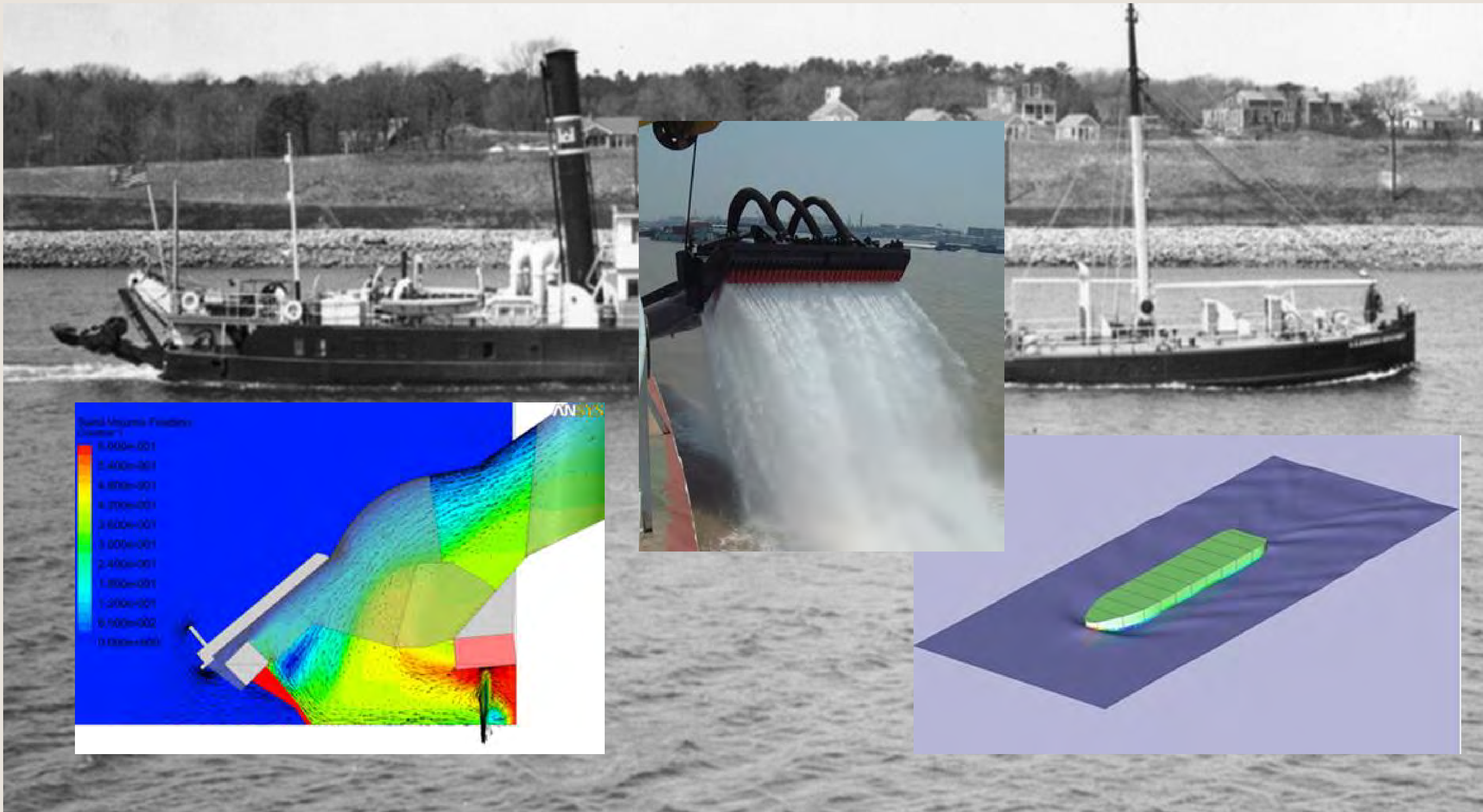
WEDA Central America Chapter

Panama City, September 13-15, 2016

Marcel Boor, Product Director

The technology innovator.

