INNOVATIVE SOLUTIONS FOR MARITIME EMISSIONS MANAGEMENT

SeaARCTOS™

THE SCIENCE OF COMPLIANCE

ACCURATE AND ACTIONABLE EMISSIONS DATA DELIVERED TO YOU IN REAL-TIME

Accurate verifiable emissions monitoring and data reporting remains a huge challenge for the shipping industry. ARCTOS-1™ is the only solution that can reliably collect and transit emissions data to the stakeholders that need it, enabling owners to increase transparency, demonstrate compliance and improve efficiency of vessel inspections.

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THE SCIENCE OF COMPLIANCE

The shipping industry is vital to the global economy, but it's also a significant source of carbon emissions. With stricter regulations like MARPOL, the IMO emissions target, Fuel EU and carbon reduction targets, shipowners, charterers, and operators face mounting pressure to monitor and reduce emissions. Existing solutions, however, are often expensive, complex to install, and prone to malfunctions or tampering—creating significant challenges for vessel owners, operators, flag states, and classification societies.

SeaARCTOS offers a solution. Designed specifically for shipowners and operators, our ARCTOS-1™ technology enables emissions compliance with real-time, accurate data.

Approved by leading classification societies and compliant with major flag states, SeaARCTOS provides reliable, tamper-proof data on sulfur and CO_2 emissions. It helps operators meet regulatory requirements, monitor emissions targets, and achieve cost-effective compliance. With its cost-efficient design, SeaARCTOS adapts to evolving regulations, ensuring you stay ahead of environmental mandates while improving operational efficiency and profitability.

EMISSIONS MANAGEMENT MATTERS

> *[SeaARCTOS] technology provides a cost-effective means to determine compliance, or non-compliance, for each individual vessel. If a vessel presents with an operating SeaARCTOS device fitted, our inspectors can focus on the other vessels that do not have the device fitted and preempt my teams inspection with 'why don't you?'*
>
> Rear Admiral John Nadeau, US Coast Guard (ret)

Emissions Management Is Key To A More Sustainable And Profitable Maritime Future

To ensure compliance with MARPOL emissions targets and other regional regulations, vessels entering and exiting designated Emission Control Areas (ECAs) are required to lower their emissions.

It is estimated that the number of (S)ECA Zone Transits that require national enforcement could conservatively reach around 800,000 per year.

The cost of MARPOL Non-Compliance

Currently, around 10% of vessels entering ports in ECA zones are inspected by coastguards. These inspections involve physical fuel tank sampling, calculations based on reported (S)ECA boundary crossings and fuel consumption, and, in some cases, chemical analysis of fuel samples. This process often leads to significant and costly delays for vessel operators.

With SeaARCTOS, we can provide accurate, real-time class approved monitoring submissions to reduce these delays. Our solution allows shipowners to present to the regulators, insurers, financiers and charterers their compliance in real time, not only avoiding these time delays, but also the potential of being sujected to the costly fines of non-compliance and damage to their corporate reputation.

Compliance leads to commercial improvements

Conservative, overly long SOx fuel switch procedures burn more expensive low sulfur fuel than is necessary to meet the needs of IMO regulations. The ability to economically demonstrate compliant behaviour with shorter fuel switch procedures has not existed until now.

With our real-time, location-specific emissions data, shipowners and operators can confidently optimise compliant fuel switch timings, transitioning closer to ECA boundaries, saving thousands annually on low-sulfur fuel costs, and ensure regulatory compliance.

A cleaner planet and a better bottom line

Reducing global emissions should be simple, inexpensive and painless. With SeaARCTOS installed, you not only ensure compliance with regulatory standards, but also transparency. The benefits? Faster port turnarounds, improved operational efficiency, preferential treatment, competitive rates, and real cost savings.

