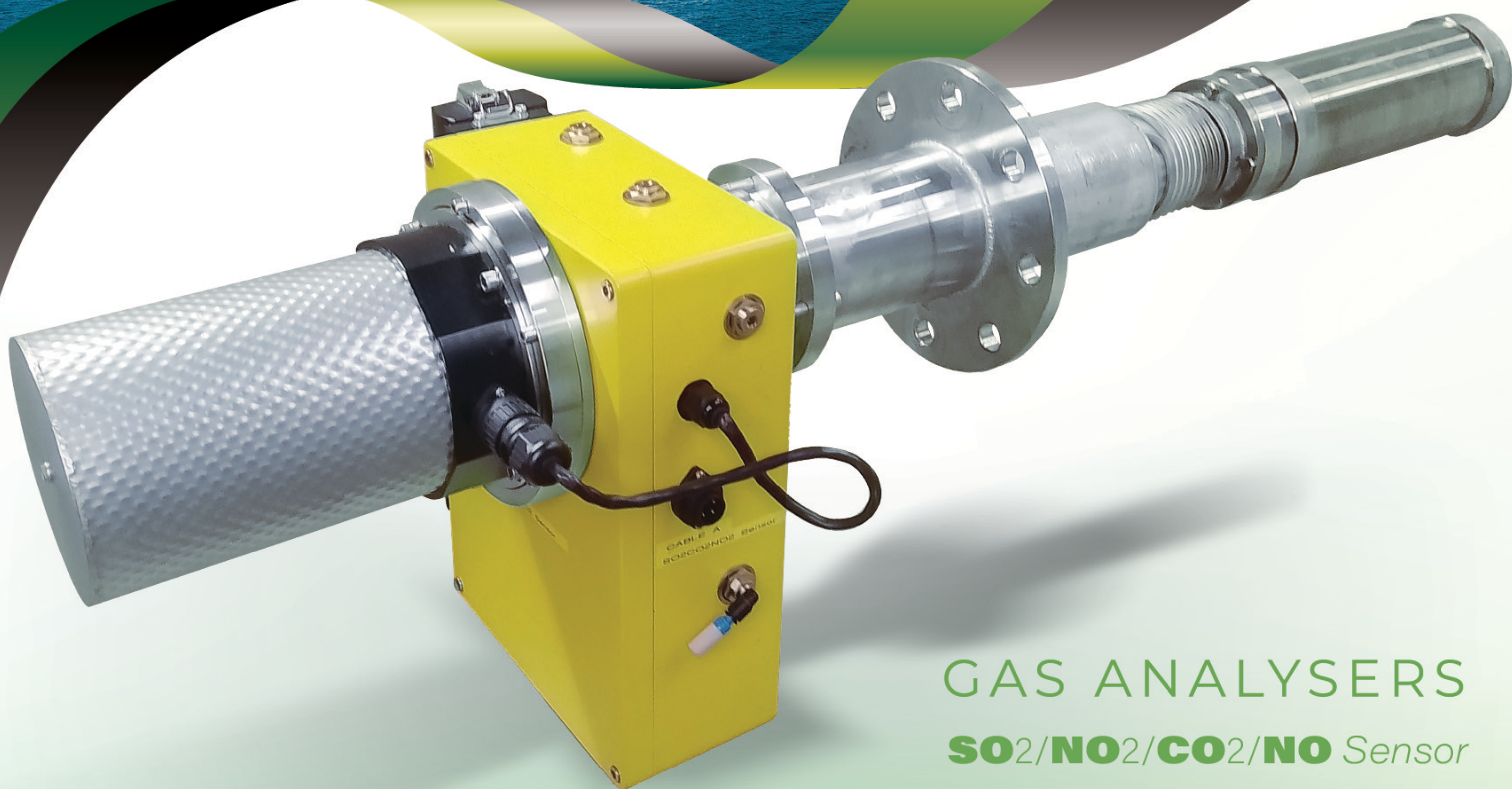




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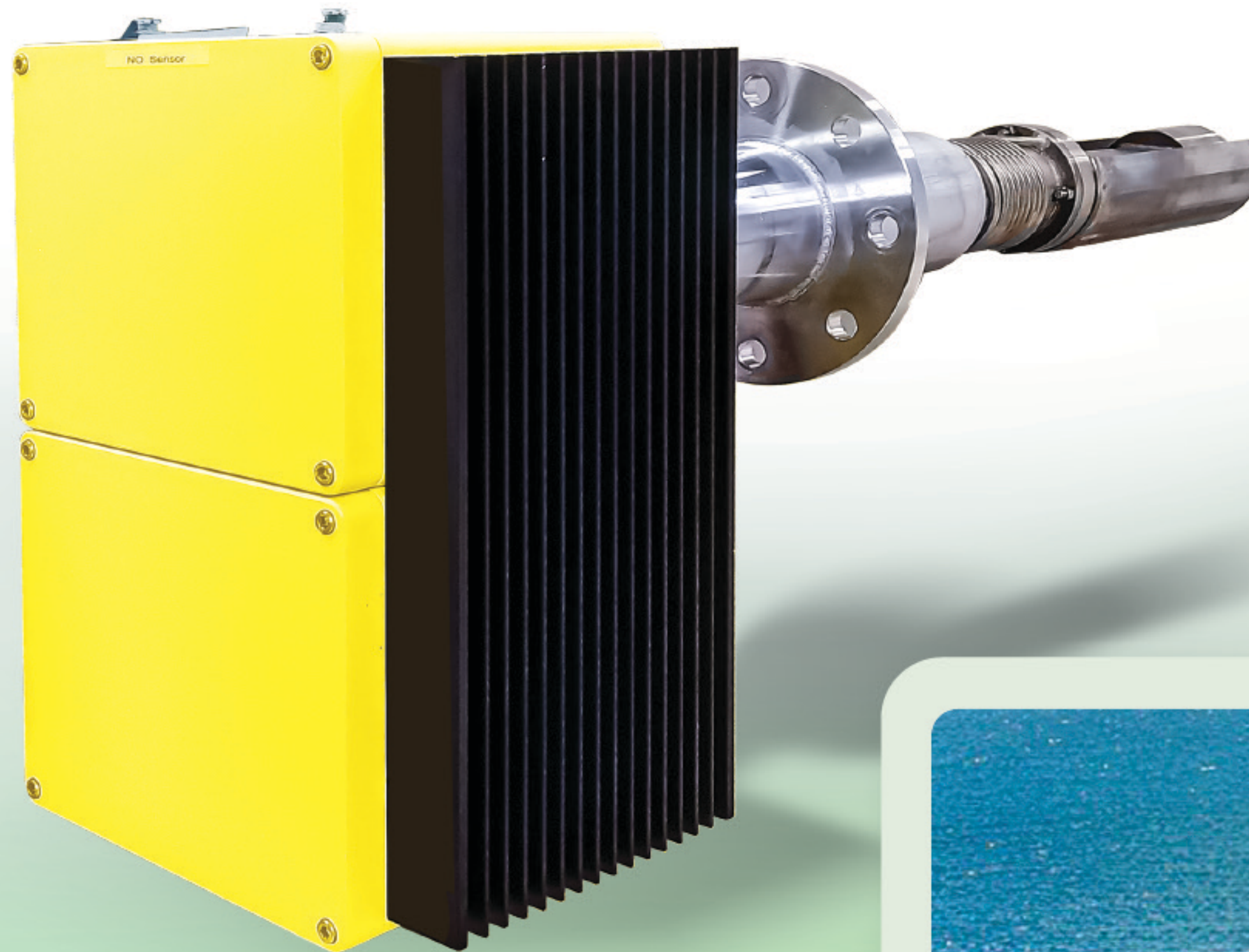
Zycor Systems Limited



GAS ANALYSERS
SO₂/NO₂/CO₂/NO Sensor

**Exhaust Gas Emission Monitors for Marine Use to
Meet MARPOL Annex VI Requirements**

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Two types of Zycor analysers are available, one measures SO₂, NO₂ and CO₂, and the other measures NO and H₂O. They both use in-situ technology, which avoids the complications of extraction and treatment of flue gas samples before presentation to the analyser. Extraction systems are notoriously maintenance intensive. The two analysers, while using the same probe design for insertion into the gas stream, utilise very different measurement technologies, both of which are novel and provide high accuracy combined with an almost zero maintenance requirement.

