

Marine Scrubbing by BELCO®



The miracles of science™

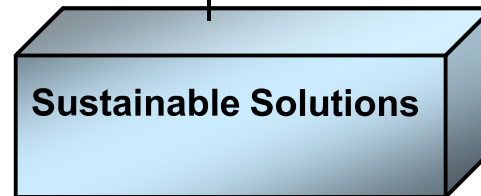
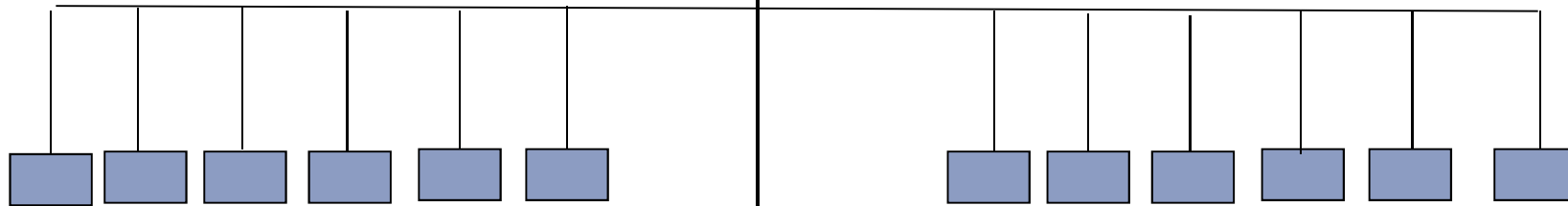


Our Family Tree...



- 60,000 people
- Offices in > 80 countries
- \$1,4 billion investment in R&D
- \$30,7 billion revenues
- Science company

13 Businesses...
...one Company



Established in 1968
and dedicated to
reduction of exhaust
gas pollutants on land
and at sea

DuPont™ BELCO® Clean Air Technologies

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BELCO's ONLY BUSINESS

Flue-gas cleaning systems
reducing stack emissions



Feasibility Studies

Field Demonstrations

Process Engineering

Detailed Design

Material Supply

Start-Up

Field Service

Spare Parts

DuPont™ **BELCO**® Clean Air Technologies
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The BELCO[®] Marine Scrubbing System

- Proven design - Installed at more than 200 commercial land-based installations worldwide
- Very high Reliability
- Customized for client's specific needs and in accordance with client's specifications.
- Open Tower design able to operate uninterrupted for many years without concerns between dry-dockings. No concerns of plugging or of having to do maintenance shut-downs while at sea.
- Can be designed for hot temperature. No need to ever by-pass scrubber
- Able to meet all IMO, SECA, EPA and other regulations



Meeting environmental requirements without switching to low sulfur distillate



BELCO[®] Scrubbing – Example 1

Design

Engine Wartsila 81.32 (3.6 Mw)

Fuel 3.5% S

Exhaust Gas Temp. 330°C

Exhaust Gas Flow Am³ 44081

Exhaust Gas Flow 18769 Nm³/hr (vol. dry)

SO₂ Content 2456 mg/Nm³ (dry)



BELCO[®] Scrubbing – Example 1

Basis: 3.6 Mw Engine using 3.5% Sulfur Fuel

		<u>Inlet</u>	<u>Outlet</u>
Gas Flow	Nm ³ /hr (wet)	20160	19207
Flue Gas Temperature	°C	330	20.2 (before re-heat)
SO _x	kg/hr	46.1	<1.3
Fuel Sulfur equivalent		3.5%	<0.1%



BELCO[®] Scrubbing – Example 2

Design

Engine	Wartsila 12V 46 CZ - 514 RPM
Fuel	3.0% S
Power	11,349 kW
Exhaust Gas Flow	21 kg/sec.
Exhaust Gas Flow	15.6 m ³ /sec
O ₂ Content	10.7% by Vol. Wet.
H ₂ O Content	7.90% by Vol. Wet.