Map showing estimated annual S(ECA) Crossing

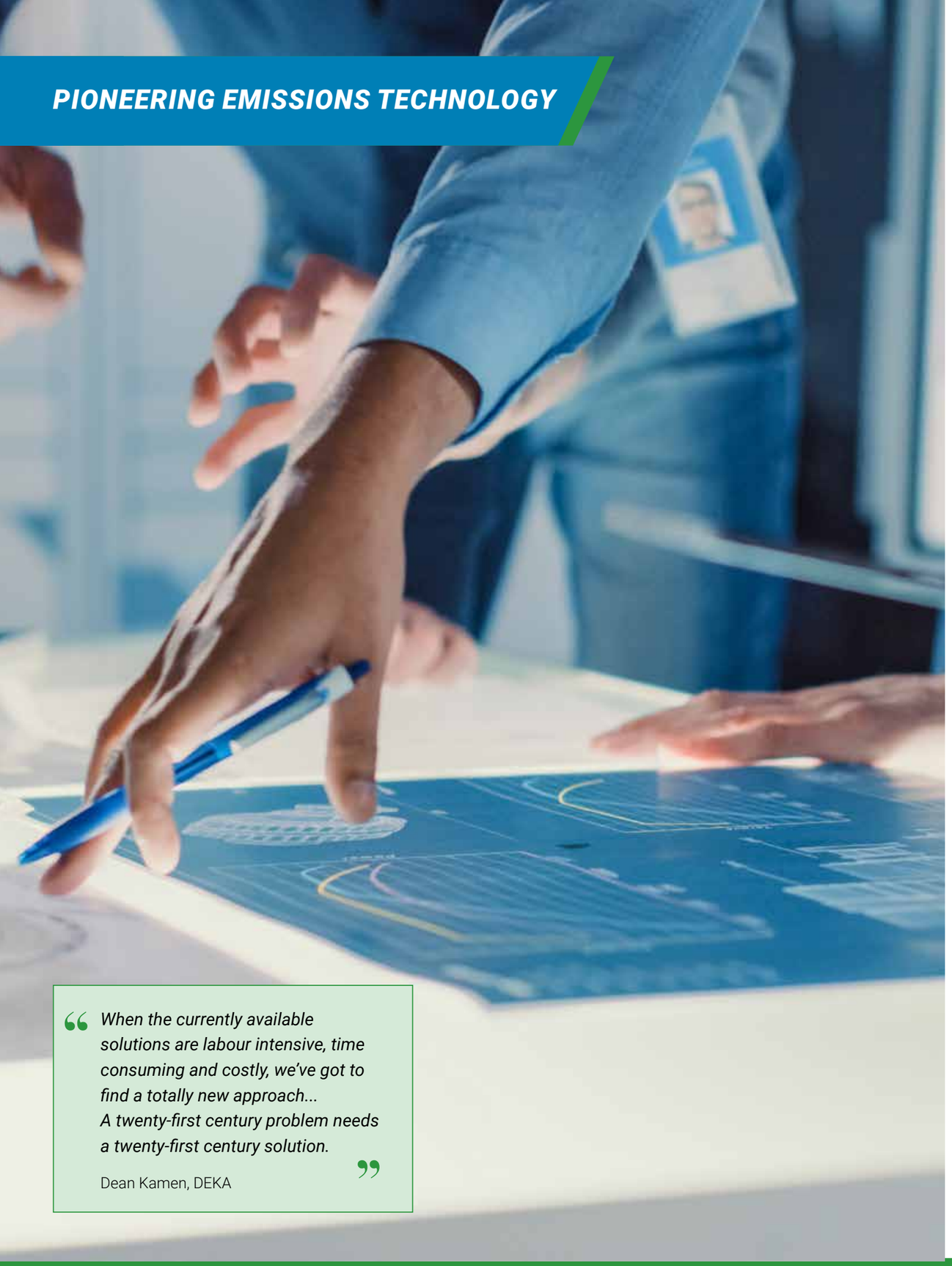
EXAMPLE MARPOL VIOLATION PENALTIES

Between August 22-August 23 the US Department of Justice levied total fines of over $11 million on multiple shipping companies and 16 years of US Maritime Probation have been applied to them. While none of these costs include the plaintiffs legal, reputational nor operational costs associated with the violations, the financial fines alone represent $31,000 a day for the period.

The majority of these violations were NOT sanctioned by the owner/operator of the vessel but they are forced to pay the financial, operational and reputational price.

MARPOL VIOLATIONS AUGUST 2022 - AUGUST 2023				
Date	**Fine (USD)**	**Probation (Years)**	**Prison (Days)**	**Owner/ Operator**
8/22/2023	$2,000,000	4		Zeaborn
7/6/2023	$1,500,000	Foreign Violation		Clipper
1/19/2023	$2,000,000	4		Empire
1/3/2023	$2,500,000	4		Zeus
11/2/2022	$3,253,000	4		Ionian
8/31/2022	$5,200		366	Foreign Ch. Engineer
TOTAL	**$11,258,200**	**16**	**366**	

PIONEERING EMISSIONS TECHNOLOGY



> *When the currently available solutions are labour intensive, time consuming and costly, we've got to find a totally new approach...*
> *A twenty-first century problem needs a twenty-first century solution.*
>
> Dean Kamen, DEKA

The SeaARCTOS Concept

SeaARCTOS set out to address the lack of effective solutions within shipping to facilitate compliance with environmental regulations in a cost effective manner.

