

Ballast Water Treatment



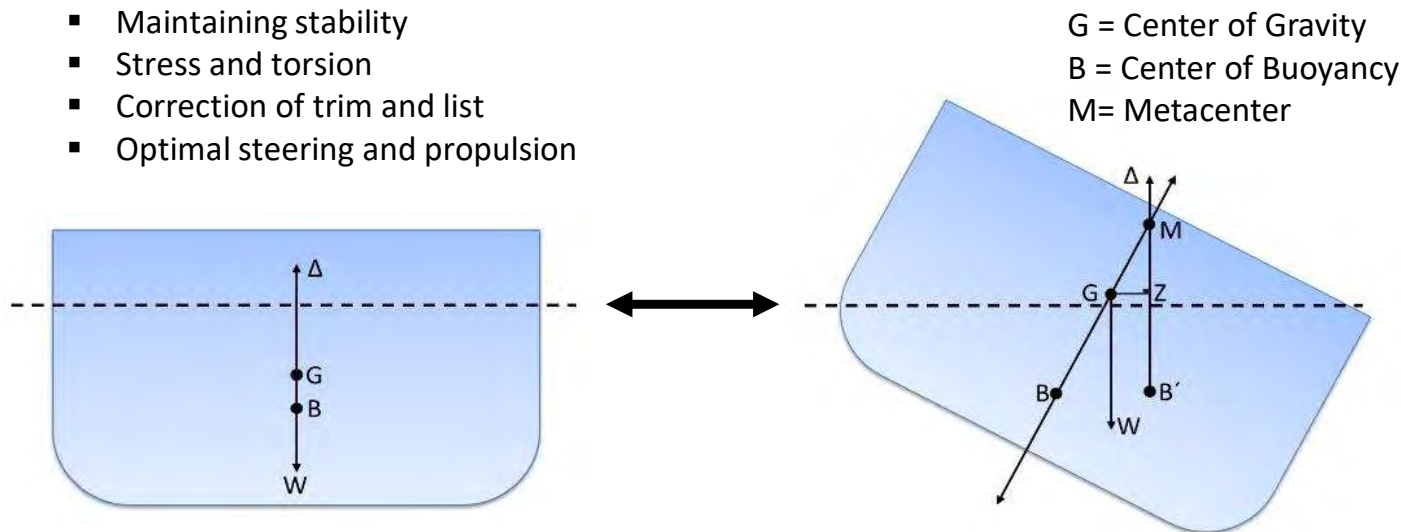
Introduction to Ballast Water

Ballast Water /'baləst 'wôdər,'wädər/

Ballast water is fresh, or saltwater, held in the ballast tanks of ships to provide stability and maneuverability during a voyage when ships are not carrying cargo, not carrying heavy enough cargo, or when more stability is required due to rough seas.

- Existing ship designs make the use of ballast water a necessity especially for operational purposes in terms of:

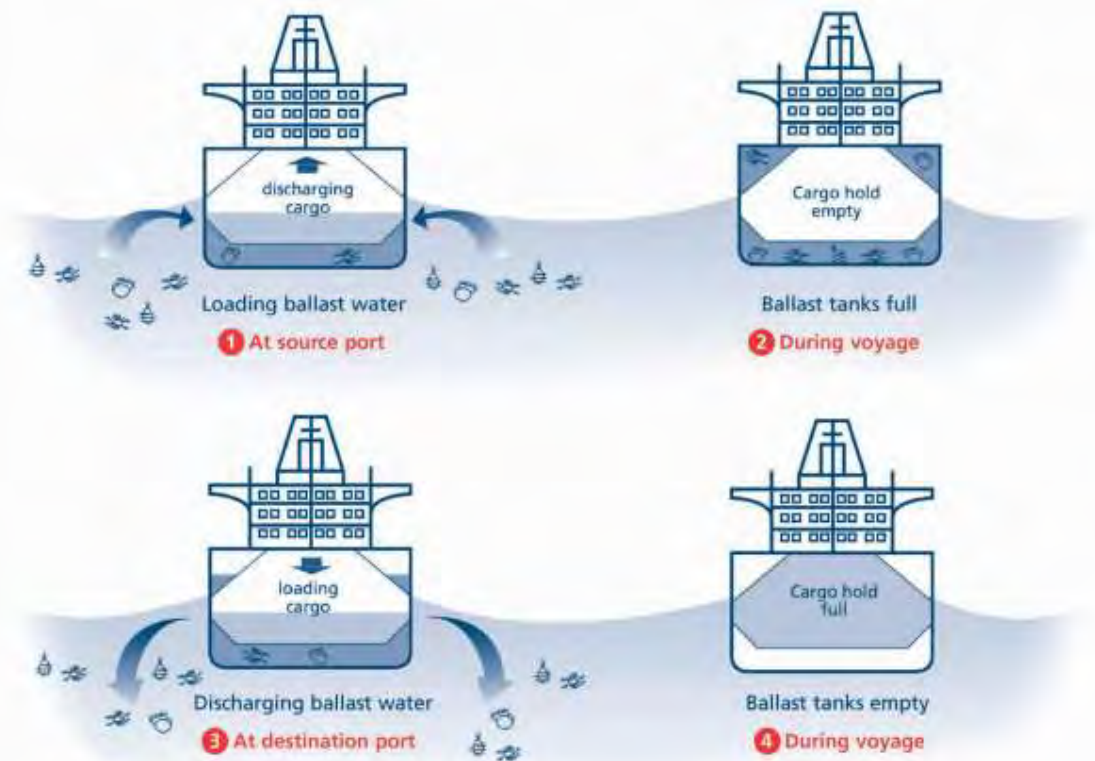
- Maintaining stability
- Stress and torsion
- Correction of trim and list
- Optimal steering and propulsion



Ballast Water and Invasive Aquatic Species

Ballasting

- When a tanker is discharging cargo, ballast water is loaded into the ballast tanks. When this happens, organisms within the water can also be loaded.



De-ballasting

- At the cargo loading port, ballast water is discharged from the ballast tanks. Without a ballast water treatment system, organisms within tanks would be discharged with the water.

Ballast Water Management Convention - IMO

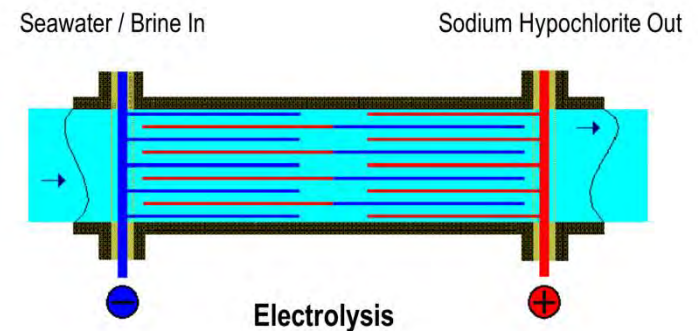
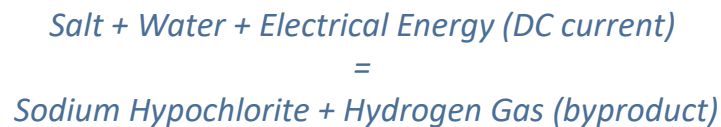
- The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) was adopted by IMO in February 2004 and entered into force globally in September 2017.
- Under the convention, all ships in international traffic are required to conform to ballast water management standards that will be phased in over a period of time. For most ships, this involves installing equipment to treat ballast water.
- Ballast Water Treatment (BWT) is a system designed to prevent the spread of aquatic invasive species via ballast systems.
- Polar Tankers utilizes the BALPURE® electrolytic disinfection ballast water treatment system.



