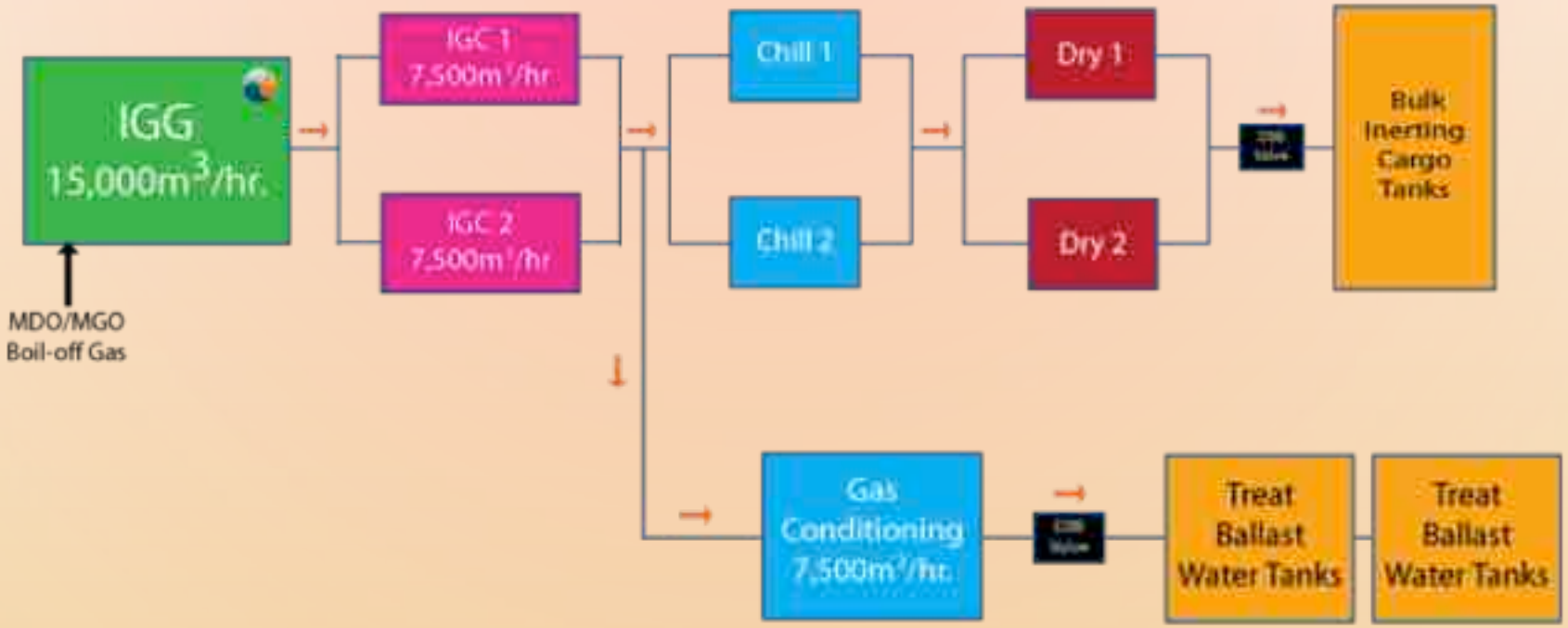
INERT GAS BASED BWTS SYSTEM

CONTRIBUTION OF C&A STAVROS KASSIDIARIS S.A. IN AUTOMATION DEVELOPMENT

- **Year established : 1978**
- **Activities : Sales, Constructions, Services**
- **Section : Electric, Electronic, Pneumatic, Hydraulic Automation Equipment & Systems**
- **Location : 97 Agchialou & 73 Aegaleo str., 18544, Piraeus**
- **Contacts :**
  - **Tel: 210-4636000 (10 lines)**
  - **Fax: 210-4624471**
  - **email: info@kassidiaris.gr**
  - **web: www.kassidiaris.gr**
- **Facilities : two owned buildings, 2.000m²**
- **Employees : 50 persons**