Developments in dredging technology



Evolution vs Revolution

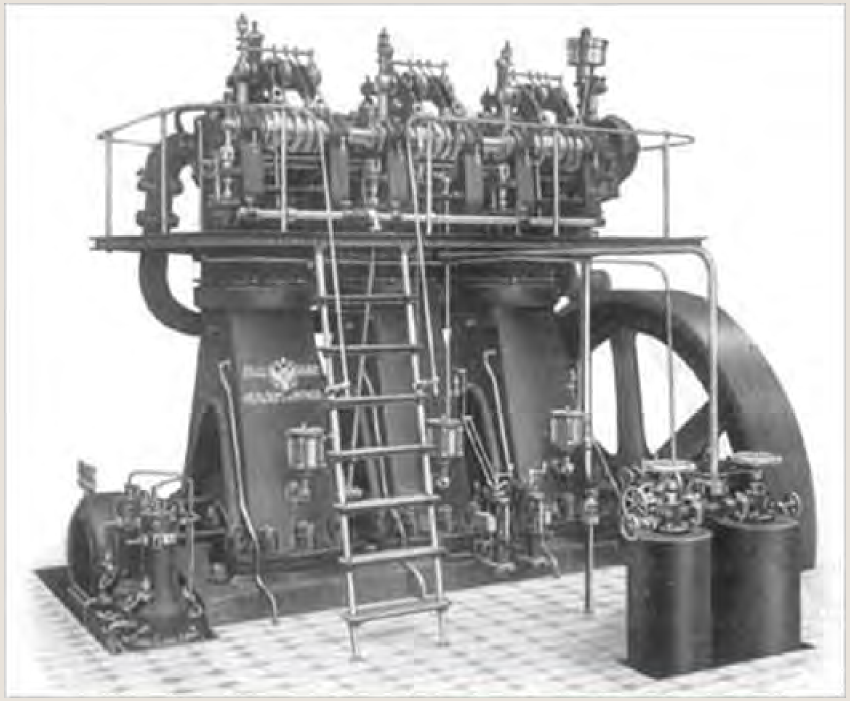
Revolution

Evolution

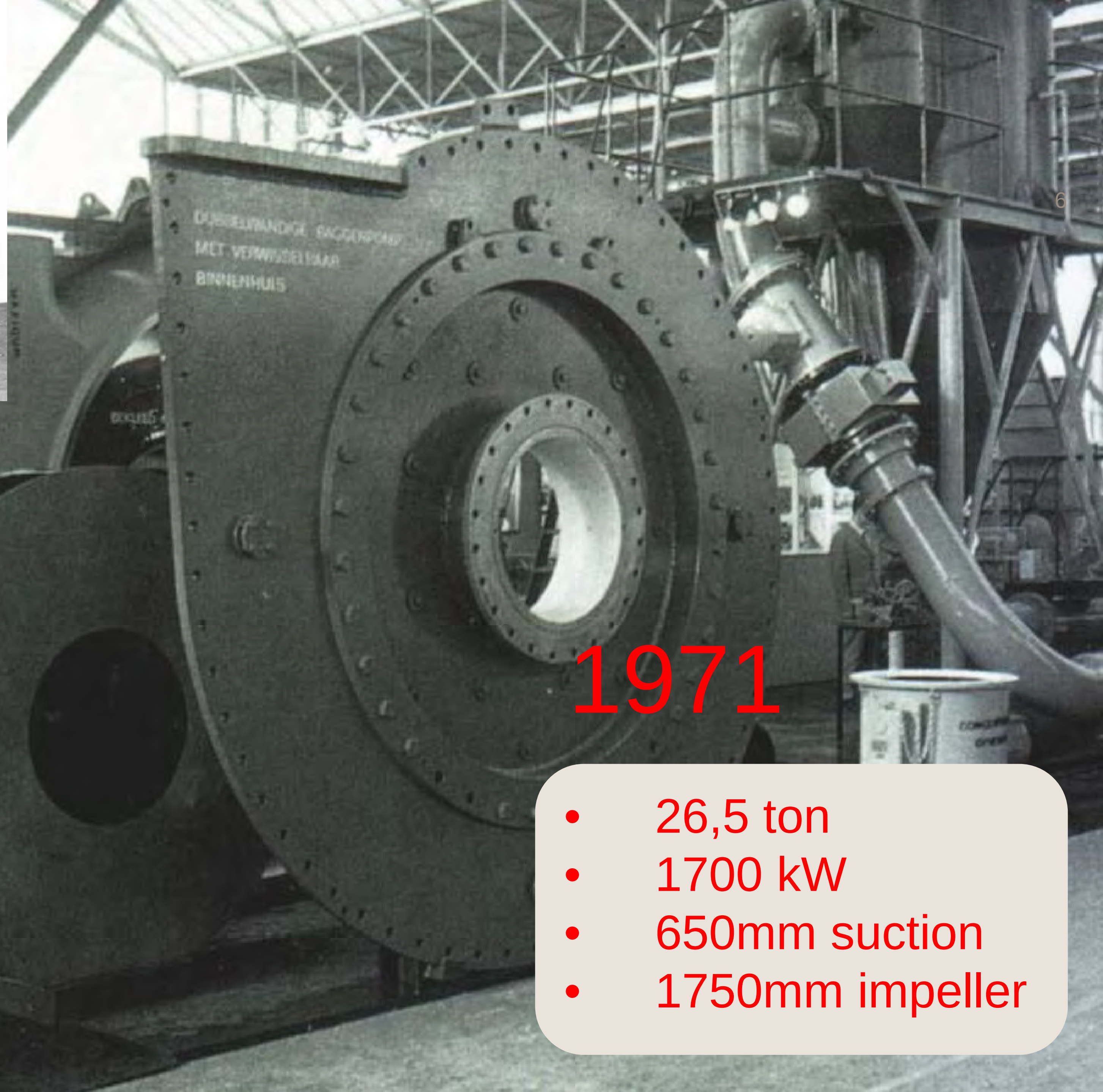
Revolution

Evolution

Modern high efficient diesel engines



1910



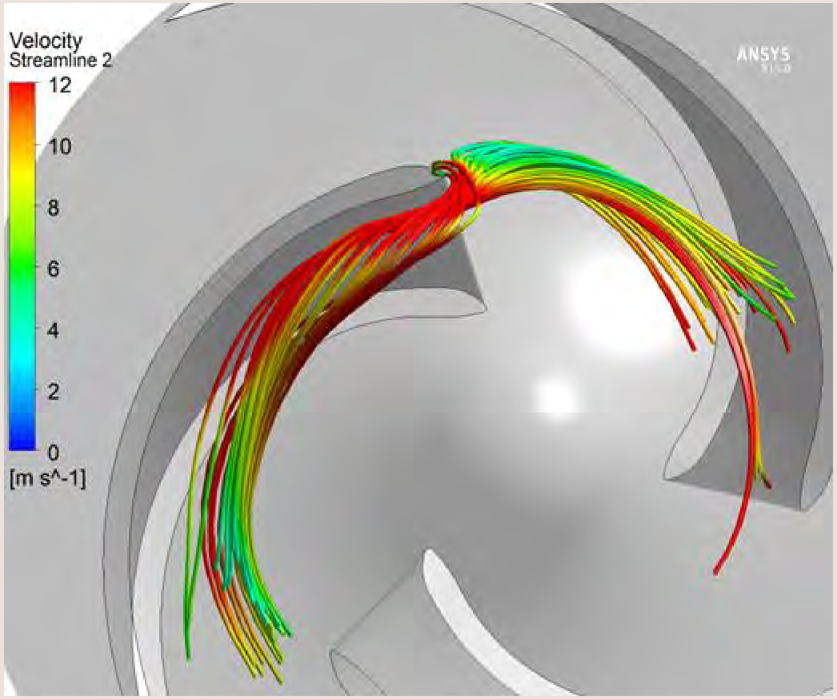
1971

- 26,5 ton
- 1700 kW
- 650mm suction
- 1750mm impeller

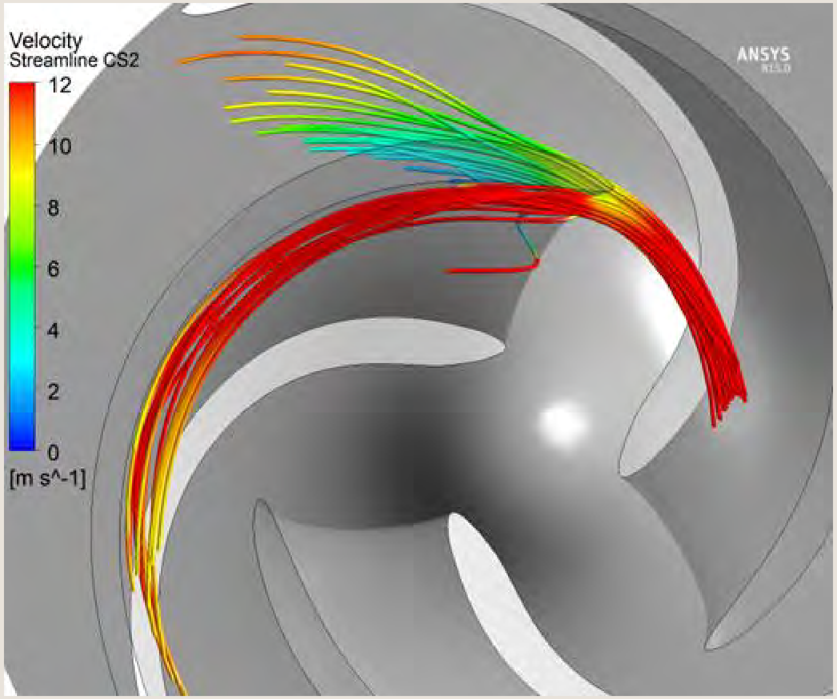
Design modifications

- CFD simulations; streamline pattern at inlet

CS1



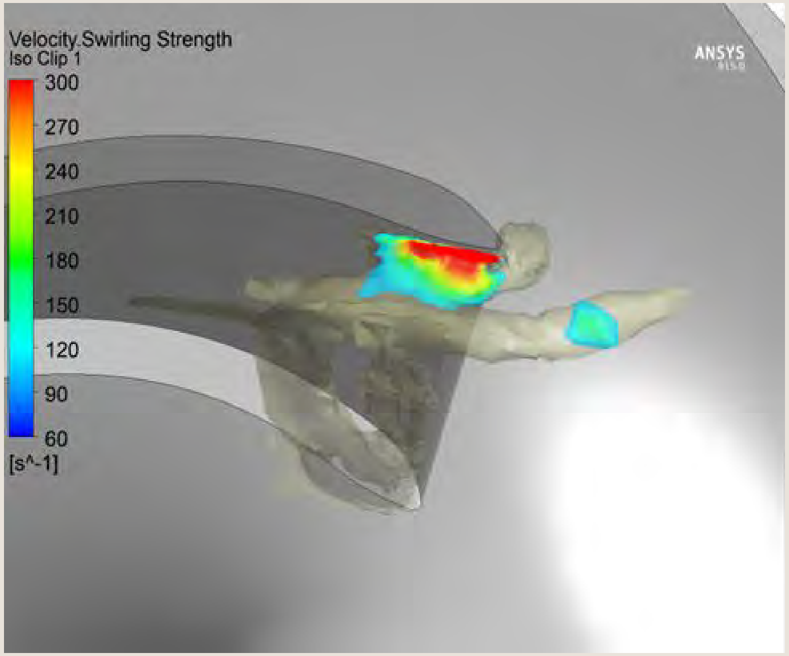
CS2



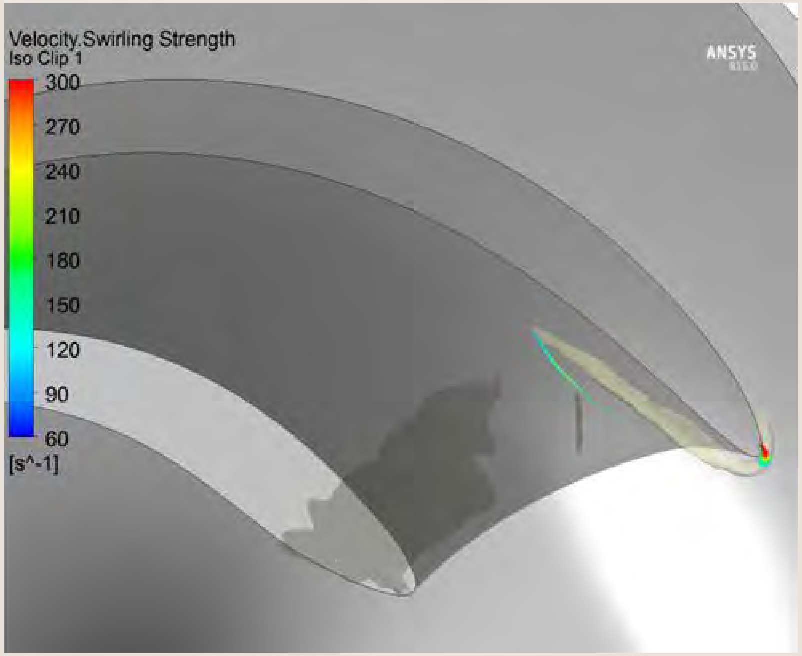
Design modifications

- CFD simulations; vortex strength

CS1

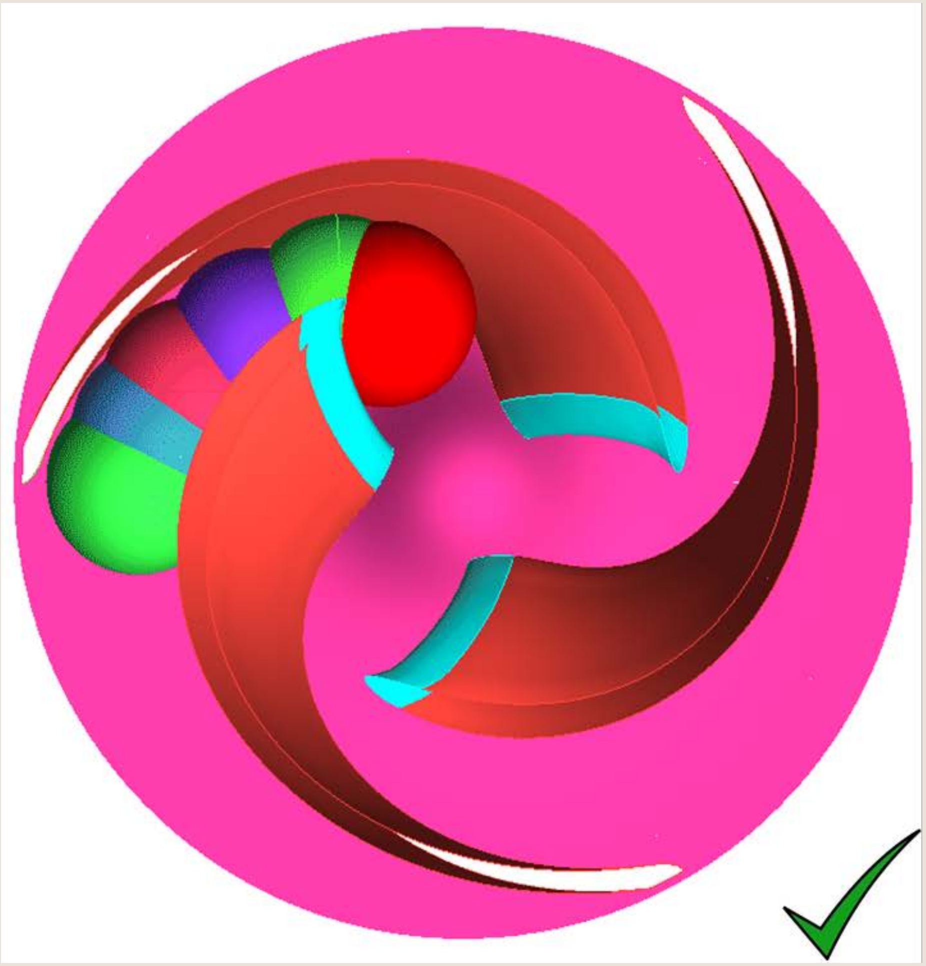


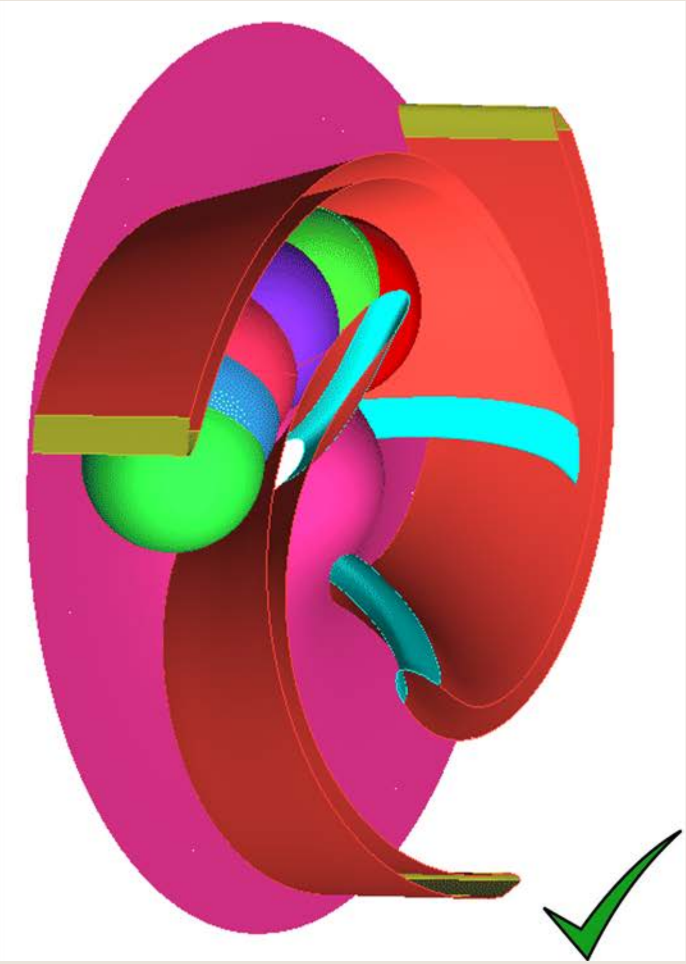
CS2



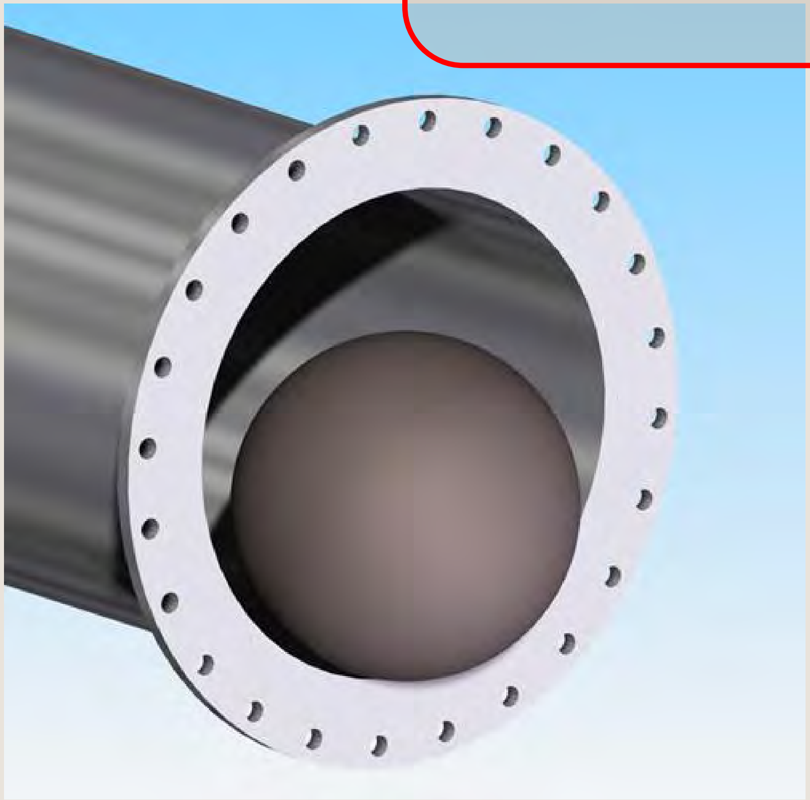
Remaining vorticity significantly weaker (~4x)