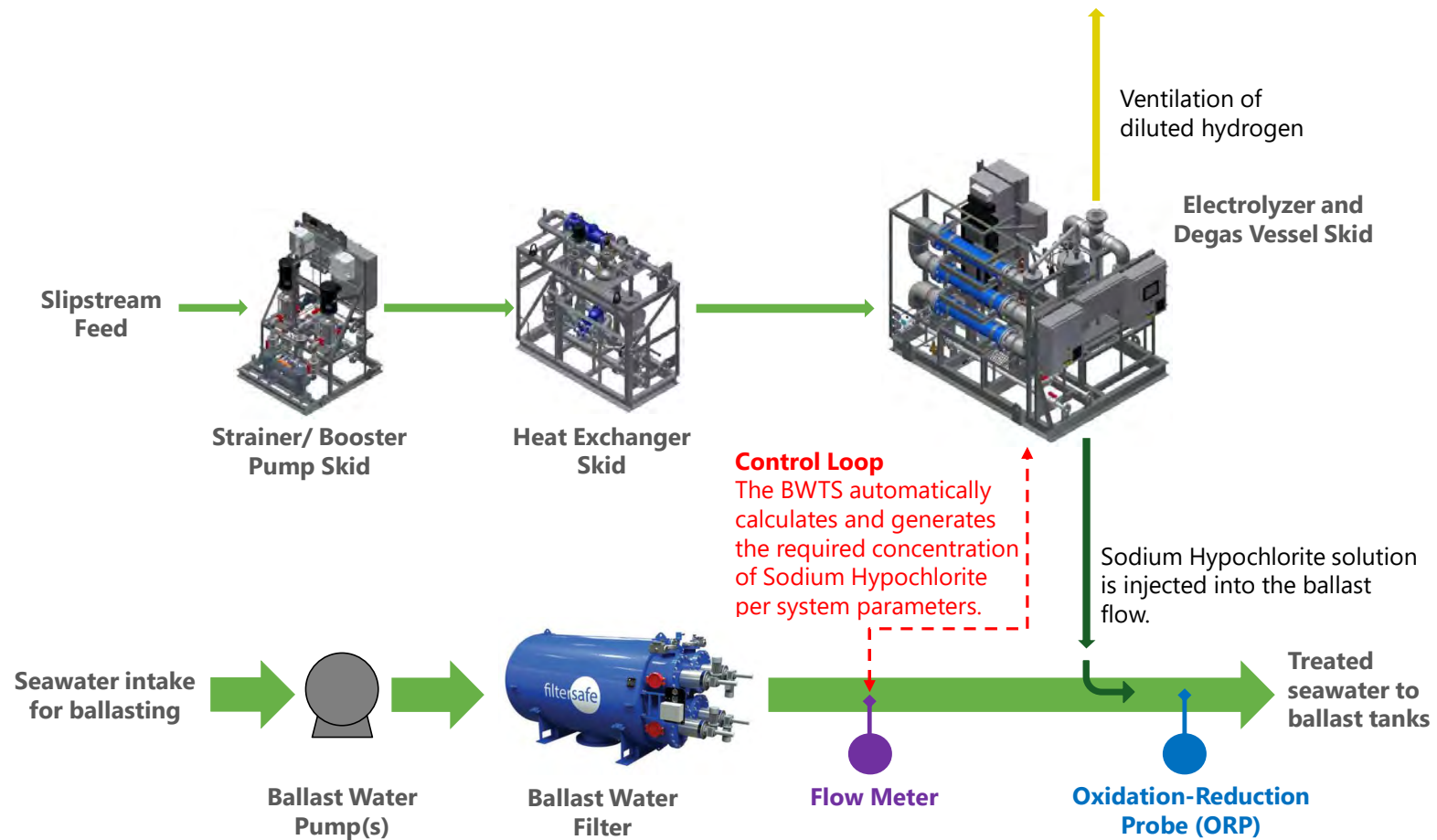
Ballast Water Treatment System (BWTS)

Treatment of ballast is a two-phase process:

- **Main Flow Filtration** – All incoming ballast water is filtered to 40 micron prior to treatment (human hair is approx. 75 micron). This reduces chlorine demand, minimizes power consumption, and minimizes silt in tanks.
- **Slipstream Electro Chlorination** – The seawater is then disinfected with Sodium Hypochlorite generated using the Electrolyzer.