BELCO[®] Scrubbing – Example 2

Basis: 11,349 kw Engine at 514 RPM using 3% Sulfur Diesel

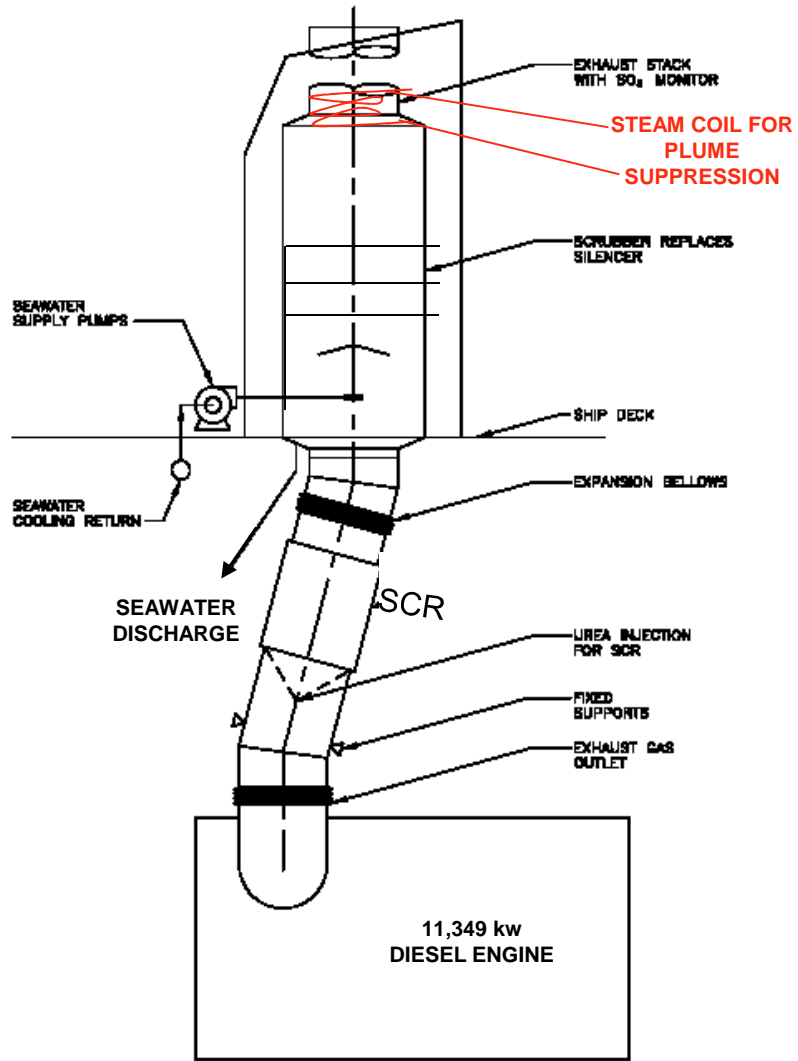
		<u>Inlet</u>	<u>Outlet</u>
Gas Flow	acfm	51, 286	30,572
Flue Gas Temperature	°F	400	77 (note 1)
SO _x	lb/hr	314	<9.15
SO ₂ reduction efficiency			> 97%
Fuel Sulfur equivalent		3.0%	0.1%
NO _x as NO ₂	lb/hr	166	146
Back Pressure	in. wc	2.4"	0"

Note 1: without re-heat and at 3% water vapor

BELCO[®] Scrubbing – Example 2

Wash-water discharge (at Design Conditions)

		Seawater to scrubber	Seawater from scrubber
Flow Rate	gpm	5430	5438
Composition:			
pH		~ 8	~ 6
Cl ⁻	g/l	11.9	11.9
TDS (salts)	g/l	48.9	48.1
COD(sulfites only)	g/l	0	0.018