IGGS for LNG Bulk Inerting

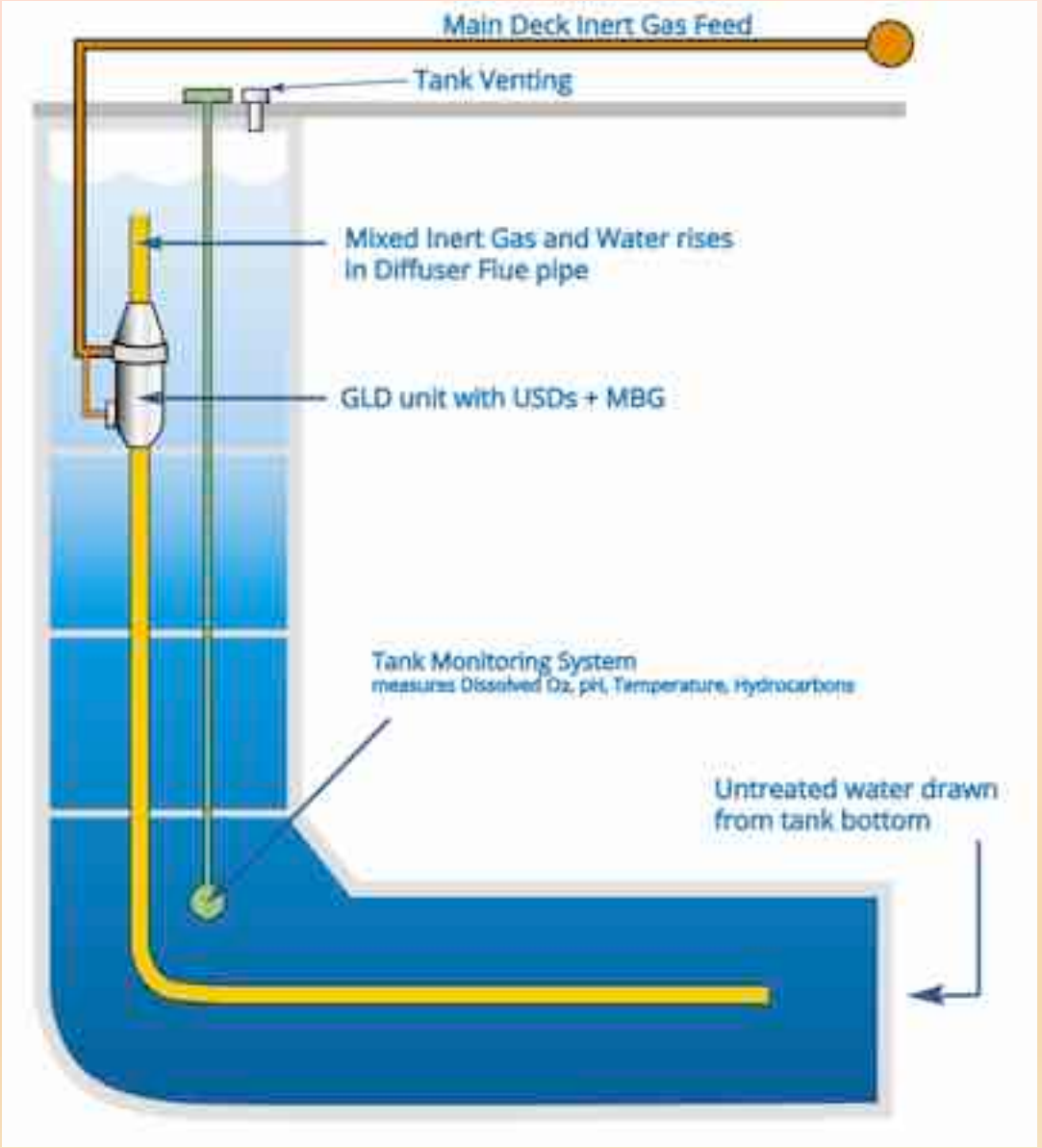


Combined System for Bulk Inerting and Ballast Water Treatment

GLD™ BWTS

In-tank, in-voyage, Inert gas based

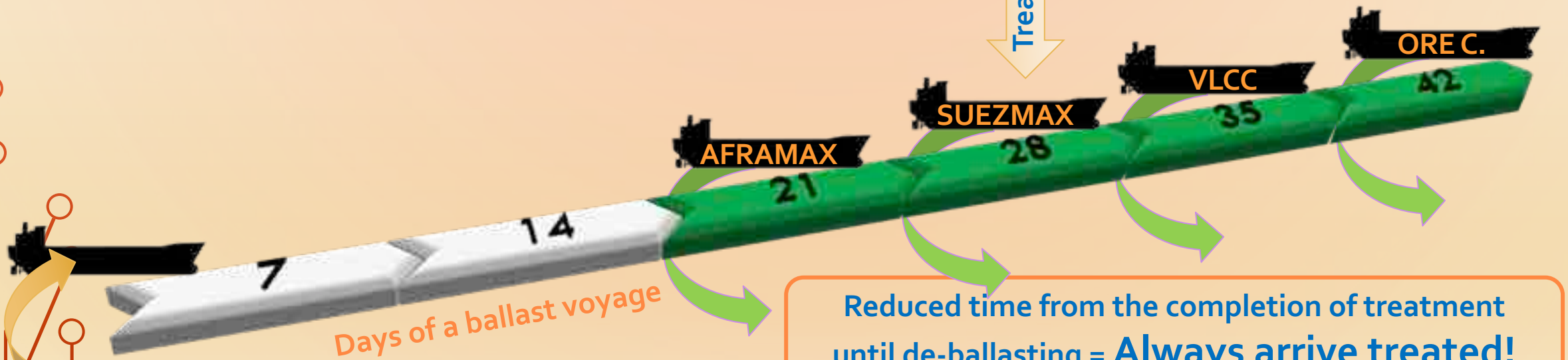
Natural fluid dynamics diffuses the inert gas through all of the ballast water inside the tank without the need for pumps.



= fit for purpose

REGROWTH & FILTRATION elimination

In-tank treatment flexibility, say about 5 days before de-ballasting



Reduced time from the completion of treatment until de-ballasting = **Always arrive treated!**