Ballasting Process Overview



filtersafe
AUTOMATIC SCREEN FILTRATION



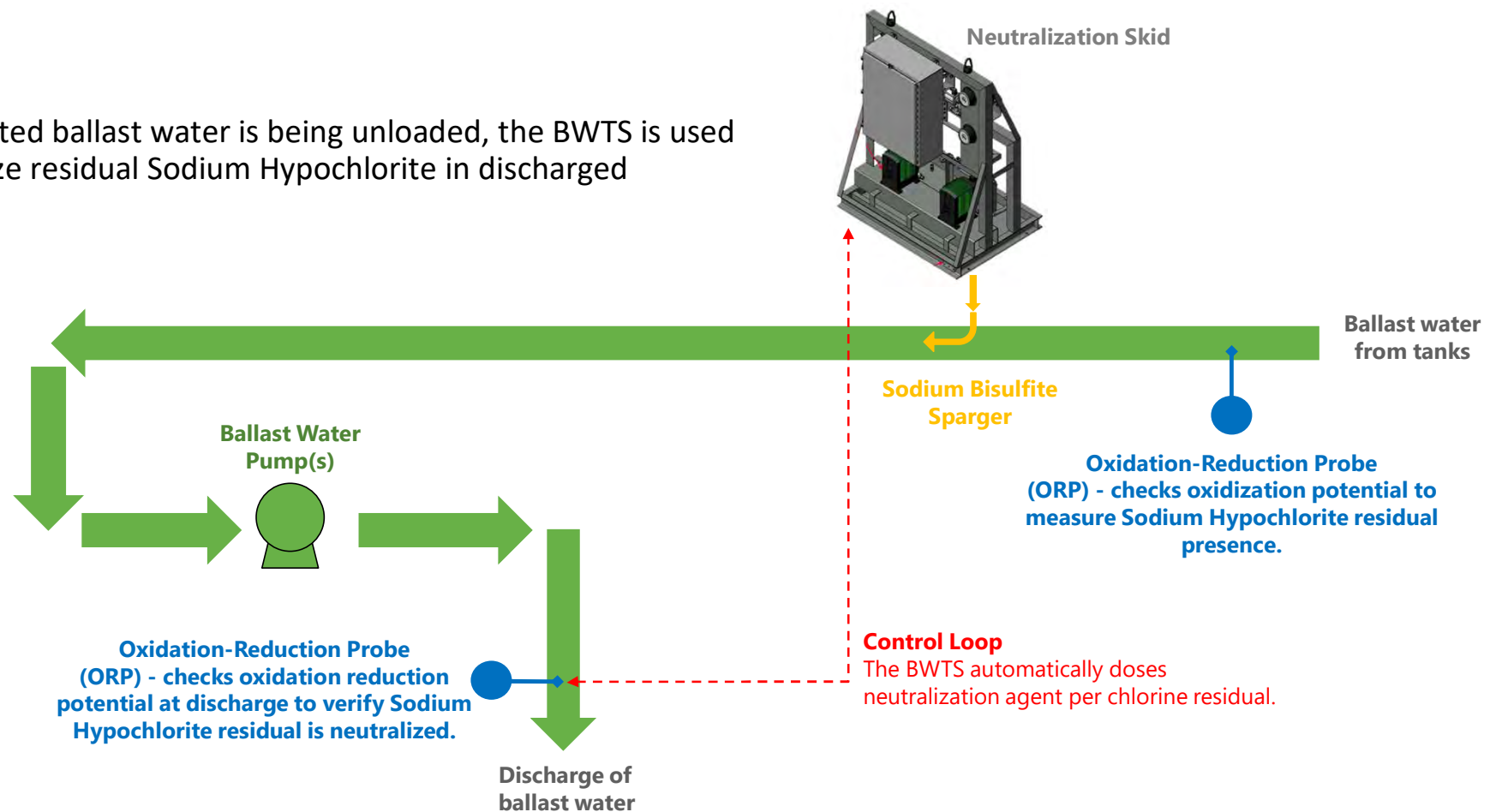
EVERCLEAR™
automatic filtration cycle

BALPURE[®] SYSTEM

PROCESS OVERVIEW

De-ballasting

- As the treated ballast water is being unloaded, the BWTS is used to neutralize residual Sodium Hypochlorite in discharged seawater.