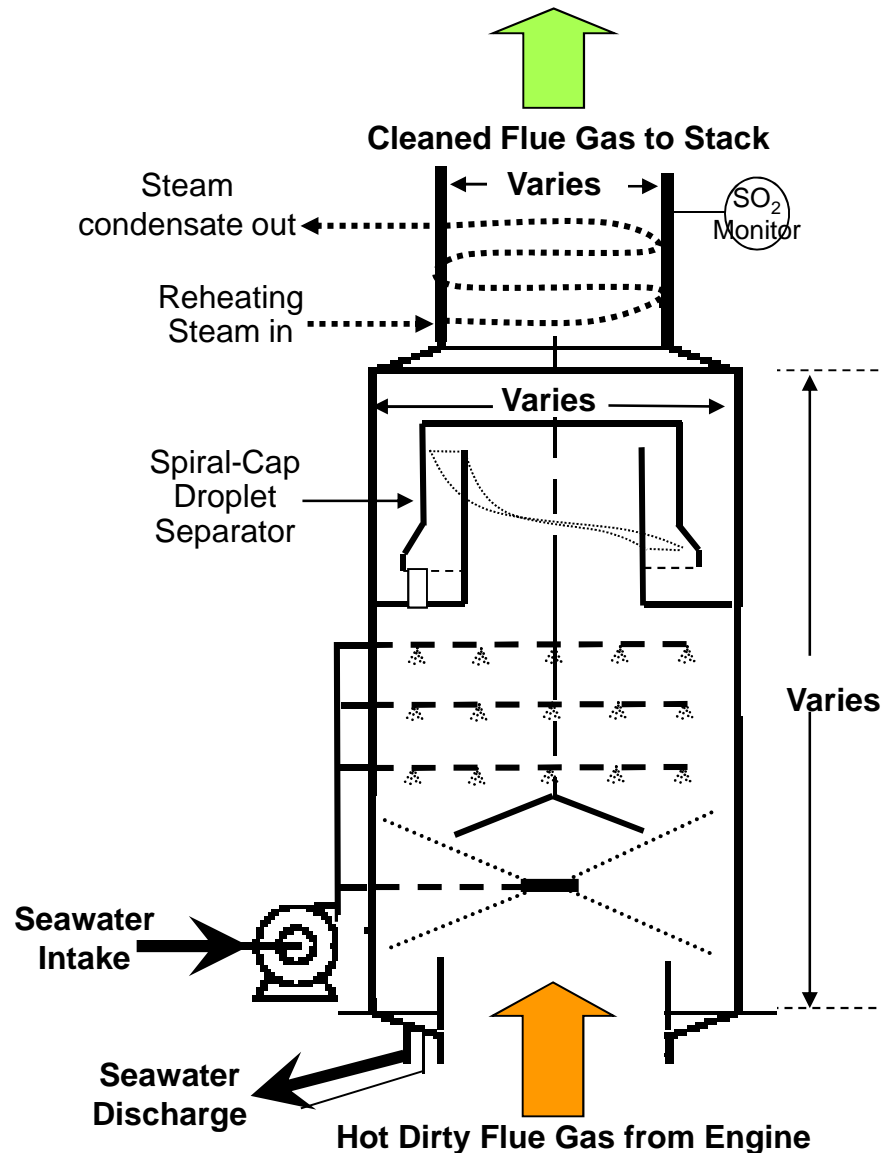


The “BELCO®” Marine Scrubbing System

SHIP POLLUTION CONTROL SCRUBBER