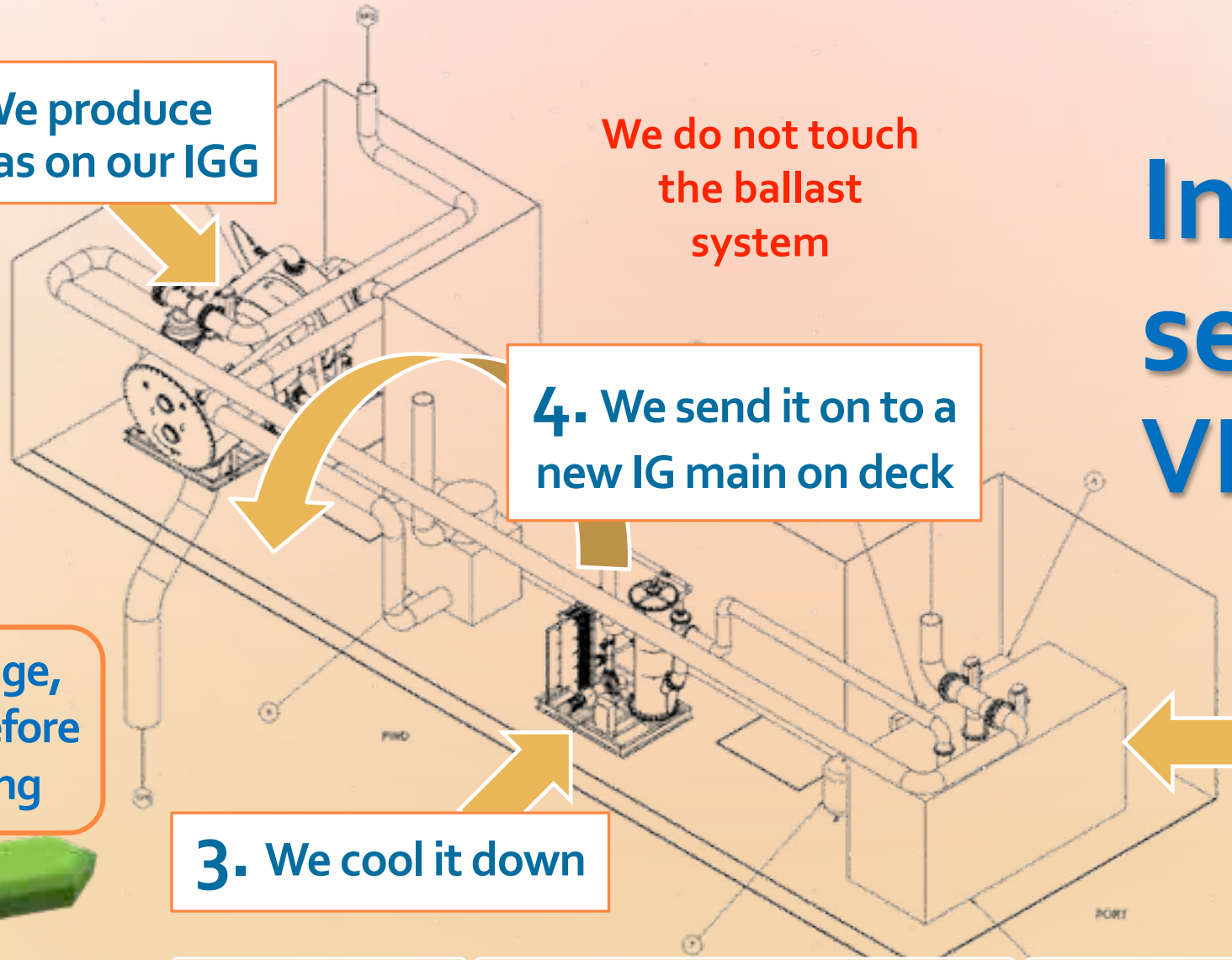
Indicative setup on a VLCC/VLOC

1. We produce Inert Gas on our IGG

We do not touch the ballast system

4. We send it on to a new IG main on deck

During voyage, say 5 days before de-ballasting



2. We compress it to 4bar

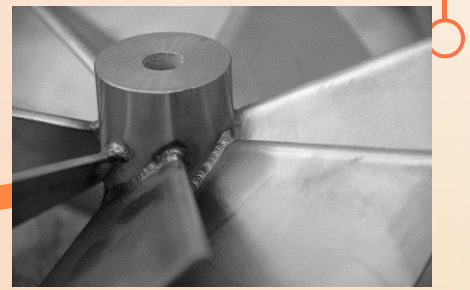
3. We cool it down

24h **IG diffusion**	60h **Dwell time**	20h **Re-aeration**
No. 1, 2 & 3 in op/n	(all main equipment is off)	No. 2 & 3 in op/n

