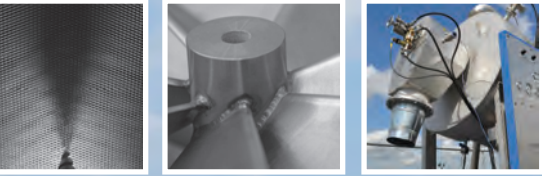


COLDHARBOUR



Sea Guardian™ Inert Gas Generator



35 YEARS

**Marine Inert Gas
& Water Treatment Experience**

Coldharbour Sea Guardian™ IGG
3rd Generation Inert Gas Technology

Smaller, Greener, Cleaner




Sea Guardian™ Inert Gas Generator

3rd Generation Design




The innovative design incorporates patented elements which achieve a cleaner and more stable operation, delivering reduced down-time and lower maintenance costs.

This 3rd generation design concept resolves many of the inherent problems found in other systems by combining traditional sections into one cost-effective, space saving, reliable unit.



Sea Guardian™ Innovations

-  No burner cone
-  No vertical scrubbing section
-  No demister pads

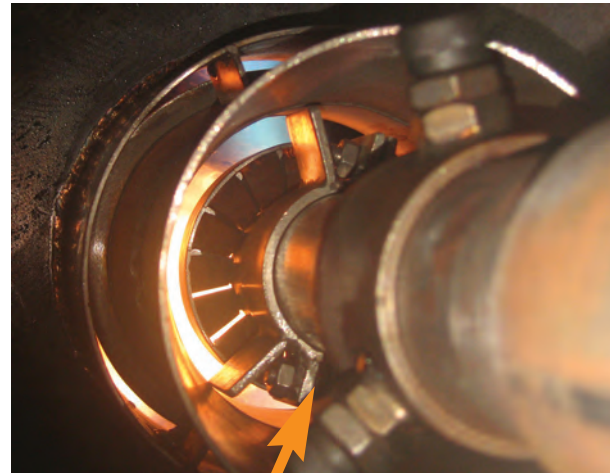
Sea Guardian™ Performance

-  Stable operation at 0.2% residual oxygen
-  Zero soot
-  Low NOx and SOx emissions

Sea Guardian™ Advantages

-  Small footprint - inherently reliable
-  Multi fuel capability*

*System can be configured for use with LSMDO/MGO and LNG fuel (including LNG boil-off)



Venturi Burner



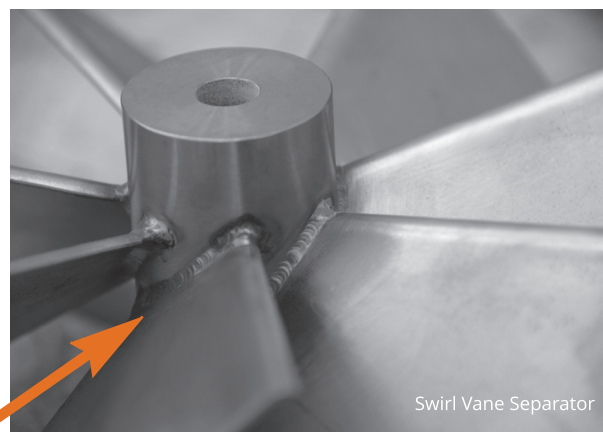
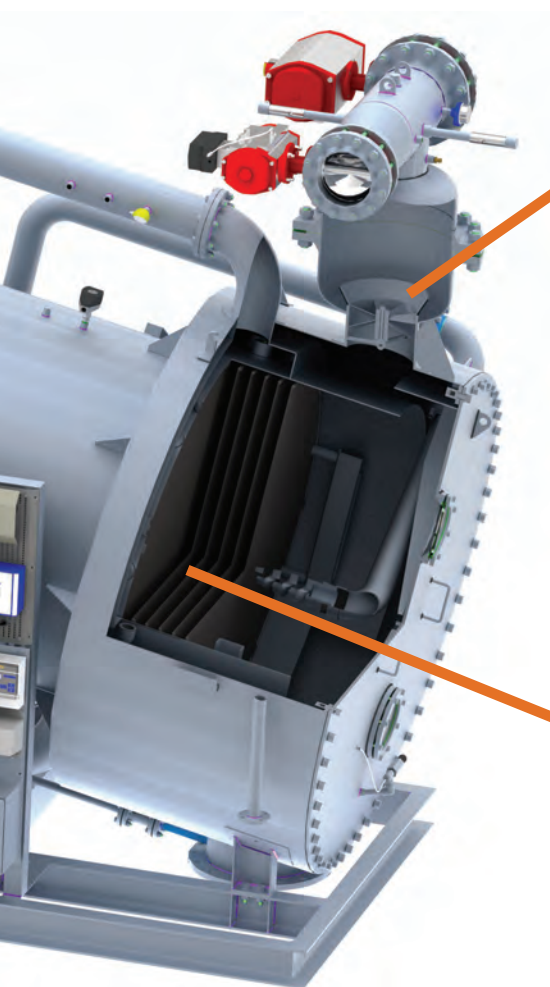
Sea Guardian™ Inert Gas Generator