BALLASTING



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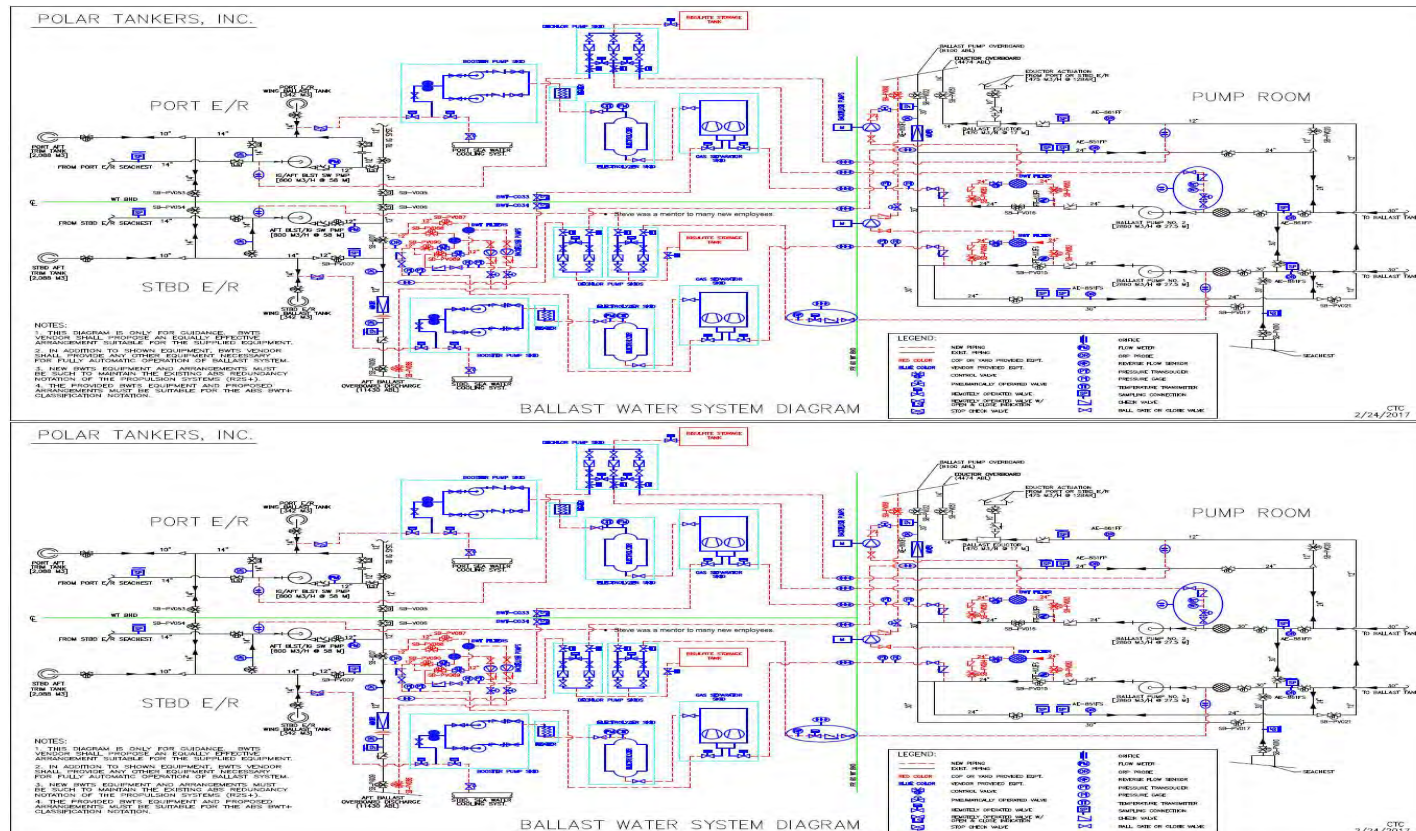
Polar Tankers BWT System Schematic

➤ AFT SYSTEM

- Pumping capacity: 2 pumps, one in each E/R
- Rating of each pump: 795 m³/h @ 49 m [3500 gpm @ 160 ft]

FORWARD SYSTEM

- Pumping capacity: 2 pumps + 1 stripping eductor
- Rating of each pump: 2,862 m³/h @ 27.5 m [12,600 gpm @ 90 ft]
- Rating of eductor: 470 m³/h @ 23 m TDH [2,072 gpm @ 75.5 ft]
- Eductor driving water flow: 475 m³/h @ 12 bar [2,085 gpm @ 170 psi]

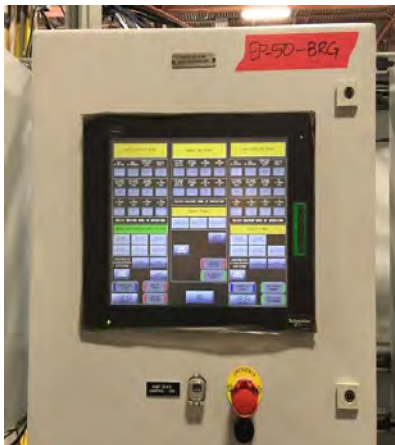


Factory Acceptance Testing (FAT)



Factory Acceptance Testing (FAT)

- 1st FAT successfully completed Dec. 2018 at DNWT facility in Sugar Land, TX.
 - All alarms and shutdowns proven operational.
 - Thorough testing of control systems allowed for several modifications to alarms/displays to be made during FAT on site.
 - Actual hypochlorite production testing proven as per design



Preparation for shipping

All equipment is packaged for safe transport and witnessed prior to shipment to Singapore in advance of the ship's arrival in the shipyard.