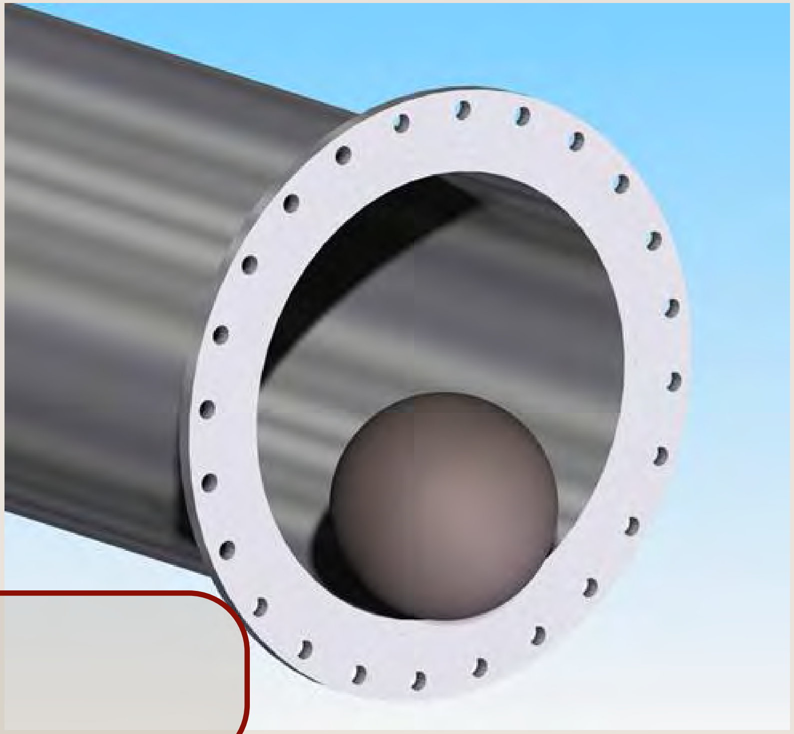
Ball passage control





Rock Special

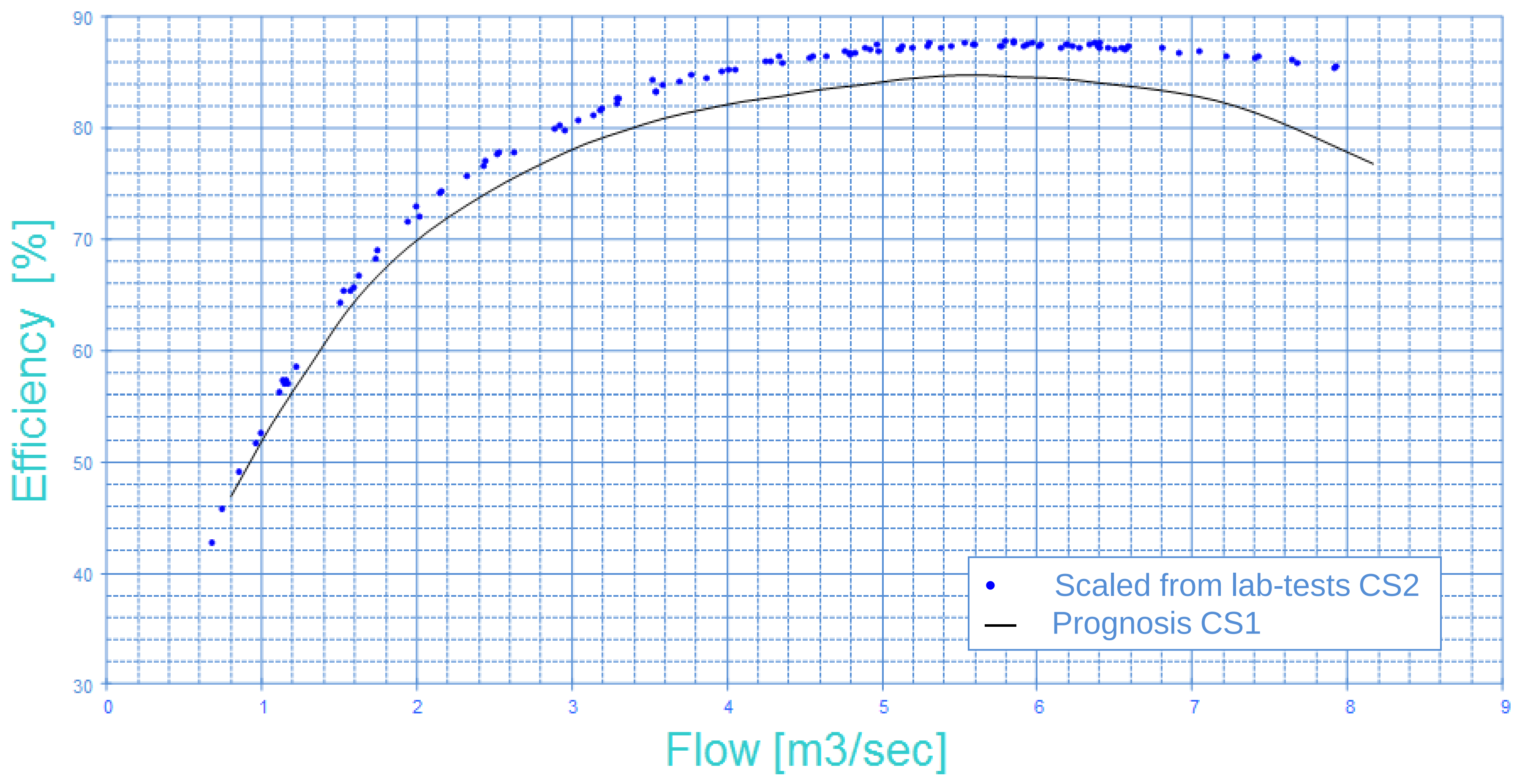


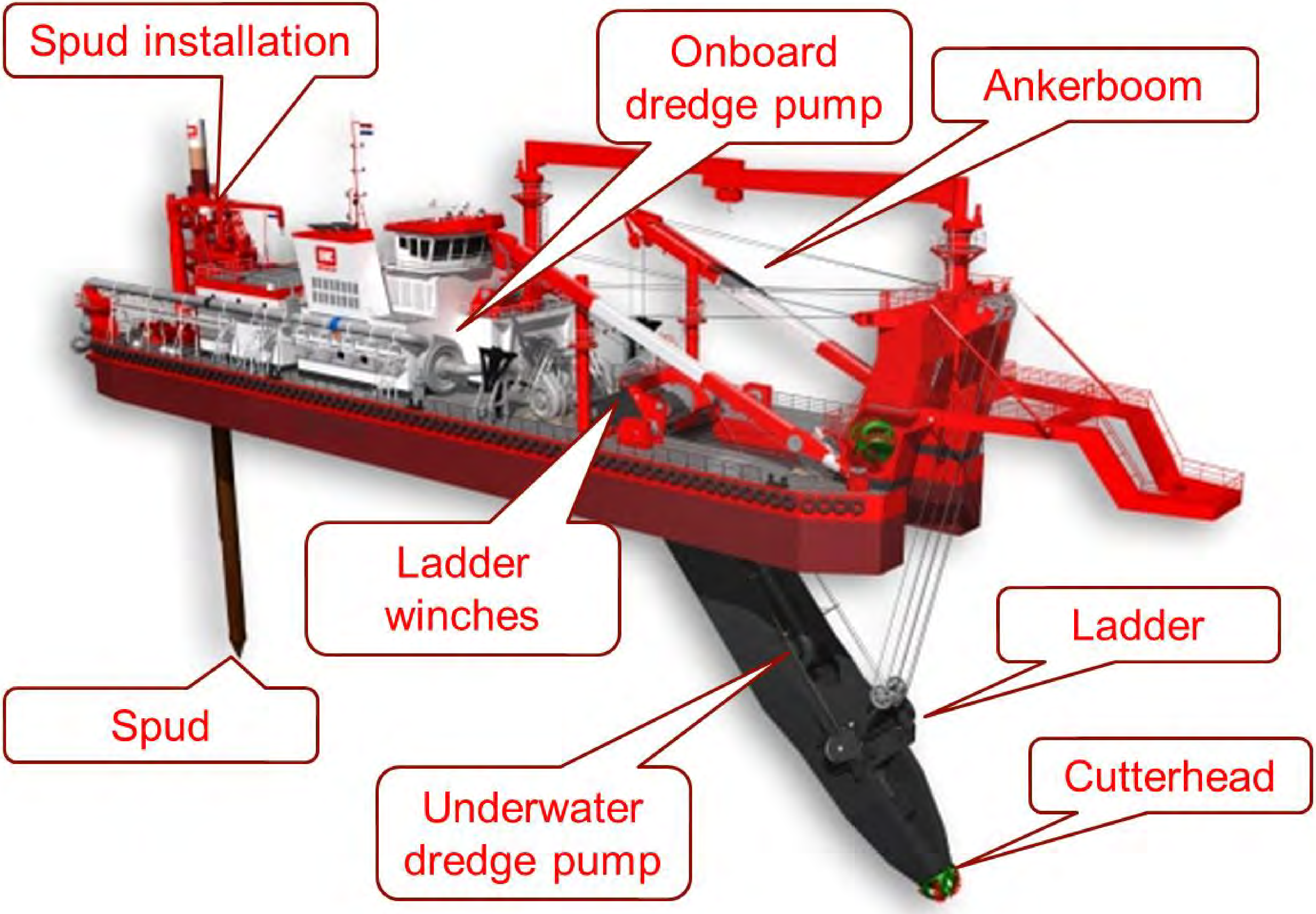


Cutter Special

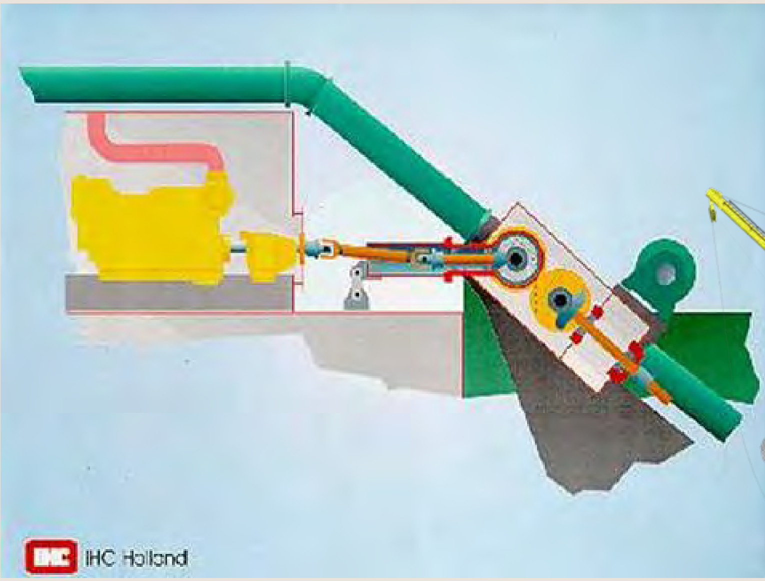
Lab Measurements – Efficiency

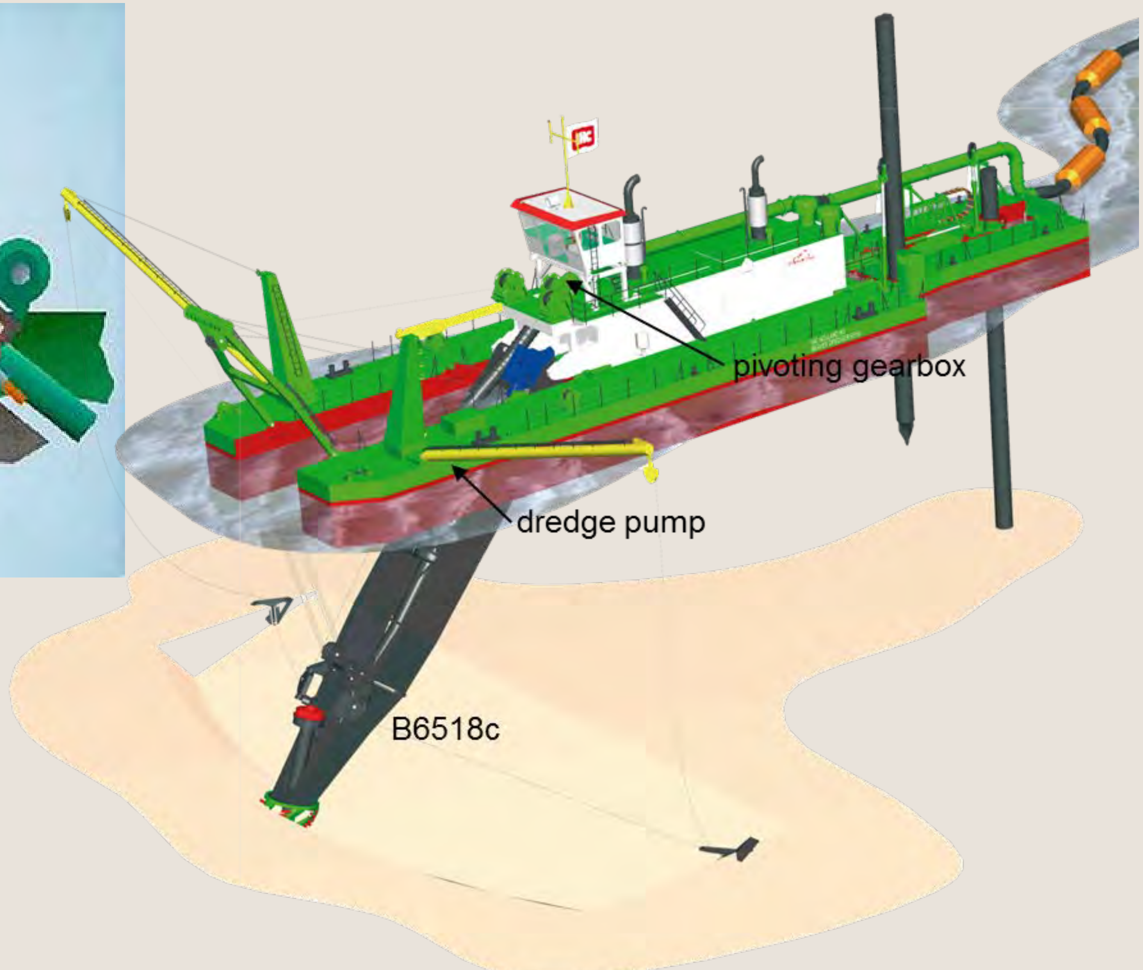
Scaled to full size; HRCS 240-50-100, 3-bladed; 267 rpm