Feature:

- ◆ IN-SITU CEMS suitable for Refineries, power plants & other industries.
- ◆ Measurement gas resolution 1 PPM and accuracy +/-2% of reading
- ◆ Specifications at par with current Refinery specifications.
- ◆ Safe Area/Hazardous area available
- ◆ UV absorption spectroscopy based SO₂ & NO₂ measurement, Laser (QCL) based NO & H₂O measurement and Infrared spectroscopy-based CO₂ measurement
- ◆ 24 VDC power supply operated.
- ◆ Remote monitoring of the system is available.
- ◆ Simple Installation as per the photograph
- ◆ Light weight so easy to install.
- ◆ Low maintenance cost
- ◆ No Shelter required



Zycor has developed state-of-the-art analysers for the measurement of flue gas emission monitoring in marine installations. They are however applicable also to a range of land-based CEMs requirements. The key requirements for marine, particularly ocean-going vessels, are measurement reliability, ease of maintenance and the ability to deliver accuracy in a wide range of ambient conditions and the presence of significant engine sourced vibration. In short, the marine applications present significant problems for the sensor development.

Measurement Principle

This sensor utilises UV absorption spectroscopy to determine SO₂ and NO₂ and infrared spectroscopy for CO₂ combined into a compact sensing head. The radiation sources for both UV and infrared are LEDs, the emitted radiation being transmitted down the in-situ probe to a measurement cell into which the flue gas diffuses. The degree of absorption of the UV and IR beams reflected into the sensor is measured to provide an accurate determination of the concentrations of the three gases SO₂, NO₂ and CO₂. The use of LEDs for the light sources enables the sensor unit to be very compact and robust, with no moving parts, thus requiring zero maintenance.

Accuracy is maintained by an integral zero calibration system where ambient air is delivered to the measurement cell by a small integral diaphragm pump. To ensure zero accuracy of the CO₂ measurement the zero air is scrubbed clear of CO₂ by passing it through a disposable filter unit, which is quickly and easily replaced after a minimum two-year operation. This is the only maintenance requirement for the analyser.

Service requirements are minimal, limited to electrical power 36V DC at @50VA. Output is via RS485 serial digital comms. Power and comms are delivered by a single 4-way sealed connector.

ZYCOR NO/H₂O Sensor

Using the same in-situ probe unit design as the SO₂/NO₂/CO₂ sensor the NO/H₂O sensor uses a similar measurement principle of determining the absorption of radiation energy to determine the concentration of both NO and H₂O in the probe measurement cell. This sensor however uses a Quantum Cascade Laser (QCL) as the source of radiation.

