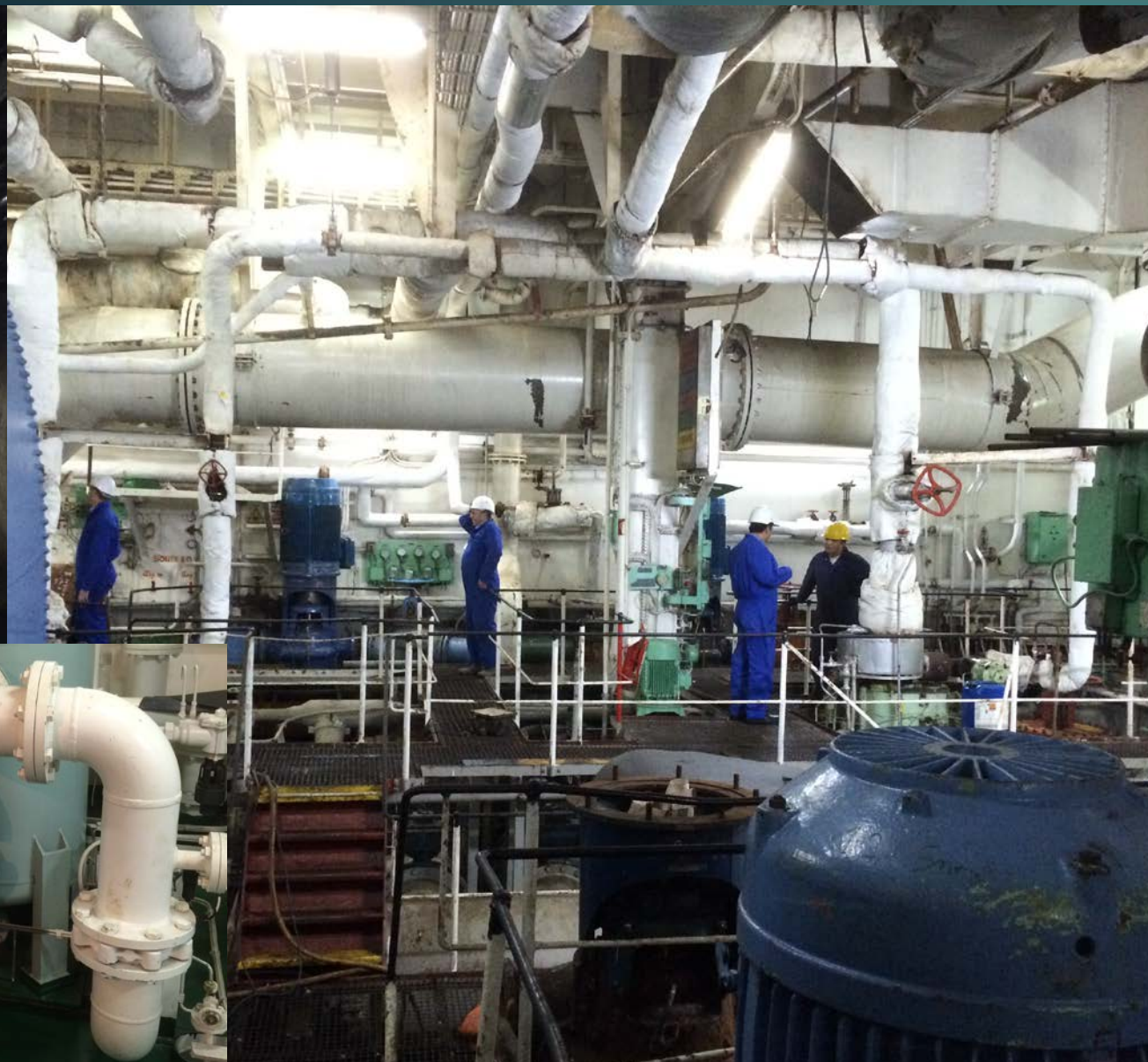
THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community

Ballast Water Risk Management
Compliance Monitoring and Contingency Treatment

Presented to:
Prevention First
8 October 2014, Long Beach, CA

Presented by: Kevin J. Reynolds, PE, The Glosten Associates

Ballast Water Risk Management
Compliance Monitoring and Contingency Measures



Ballast Water Risk Management
Compliance Monitoring and Contingency Measures

$40 Billion

Ballast Water Risk Management
Compliance Monitoring and Contingency Measures

PROVEN TREATMENT TECHNOLOGY

Is there proven technology for MY marine vessel?

COMPLIANCE MONITORING & ENFORCEMENT

How do I (and Port State Control) know that it is really working?

CONTINGENCY MEASURES

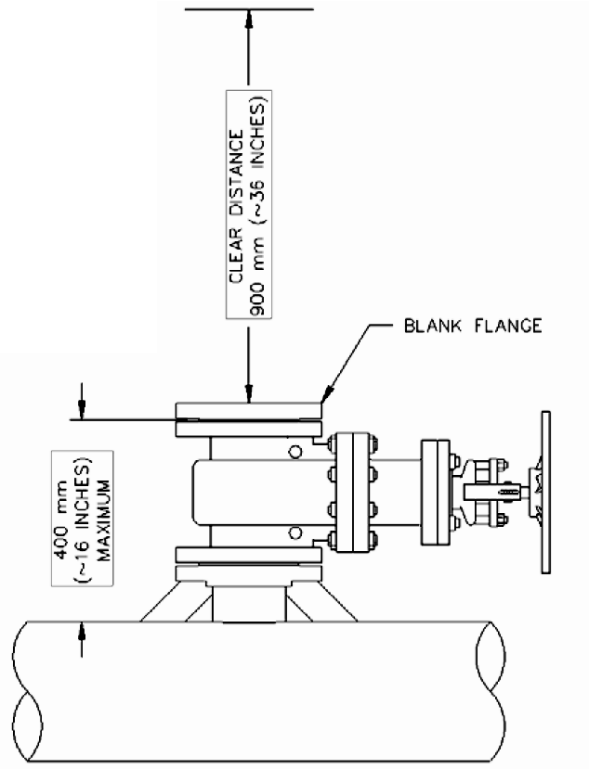
What do I (and Port State Control) do if it isn't working? M&R Issue, Technology Issue, etc.

$40 Billion

Ballast Water Risk Management Compliance Monitoring Overview

Pitot Insertion

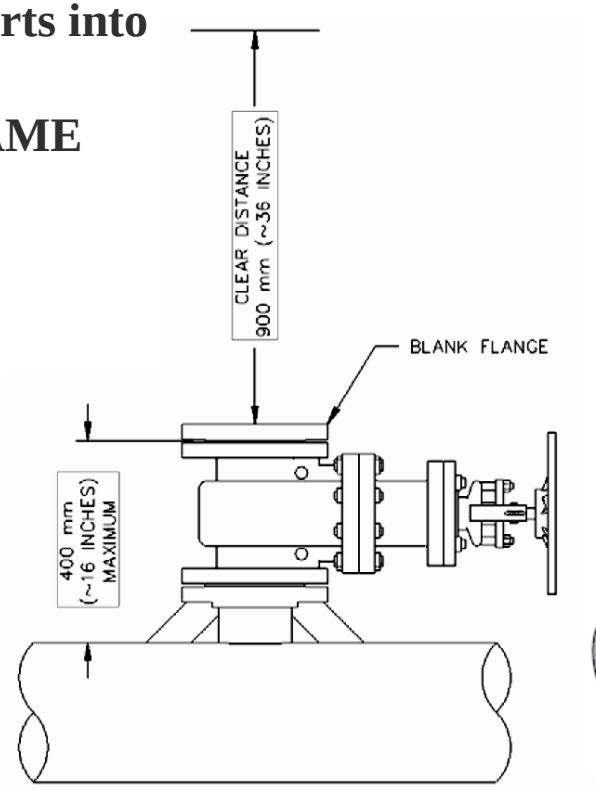
- **Established “standard” sample port as DIN 400 mm flange, fully ported valve, and blank flange. There is NO PITOT to corrode, foul, or break-off**