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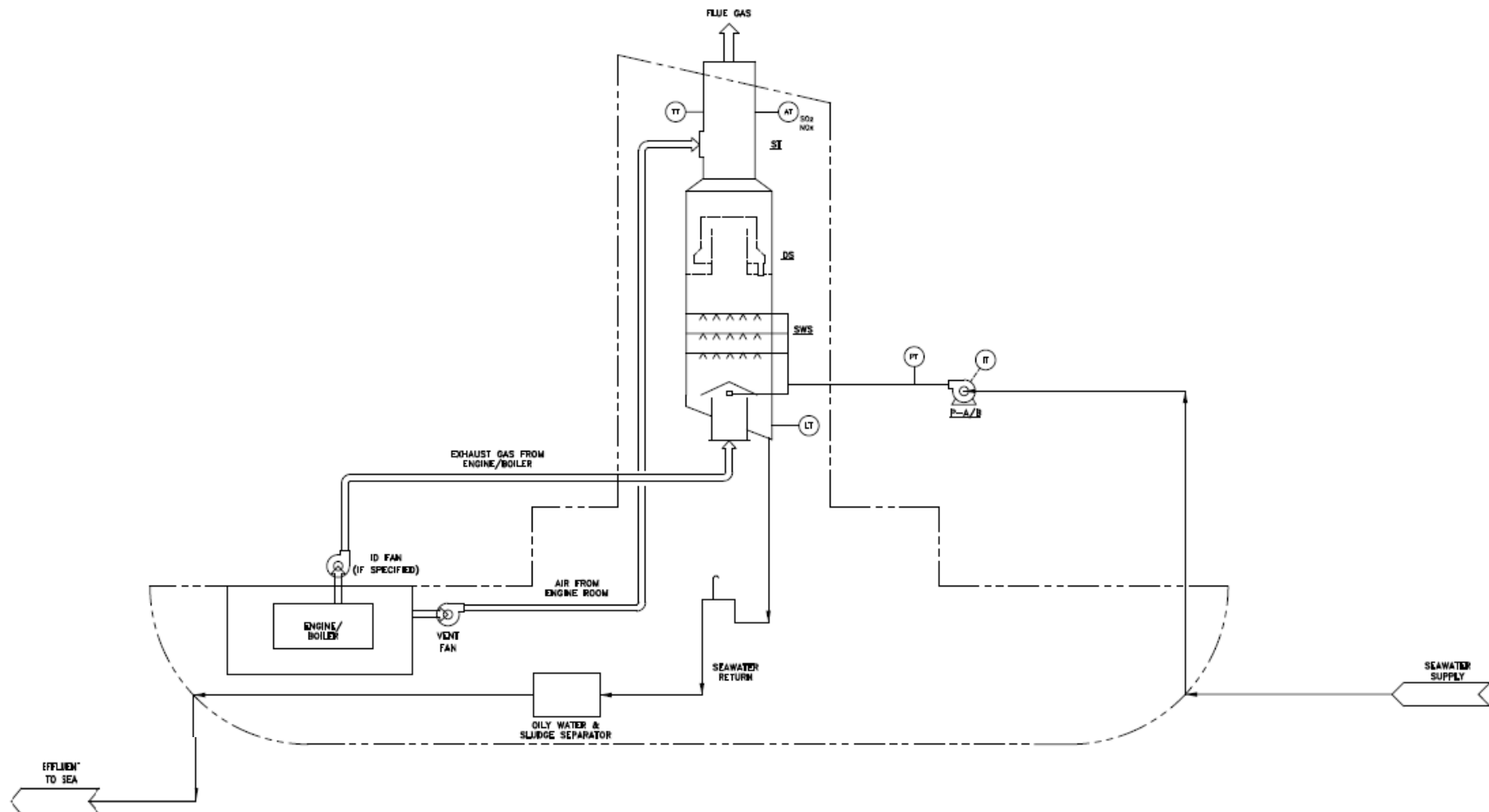