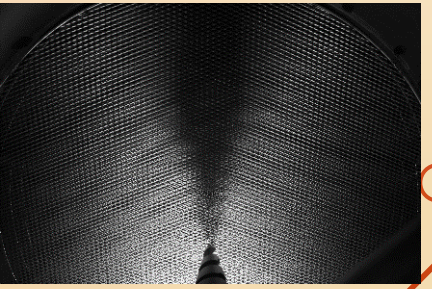
Sea Guardian™ Inert Gas Generator

Design Innovations

Venturi Burner Lance
no burner cone required

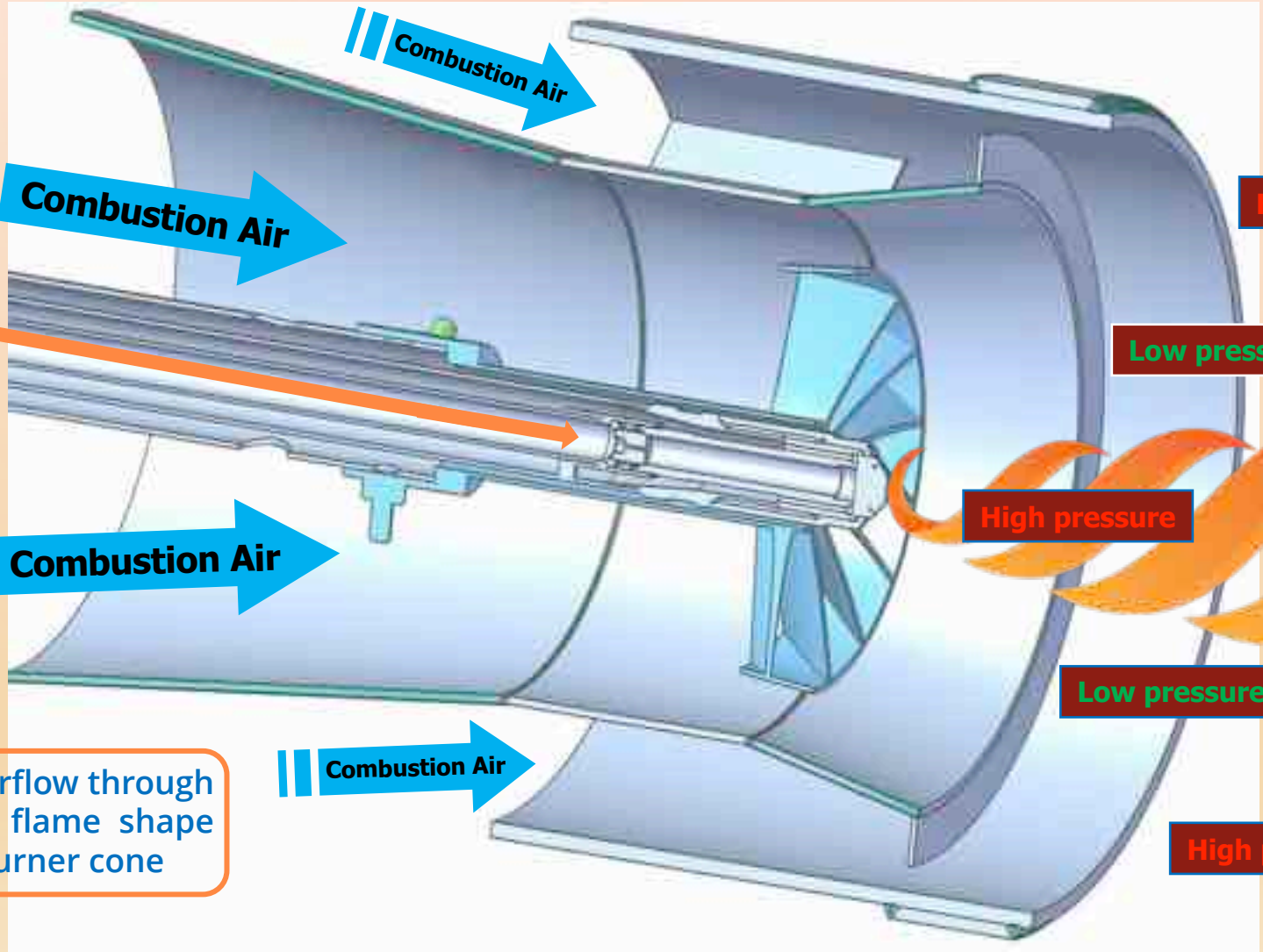


Swirl Vane Separator
no demister pads needed



Quench Scrubber Matrix
no bulky scrubber tower

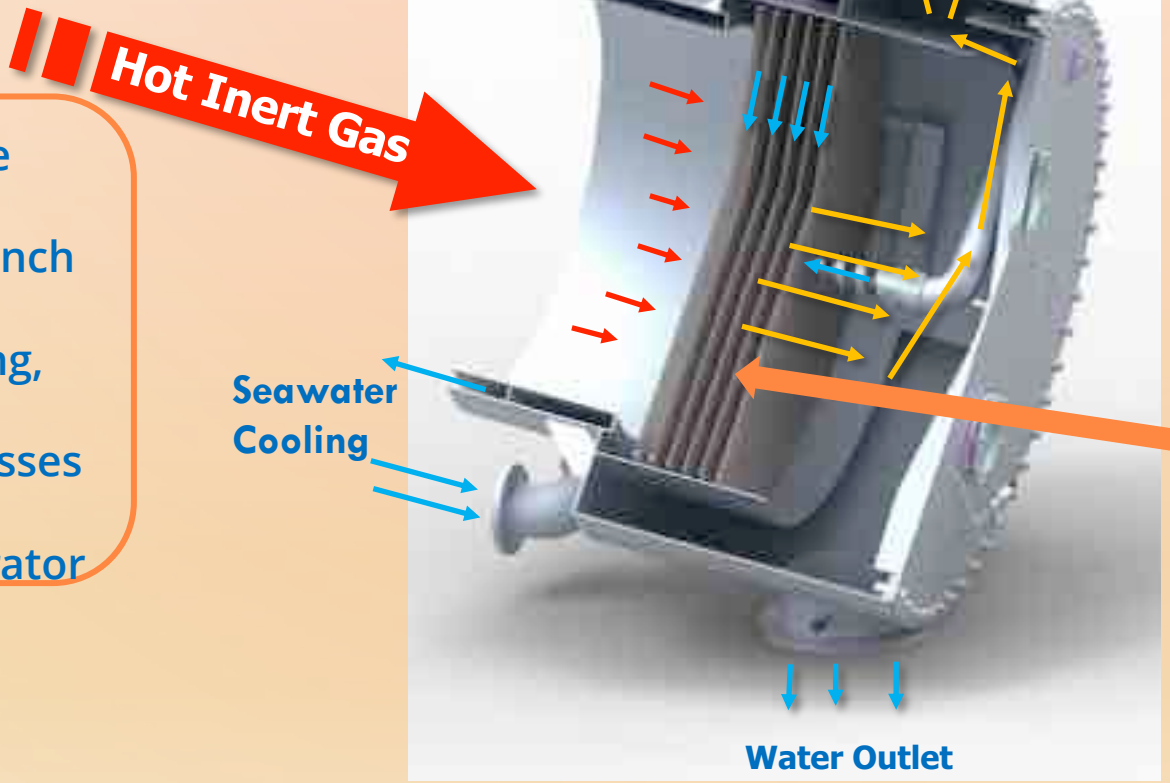
Venturi Burner Lance Flame Control

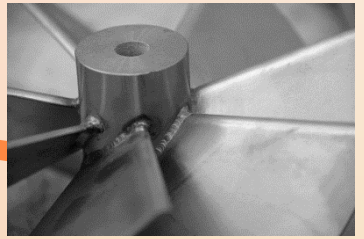


High and low pressure airflow through the casing controls the flame shape without the need for a burner cone

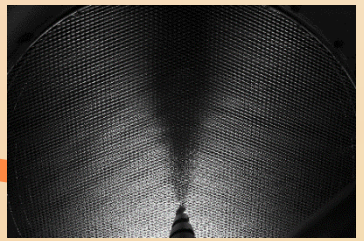
Sea Guardian™ Quench Scrubbing System

Hot gas from the burner passes through the quench scrubber mesh matrix for cooling, shedding water droplets as it passes the through the swirl vane separator





