the Control Environment for emissions reductions is not widely spread).[2]

1.2 Execution Bro Atland

1.2.1 Ship visit Bro Atland

The auditor Johan Jacobsson, PricewaterhouseCoopers visited Bro Atland during the monitoring test (18 December 2003) and joined Bro Atland when the vessel arrived at the port in Le Havre. Interviews with key personnel such as technical chief (Sven-Olof Olsson, Broströms), electrician and person responsible for the SO_2 measuring (Eje Flodström, IVL) were conducted.

Review of monitoring equipment

Review included the following checks on the monitoring equipment:

- Routines for measuring oil fluid meters, data samples extracted every hour during the trip from Antwerpen to Le Havre. → OK!
- Measurement instrument settings for measuring number of turbo revolutions (turbo revolutions correlate directly with engine load through a constant). The revolutions were sampled every tenth minute via the instrument giving a mA signal that was converted into a mV signal. → OK!
- Calibration of cylinder pressure is done one time per month; this gives engine load and the correlating constant to turbo revolution. → OK!
- Instrument display on turbo revolutions and computer input correspond to noticeable (by engine sound and vibrations and throttle lever) adjustments of engine effect. → OK!

[2] Discussions with Peter Stenberg, Technical Manager, Broström Ship Management AB and Christer Carrwik, Technical Superintendent, Broström Ship Management AB.

- Electrical cables running from turbo instruments to one independent logger and one PC-computer. All monitoring parameters stored in PC (both a: and c: discs) and logger → OK!

Review included the following checks on the monitoring equipment in the engine room:

- Fuel pump index on the last check for ME, these are manually recorded → OK!
- Fuel tank monitoring (which tank that was connected to the settling tank) checked through the instrument panel → OK!

Executed counter checks

- Turbo revolutions giving engine load and fuel consumption where counter checked with flow meter → OK!
- A discussion with the technical chief (Sven-Olof Olsson, Broströms) made it clear that different fuels are never mixed when fuelling up, this because it may inflict damage to the main engine. If fuels are mixed they will be used in the heaters instead.

1.2.2 Interview with key persons, etc

During the ship visit the person responsible for the monitoring test (Eje Flodström, IVL), the technical chief (Sven-Olof Olsson, Broströms) and the electrician in the engine control room were interviewed briefly. Issues discussed were existing practices/operations and suitable routines or management system to fit potential future monitoring routines in. During the ship visit observations of practices/operations was also conducted → OK!

A more thoroughly follow-up interview with Eje Flodström, IVL, was conducted 11th February 2004.

1.2.3 Review of documents, systems and control environment

The control environment of IVL is assessed as being very good. The Swedish Board for Accreditation and Conformity Assessment (SWEDAC) has accredited IVL to perform monitoring based on the Technical NOx Code[3] and ISO 8178 (relevant for measuring engine load as well). → OK!

The documents, systems and control environment of the ship are not relevant in this case since a continuous monitoring system and corresponding monitoring routines for the purpose of emissions trading is not implemented. However, some documents regarding routines for reading of meters, instruments and position resulting in metered data in logbook were reviewed during the ship visit → OK!

1.3 Completion - Document review and examination of measuring results and calculations – Bro Atland

1.3.1 Analysis of verification data – Bro Atland

Interview with key persons, etc

A thoroughly interview with Eje Flodström, IVL, was conducted 11 February 2004. All raw data, calculation models and background documents (electronic & paper) were reviewed.

[3] Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines, MARPOL, Annex VI

Analysis of verification data

In the process of calculating the emissions and imaginary emission reductions as presented in the report "Sulphur emission monitoring on board Bro Atland"[4] IVL has used the following steps (according to methods described in the draft Phase 1 report[5]) to convert raw turbo speed data to reported emissions/emissions reductions: conversion of raw data (in mV) to correct unit (kg), correction for drift of instruments (from calibrations, correction for turbo speed through cylinder pressure), correlation factor between turbo speed to engine load, correlation factor between engine load to fuel consumption (from engine test bed protocol, MAN B&W), emission factor for relevant fuel (sulphur content). All steps demonstrated and documents reviewed. Assumptions and methods reasonable and in line with relevant standards (as presented in the Phase 1 draft report) → OK!