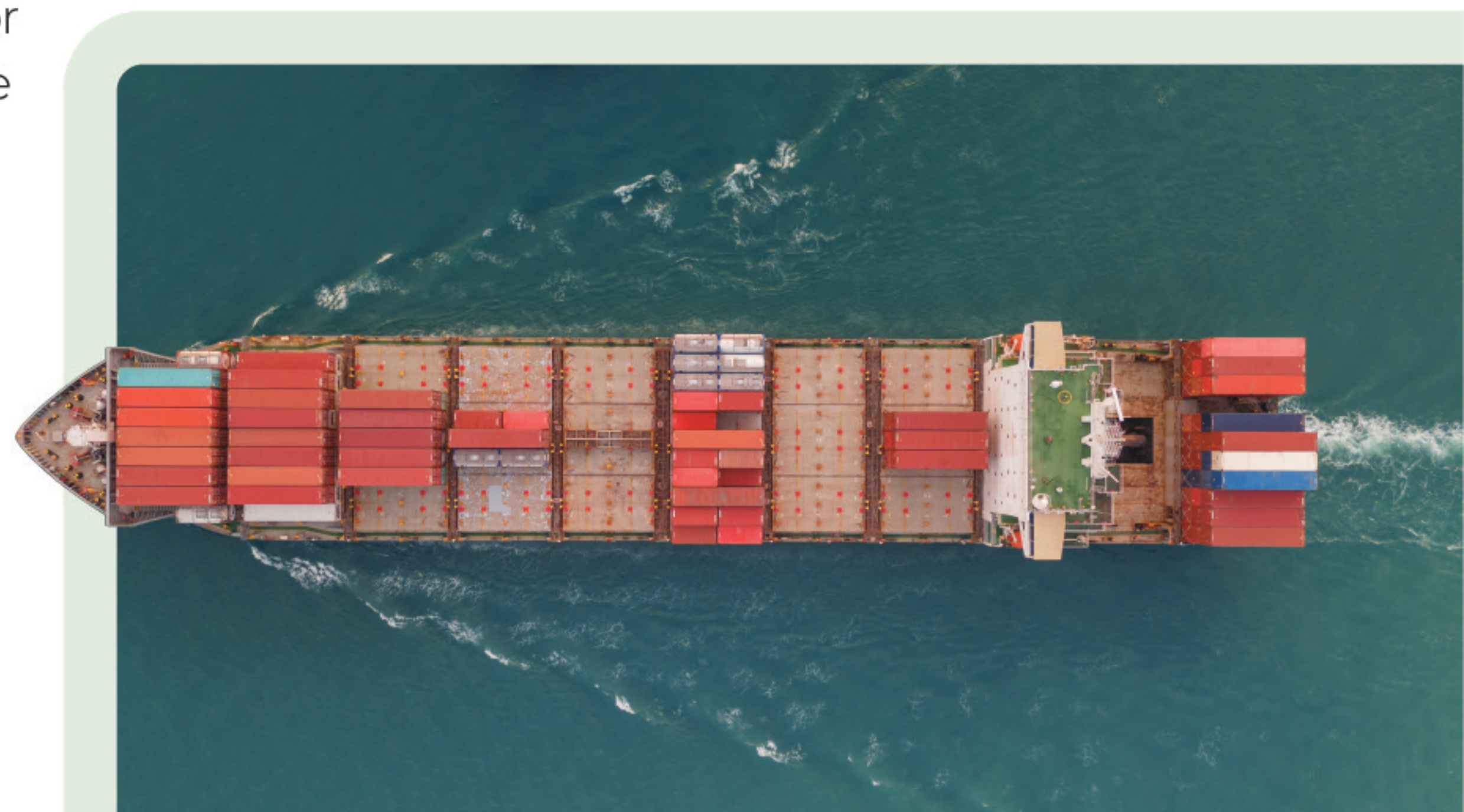
The use of a QCL overcomes all such difficulties. The QCL used in the Zycor sensor emits a very narrow and precise beam of infra-red energy which enables a single NO absorption line, within its absorption band, to be scanned by the laser. A suitable absorption line can be chosen which is free from H₂O interference thus enabling an accurate determination of NO concentration to be made. The wavelength of the emitted QCL radiation can be varied by accurate control of the laser temperature enabling the single NO absorption line to be scanned to produce a very stable, noise-free, accurate measurement of the NO concentration, free from other gaseous interference. This same laser also measures the H₂O concentration by monitoring an H₂O spectral line adjacent to the NO line.

The sensor is capable, without modification or rescaling, of measuring NO levels varying from less than 10 ppm to several thousand ppm at temperatures up to 450degC. In common with the SO₂ sensor, the NO sensor has no moving components and requires zero maintenance. QCLs are noted for very high reliability with mean time between failures measured in tens of years.

While the current QCL sensor is designed for the measurement of NO, the sensor is readily adaptable for the measurement of other difficult-to-measure gases by changing the QCL for one with emission wavelengths appropriate for the gas in question. For example, low concentrations of NH₃ can be easily measured by selecting a QCL emission wavelength appropriate to the NH₃ absorption band around 9 micrometres, making it eminently suitable, along with the NO sensor, for the monitoring and control of plants for the Selective Catalytic Reduction of NO on coal-fired power plant.

Current Status

- ◆ 0.1% Sulphur in fuel limit imposed in ECAs
- ◆ 0.5% Sulphur in fuel limit imposed worldwide from January 2020
- ◆ Over 3000 vessels fitted with SO₂ seawater scrubber systems to reduce SO₂ emissions to levels equivalent to 0.1% sulphur in fuel