Spud installation
Onboard dredge pump
Ankerboom
Ladder winches
Ladder
Spud
Underwater dredge pump
Cutterhead

Direct drive Submerged dredge

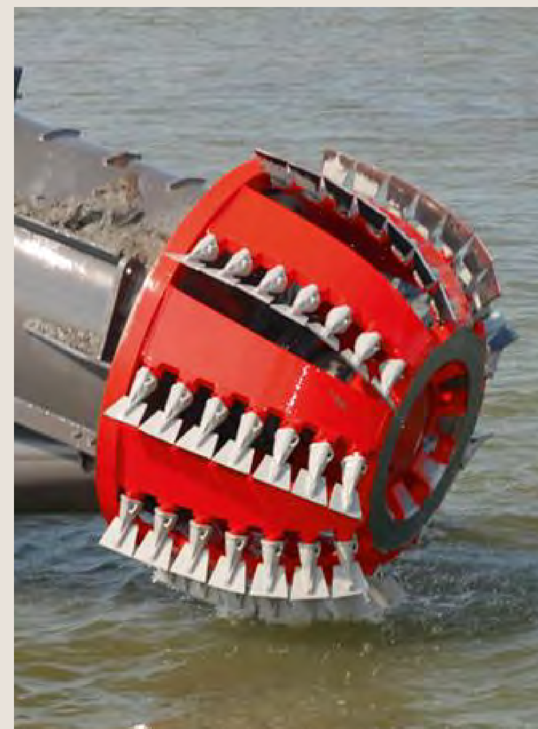




Cutterhead developments

Blades with serrated edges

multi purpose with replaceable teeth



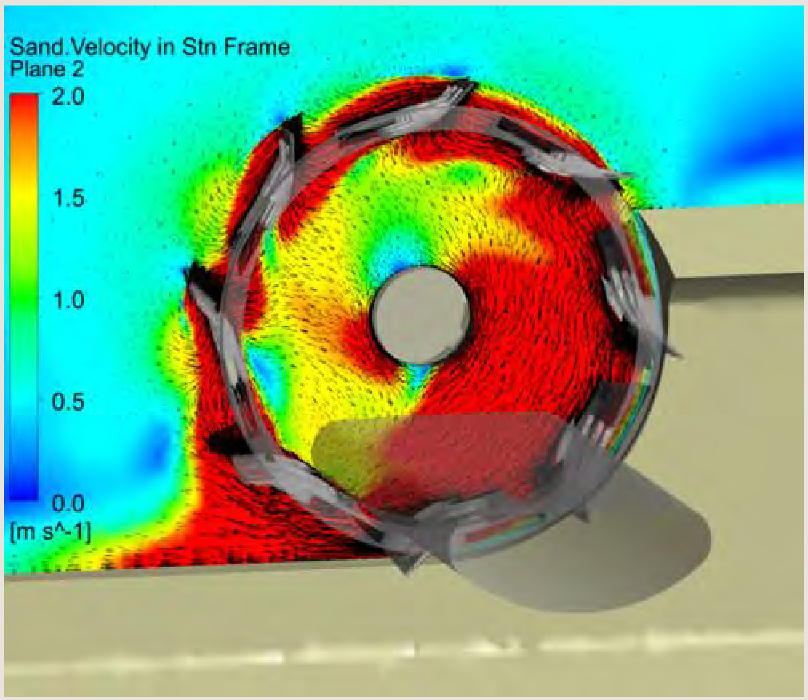
Lancelot ® cutterhead

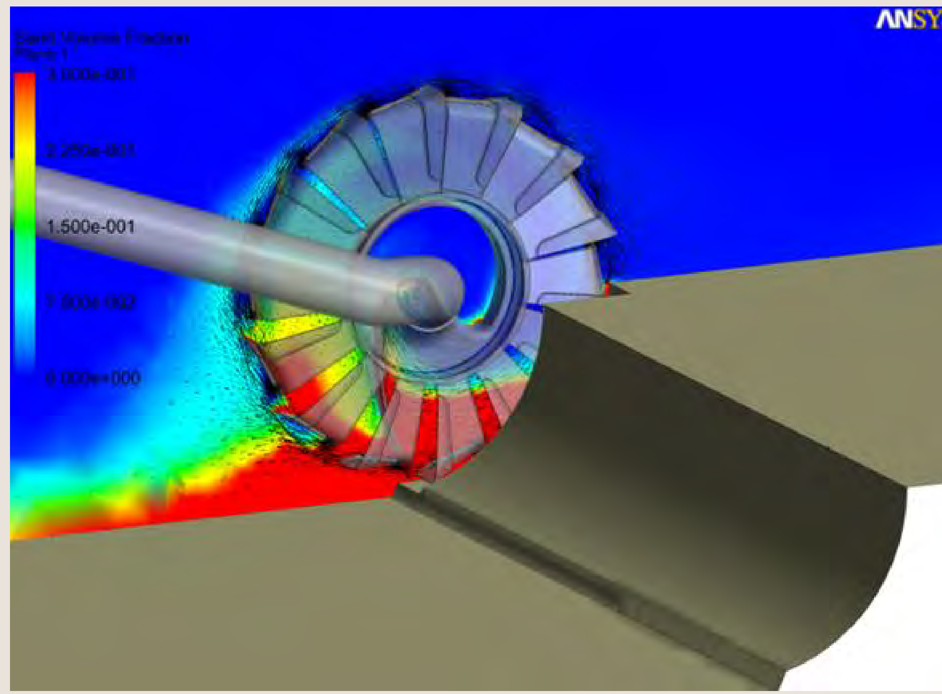

IHC Excalibur ® heavy duty Rock Cutter


Dredging wheel

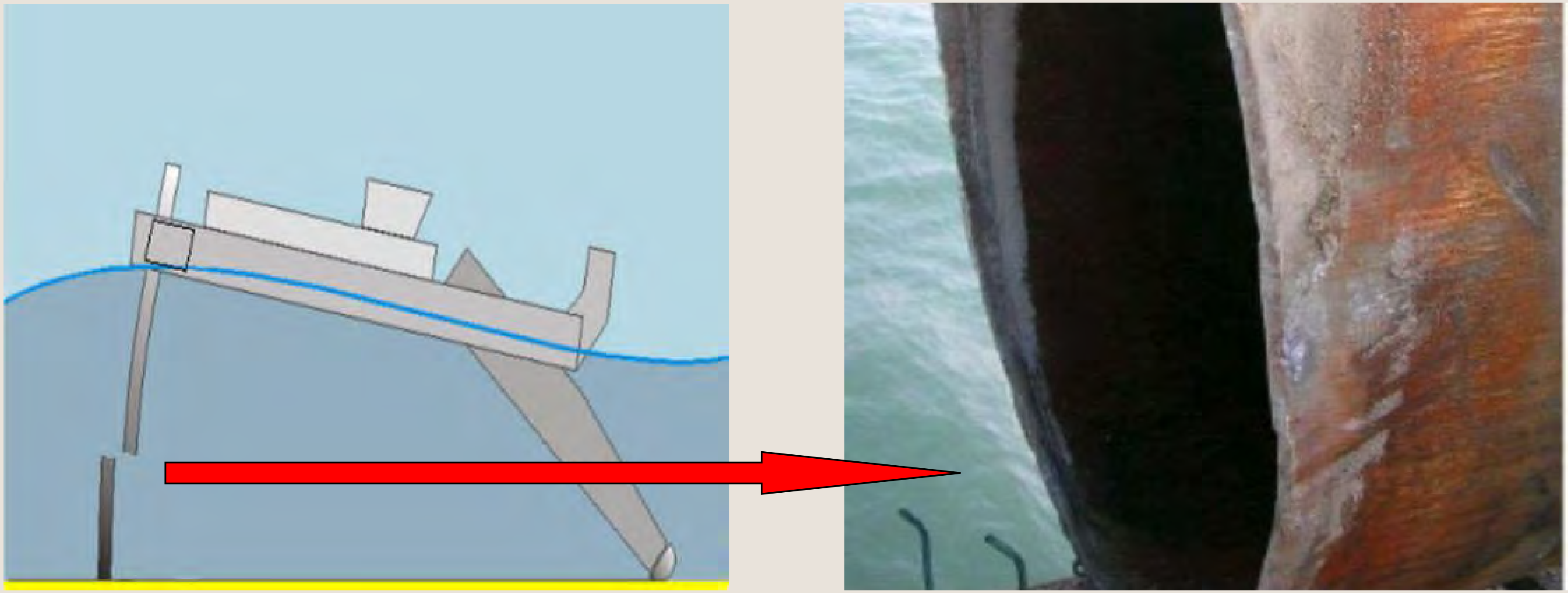

‘Environmental‘ Cutterhead

Alternative designs


Sand.Velocity in Stn Frame
Plane 2
2.0
1.5
1.0
0.5
0.0
[m s^-1]