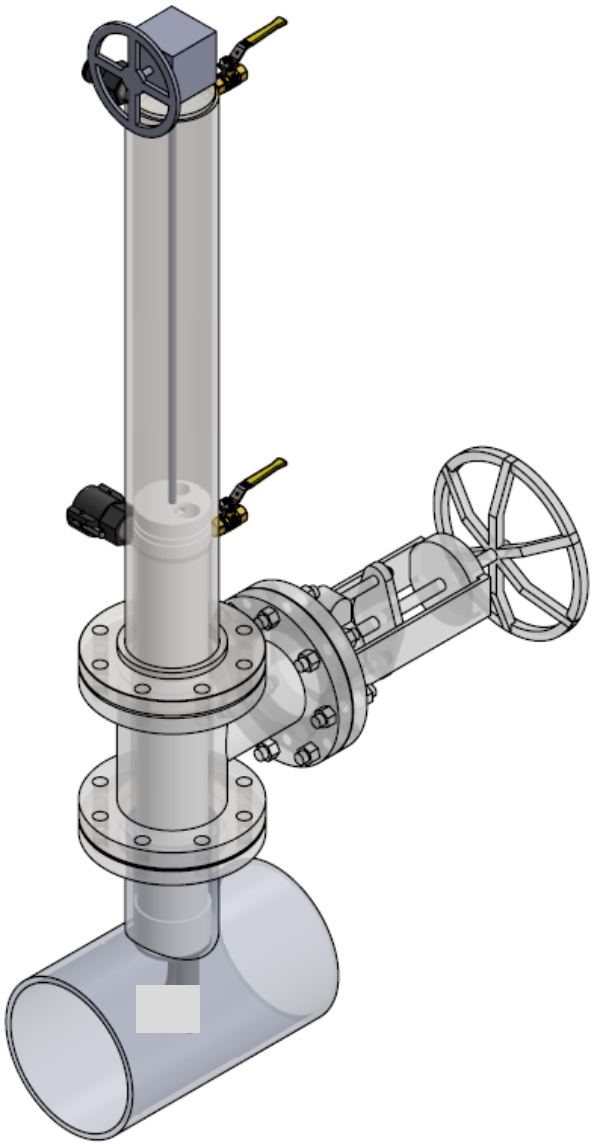


Ballast Water Risk Management Compliance Monitoring Overview

Pitot Insertion

- **Established "standard" sample port as DIN 400 mm flange, fully ported valve, and blank flange. There is NO PITOT to corrode, foul, or break-off**
- **Portable device connects to flange, operator opens valve, pitot inserts into ballast water stream**
- **Sample RETURNS through SAME sample port**

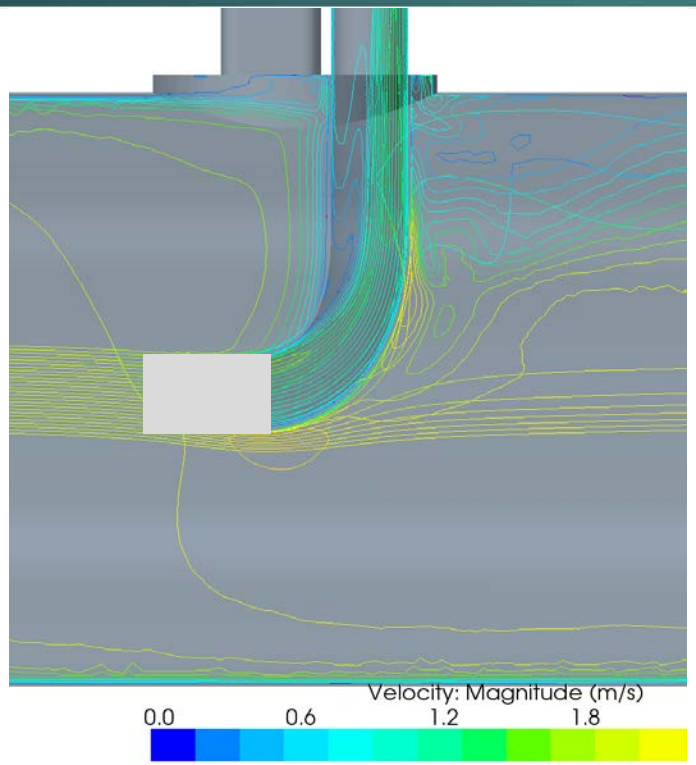




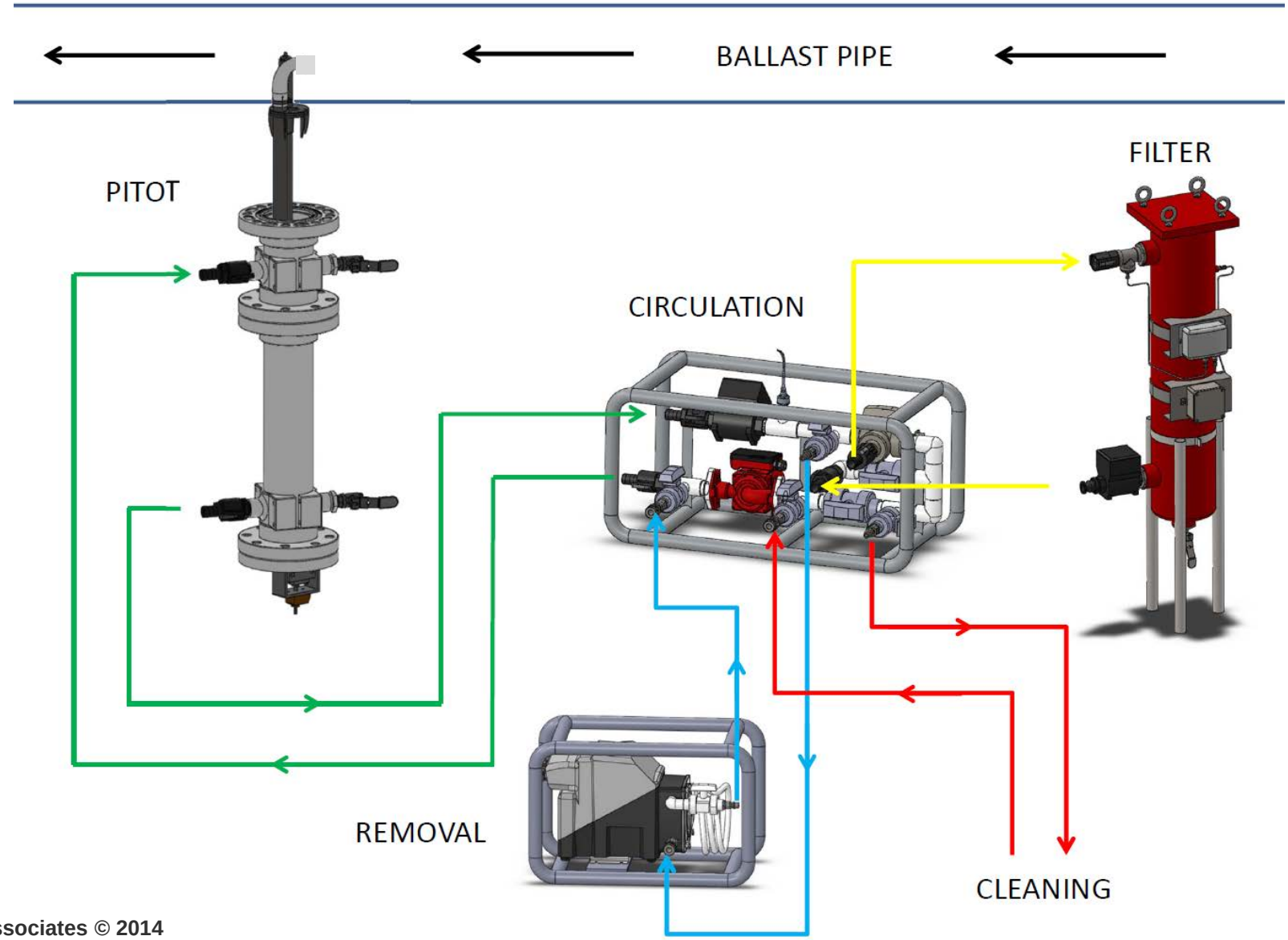
Ballast Water Risk Management Overview

Fluid Analysis

- Identified pitot shape to minimize shear forces
- Coupled with flow control to work with multiple ballast main velocities
- Determined required insertion distance to reach developed flow
- Examined across typical ballasting velocity range
- Established single tool for variety of ballast main sizes