Desired Attributes for a Marine Gas Analyser

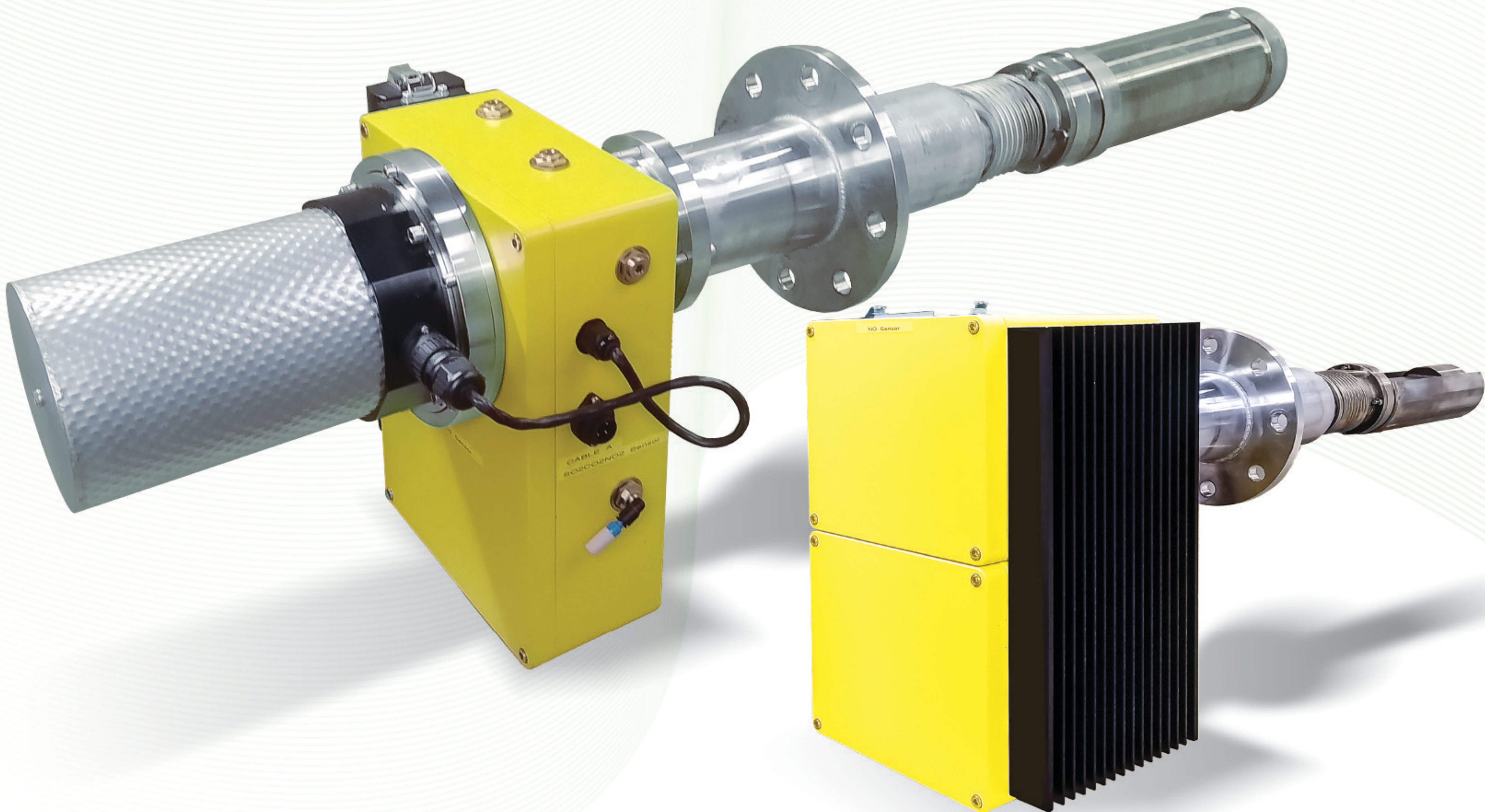
- ◆ Accuracy – The analyser must meet the accuracy requirements set out in MARPOL Annex (VI)
- ◆ Reliability – Limited access to ocean-going vessels

Specification ZYCOR SO2/NO2/CO2		
Measurement Method		In-situ Probe UV and IR spectroscopy
Range	SO2	0 to 1000ppm
	NO2	0 to 1000ppm
	CO2	0 to 10%
Resolution	SO2	1ppm
	NO2	1ppm
	CO2	0.1%
Uncertainty of measurement		
	SO2	2ppm or 2% of reading
	NO2	2ppm or 2% of reading
	CO2	0.1% CO2
Response SO2/NO2/CO2		100 seconds
Flue gas temperature		0 to 450 deg C °
Ambient temperature		-20 to +50 deg C °
Power Requirements		24 to 36V DC at 50VA
Additional services		None required
Data Output		RS485 Modbus RTU (baud rate 19200)
Probe Material		Stainless Steel 316L
Total Weight		25Kgm

necessitates a high mean time between failure operations to avoid long periods of inoperability