Mathematical solutions based on estimates and past performance are not able to accurately confirm fuel switches or real time efficiencies. This can only be achieved by sampling the actual exhaust gas that a vessel emits.

SeaARCTOS has developed a class-approved, flag-supported physical vessel emissions monitoring solution, based on hardware, software and analysis.

After development and deployment, its extensive real-world testing and refinement has resulted in the accuracy, reliability and integrity of the system, ARCTOS-1™. It has reduced costly, time and labour-intensive reporting and monitoring, with a tried and tested point-of-use, bottom-up consolidated vessel emission monitoring solution that can either be viewed in an independent dashboard or be incorporated into an operator's current data system.

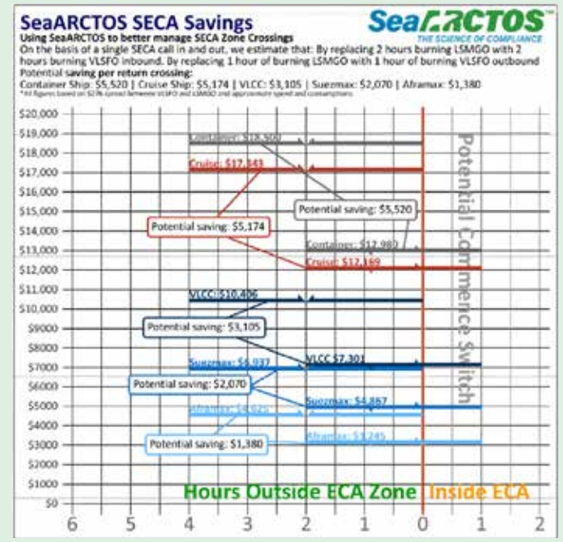
Our dedicated team of engineers, chemists and data and marine experts are constantly refining and improving SeaARCTOS hardware design, data collection, transmission, algorithms and integration.

We have now completed over 20,000 hours of real world at sea testing of stack-mounted devices and systems to improve resilience and accuracy to acceptable levels for all maritime participants.

OUR KEY BELIEFS

- **Intelligence gathering needs to be replaced with actual real-time data to enable meaningful emissions monitoring and help counter climate change.**
- **Accurate vessel emissions are essential for reliable calculations.**
- **Emissions data should be available in real time, not over a year later.**
- **By accurately measuring, you can accurately manage your emissions.**
- **Creating more GHG in order to measure GHG or remove SO_2 from exhaust is counter-productive for the global population and the planet.**
- **Monitoring should be simple to install and cost appropriate.**

Example charts showing entering and exiting ECA Zones and associated fuel cost savings



The figures above illustrate savings based on the VLSFO–LSMGO spread as of October 30, 2023, for a single two-way ECA crossing.

Example charts showing entering and exiting ECA Zones and associated fuel cost savings

TRUE, TRANSPARENT & TIMELY VESSEL EMISSION DATA AT YOUR FINGERTIPS

The world's first of its kind shipboard solution for real-time emissions monitoring and reporting

ARCTOS-1™ is completely carbon neutral, self-powered, swappable emissions sensor. Affixed to the top of a vessel's exhaust stack and using proven technology, ARCTOS-1™ independently monitors MARPOL required fuel switches and reports actual vessel exhaust emissions in real time. ARCTOS-1™ indicates actual CO_2 percentages and measures the effect of emissions saving technologies.

ARCTOS-1™ provides accurate, real-time data and analysis for ship owners, managers, charterers, financiers and other stakeholders. At anytime and anywhere in the world, they can moniter their vessel's compliance to SO_2 fuel switch requirements when entering and exiting designated (S)ECA zones and see the effects of efficiency measures with fuel additives and other interventions.

