

Ensuring **real-world NO_x** **compliance** through mandatory continuous emission monitoring

Introduction

Experience from recent Port State Control inspections and operational data indicates that NO_x emissions from ships, including TIER III-certified ships, are in several cases higher than expected under real operating conditions. These exceedances are suspected to originate from partial or complete malfunctioning, degradation, or non-operation of NO_x reduction systems, including SCR and EGR. The core challenge is not the absence of certified technology, but the lack of effective means to verify its continued, real-world performance. (IMO, 2026;PPR 13/8/1)

Danfoss IXA, as a manufacturer of continuous emission monitoring systems (CEMS) for marine applications, presents this paper to highlight the limitations of current compliance approaches and to propose continuous NO_x monitoring as a practical and technically mature solution.

Limitations of existing compliance methods

The current methods used to determine continued functioning of NO_x reduction systems have fundamental shortcomings.

The Parameter Check Method, while simple to apply, cannot properly detect SCR degradation, catalyst poisoning, incorrect dosing, or bypass operation. As a result, real-world NO_x emissions remain unknown, even when all parameters appear nominal.

The Simplified Measurement Method (SMM) provides some onboard NO_x measurement, but only at discrete points and operating conditions. It therefore offers a fragmented picture and cannot reliably detect dependency-related failures or long-term degradation of NO_x reduction systems.

Advantages of continuous NO_x monitoring

Direct, continuous measurement and monitoring of NO_x emissions provides full transparency of actual emissions under all operating conditions. Continuous NO_x monitoring detects SCR degradation and malfunction in real time, reflects true emissions during transient operation and varying loads, and enables alarms when limits are exceeded.

A mandatory continuous NO_x monitoring approach could replace the current non-representative load-cycle-weighting methodology with averages based on actual time spent in Emission Control Areas, significantly improving environmental integrity.

Benefits for Port State Control and Class Surveys

With continuous NO_x monitoring, both Port State Control inspections and Class Surveys are simplified. Compliance can be demonstrated through recorded data rather than documentation alone, and clear alarms can indicate exceedances at engine-specific limits correlated with load.

Experience from exhaust gas scrubber regulation shows that when continuous monitoring is mandatory and enforced, both abatement systems and monitoring equipment are maintained and failures are addressed promptly. A similar regulatory approach for NO_x would deliver comparable results.

Equality between compliance procedures

A key concern is the lack of equality between different compliance procedures. In practice, voluntary NO_x measurement has proven ineffective. When NO_x data is perceived merely as an operational inconvenience rather than a compliance requirement, real emission reductions are not achieved.

To establish level playing field, measurement of the regulated substance, NO_x, must not be optional. Compliance pathways can only be considered equivalent when based on objective and verifiable emission data.

Cost, feasibility, and market maturity

Continuous NO_x measurement technology is already available and reliable. The cost of installing and maintaining CEMS is modest relative to investments in NO_x abatement equipment and insignificant compared to the environmental cost of non-compliance.

Concerns regarding limited sensor availability should be addressed through regulation rather than inaction; mandatory requirements will expand the market and further improve reliability and cost efficiency.

Conclusion and recommendation

The primary reason for undetected NO_x non-compliance today is the absence of continuous measurement. As the regulated substance, NO_x, must be monitored directly to ensure that regulations achieve their intended effect.

Danfoss IXA recommends making continuous NO_x measurement mandatory, at least during operation in Emission Control Areas, as part of demonstrating continued compliance of NO_x reduction systems..