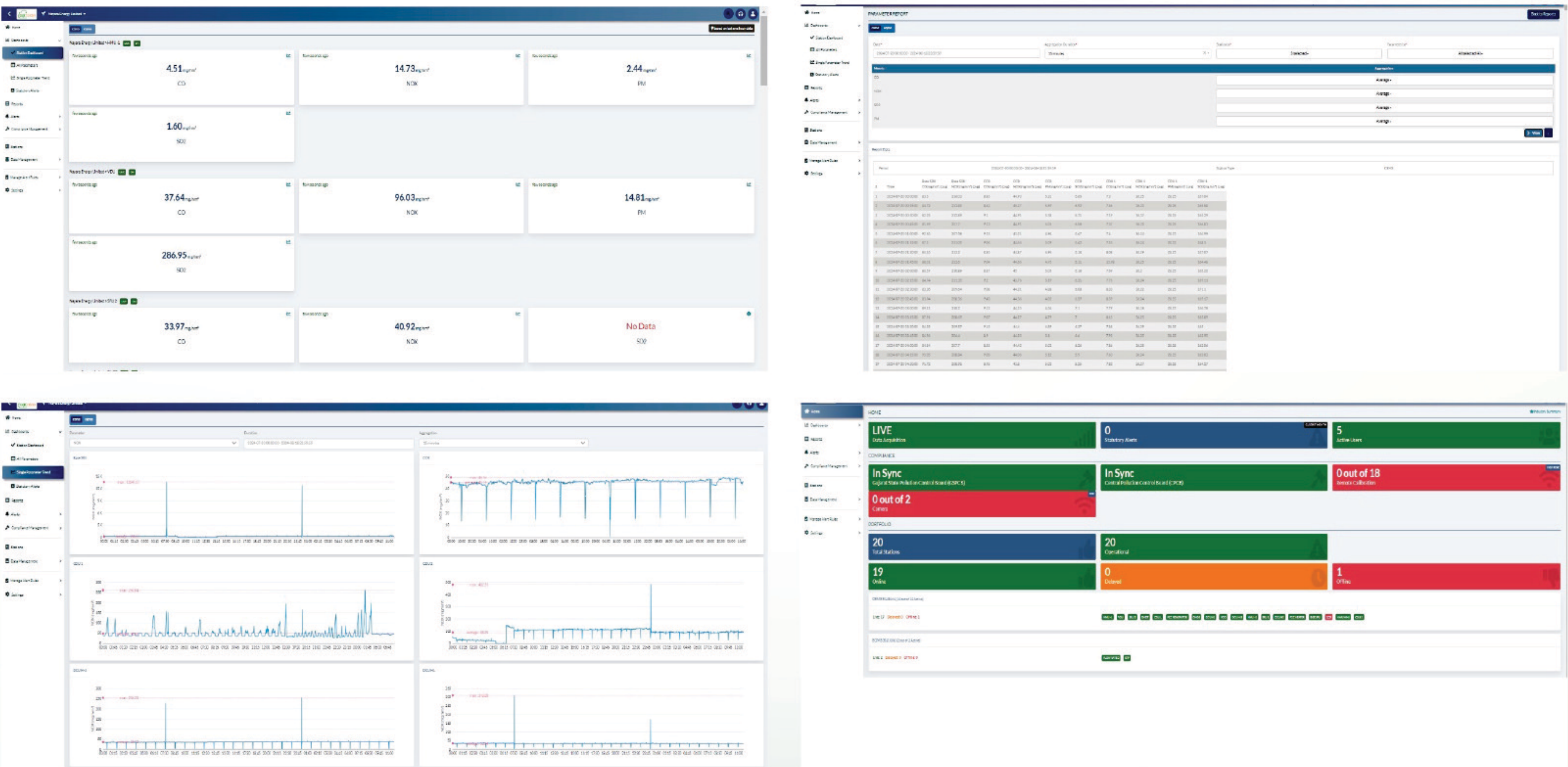
- ◆ Maintenance – Gas analysers are complex devices requiring high skill levels from maintenance engineers experienced in their use. Maintenance requirements must be kept to an absolute minimum for marine applications.
- ◆ vibration resistance – Large marine diesel engines produce significant levels of mechanical vibration. Exhaust stack monitors must be able to operate without increased failure rates in such high-vibration situations.