Sea Guardian™ IGG
capacities available from
500 - 20,000Nm³/hr

Venturi Burner Lance

A specially developed venturi type burner lance incorporating axial flow staged fuel and low NO_x atomisation ensures there is a controlled, accurate and clean burn across the capacity range.

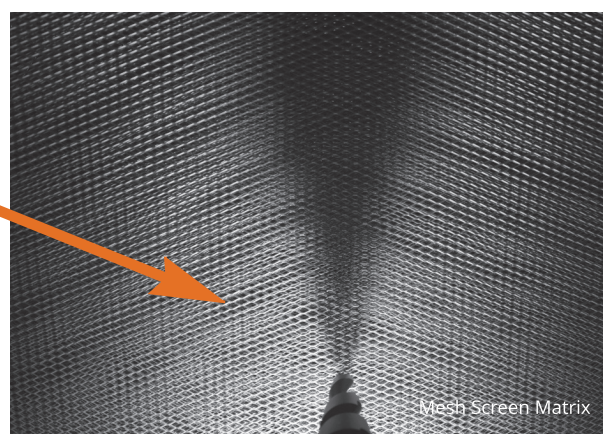
High and low pressure airflow through the burner casing and an even burn with a controlled flame shape is achieved without the need for a burner cone. This results in greatly reduced maintenance costs and little or no downtime during operations.



Swirl Vane Separator

Cooled gas enters the swirl vane separator, a static blade style arrangement with low pressure condensing zones, which induces the cooled gas to spin in a vortex, shedding water droplets as it does so.

The water droplets recover to the cooling water within the duplex body of the IGG and are vented through the same outlet, which means that a separate demister pad section is not required.

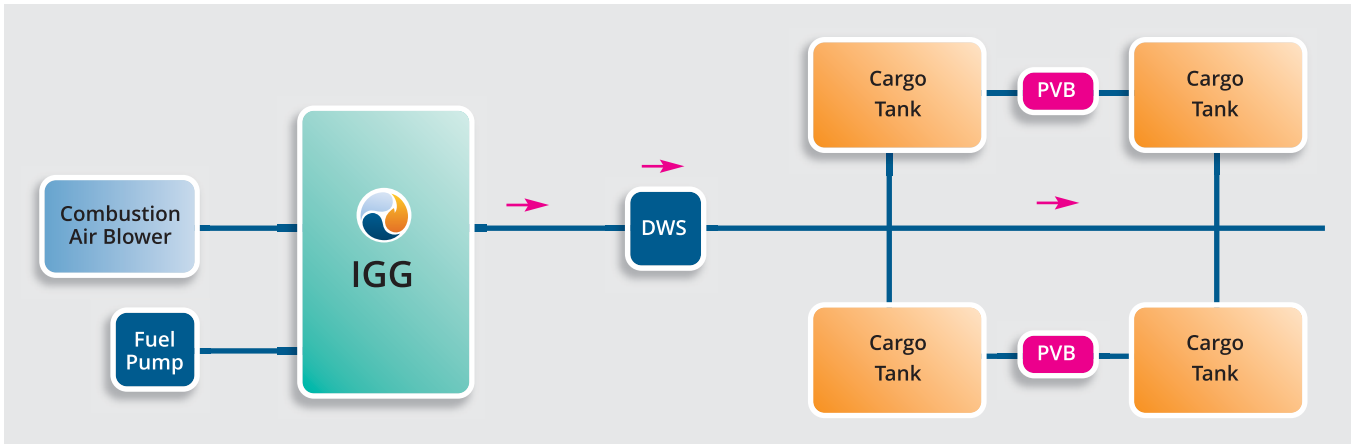


Patented Quench Scrubber Matrix

Hot gas from the burner is passed through a patented quench scrubber design, based on an inclined water curtain system incorporating a high temperature, corrosion resistant, expanded metal mesh screen matrix. The design of this unique quench scrubber matrix means there is no need for a separate and bulky scrubber tower unit.