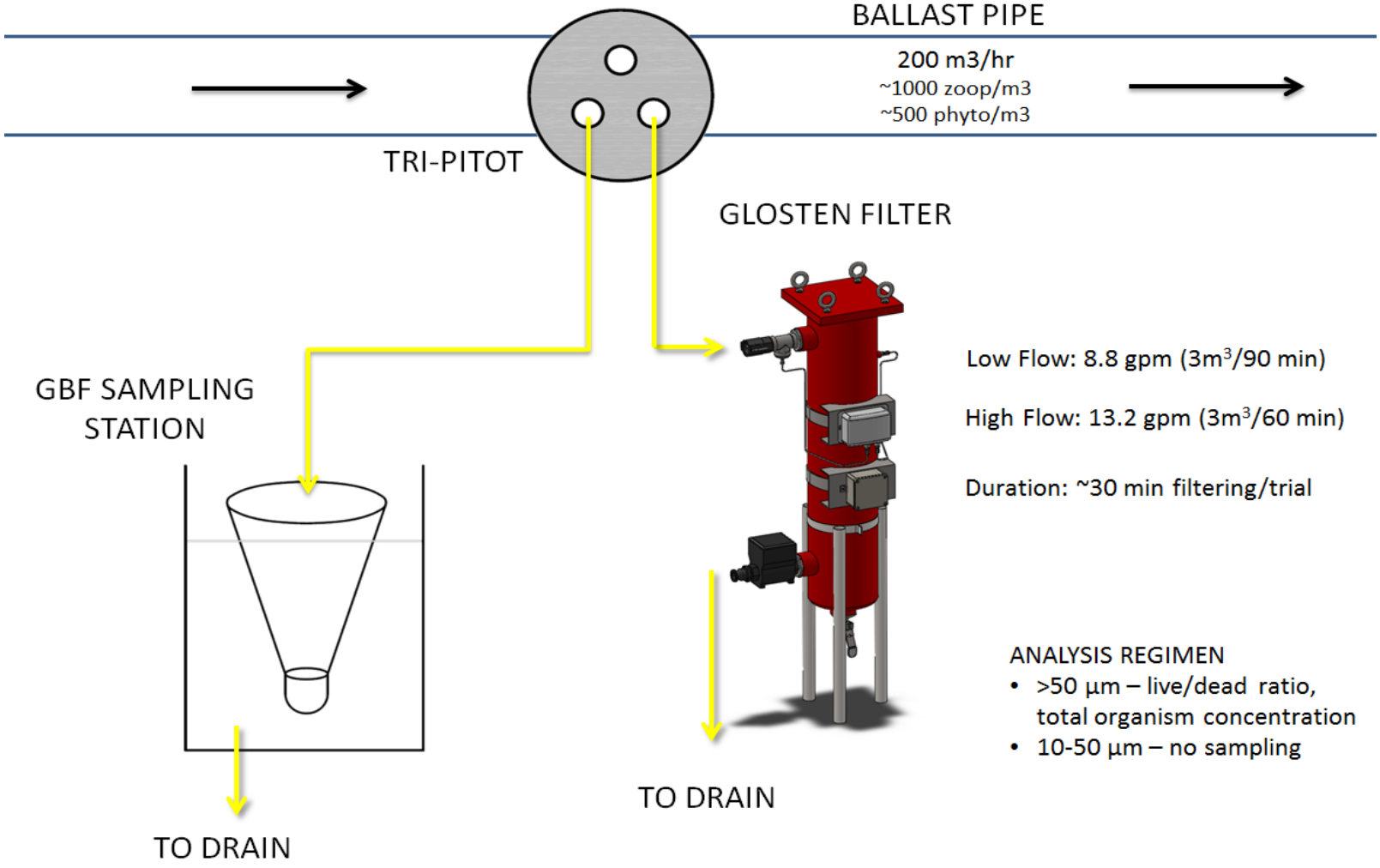


Ballast Water Risk Management
Compliance Monitoring – Prototype



Ballast Water Risk Management Compliance Monitoring – Prototype

FILTER TESTING (3x replicates low flow, 3x replicates high flow)



Low Flow: 8.8 gpm ($3m^3$/90 min)

High Flow: 13.2 gpm ($3m^3$/60 min)