Multi-functional utility

Based on SeaARCTOS's patented fuel exhaust analysis technology, ARCTOS-1™ delivers multi-functional utility:

- Accurate emissions data monitoring and reporting from all your vessels in real-time
- Sulfur fuel switch data recorded both when entering and, the previously impossible, after exiting (S)ECA zones to prove vessels are complying with regulations, not avoiding them
- Measure efficacy of emissions, reducing expensive additives or equipment accordingly
- Benchmarking of your fleet, internally and against type and similar vessel index
- Dynamic reporting for ESG reports across the marine value chain
- Engine condition monitoring/ fuel economy

Vessel-Specific Realtime Emission Data Straight from Your Stack to Your Inbox

No capital outlay and low cost of operation

No capital requirement: There is no upfront capital investment required.

Subscription model: ARCTOS-1™ is available on a subscription basis. You simply pay per vessel per day, making it easier on your cashflow.

Ease of Installation: Installation takes under 60 minutes and can be done by your own crew using instructions provided. No cutting, cabling, or hot work is required and the vessel does not need to be in the dry-dock or off hire.

Self powered: ARCTOS-1™ is self- powered using waste heat from your stack emissions. There is no additional energy cost and the unit is carbon neutral.

In-built Satellite System: ARCTOS-1™ has its own encrypted satellite system, independent of the vessel's communications, so there are no extra or hidden costs.

Zero maintenance: ARCTOS-1™ requires zero maintenance, and has no user serviceable parts. There is no need for a costly service contract and zero vessel delays due to system failure - if there is an issue, we simply send you a replacement.

ARCTOS-1™

BENEFITS

- Delivers real-time, accurate emissions data to ensure compliance with environmental regulations
- Eliminates lengthy inspections and extended port delays
- Reduces GHG emissions from vessels and ancillary services during inspections (e.g., tugs, pilot boats, drones)
- Provides key stakeholders (investors, banks, supply chain customers and more) concrete evidence that your ships are fully compliant and eco-friendly
- Gets your ships moving faster, reducing downtime and generating optimal productivity for your crew
- Reduces risk of fines by identifying and rectifying emission issues early
- Contributes to a cleaner planet, as well as commercial improvements and a better bottom line
- Monitors efficacy and emissions 3rd party interventions
- Highlights your commitment to reducing global emissions

KEY ATTRIBUTES

- The worlds most economical stack mounted self powered exhaust sensor system
- Carbon dioxide & Sulfur dioxide emissions logging
- VLSFO/ULSFO EMO Zone fuel burn compliance validation
- Very-low level and broad range SO_2 detection for real-time fuel quality monitoring
- Small footprint (shoebox dimensions)
- Entirely self-powered and maintenance free using hourly sampling exhaust characteristics of CO_2, SO_2, CH_4 plus transmission of "spoof" proof geolocation

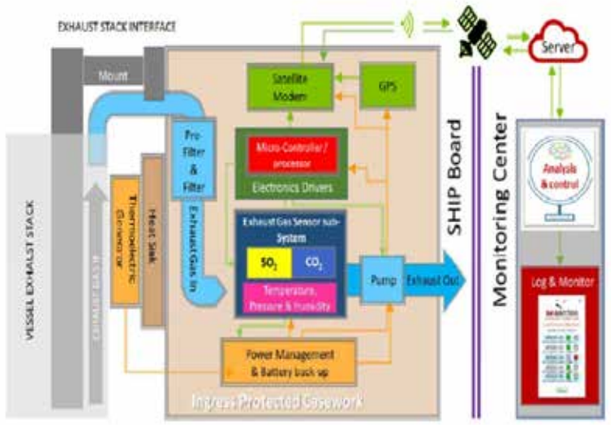
FUNCTIONALITY & SPECIFICATIONS

DEVICE OPERATION FEATURES

- OPEX data subscription
- Alerts, reports
- Dashboard integration
- Internal satellite modern and GPS
- SeaARCTOS managed hardware
- Maximum one hour “Surface” installation process
- No cutting/welding/wiring/hot work required
- Waste heat powered, CO_2 neutral in operation
- No vessel communications connection required
- Maintenance-free sense unit
- SeaARCTOS device health monitoring
- Free replacement arrangements
- Tamper evident