Swirl Vane Separator



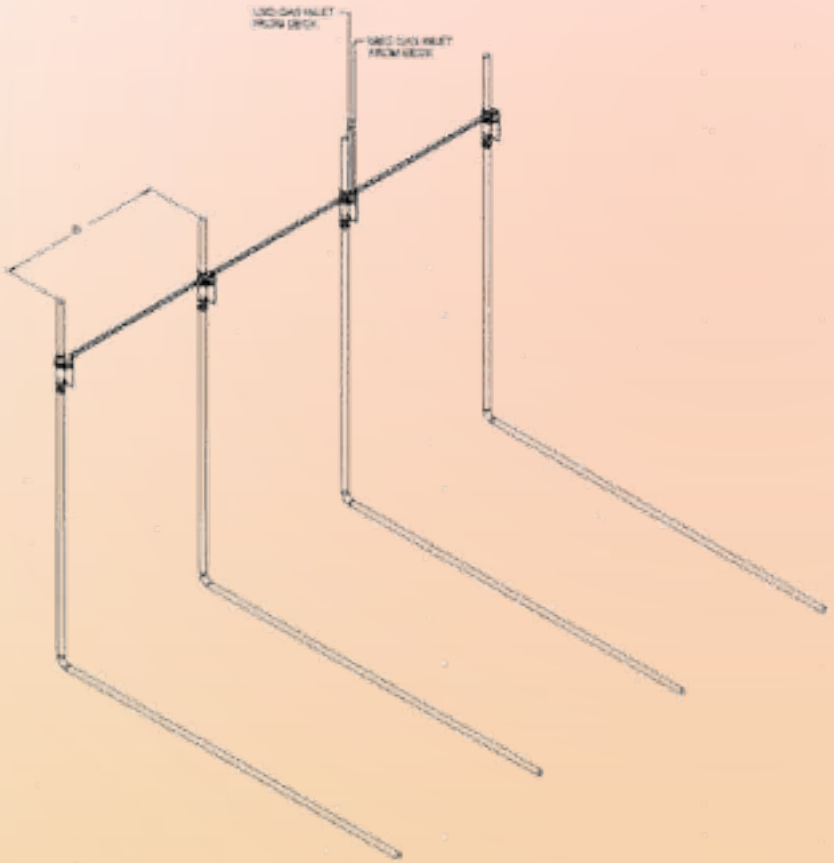
Quench Scrubber Matrix

Sea Guardian™ Advantages

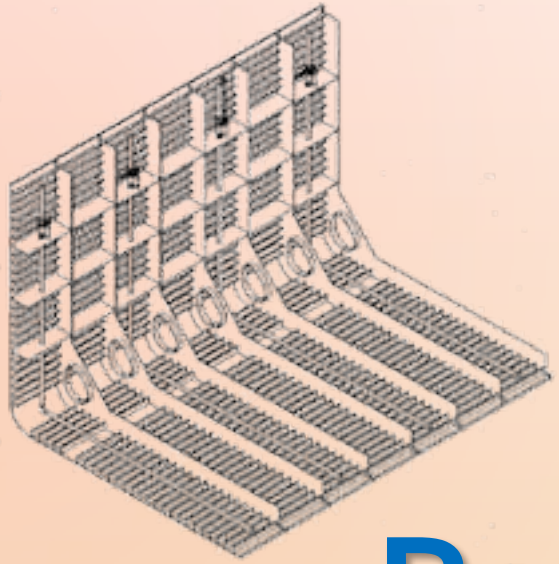
- No burner cone = very low maintenance
- No vertical scrubbing section = smaller foot print, especially for larger system installs
- No demister pads or filters = 100% uptime & zero unscheduled downtime
- Stable operation at 0.2% residual oxygen
- Zero soot
- Low NOx and SOx emissions
- Small footprint, engineered for 100% reliability
- Multi-fuel capability = LSMDO/MGO or LNG (incl. Boil-off Gas)

Sea Guardian™ Applications

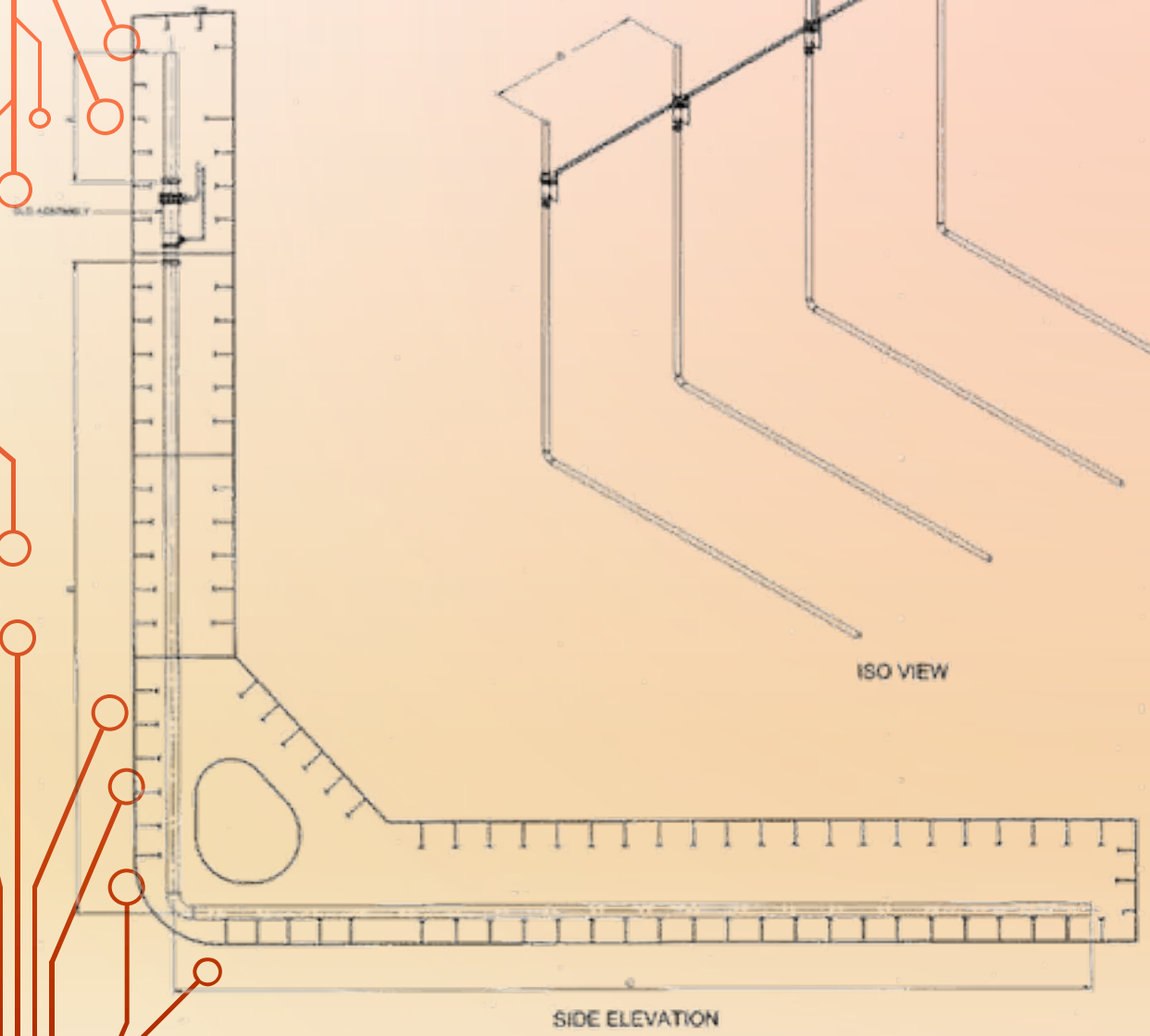
- Cargo blanketing duty
- BWTS duty + cargo blanketing top-up combined (1 IGGS required)
- BWTS duty only
- Bulk Inerting for LNG carriers
- Combined BWTS & Bulk Inerting for LNG carriers