Sea Guardian™

Cargo Blanketing System for Oil Tankers



Schematic example of Sea Guardian™ IGG used for Cargo Blanketing (top-up) © Coldharbour Marine

Innovative Design

In designing the Sea Guardian™ Inert Gas Generator, Coldharbour engineers incorporated the experiences passed onto them by marine IGG operators and created a 3rd generation system with all the typical operating issues of a traditional system engineered out. As a result there is no burner cone, no separate scrubber tower and no demister pad section, so there is nothing to block and very little to corrode. Maintenance costs are greatly reduced and unexpected downtime is practically eliminated.

Combustion Air Blower

The Combustion Air Blower is a Roots type unit of compact design. These units feature in-built safety relief valves and are selected for their low noise and low maintenance characteristics

Deck Water Seal

The Deck Water Seal is a wet type design with an external seal pipe for added safety. Water is displaced during normal gas flow forming a semi-wet seal. Entrained water is expelled by swirling the gas in the vessel and passing it through an integral demister



Deck Water Seal



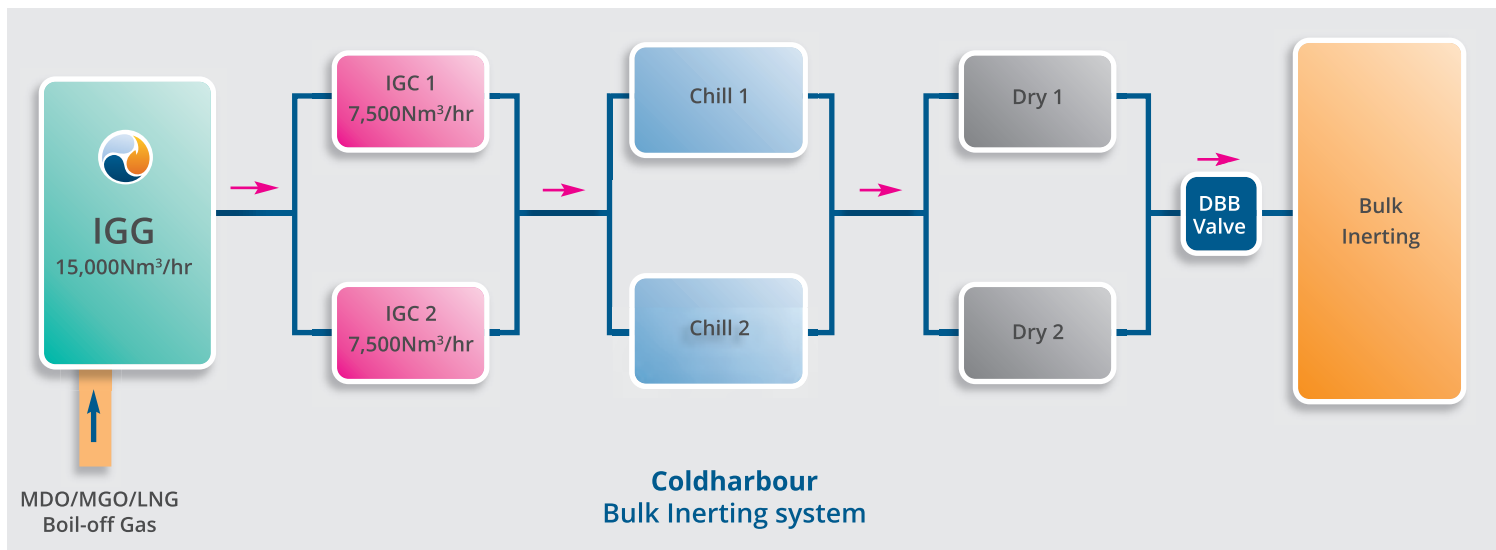
Pressure/Vacuum Breaker

The Pressure/Vacuum Breaker valve provides external protection by releasing excessive pressure or vacuum from the cargo tanks and is designed to be fail-safe in operation.

Pressure/Vacuum Breaker Valve

Sea Guardian™

Bulk Inerting System for LNG carriers



Schematic example showing equipment sets for bulk inerting on LNG vessels © Coldharbour Marine

Small Footprint

The innovative IGG design ensures that the operating pressure remains constant which allows the inert gas to be fed directly from the generator to the gas compressor unit. By compressing the gas prior to the chilling and drying operations, the size of downstream units and the overall footprint of the IG system is greatly reduced when compared to other system makes. Combined with the multi-fuel capability of Sea Guardian™ (including the option of burning LNG boil-off gas), the smaller footprint makes the Coldharbour system the ideal choice for LNG newbuilds.