Duration: ~30 min filtering/trial

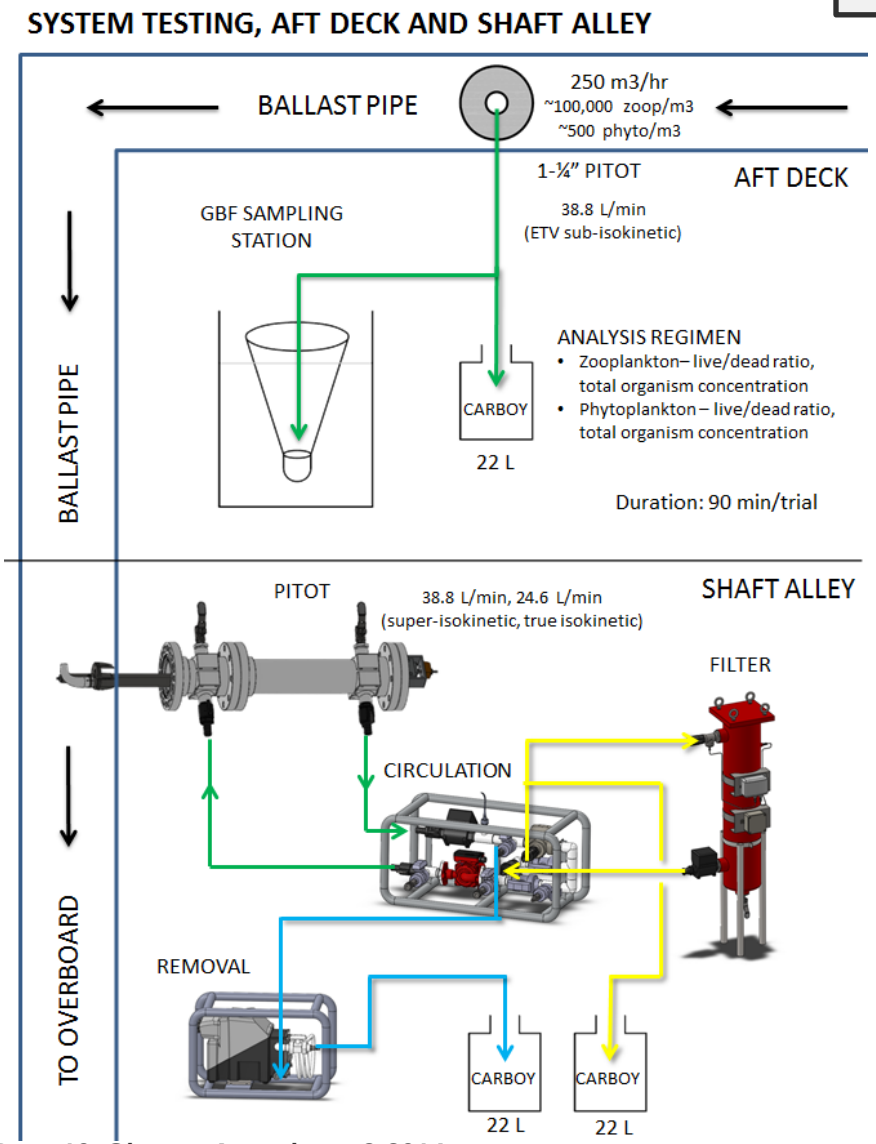
ANALYSIS REGIMEN

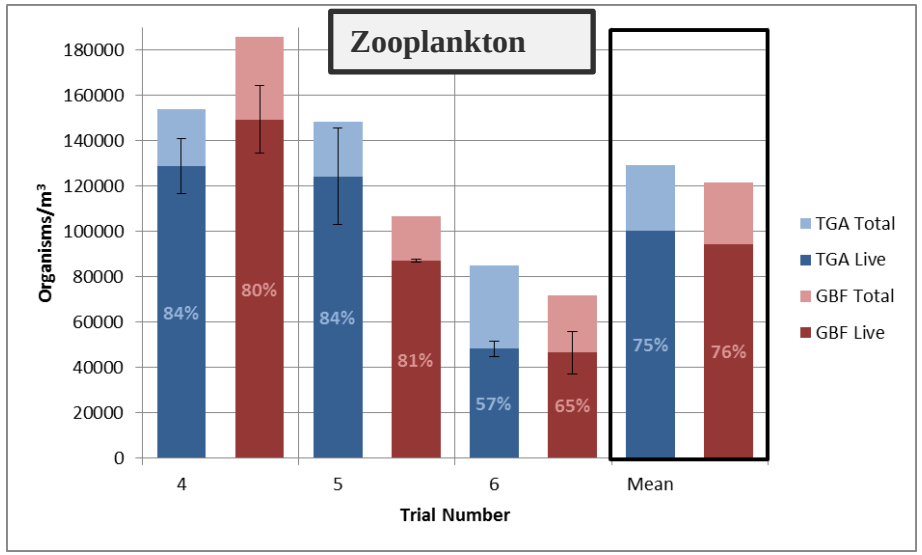
- >50 µm – live/dead ratio, total organism concentration
- 10-50 µm – no sampling

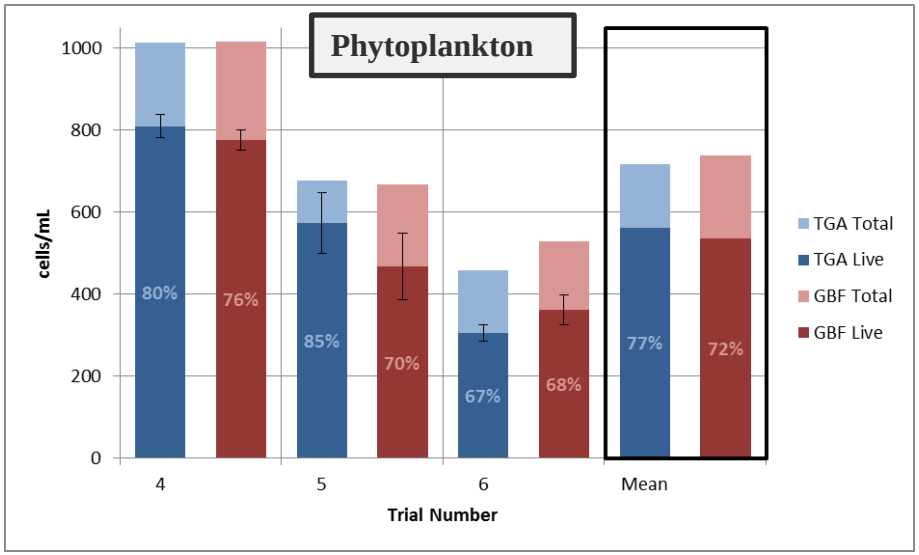
Compliance Monito
True Isokinetic

Results

- Zooplankton samples are comparable!
- Phytoplankton samples are comparable!