DEVICE PROVIDES

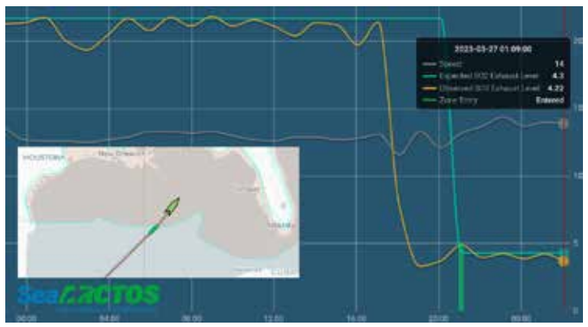
- SOx fuel switch
- ECA Zone monitoring
- Location/speed - no AIS Spoofing
- Reduce fuel & CO_2 on each ECA crossing

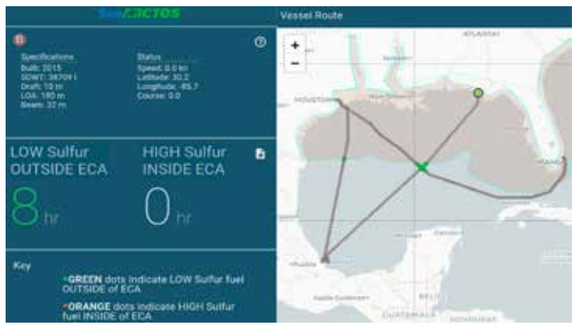


ARCTOS-1™	TECHNICAL SPECIFICATIONS
Dimensions	35cm x 25cm x 20cm
Weight	3.5kg including mounting
Mounting & Inlet	Stainless steel bracket 0.5m below exhaust stack exit
Power	Self-powered; Thermoelectric Generator and LiFePO4 battery back-up
Placement	Main engine exhaust stack
Tracking	GPS enabled for Time, Latitude, Longitude, Speed and Heading tracking
Communications	Satellite 1/0 a 60-minute download/ upload intervals
Data Output	SO_2 & CO_2 emissions levels, plus ancillary sensor metadata; environmental sensors, GPS and system configuration variables
User Interface	Cloud based fleet monitoring; 60-minute data updates for with up to 3-year data-log per unit
Operational Cycle	Continuous 24/7 at 60-minute sampling rate
Operational Lifetime	3 years with no servicing requirements
Ingress Protection	IP66 (NEMA4x rated)
Climatic Rating	Fully operational within 95% of commerce shipping routes
Installation Time	<60 minutes with standard off-the-shelf tooling

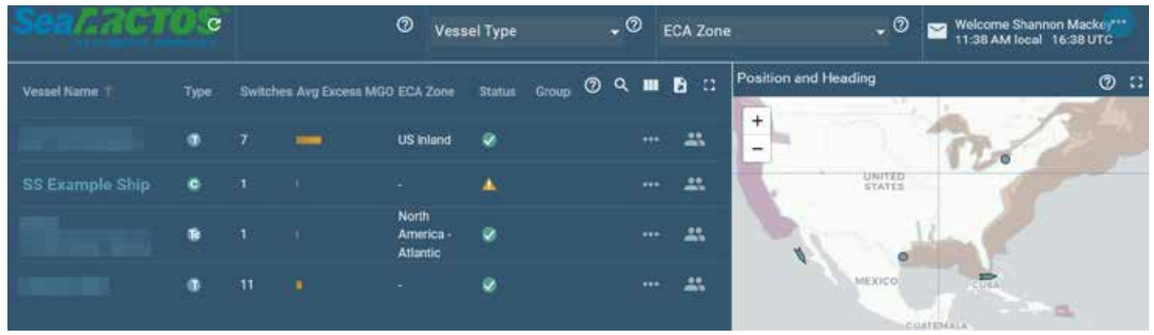
DETECTION & MONITORING SPECIFICATIONS

- Non-Dispersive Infrared Absorption Spectrometry (NDIR-AS)
- Exhaust SO_2 content detection of range 2 to 500 parts per million volume (equivalent to FSC < 0.1% - 3.5%)- ULSFO & VLSFO through to clandestine HFO burn monitoring, under all engine load conditions
- Exhaust CO_2 content detection range <100 to> 1000 parts per million volume
- Sampling interval <60 minutes
- <20 nautical mile resolution in fuel switch monitoring for ECO compliance validation





Example Data Charts Showing Vessel Expected and Observed Emissions Levels in ECA Zones



Fleet Tracking And Realtime Emission Data From Your Vessels Straight To Your Inbox

WE COULDN'T DO THIS ALONE
OUR DEVELOPMENT PARTNERS

For more information contact us at
enquiries@seaarctos.com or visit www.seaarctos.com

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