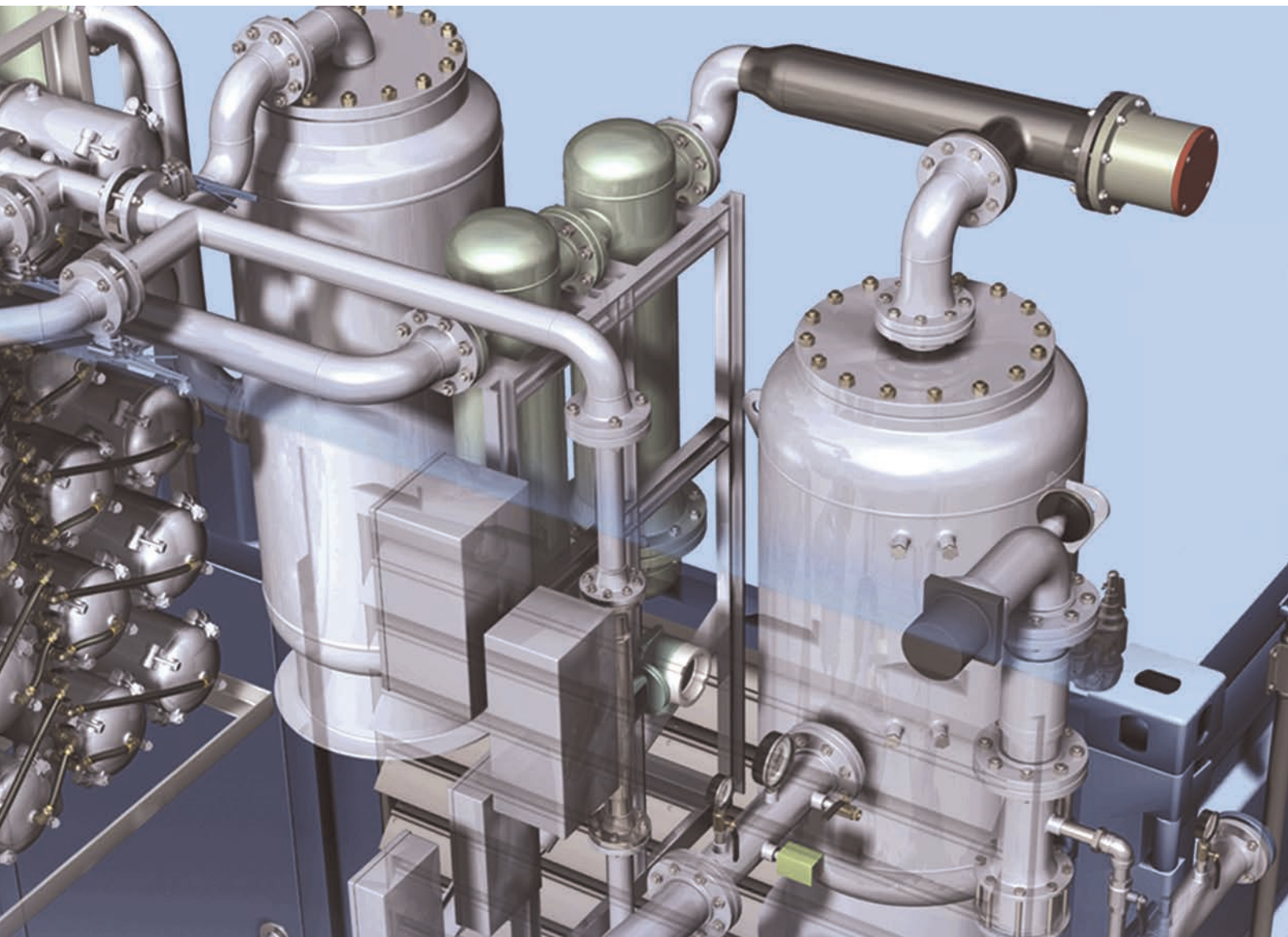


NITROGEN MEMBRANE

inert gas system



THE NUMBER ONE SAFETY SOLUTION

for cargo transportation



Transportation of flammable cargo such as gas, oil and chemicals require an inerting solution to prevent fire and explosion within the cargo and void spaces. This also applies to transportation of liquefied gas in order to prevent ice concentration around the cargo tanks. Nitrogen solutions are further used to prevent fruit from spoiling during transport.