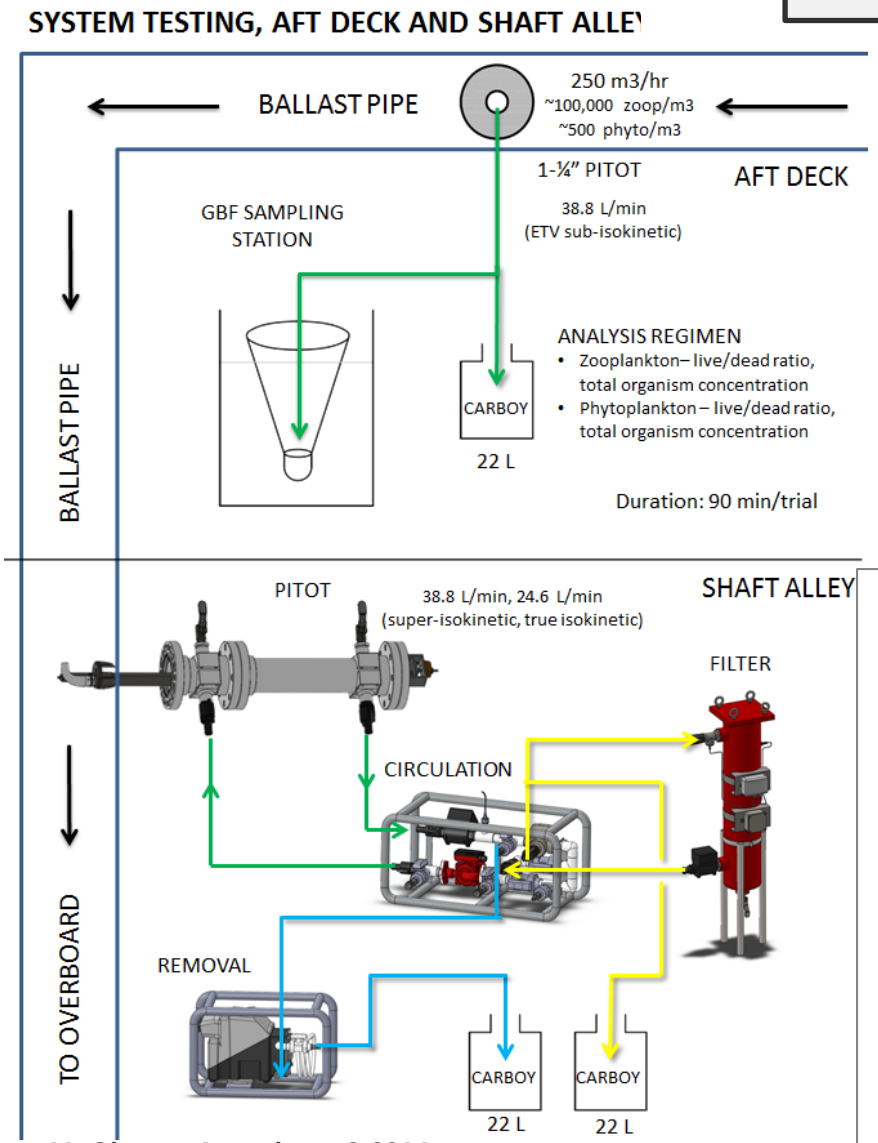


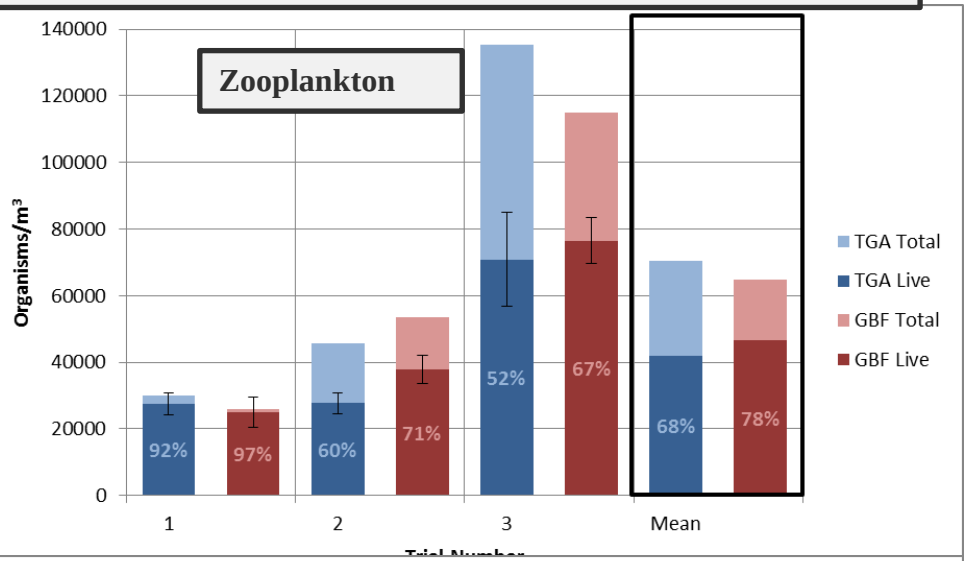


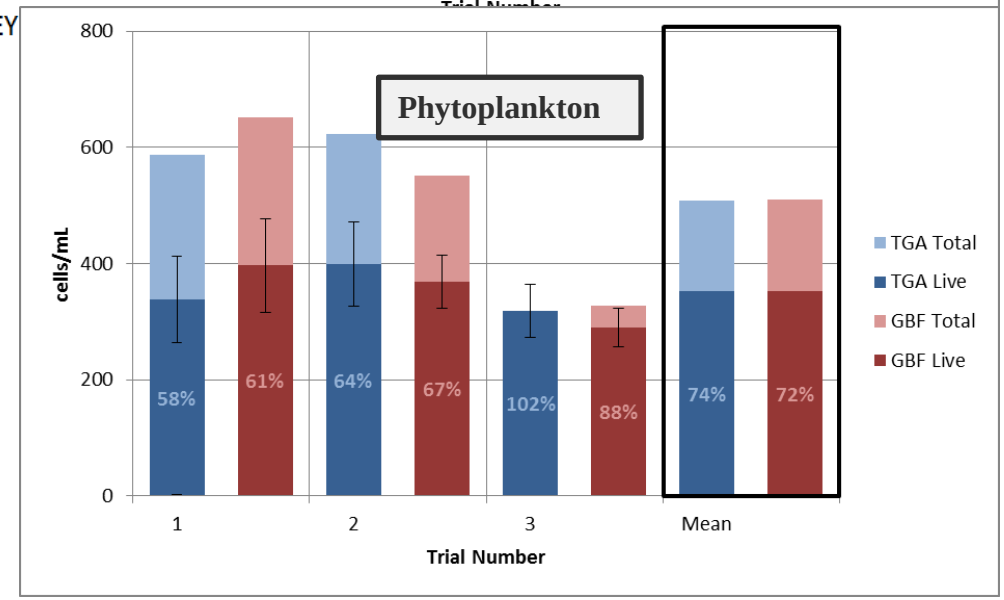
Compliance Monit
Super-isokinetic

Results

- Zooplankton mortality increased
- Phytoplankton samples are comparable!







Ballast Water Risk Management
Compliance Monitoring

Next Steps

- Smaller, Lighter, Simpler
- Smaller, Lighter, Simpler

Program Details

- Sponsored by California State Lands Commission
- Design patented by Glosten Associates
- Tested in Summer/Fall 2013 at Golden Bear Facility by Moss Landing Marine Laboratory

Findings

- Current approach of pre-installing a pitot tube at the shipyard risks contaminated samples, corrosion, and even ballast system failures.
- It is only practical to be able to "hot-tap" the ballast water main. Need international cooperation to amend IMO G-2 Sampling Guidelines to outfit ships with a much simpler and standard 100 mm flange and valve for sampling
- Kit needs to be able to change sampling rate with the ballast water system, and gain an adequate sample in a short time
- Kit needs to return sampled water to the ballast water main

Ballast Water Risk Management Overview

Is there proven technology for MY marine vessel?

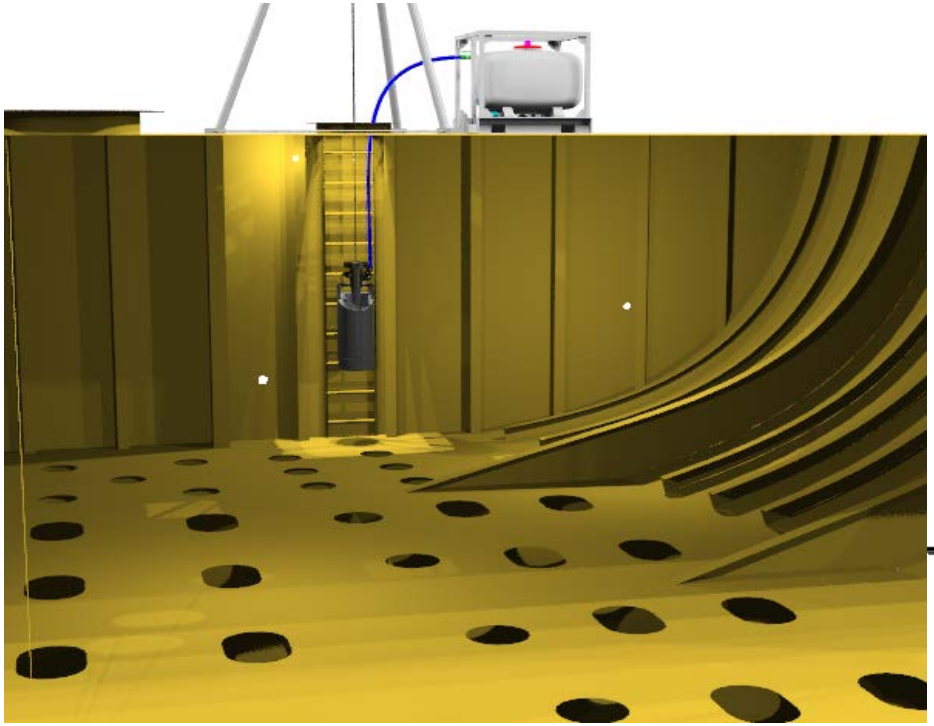
How do I (and Port State Control) know that it is really working?

What do I (and Port State Control) do if it isn't working? M&R Issue, Technology Issue, etc.

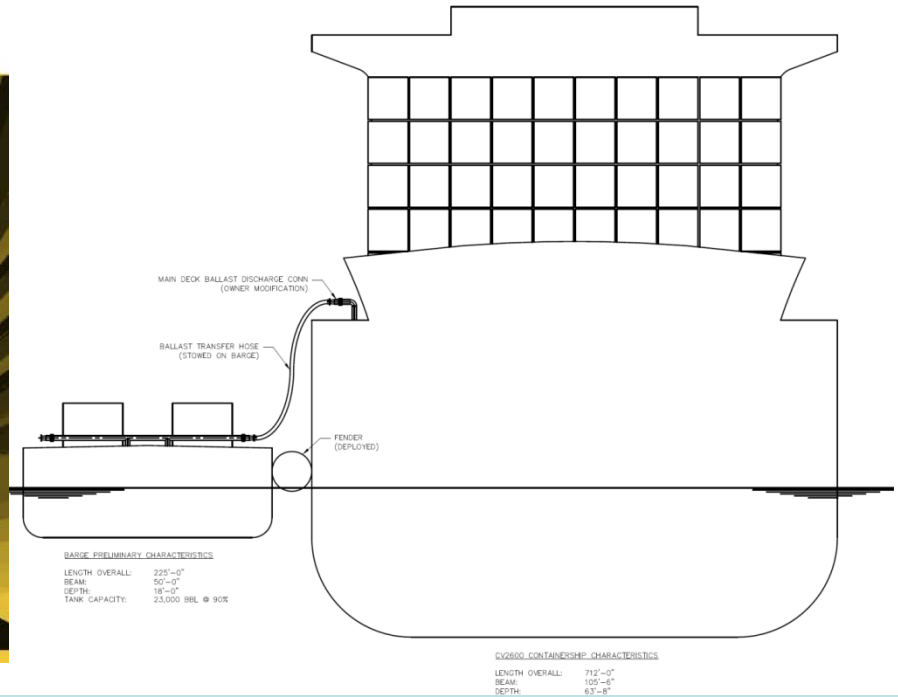
Contingency Measures
TRANSFER OFF-SHIP

Contingency Measures
OPTIONS

Onboard/ In-Tank



Transfer Off-ship



- Mobile Deployment
- Ship's Crew or Shore Team Deploys Onboard
- Dose Tank by Tank

- Transfer Off-ship (Shore, Barge, Ship)
- Refit Ship with Deck Connection, or Attach to Hull
- Transfer Ballast for Off-ship Treatment

Contingency Measures – Ballast Responder
PARTNERSHIPS

Development Team

National Park Service, U.S. Geological Survey, The Glosten Associates

Collaborators

University of Minnesota, Naval Surface Warfare Center, Michigan Technical University, American Steamship Company, California Maritime Academy

Funding and Project Management

California State Lands Commission, National Parks of Lake Superior Foundation, National Oceanic and Atmospheric Administration, US Maritime Administration, Great Ships Initiative, Great Lakes Fisheries Trust , Legislative-Citizen Commission on Minnesota Resources, Glosten Associates