4000Nm³/hr Sea Guardian™ Inert Gas Generator
on test at the Coldharbour UK test facility

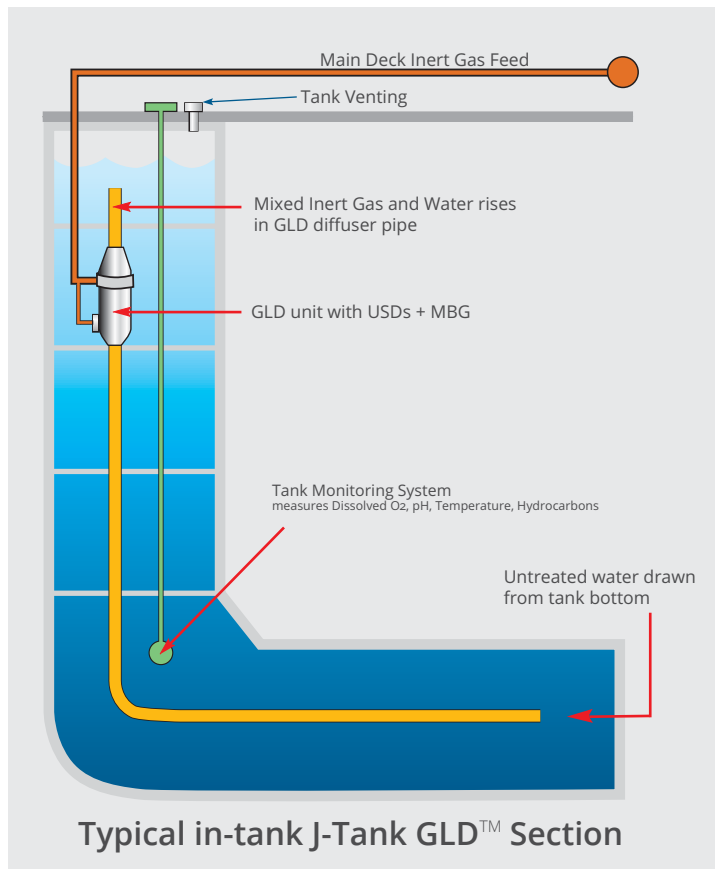
Clean Combustion

Clean combustion delivers inert gas with zero soot, low NO_x and SO_x levels and with stable 0.2% residual oxygen content.

By removing some of the major traditional elements such as the burner cone, cooling tower and demister pad section from the IGG design, the requirement for maintenance is much reduced and costly downtime is virtually eliminated.

Sea Guardian™ IGG

an integral part of the Coldharbour BWTS



The system operates in-tank and in-voyage using the inert gas output of the Sea Guardian™ IGG, linked to specially designed Gas Lift Diffusion (GLD™) units inside the water ballast tanks.

As the inert gas diffuses into the ballast water, oxygen is stripped from the water whilst the elevated level of CO₂ in the inert gas temporarily reduces the pH level of the water, inducing hypoxia and hypercapnia, conditions which are fatal to marine organisms.

Bacteria (E. coli for example), are treated by a patented method of gas-induced ultrasonic shock waves, which rupture the cell wall causing cellular destruction.

A stream of micro bubbles of inert gas are introduced into the base of the GLD and as the water rises through it, the microbubbles are carried into the ultrasound shock zone where they micro-cavitate, amplifying the cellular destruction created by the ultrasonics.

Optimised for large oil tankers, bulkers, ore carriers and LNG vessels

Coldharbour GLD™ BWTS	
No disruption to terminal operations	✓
Gravity ballasting / de-ballasting allowed	✓
No extra power capacity required	✓
Future-proof technology	✓
Robust, simple to use - small footprint	✓
Low running costs, minimal downtime	✓
No specialist maintenance required	✓
No risk of damage to tank coatings	✓
No regrowth on long ballast voyages	✓