ISO VIEW



ISO VIEW



SIDE ELEVATION

Retrofit setup VLCC-B

Retrofit Experience

- First BWT system to be retrofitted to a VLCC
- Completed in 10 days during dry-docking

Gas Lift Diffusor (GLD) unit in ballast tank

No significant engineering issues encountered during the retrofit installation

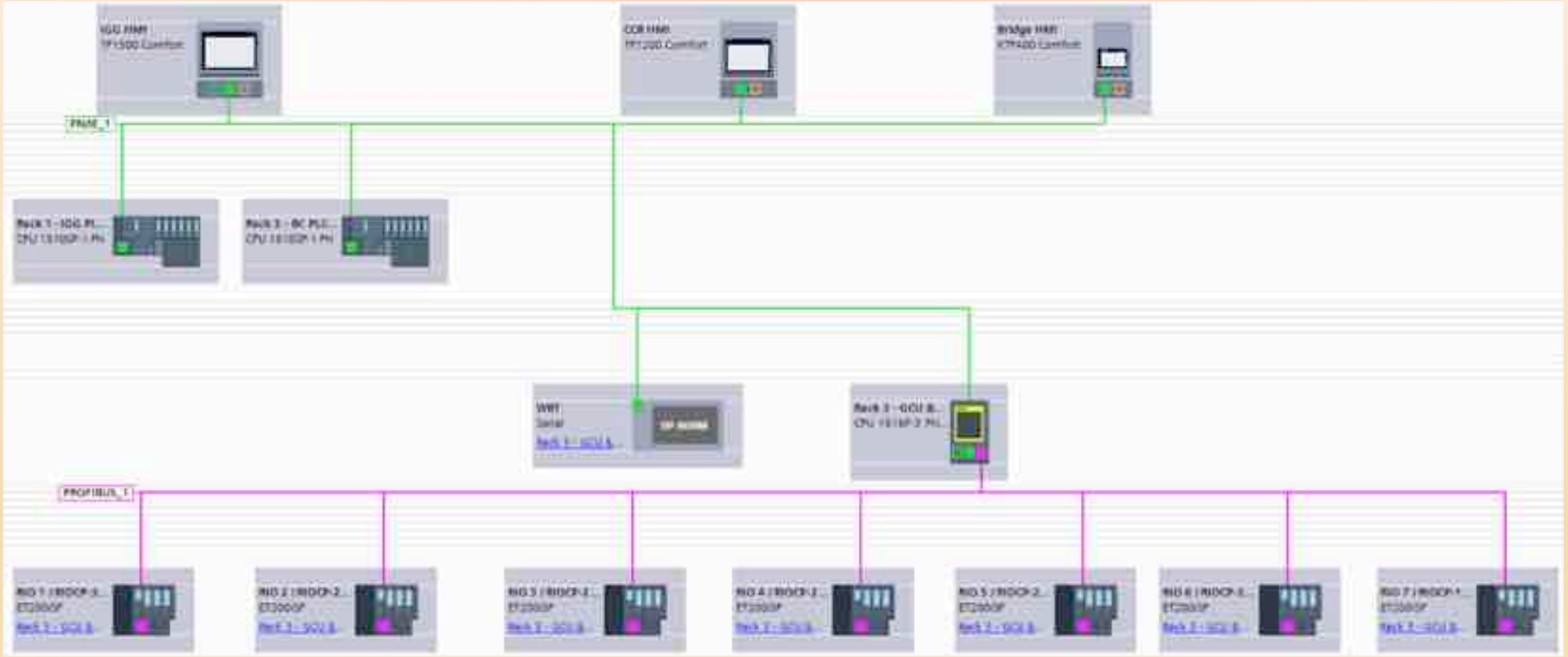
How the treatment works – Hypoxia, Hypercapnia, Ultrasonic Shockwaves and Micro-Bubbles

- The inert gas reduces the O_2 content of the ballast water to 0.2% over a 12-hour period, killing the oxygen breathers (via **Hypoxia**)
- The elevated level of CO2 in the inert gas also slightly lowers temporarily the pH of the ballast water, to about 5.9pH, i.e. **not a threat to tank coatings**, killing most of the anaerobic organisms (via **Hypercapnia**).
- The remaining anaerobic organisms such as enteric bacteria (e.g. E.coli) and Barnacle larvae are killed inside the GLD units by a patented method of **gas-induced ultrasonic shockwaves**, causing **cellular rupture**: inert gas micro-bubbles are created within the GLDs to enhance the effect and these are imploded by the ultrasonic shockwaves.

Operational Benefits

- Not any effect to vessels' operation while at port – the BWTS is always idle then
- Ballast operations unaffected, as in the past – including gravity ballasting / de-ballasting
- No modifications or additions to ships power generating capacity
- No filters, back-flushing, pressure drops, chemical additives or neutralization
- Familiar IGG technology for the crew
- Operation is unaffected by salinity, water temperature or high TSS
- Treat towards the end of the ballast voyage = ALWAYS arrive treated!