Ship Platforms

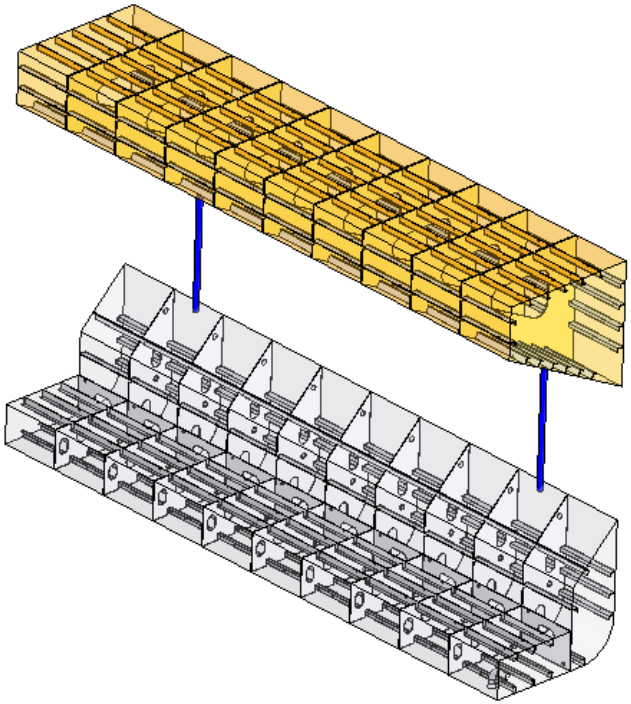
Ranger III*, *MV Indiana Harbor*, and *TS Golden Bear

Peer Review

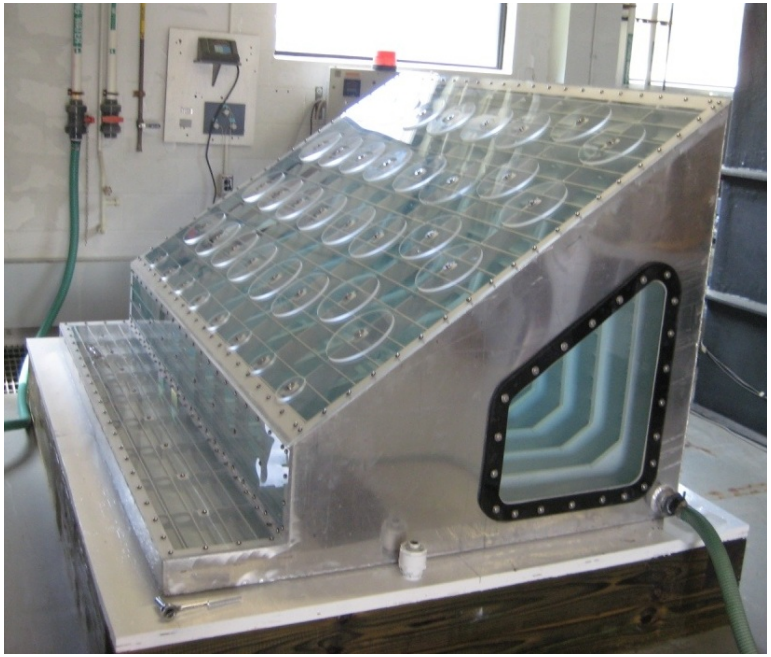
American Salvage Association, U.S. EPA – Great Lakes, U.S. EPA – Region 5, U.S. Coast Guard Cleveland, NOAA, California State Lands Commission, and University of Wisconsin-Superior

Ballast Responder – Mobile Treatment
DEVELOPMENT TRIALS (LABORATORY AND *MV INDIANA HARBOR)*

CFD Analysis at Naval Surface Warfare Center



Scale Model Development Trials at U.S. Geological Survey, Leetown Science

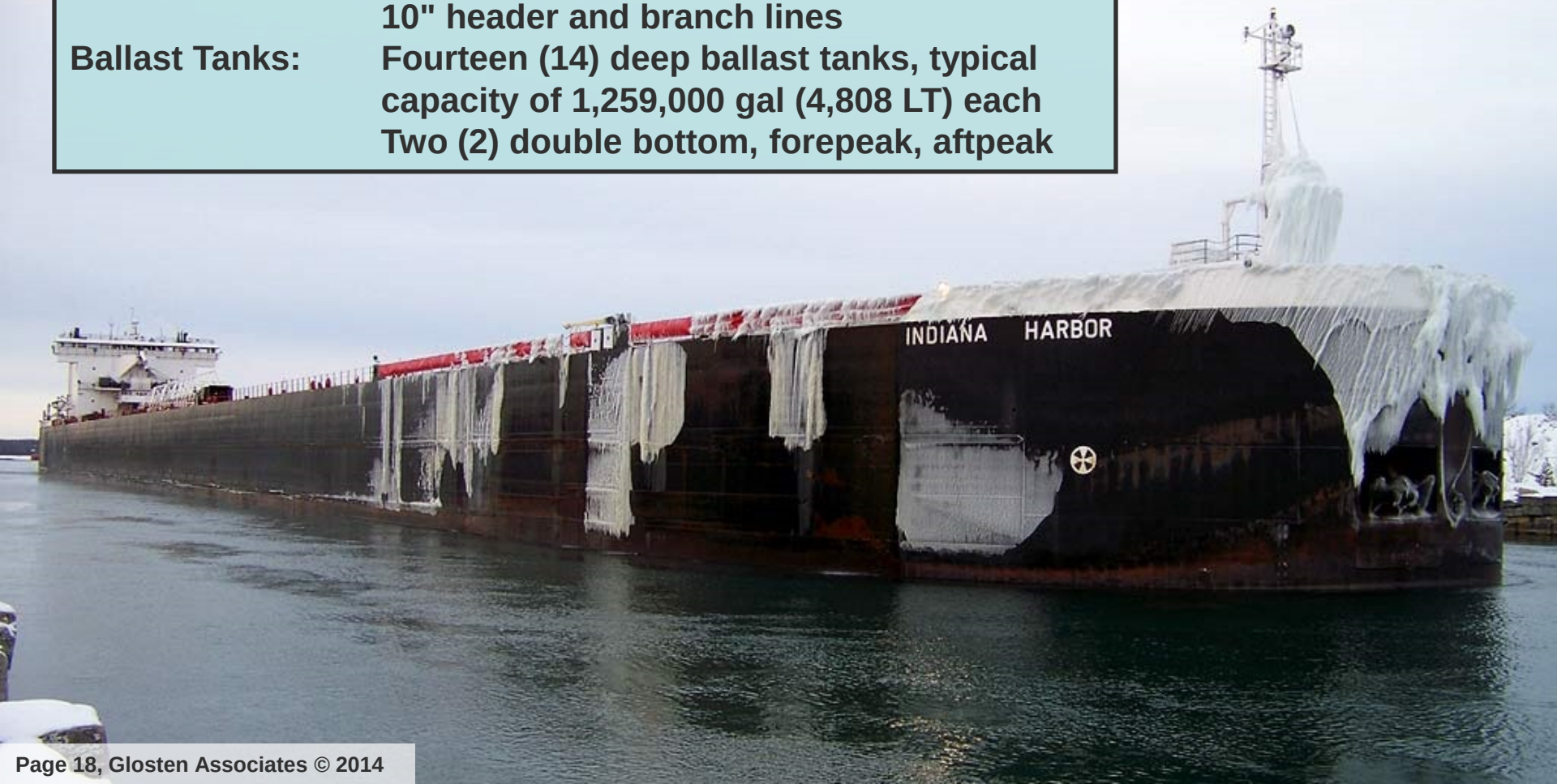


Analysis Tools

- **Established “energy” and time required to mix complex, full ballast water tanks**
- **Allowed development of core technologies in laboratory settings, ahead of full-scale trials**

Ballast Responder – Mobile Treatment
DEVELOPMENT TRIALS (LABORATORY AND *MV INDIANA HARBOR)*