Specification ZYCOR QCL NO	
Measurement Method	In-situ Probe – QCL IR spectroscopy
Range	0 to 1000ppm NO
Resolution	1ppm
Uncertainty of measurement	1ppm or 2% of reading
Response	100seconds
Flue gas temperature	0 to 450 deg C °
Ambient Temperature	-20 to +50 deg C °
Power Requirements	24 to 36V DC at 50VA
Additional Services	None required
Data Output	RS485 Modbus RTU (baud rate 19200)
Probe Material	Stainless Steel 316L
Total Weight	25Kgm

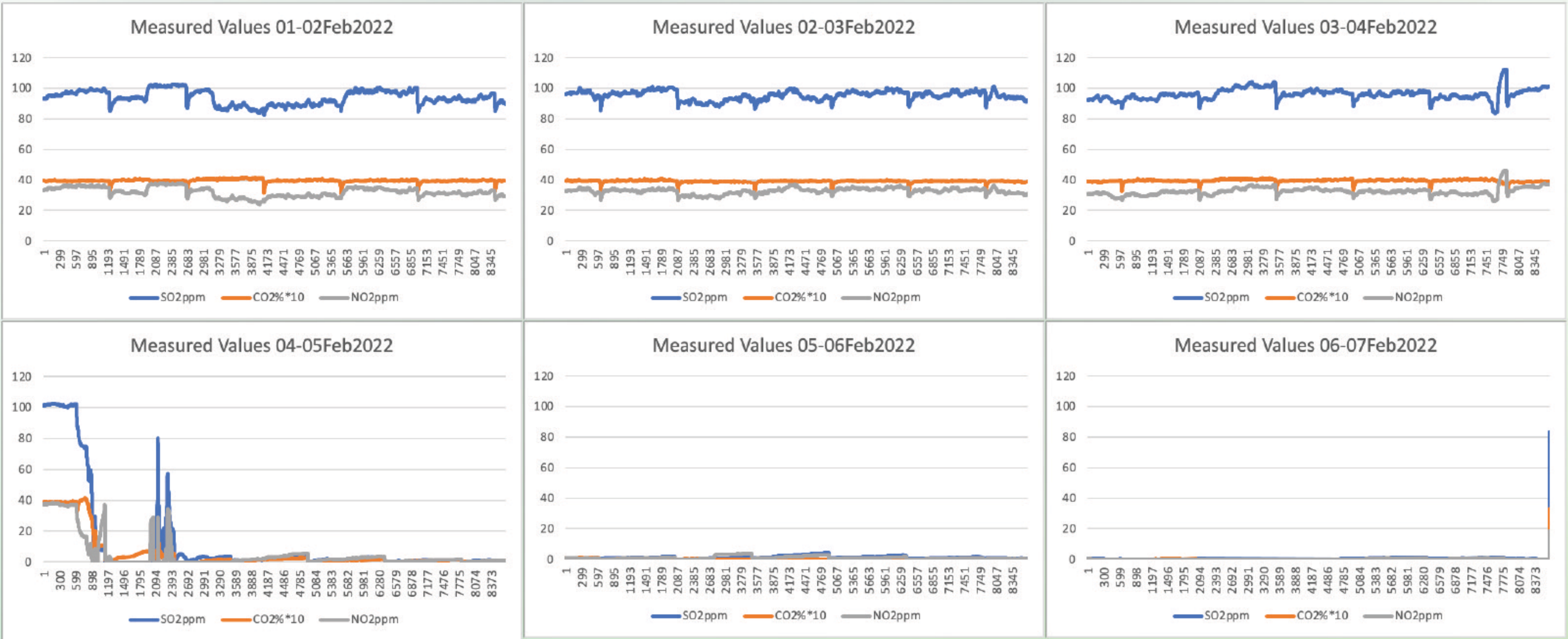


SMART CEMS APPLICATION MIAN SPECIFICATION & FEATURE

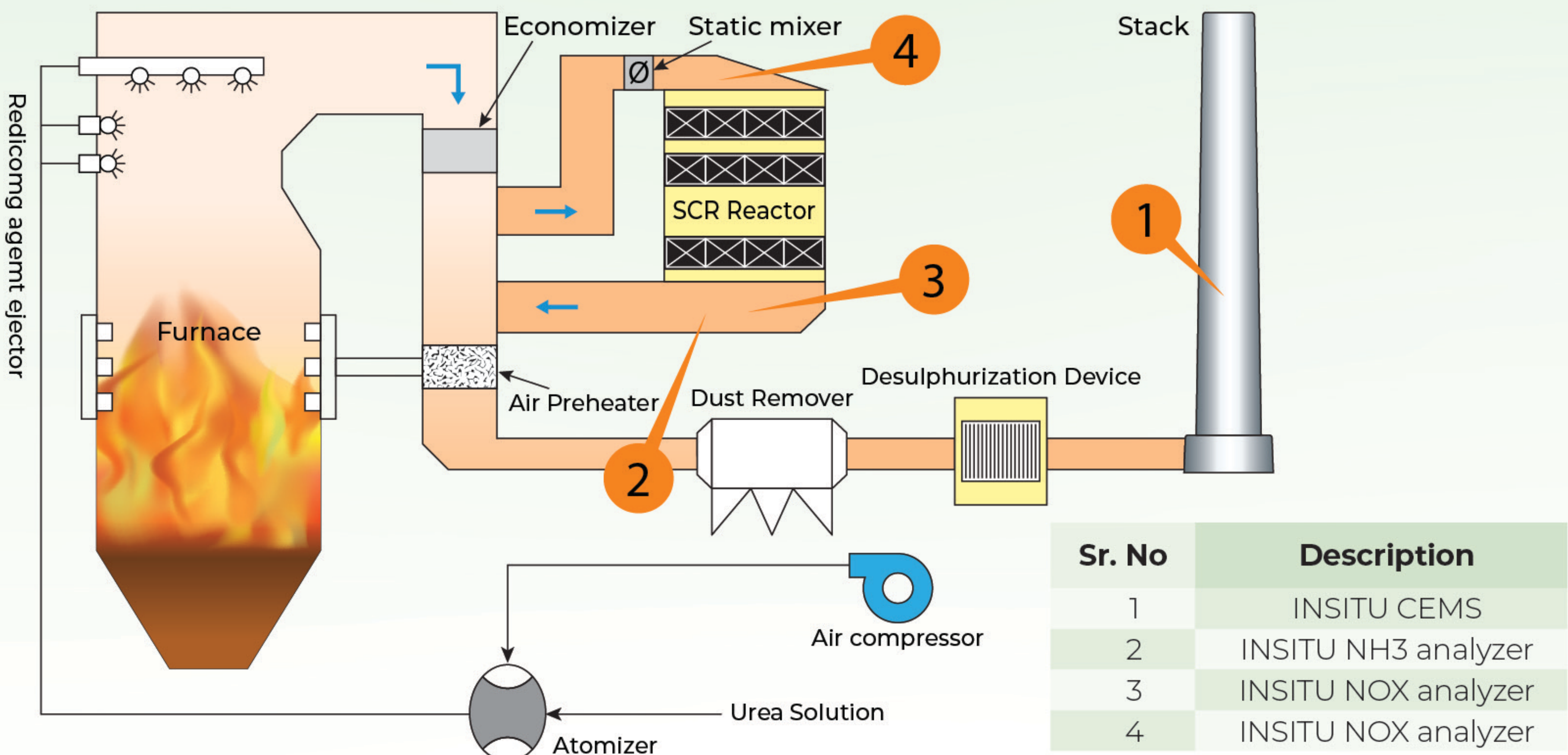
- ◆ SMART CEMs collect, measure, process and store data on Premise database So that user can monitor and manage the data from every time and everywhere as they need.
- ◆ It can data ingestion from analyzers or any devices through 4-20mA , RS485 or Modbus TCP.
- ◆ Historical Data and Reports can be filtered and collected according to user-defined criteria.
- ◆ Daily, Weekly, monthly, Perodic data listing tabular and graphical reports.
- ◆ It is the User friendly Interface of Web UI and only need basic knowledge of computer to operate the system.
- ◆ The system has the capability of detecting error and autonomously transmitting alarms notify to dedicated user through Application.



Ship trials report



Coal-fired power plants are main pollution source of flue gas SO₂ and NO_x, etc. The pollution from Coal-fired power plants severely destroy living environment and ecological environment. Monitoring gas components is the main way to control process and exhaust emission, optimize industrial process and it can achieve ultra low emissions.



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