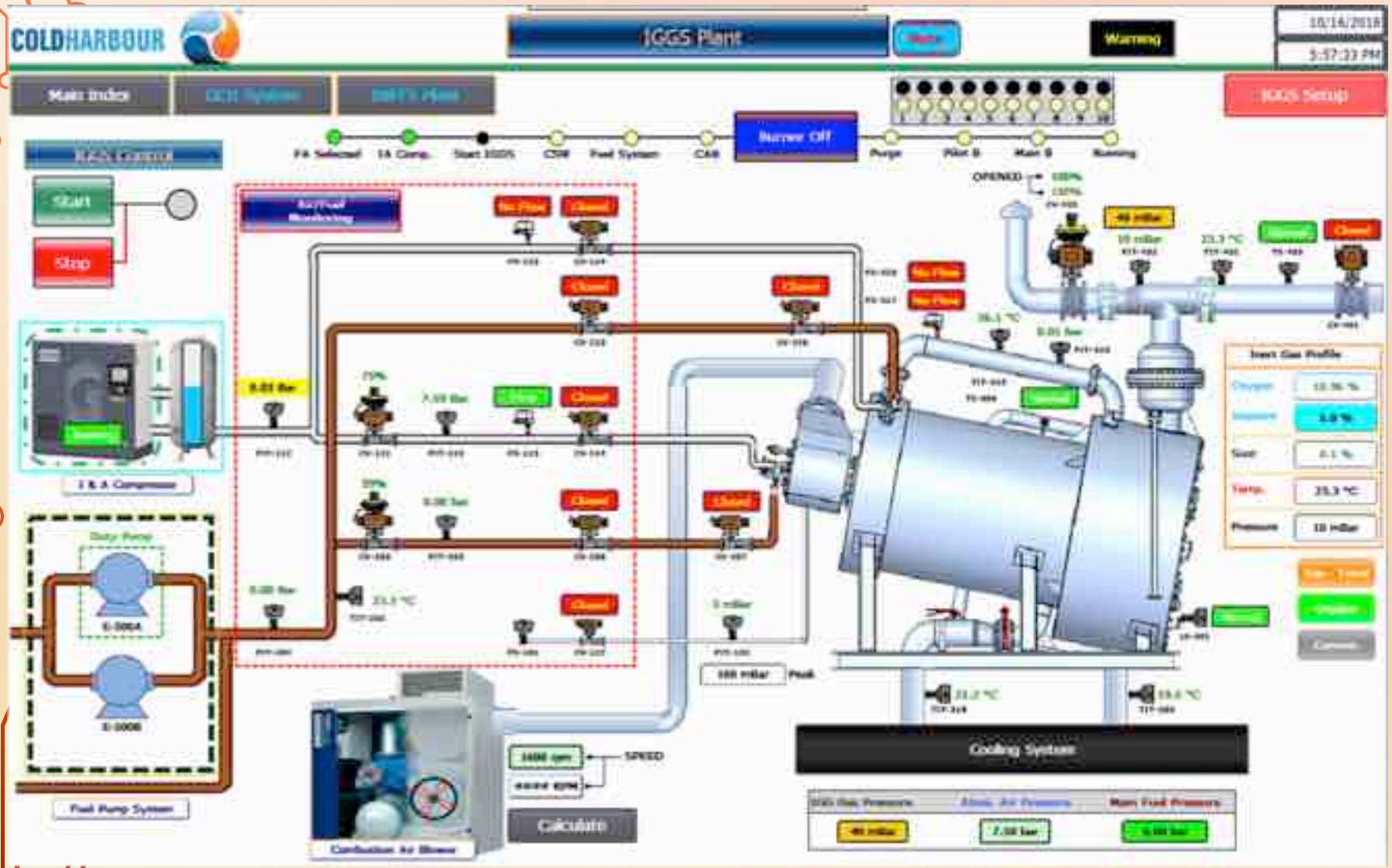
Electronics & Networks View



Brief description of structure

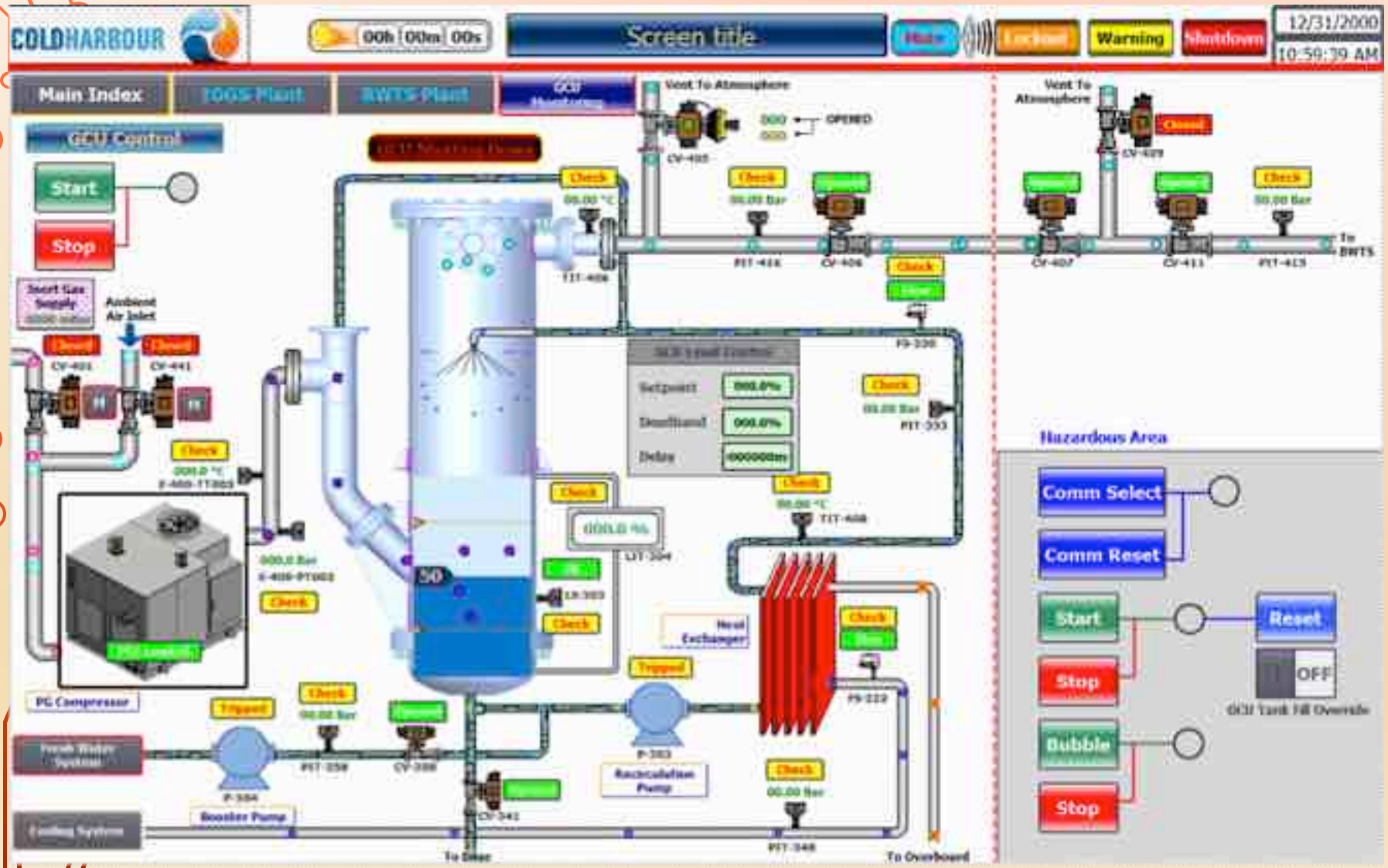
- The system consists of three PLC CPU’s for IGG Burner Control, PGC & GCU Automation
- Ex-Proof Remote IO Panels on deck (for 1,2 or 3 Tanks)
- Three HMI’s for control & monitoring (Locally, CCR and Bridge)
- Optional interface with vessel’s BWT Monitoring
- Optional interface with vessel’s PMS
- Optional LogFile extraction & data send on shore