In order to convert raw data from turbo speed to engine load and fuel consumption the following steps has been used (according to methods described in the draft Phase 1 report): engine test bed protocols, fuel receipts and fuel analysis (sulphur content). All steps demonstrated and documents reviewed. Assumptions, values and methods reasonable and in line with relevant standards→ OK!

Recalculation of spot checked data

Spot-checks where performed using the data IVL collected through the logger. The Excel sheet was thoroughly examined; turbine speed relation to engine load and corresponding fuel consumption was recalculated and thereby verified. The cylinder pressure by Imnes[6] that was used for calibration of turbo performance vs. engine load was recalculated and thereby verified → OK!

Uncertainty calculations

The uncertainty calculation for the monitoring performed on Bro Atland is identical with the one in chapter 8.4 in the draft phase 1 report (Summary of parameter uncertainty and IMO QA routines) of the Phase 1 draft report. These calculations generate an estimated uncertainty on ± 5-15% (95% confidence level) according to the Phase 2b report. In order to achieve the materiality level selected for the verification an addition of the reported emissions have to be done to be sure (95% confidence level) that the reduction is not overestimated with more than the selected materiality level. Since the reported uncertainty is ± 5-15% an addition with 5% will be done due to uncertainty when the reported emissions are verified.

1.3.2 Management representations – Bro Atland

Management representations have not been included in this test. In this test the management representations is replaced by the emissions/emission reductions reported for Bro Atland in the monitoring report of IVL. In the IVL report emissions of 1104±55 kg SO_2 during a voyage between Antwerpen and Le Havre (21 h) the 17th-18th December 2003 is reported.

In the future trading system the management representations will probably be in the form of monthly emission reports for each ship (if selected as operational entity). An annual emission report/statement with summarised emissions/emission reductions and key information regarding ship, abatement technology and monitoring technique would probably be the document the verifiers would express an opinion on. The annual emission report/statement should be signed by a person authorised to sign for the ship owner of the particular ship.

[4] Flodström, E. (2004-01-29) 'Sulphur emission monitoring on board Bro Atland', IVL report U -905.
[5] Hansén, O., Gavelius, M., Jämttjärn, J., Cooper, D. and Flodström, E. (2003) 'Feasilibity of emission trading at sea – Phase 1 draft document 2003-08-28' chapter 6 and 7
[6] Imnes Cylinder Pressure Measuring, IVL Report U-905 appendix 3

1.3.3 Verification results & reporting – Bro Atland

The emissions discharged by Bro Atland the 17th-18th December 2003 that can be verified and reported to a potential EU Registry[7] are 1159kg SO_2. A 5 % addition from the emissions reported in the IVL report (1104±55 kg SO_2) has been done as a result from the presumed materiality level, the reported uncertainty and reviewed uncertainty calculations. The final verification reporting from this test (with the limited scope) is an Audit report (attached to this report).

In the future trading system the verification reporting will probably cover the emissions/emission reductions reported annually and the assurance engagement will consider both the verification of data and management systems as well as the behaviour of key personnel. In this specific case we have emissions reported for a couple of days and an assurance engagement mainly considering the verification of data, since management systems and thus the behaviour of key personnel regarding emissions monitoring and reporting are not yet implemented. In the future the monitoring systems will most probably be able to report emissions data with less uncertainty.

1.3.4 Management reporting- Bro Atland

In this test the management reporting will be to the steering committee of the Demo project.

In the future emissions trading system an add-on value of the verification will be the recommendations of improvements that the verifier will communicate to the management of the ship and the ship owner.

[7] Or other equivalent authority or organisation that will be responsible for keeping track on all created and transferred emission reductions/credits.