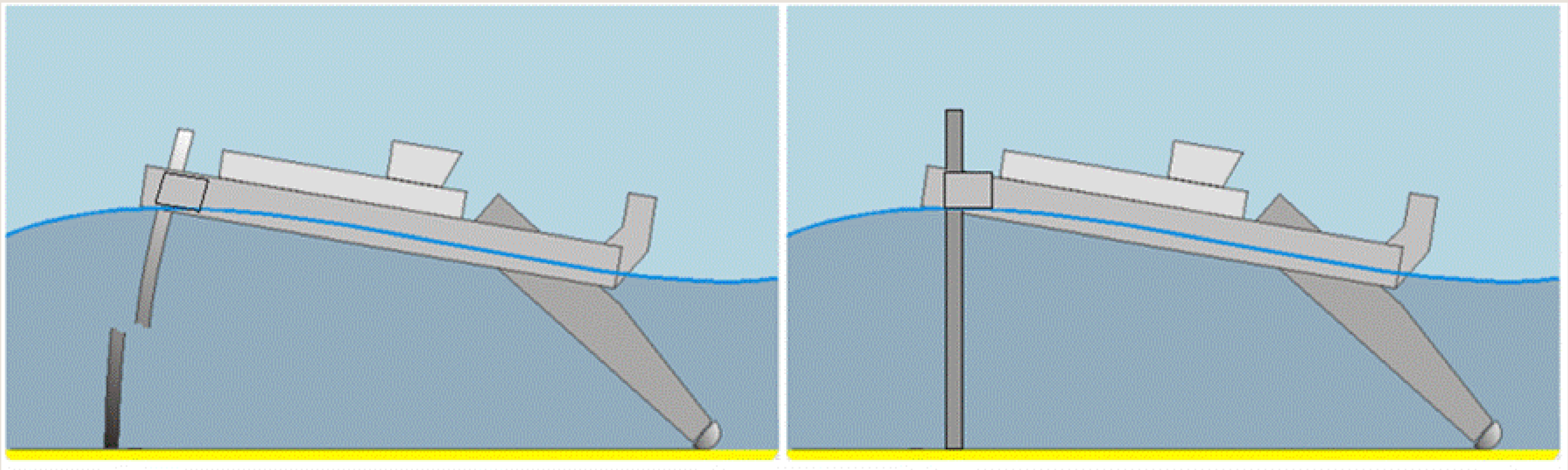

ANSYS
1.500e-001

Spud Guard: the issue



Basic idea

Conventional SpudGuard



Balance safety and cutting force

Increase of workability

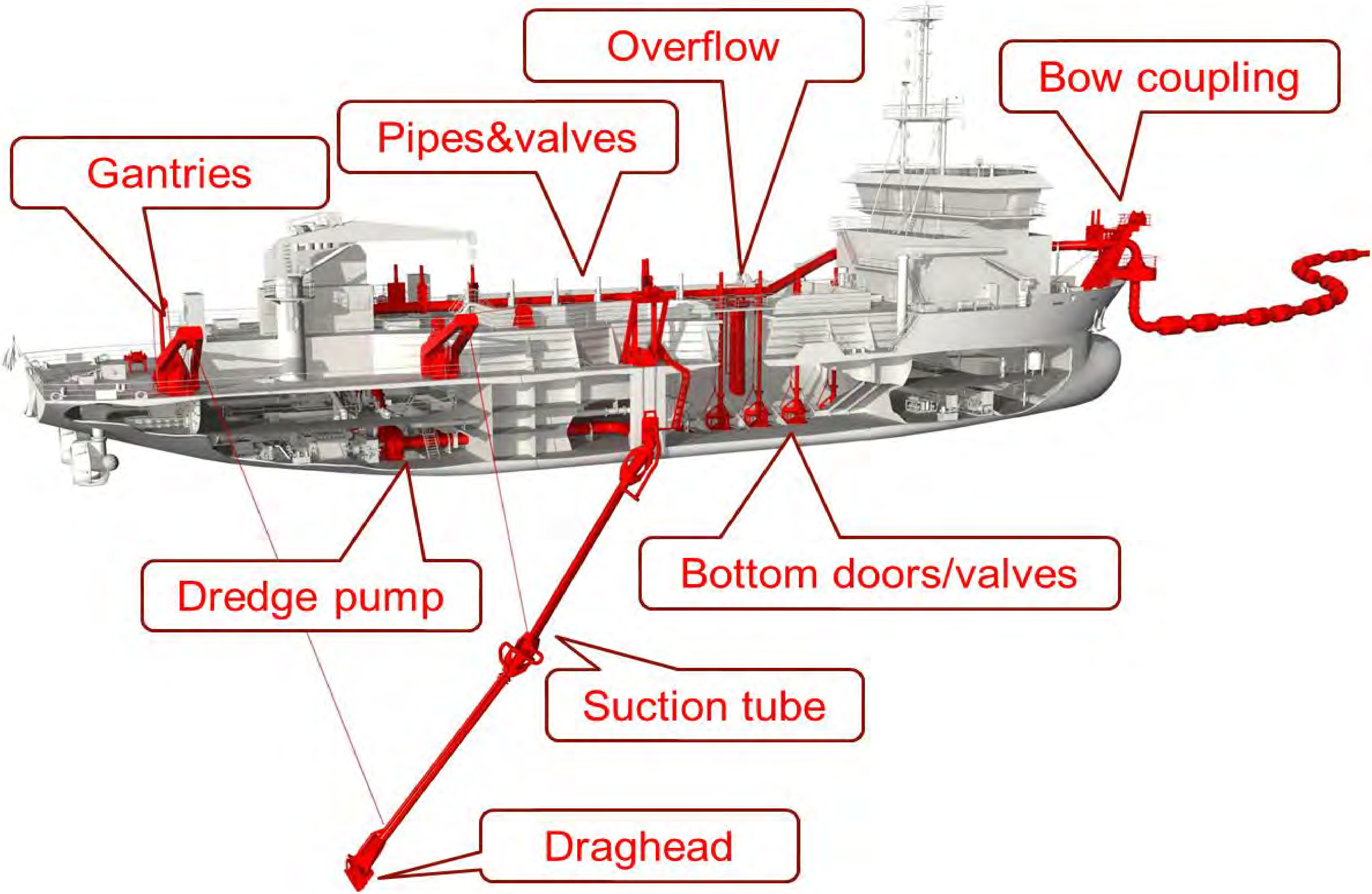
Interchangeable with conventional spud carriage

Cutter Suction Dredgers:

IHC Beaver series

- 6th generation
- Built for stock!
- >800 pcs delivered

	Beaver 300	Beaver 40	Beaver 45	Beaver 50	Beaver 65 DDSP
Installed power	240 kW	447 kW	746 kW	1350 kW	2819 kW
cutter power	30 kW	50 kW	110 kW	170 kW	700 kW
dredging depth	6 m	8 m	10 m	14 m	18 m
Discharge pipe diameter	260 mm (12")	390 mm (16")	450 mm (18")	500 mm (20")	650 mm (26")


Overflow
Bow coupling
Pipes&valves
Gantries
Dredge pump
Bottom doors/valves
Suction tube
Draghead

Increase of scale

Increasing scale


1

4550 tons


2

5970 tons


3

6570 tons


4

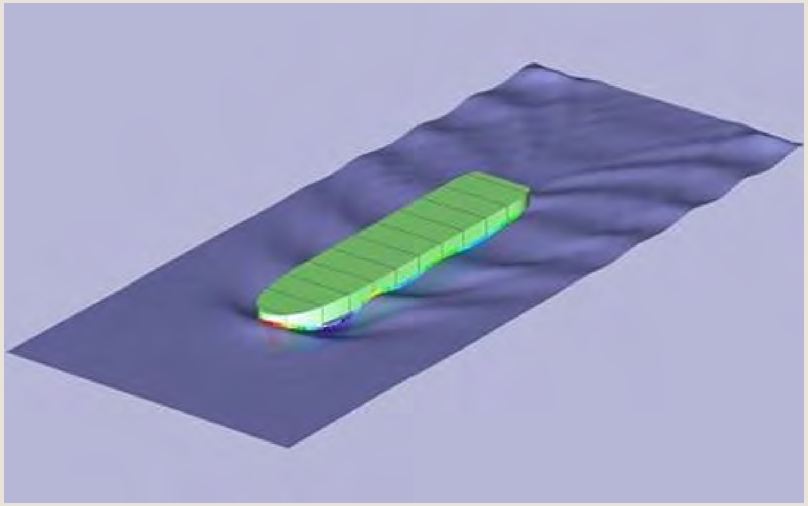
7150 tons


5

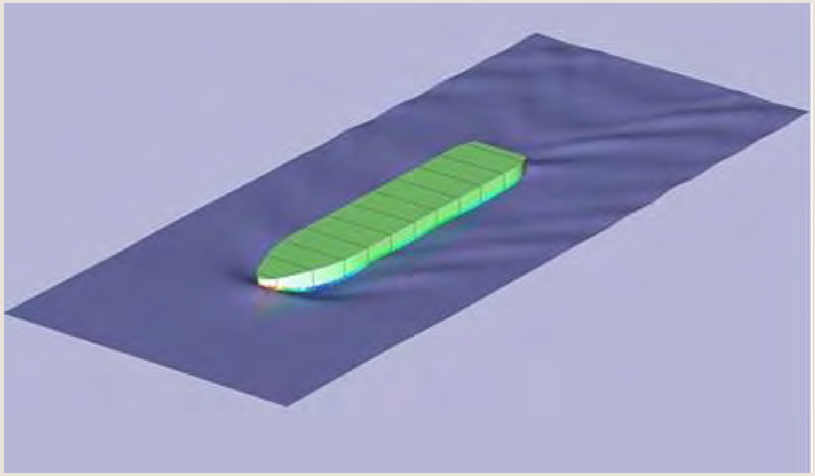
8000 tons

Year	Name ship	Hopper capacity	Deadweight	Length	Breadth
1994	HAM 311	3522 m^3	4640 tons	84,95 m	17,00 m
1997	HAM 312	3518 m^3	4640 tons	84,95 m	17,00 m
1999	Volvox Atalanta	4500 m^3	5870 tons	84,95 m	17,00 m
2000	HAM 317	4400 m^3	6667 tons	84,95 m	18,40 m
2003	Volvox Olympia	4750 m^3	7140 tons	84,95 m	19,90 m
2004	Pallieter	5600 m^3	7980 tons	84,95 m	21,60 m


Without bulbous bow
LANGE WAPPER




With bulbous bow



Shallow depth Aft ship hull design

- Twin gondola design (complex 3D hull shapes)
- Optimal water supply to propellers in shallow waters
- Excellent maneuverability

New versus traditional hull shape

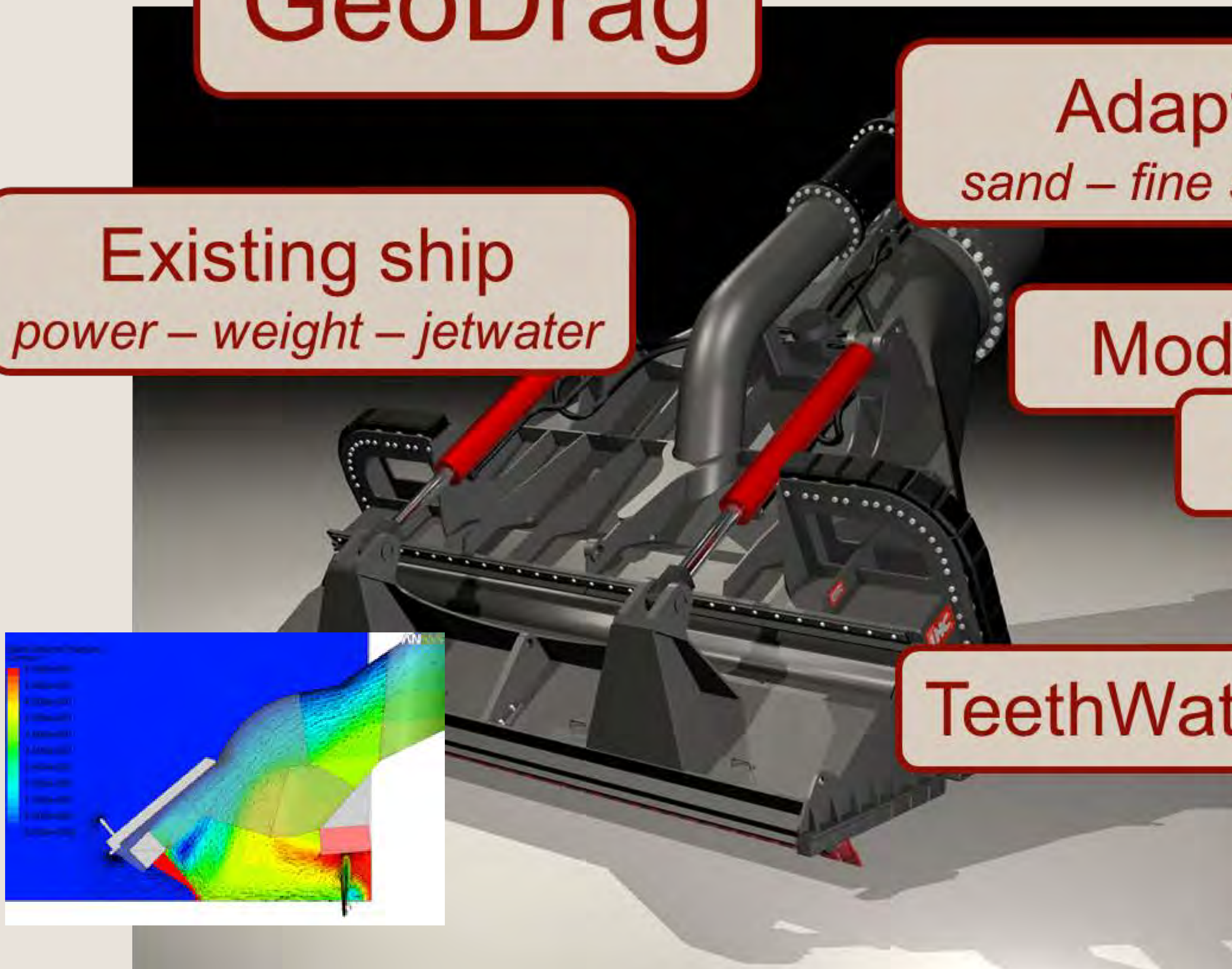
- Up to 25% fuel savings
- Less waves in port
- Higher sailing speed
- Shorter cycle times
- Higher productions