Maritime and Coastguard Agency

IMO Type Approval February 2015 by the UK Maritime & Coastguard Agency



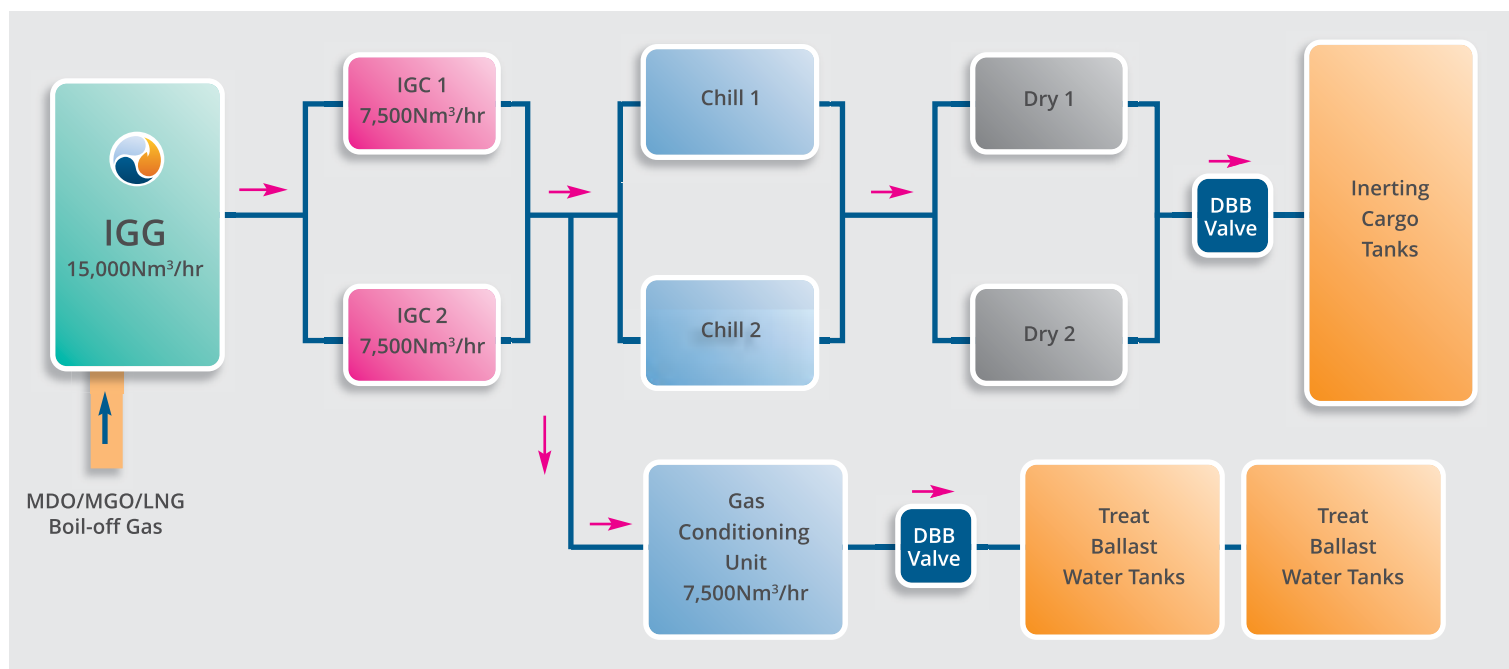
Lloyd's Register Type Approval
July 2016



USCG AMS June 2015
Full USCG Type Approval in progress

Sea Guardian™ and GLD™ BWTS

Combined solution for Bulk Inerting and Ballast Water Treatment



Schematic diagram showing equipment sets for combined ballast water treatment and bulk inerting on LNG vessels © Coldharbour Marine

The Sea Guardian™ IGG provides clean inert gas with very low residual oxygen content (0.2%) to operate the Coldharbour in-tank BWTS, with sufficient capacity for bulk inerting of the cargo tanks when required. The IGG operates efficiently at 50% of maximum capacity for BWTS duty, managed by pre-programmed automated protocols. When compared to a traditional bulk inerting arrangement, the Coldharbour combined BWTS and Bulk Inerting system has a much smaller footprint, requiring significantly less deck space on board, with the added benefit that the downstream units and piping are also much smaller and less bulky.

The IGG has been designed with no burner cone, no separate scrubber tower and no demister pad section, resulting in very low maintenance costs and minimal downtime. Sea Guardian™ IGG can be configured to use LSMDO / MGO, LNG and LNG Boil-off gas.

Combined Solution Benefits

- One IGG unit provides inert gas for both bulk inerting and ballast water treatment.
- The units downstream of the IGG are compact compared with traditional systems.
- The IGG is multi-fuel capable, running off LSMDO/MGO or LNG (including Boil-off Gas).
- Utilised on each ballast leg for BWT duty, the IGG is protected against maintenance and downtime issues caused by long periods of inactivity.

Control panel for the Sea Guardian™ Inert Gas Generator



COLDHARBOUR



Coldharbour Marine Limited is based in the United Kingdom and has been supplying marine equipment for more than 35 years.

Our products and designs have been used extensively in both the marine and offshore sectors.

We make it our business to understand your requirements and to provide genuinely practical solutions to your technical problems.

We combine engineering excellence, intelligent application, efficient installation and years of experience in order to provide our customers with reliable, robust, advanced technologies for use in extreme environments.

Coldharbour Marine future proofs its technologies. We continually develop and enhance our products to satisfy and exceed both operational and legislative requirements.



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