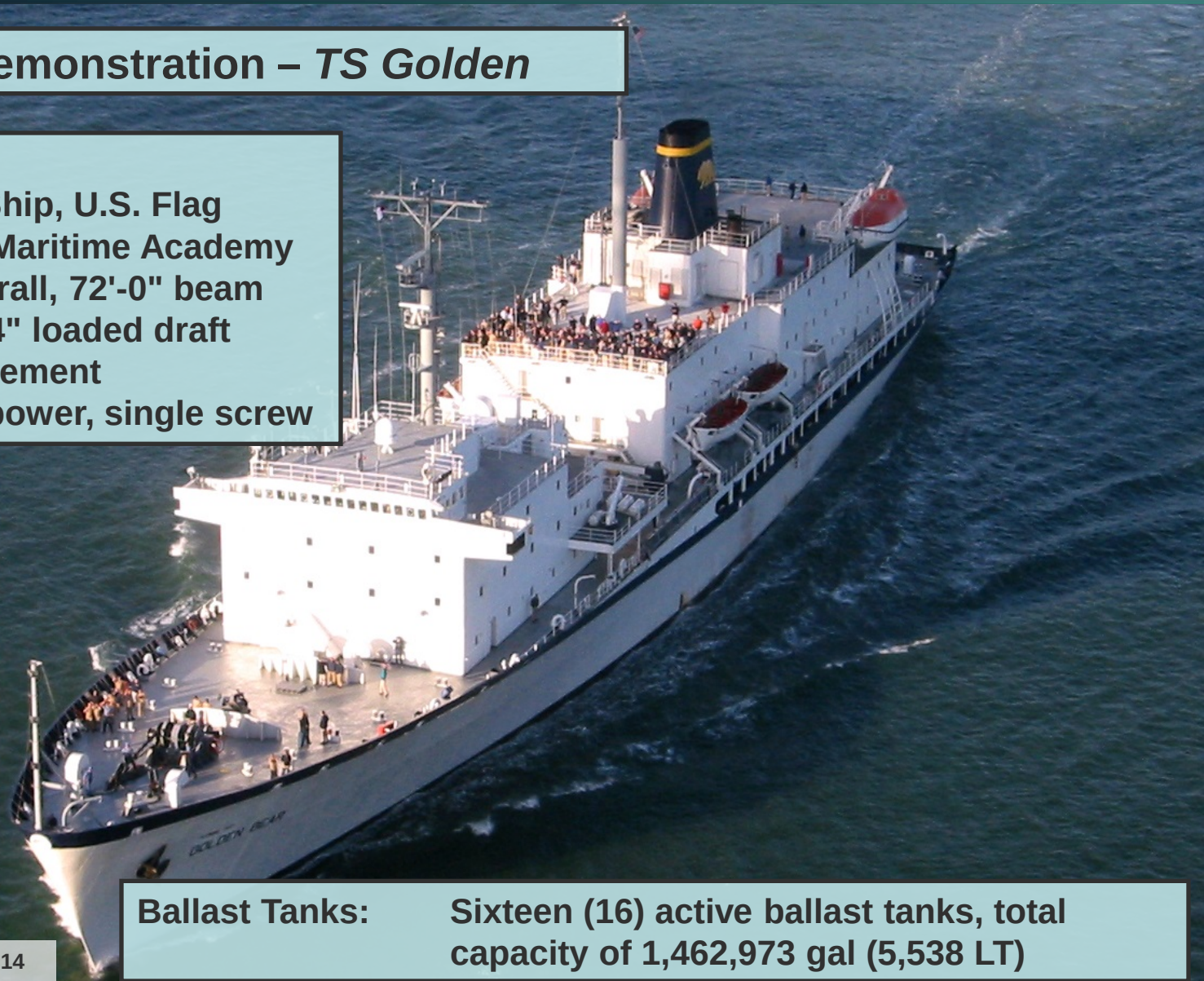
Ballast System:	**Four (4) main pumps at 13,000 gpm each** **30" header and 14" branch lines** **Two (2) stripping pumps at 4,000 gpm each** **10" header and branch lines**
Ballast Tanks:	**Fourteen (14) deep ballast tanks, typical capacity of 1,259,000 gal (4,808 LT) each** **Two (2) double bottom, forepeak, aftpeak**



Ballast Responder – Mobile Treatment

Prototype Demonstration – *TS Golden Bear*

Particulars:
Maritime Training Ship, U.S. Flag
Serving California Maritime Academy
499'-10" length overall, 72'-0" beam
42'-0" depth, 30'-3/4" loaded draft
15,821 tons displacement
17,000 shaft horsepower, single screw

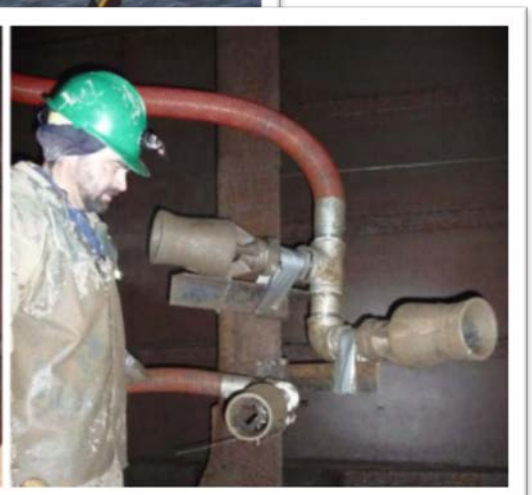


Ballast Tanks: **Sixteen (16) active ballast tanks, total capacity of 1,462,973 gal (5,538 LT)**

Ballast Responder – Mobile Treatment
DEVELOPMENT TRIALS (LABORATORY AND *MV INDIANA HARBOR)*

Prepare Chemicals for FULL Ballast Tanks

Dose One Method



Dose Subsequent Methods

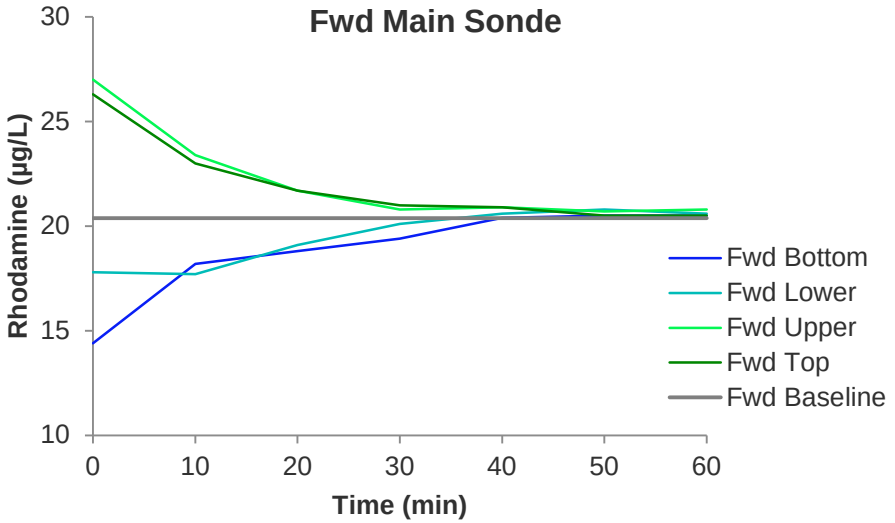
Ballast Responder – Mobile Treatment
PROTOTYPE DEMONSTRATION – *TS GOLDEN BEAR*