TSHD - Dragheads

GeoDrag

Adaptable
sand – fine sand – clay

Existing ship
power – weight – jetwater

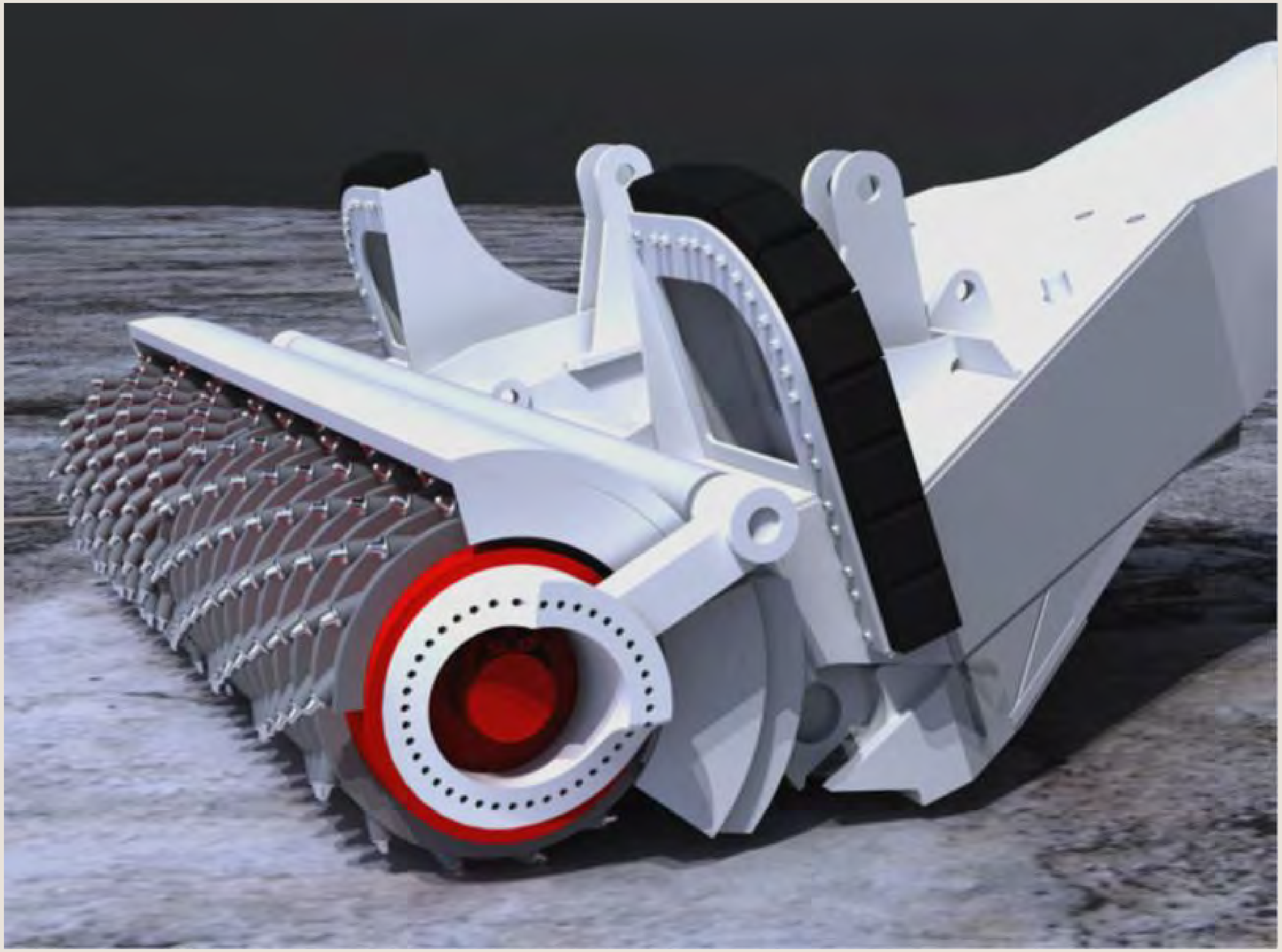


Modular

Add-Ons

TeethWater

Hard soil draghead?

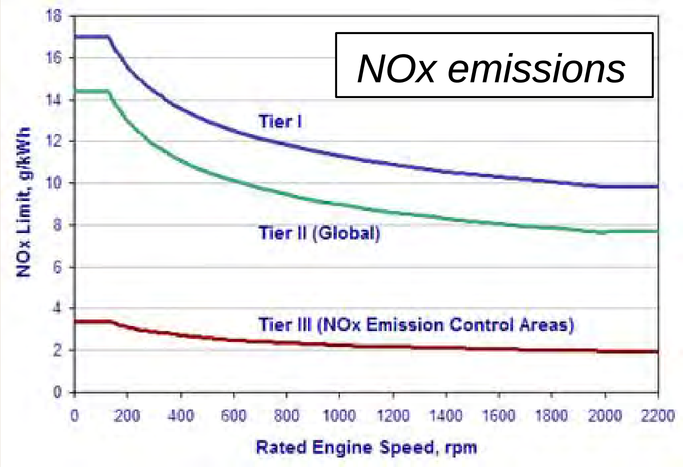


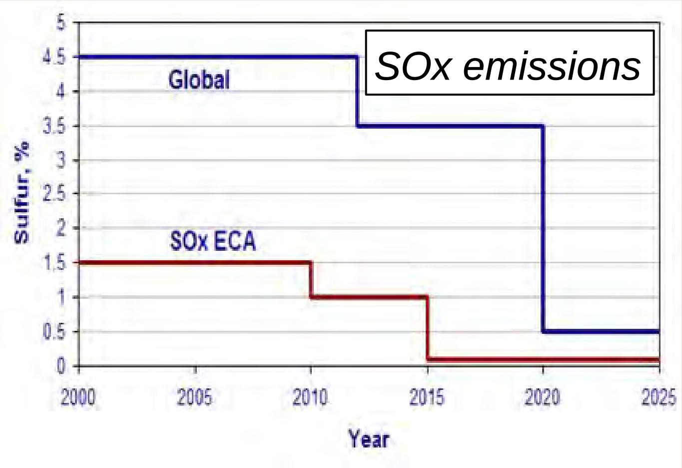
Fuel technology in the dredging sector

- Man-powered
- Horse-powered
- Fossil fuels: Coal (steam) & Oil (diesel)
- Electric dredgers
  (hydrodam reservoirs/mining plants)
- Fuel-cell technology (hydrogen, not yet suitable)
- Future: Battery charged / changeable batteries?
- LNG

Emission reduction

Exhaust gas emission regulations (SO_x, NO_x)
Energy Efficiency Design Index (CO_2)
Sustainability ambitions





Emission reduction

How to comply to emission regulations:

- Switch to Marine Diesel Oil:
  ⇒ 30-50% more expensive than HFO
- Switch to Low Sulfer Heavy Fuel Oil:
  ⇒ limited availability
  ⇒ higher cost price
- Use Heavy Fuel Oil:
  ⇒ after treatment of exhaust gasses necessary
  ⇒ high investment costs
  ⇒ poor earn back potential
- Use LNG

LNG

Compared to heavy fuel oil LNG reduces:

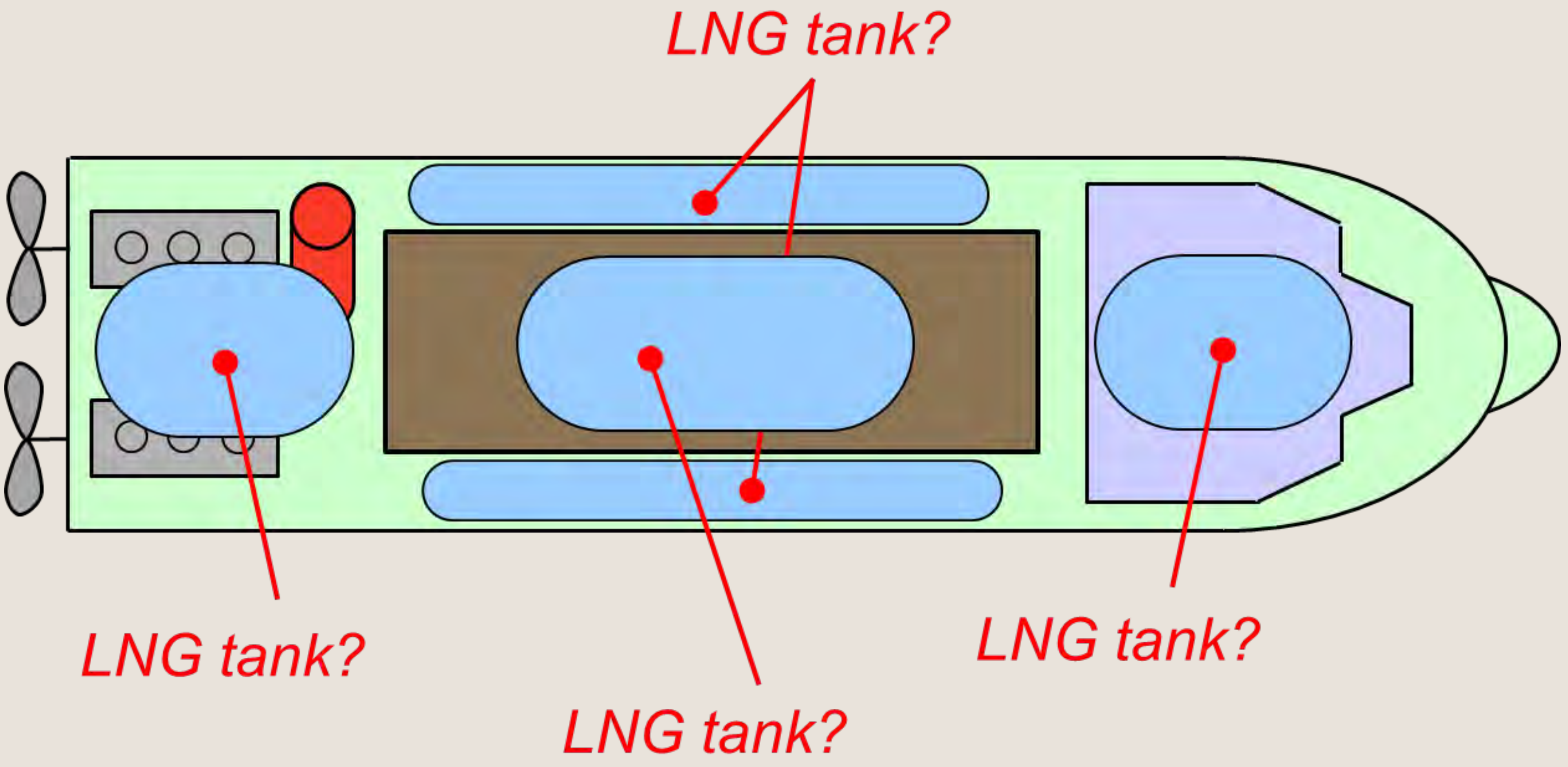
- SO_x emission by approx. 99%
- NO_x emission by approx. 85%
- CO_2 emission by approx. 25%
- Particulate Matter by approx. 99%

Compliant to SO_x, NO_x and EEDI regulation

Earn back potential due to lower price

Location LNG tank

LNG storage:



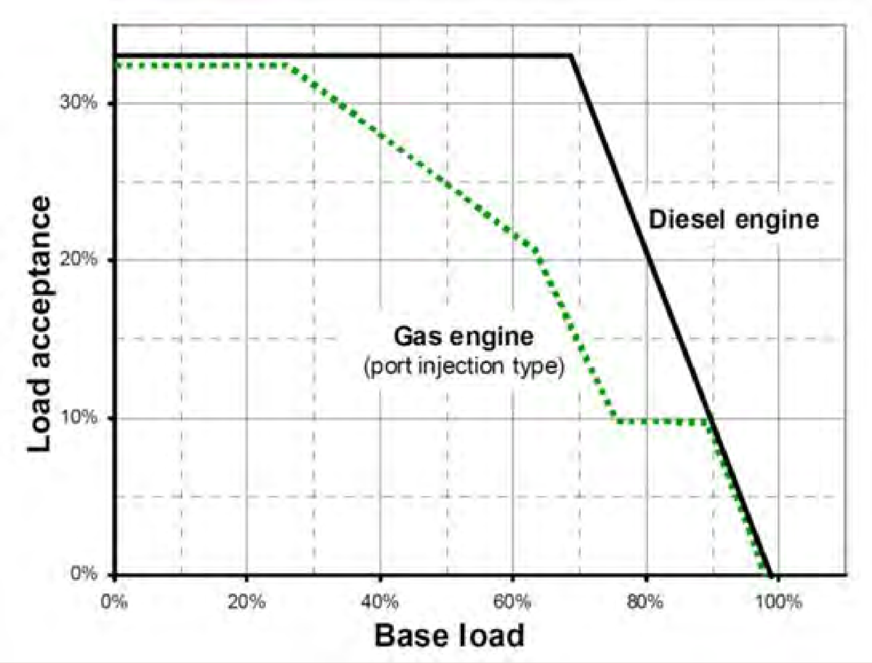
Challenges

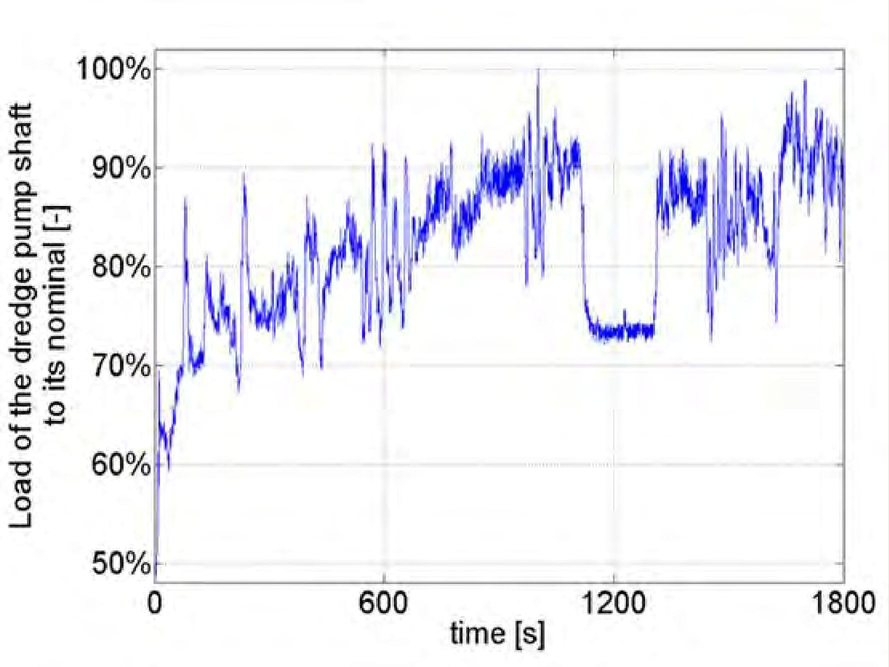
- Size of LNG storage tank:
  - LNG storage needs twice the space of diesel storage
- Position of LNG tank
  - Below / above deck
  - Single / double walled
  - Safety zones
- Large impact on vessel lay out

Challenges

Load step capability:

- Diesel engines have better load step capability than LNG engines





Challenges

Availability of LNG

Challenges

Bunkering:
Truck
Bunker ship
Bunker station (gate terminal)
Containerized

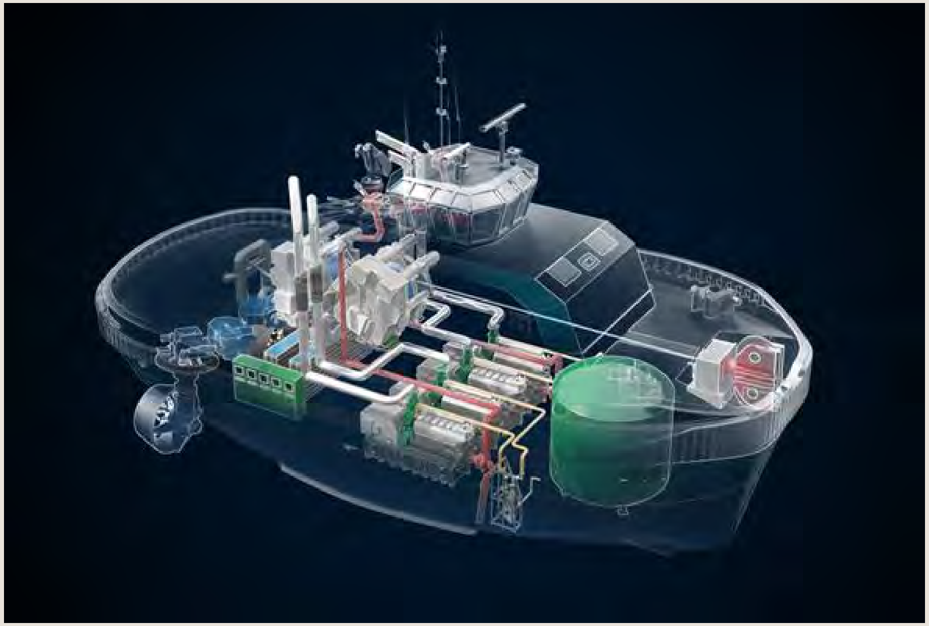
LNG bunker ship Rotterdam
(6500 m3, 2016)

World's first LNG powered hopper dredgers…

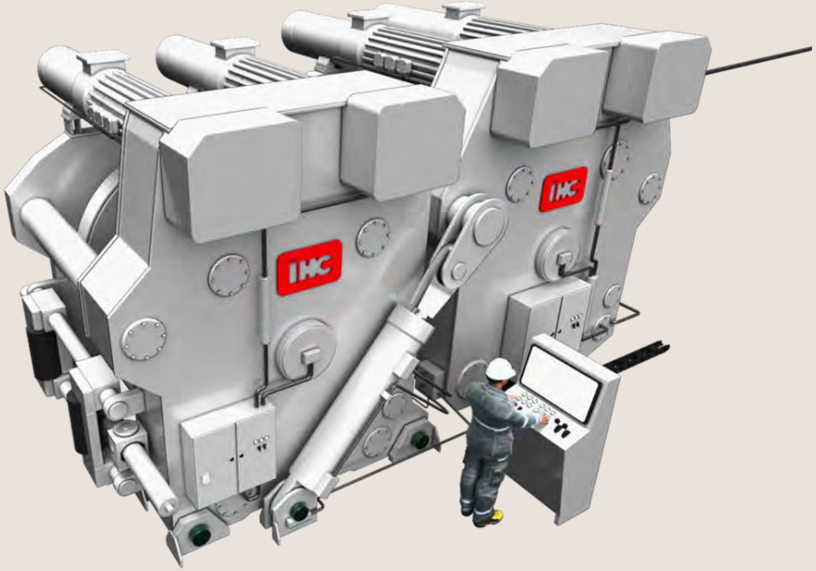
1 x 3500 cbm – full LNG
1 x 8000 cbm – full LNG
1 x 15000 cbm – LNG ready

Other applications: Delta Escort Tug T100-15

Other applications: Delta Escort Tug T100-15



- LNG fueled
- Battery boost
- 100t bollard pull

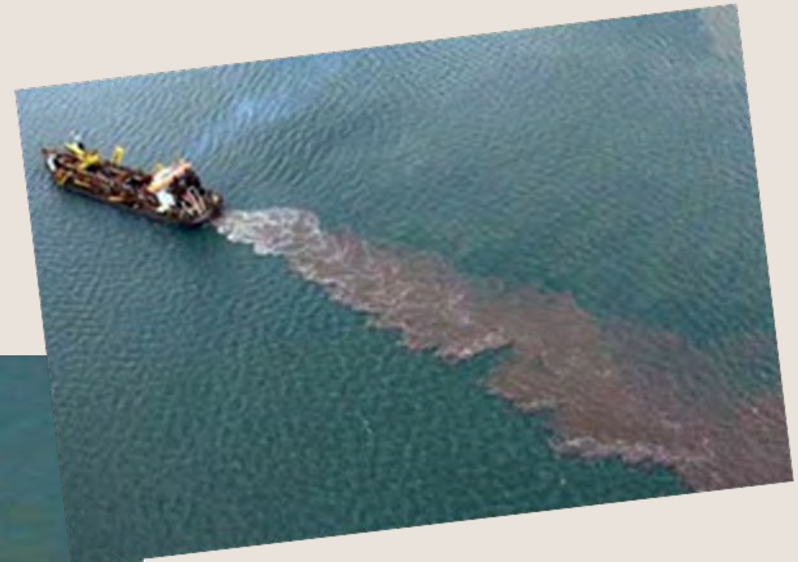


- Fiber rope escort winch
- Shock absorbers-500t snatch load

Conclusions

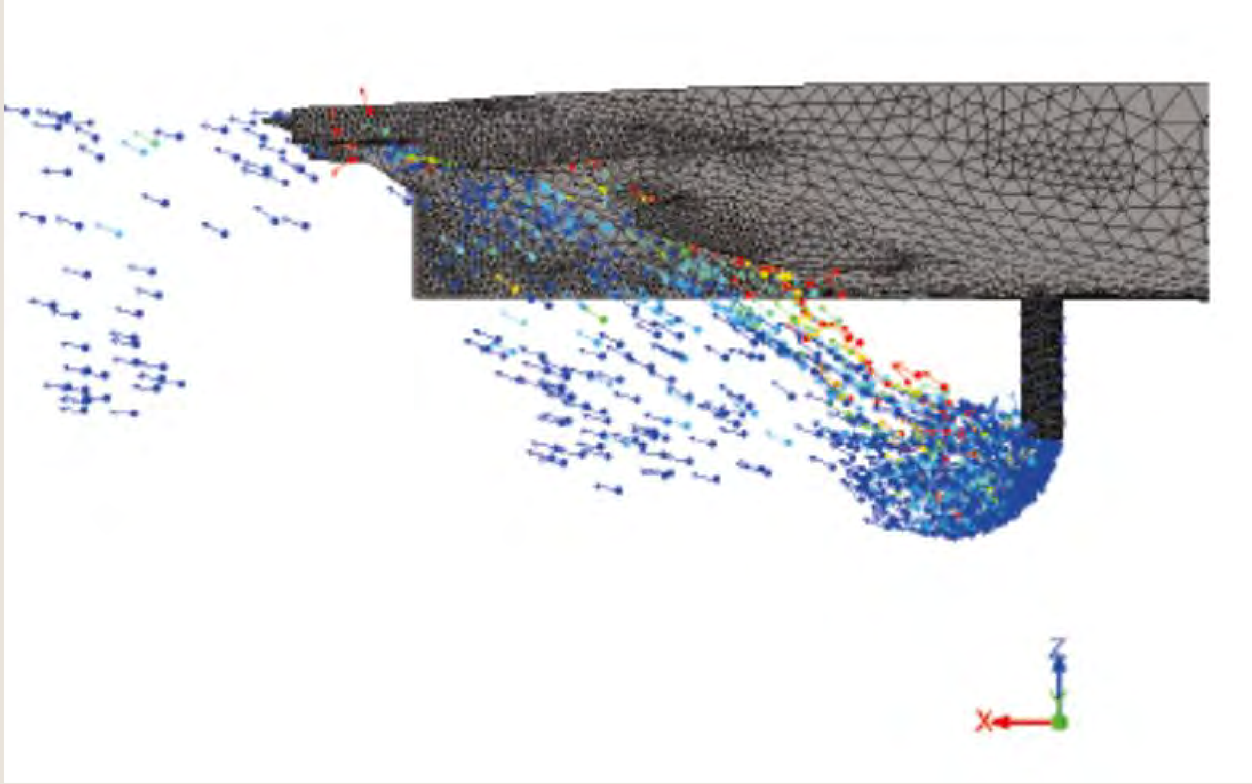
- ✓ Emission regulations will have impact on ship design
- ✓ LNG is a economical viable alternative, due to its earn back potential on fuel price
- ✓ LNG storage has impact on ship design
- ✓ Load step capability can be critical, additional measures might be necessary
- ✓ LNG class rules add extra complexity to design and engineering
- ✓ LNG is a sustainable and feasible answer to strict emission regulations

Turbidity and air



Turbidity and air

B. Decrop, 2015:
"the presence of air bubbles in the overflow has the potential to increase the surface plume concentrations with a factor 5 to 10"