Whilst different types of inert gas are available, nitrogen is the purest, and thereby the preferred solution for applications where cargo contamination could be an issue.

The Unitor-Generon Nitrogen Membrane Inert Gas system (Unitor Inert Gas system) utilises hollow fibre technology. The hollow fibre membrane manufactured by Generon IGS has been the benchmark of nitrogen systems for over thirty years, providing an effective, reliable and safe solution to protect vessels and their cargo.

The system is designed in accordance with SOLAS and IMO MODU Code, and standards for the maritime and offshore markets. The system's design is approved by all major classification societies.

Lifetime commitment to safety

The Unitor Inert Gas system's application ranges from cylinder banks and cylinder topping-up generators to skid mounted total inert gas systems.

Today, the system is installed on over 600 vessels that requires a clean, dry inert gas for:

- Maintaining a non-explosive atmosphere in cargo tanks
- Preserving cargo quality
- Preventing ice build-up on insulation

Our nitrogen generators range from 10m³/h to 6000 m³/h with a capability of providing nitrogen with a purity from 95% to 99.9%, and dew points to -70°C.

Wilhelmsen Technical Solutions has a lifetime commitment to inert gas systems. Highly qualified in-house service engineers are available for system inspection, repairs, planned maintenance, trouble shooting and calibration of key components. Our worldwide service organisation responds to urgent service calls, regardless of vessel location.

Solution benefits

The Unitor Inert Gas system uses advanced low pressure fibre technology, and is easy to install, operate and maintain. The system's full range of components provides flexibility to customise the system to meet any specific needs.

The system has been installed on over 600 vessels, such as :

- Chemical tankers
- LNG/LPG tankers
- Offshore supply vessels
- FPSOs
- Reefer vessels
- Research vessels
- Asphalt tankers
- Aircraft carriers
- Barges

Increased operation efficiencies

The system has simple and flexible installation with high operational efficiency:

- Space saving, compact modular design for below deck installation
- Fully assembled units on skids simplify installation
- Long life of membrane module
- Low maintenance requirements

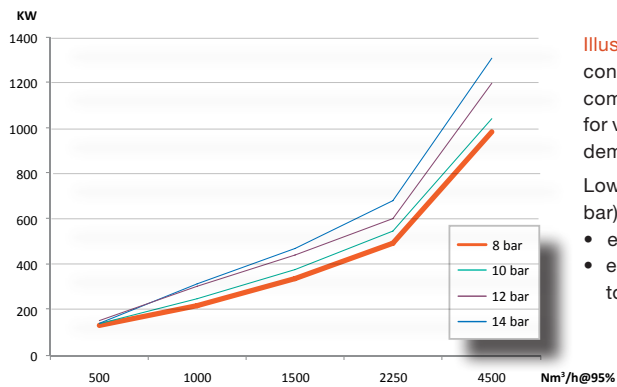


Illustration of power consumption of compressors used for various nitrogen demands.

Lower air pressure (8 bar) means

- energy saving
- energy needs similar to PSA solution

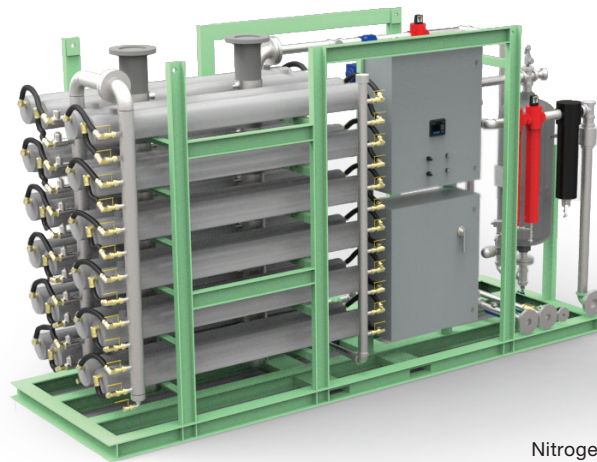
System description

The Unitor Inert Gas system uses marine quality rotary screw oil-flooded compressors to achieve the optimal amount of air supply. Advanced feed air treatment ensures high quality air, prolonging the lifetime of the membrane system.