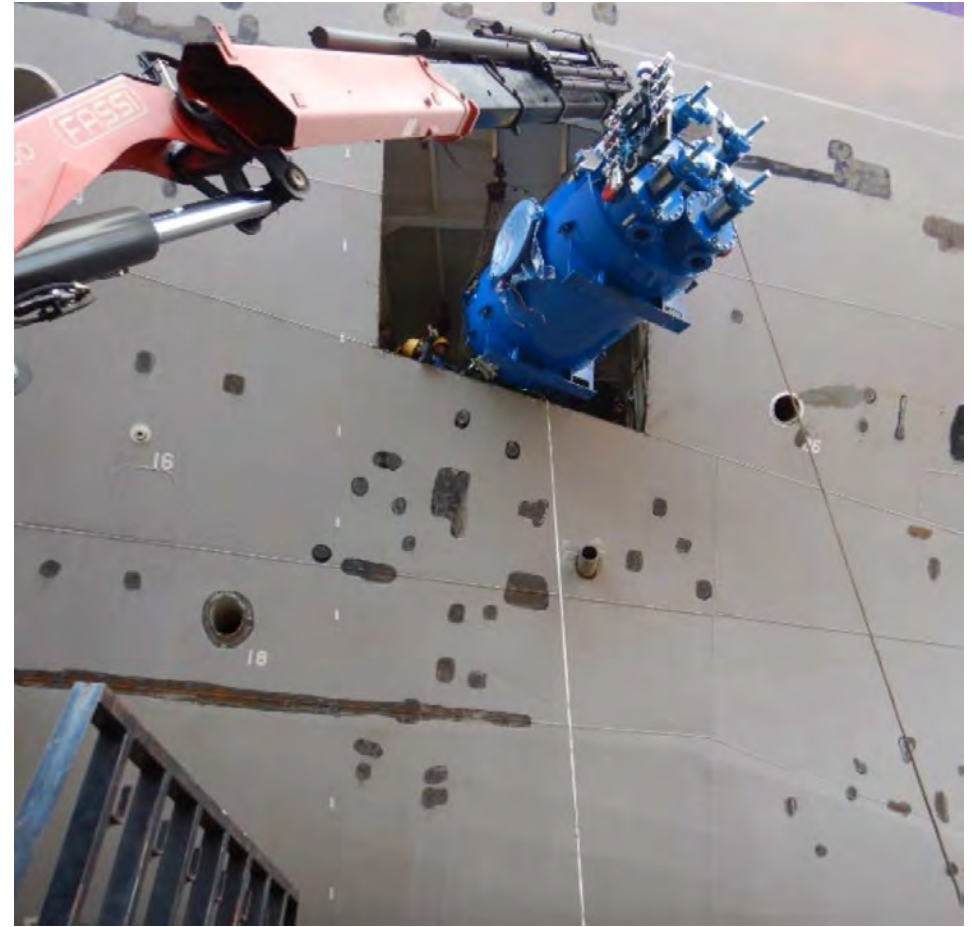


Installation



Equipment Installation Challenges

- ▶ The BWTS is modular by design requiring components to be fit into existing spaces. In some cases, the space for installation is very restricted requiring specialized installation plans.



Ballast Water Treatment System Installation Details

Added weight: **135.3 Tons**

Weight of new equipment:	37 tons
Weight of new structural steel:	26.5 tons
Weight of new piping:	43 tons
Weight of bisulfite tanks (full):	18 tons
Weight of new cables:	9 tons
Miscellaneous new weights	1.8 tons

New piping and tubing: **9,800 Feet**

New cables:

Number of different cable types:	30
Total number of individual cables:	320
Total length of installed cables:	61,200 ft (11.6 miles)



Q & A