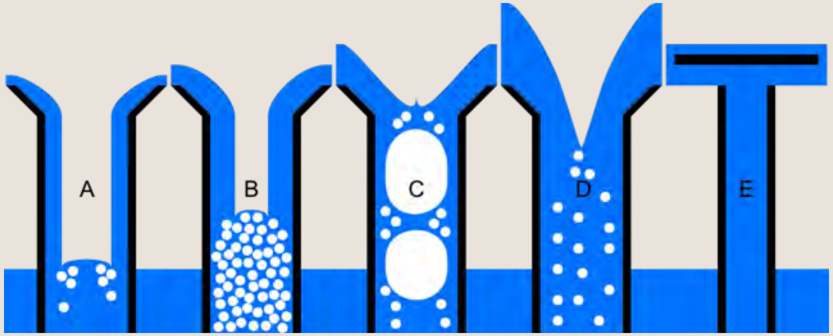


Airless Overflow

- Reduce turbidity by reducing air bubbles in the overflow plume
- Prevent possible damages resulting from air underneath the vessel

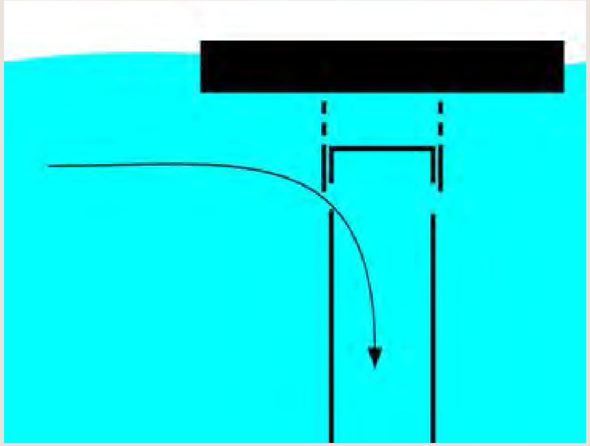
Airless Overflow

- Small lab tests to identify flow regimes and understand air enclosement
- Try different principal solutions to prevent air entering the overflow
- Understand necessary boundary conditions

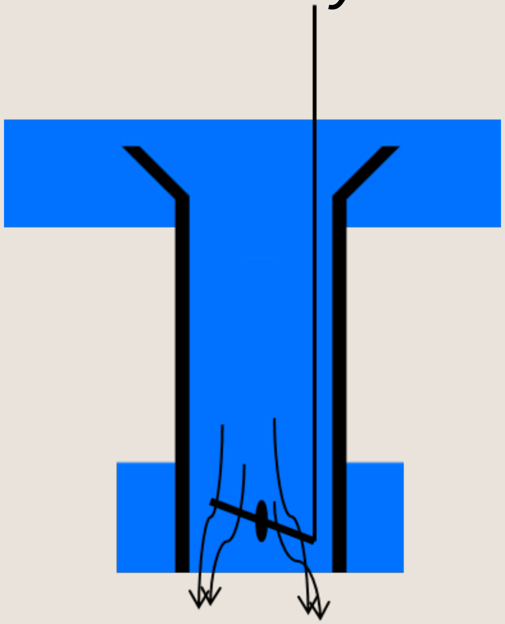


Airless Overflow

First prototype test on Easydredge 2700

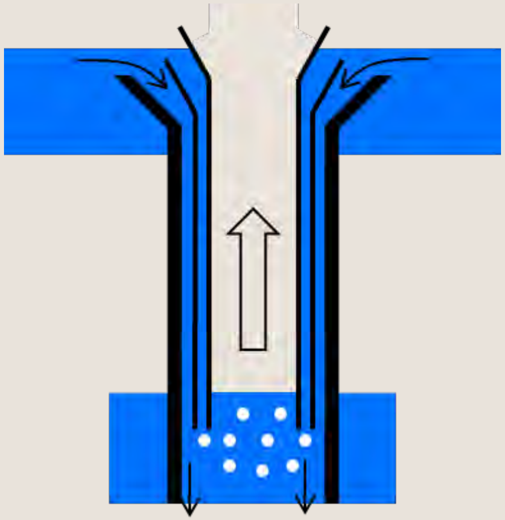


Anti turbidity valve



Chocked flow
Moving parts under water
High wear

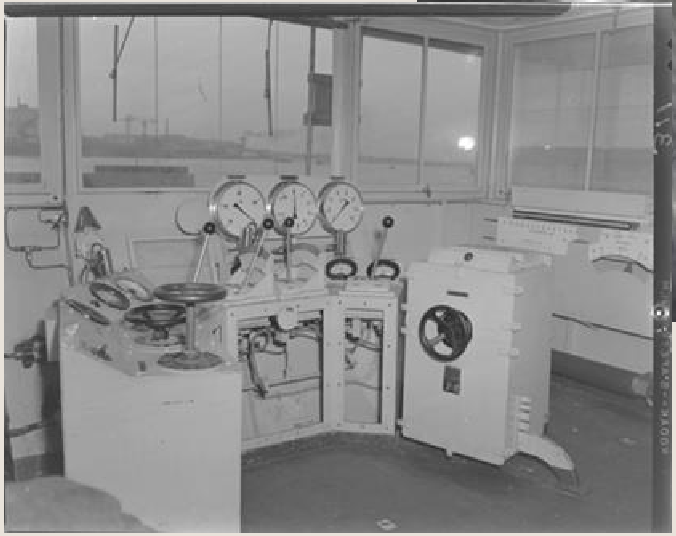
Airless Overflow



Free flow
No moving parts
Easily replaceable add-on

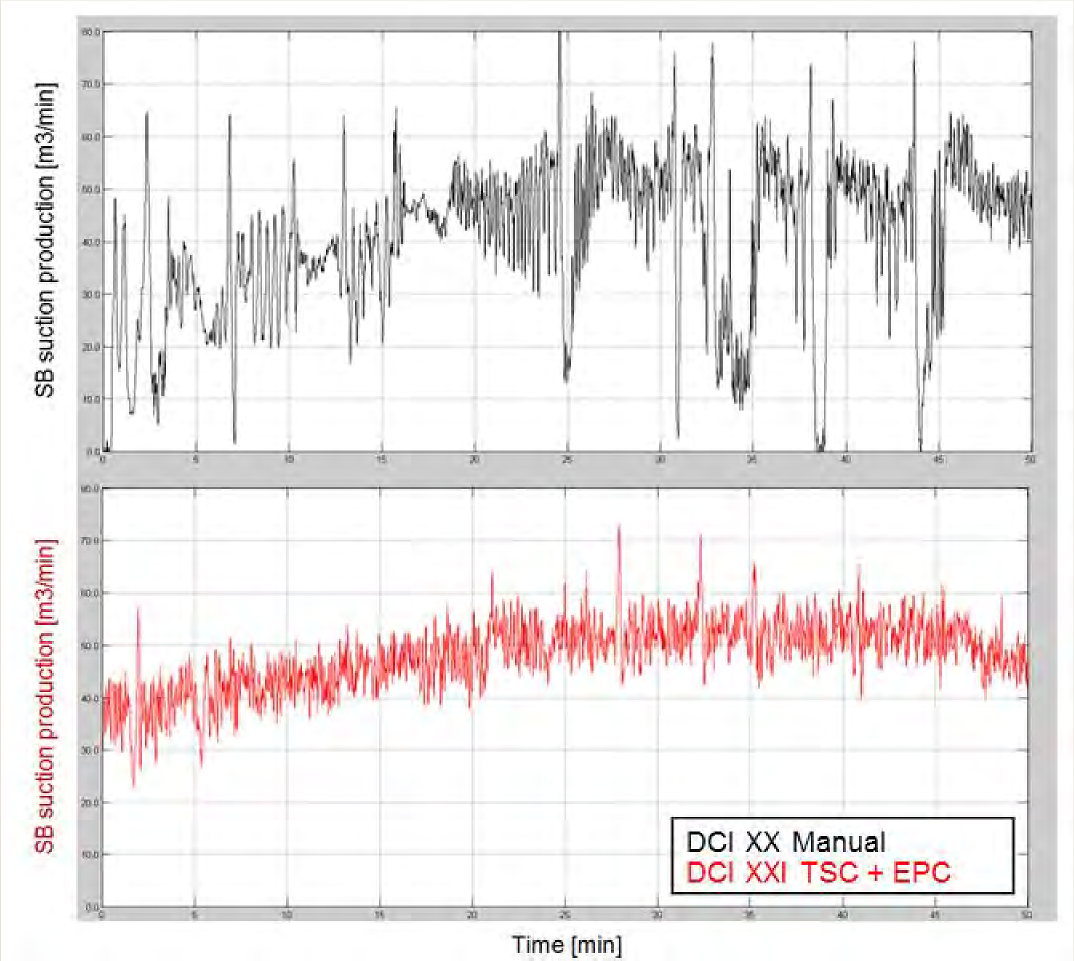
IHC Plumigator

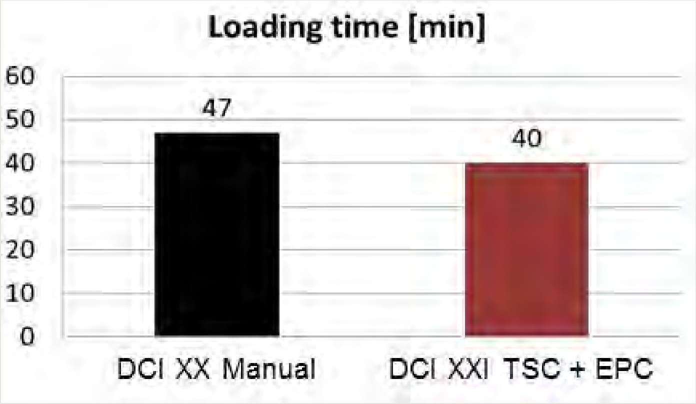
Instrumentation & Automation

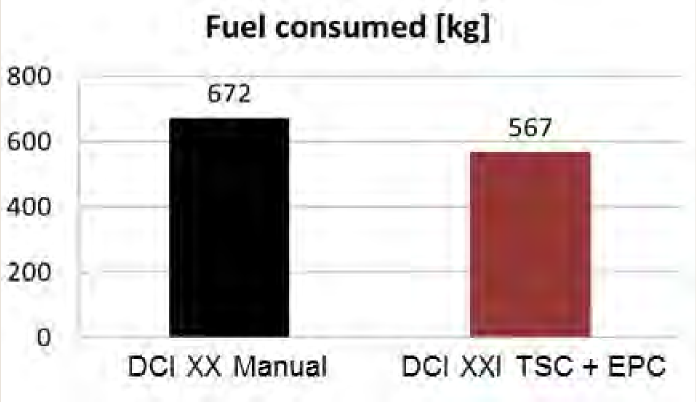


IHC Eco Pump Control

The impact of automation...

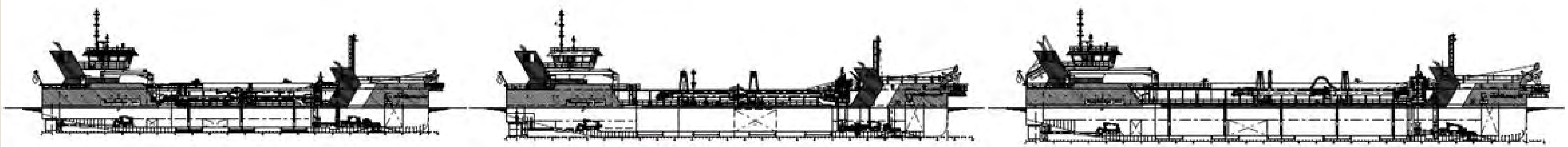






The Easydredge® series

	Easydredge™ 1600	Easydredge™ 2700	Easydredge™ 3700
Length overall	71.75 m	81.75 m	92.95 m
Breadth moulded	14.00 m	15.80 m	16.30 m
Hopper volume	1,600 m^3	2,700 m^3	3,700 m^3
Dredging draught (design)	4.50 m	5.50 m	6.20 m



The IHC Beagle® series

	Beagle 6	Beagle 8
Length overall	m	104.50 m
Breadth moulded	m	24.20 m
Hopper volume	6,000 m³	8,000 m³
Dredging draught (design)	6.50 m	7.80 m

(R)evolutions in dredging

Huge efficiency improvements due to:
- increase of scale
- efficient engines and gearboxes, hydraulic pumps/systems
- efficient dredgepumps
- efficient cutter heads and dragheads for different soil types
- improved reliability
- increased wear resistance - longer lifetime of wearing parts
- Automation (Automatic Pump control / Automatic Trailspeed control)
- ergonomic improvements
- increased working window (swell compensators / spudguard system)
- Remote access
- Standardisation

Conclusion:

Overall efficiency is determined by multiplying the efficiency factors of the individual components

1,4 * 1,4 * 1,4 * 1,4 * 1,4 * 1,4 * 1,4 = 10

Thank you for your attention