The system works by separating air into its component gases by passing low pressure compressed air through hollow fibre, semi-permeable membranes. Then the air is divided into two streams; nitrogen which holds purity level between 95% and 99,5% and remaining air flow which is vented to a safe area.

Depending on the application, the nitrogen can be delivered directly to the cargo or void space, or stored in a receiver for later use. A booster compressor can be included to provide nitrogen at higher pressures, needed for filling Unitor 200 bar nitrogen cylinders.

The PCCP membrane modules are best suited for low pressure nitrogen use. The membrane modules are the most compact air separation membranes in the world. The new technology allows 25% lower energy consumption, an even smaller footprint and lower weight than previously. The PCCP membrane modules are designed to recover over 50% at operating temperature of 35°C and a nominal air pressure of less than 10 bars.



Nitrogen generator open skid design

Generon Hollow Fibre Technology

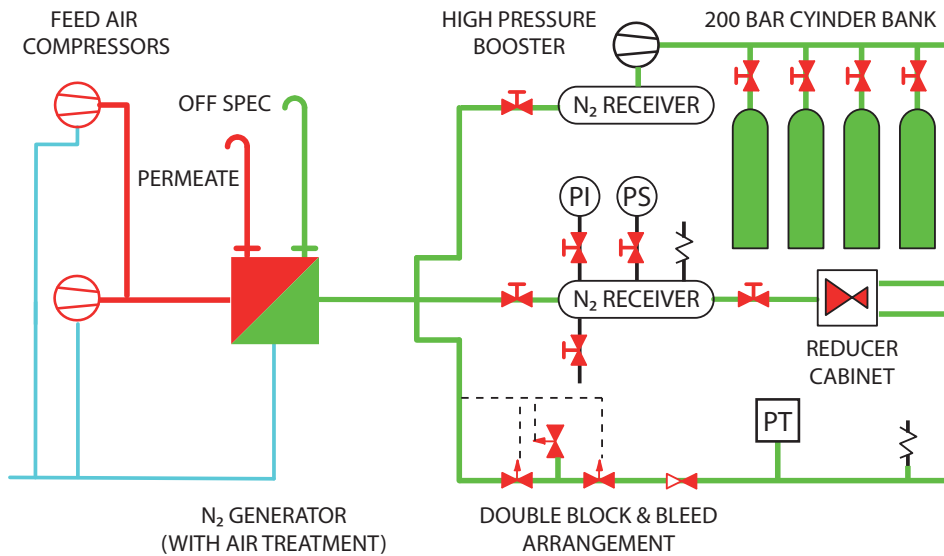
Generon IGS controls all aspects of its proprietary and patented membrane manufacturing process. Years of experience in the design and fabrication of membrane fibres and systems have made GENERON® systems to be the best in class.

Features including simple operation, proven reliability, minimal space requirements, a wide range of operating conditions and the lowest energy consumption make Generon the preferred technology partner for maritime applications.



Nitrogen generator cabinet design

Standard configuration



Technical data

COMPRESSORS

Type	oil flooded screw compressors
Control method	modulating control and variable speed drives
Pressure	8 - 14 bar(g)
Cooling	air, fresh or sea water cooled
Power consumption	22kW per 100 Nm ³ /h@95% N ₂
Starting method	star / delta

N₂ GENERATORS

Cabinets	up to 500 Nm ³ /h@95%
Open skid design	up to 6000 Nm ³ /h@95%
Process controlled	PLC
Ambient temperature	3 - 45 °C
Pressure	8 - 10 bar
Air temperature	34 +/- 5 °C

PRODUCT SPECIFICATION

Capacity	10-6000 Nm ³ /h
Purity	95-99.9% N ₂
Dew point	-70 °C
Pressure	approx 8 - 14 bar(g)
Operating temperature	34 +/- 5 °C
Oil content in product	less than 10 ppb
Particles in product	max 0.01 micron

INERT GAS SOLUTIONS

MARITIME PROTECTION INERT GAS SYSTEMS

- Flue gas system
- Inert gas generator
- Flex-inert system
- Dry inert gas generator
- Dual fuel inert gas generator
- Flue-generator system
- Inert gas deck house modules

UNITOR-GENERON INERT GAS SYSTEMS

- Nitrogen membrane inert gas system
- Nitrogen membrane controlled and modified atmosphere system