Main control screens



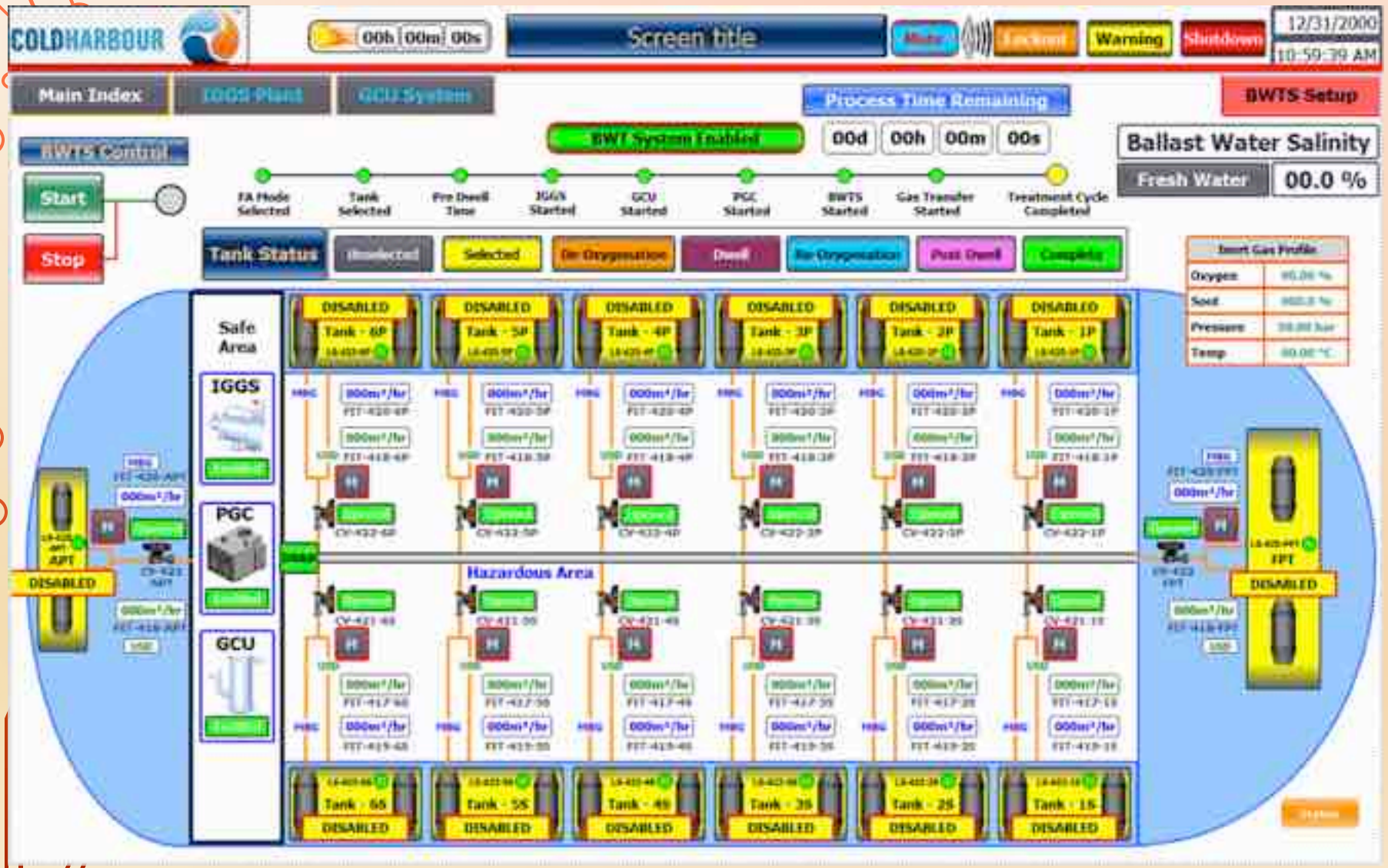
Inert Gas Generator Plant

Main control screens



Process Gas Compressor & Gas Conditioning Unit

Main control screens



BWT tanks Monitoring & Process Control

Setup & Customization screens (1/2)

Setup & Customization screens (2/2)

GLD™ System Certification

- IMO Type Approved (G8) Feb 2015.

  Awarded by UK MCA, supervised by Lloyd's Register.

- Accepted as an Management System (AMS) by USCG June 2015
- USCG TA process commenced – tests will be finalised by Q2/Q3 2019

Awards

- Innovation Award – Marine Propulsion & Auxiliary Machinery April 2015
- Technical Innovation Award – Tanker Shipping & Trade – November 2015

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Thank you for your attention!