The “BELCO®” Marine Scrubbing System

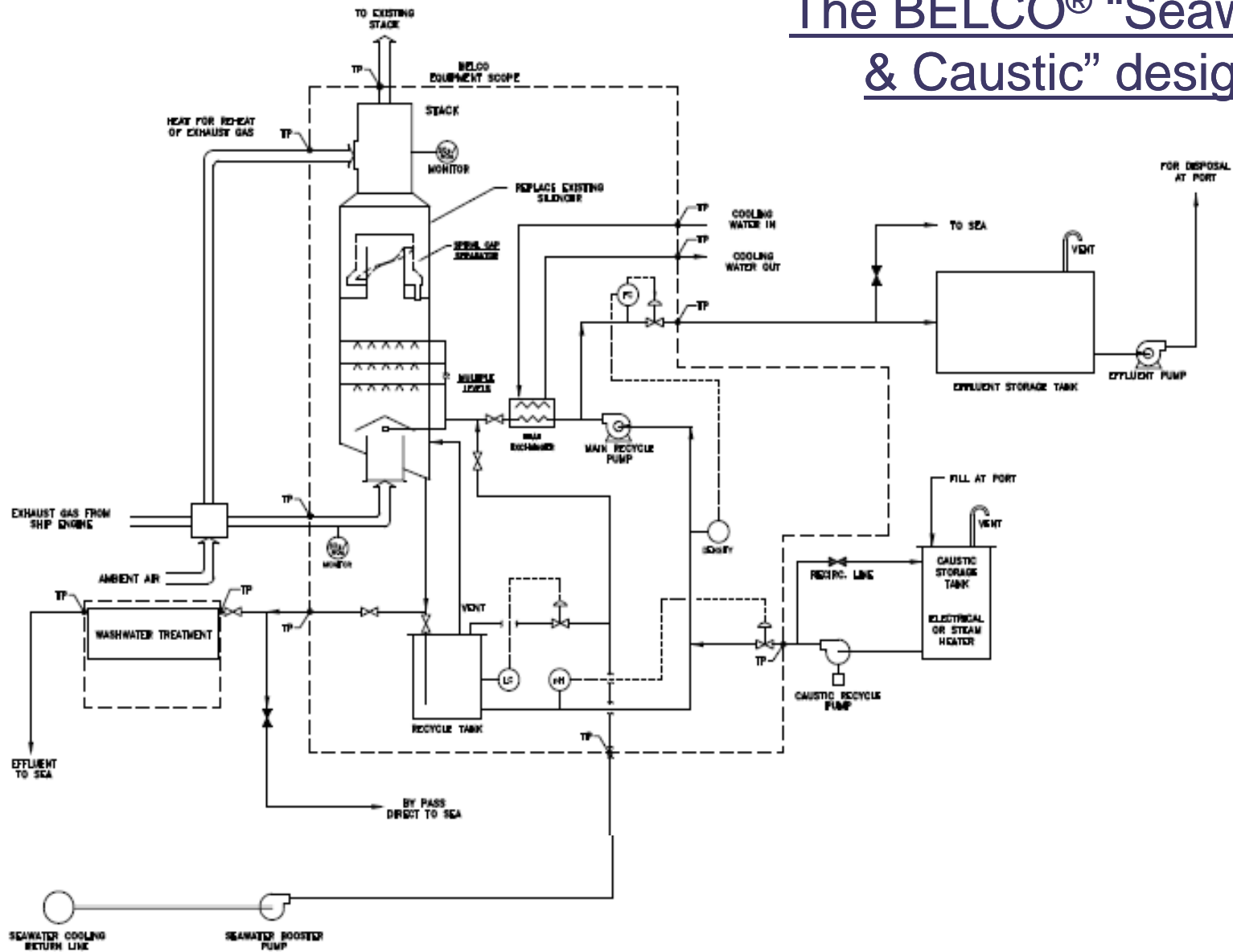
- Proprietary Components
- Designed specifically to operate on ships
- Very low maintenance
- Very high reliability
- Excellent efficiency
- Meeting IMO, SECA and EPA compliance requirements even when using cheaper high sulfur fuels
- Estimated Operating weight “Varies” with size of engine

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The BELCO® “Seawater Only” design



The BELCO® “Seawater & Caustic” design



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polluting smokestacks are going to be a thing of the past.

Scrubbing Systems help reduce emissions without switching to expensive low sulfur fuel.



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