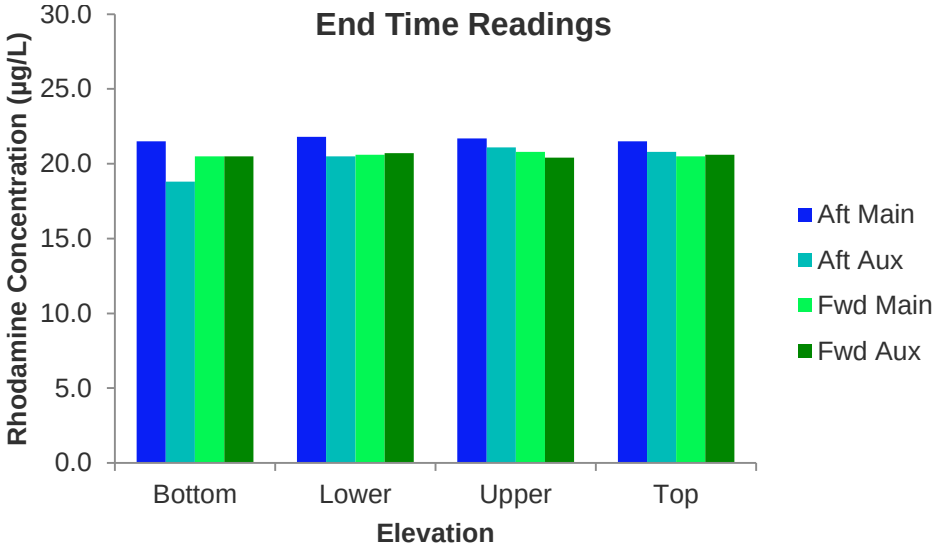
Results

Trial No.	1	Date
Tank	3-174-2	Volume (tonnes)
Dye Added (mL)	360	Expected Concent
Pre-Trial Aft Conc. (µg/L)	0.0	Pre-Trial Fwd Conc
Mixing Pump Start Time	17:48	Dosing Skid Start
Trial Start Time	18:28	Trial Finish Time
Airlift Start Time	19:41	Airlift Stop Time

Rhodamine Concentration (µg/L)

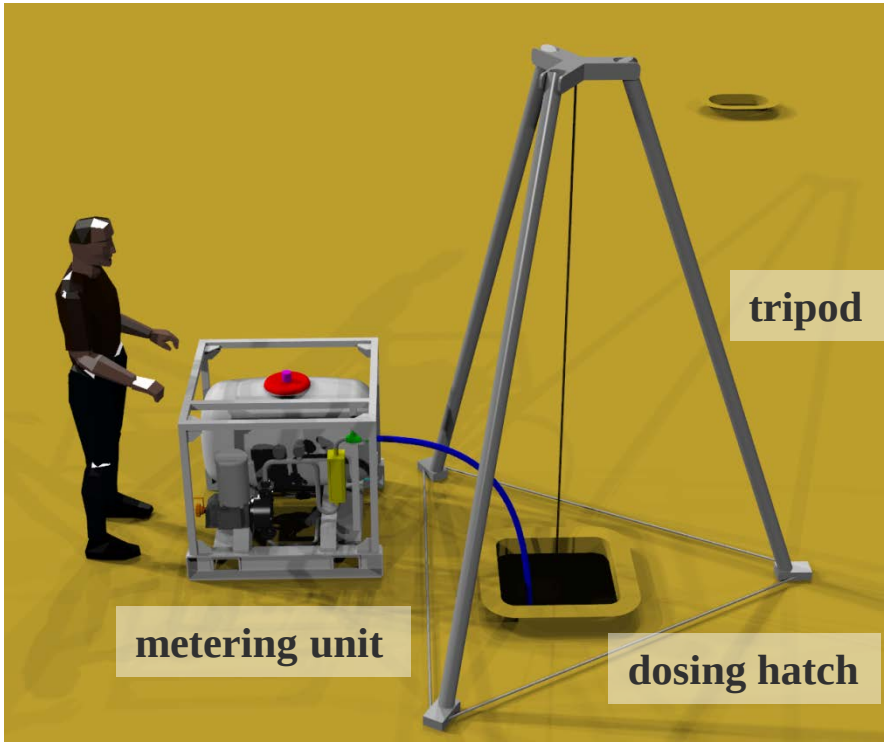
Time (min)	Aft Bottom	Aft Lower	Aft Upper	Aft Top	Fwd Bottom	Fwd Low
0	12.5	25.7	26.6	27.2	14.4	17.
10	18.6	22.0	23.6	23.0	18.2	17.
20	19.8	22.1	22.8	22.5	18.8	19.
30	20.1	22.0	22.5	22.0	19.4	20.
40	21.1	21.6	21.7	21.9	20.4	20.
50	21.5	21.7	21.9	21.7	20.5	20.
60	21.5	21.8	21.7	21.5	20.5	20.
Auxiliary	18.8	20.5	21.1	20.8	20.5	20.
Airlift	21.2	21.2	21.2	21.4	20.7	20.
	Aft Airlift Average (µg/L)			21.3	Fwd Airlift Averag	



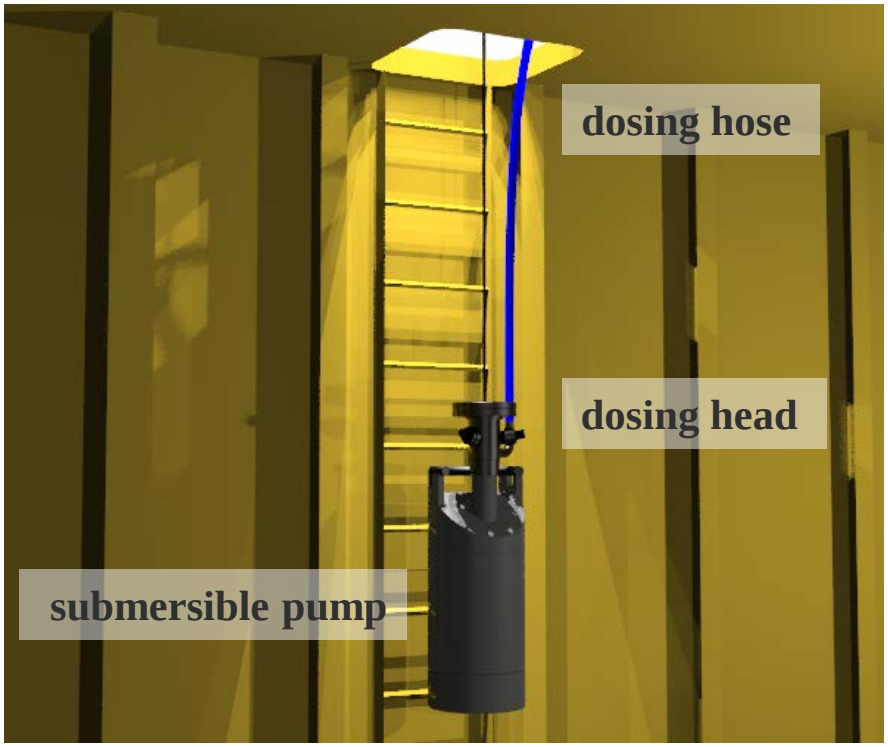


Ballast Responder – Mobile Treatment
PROTOTYPE DEMONSTRATION – *TS GOLDEN BEAR*

Dosing



Mixing



Ballast Responder – Mobile Treatment
PROTOTYPE DEMONSTRATION – *TS GOLDEN BEAR*

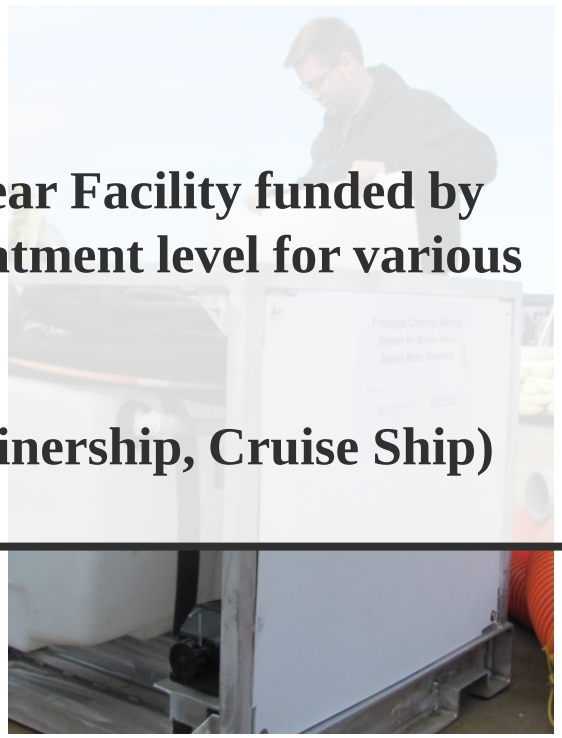
Ballast Responder – Mobile Treatment
PROTOTYPE DEMONSTRATION – *TS GOLDEN BEAR*

Findings

- Able to mix large, small, and complex shaped tanks ~45 minutes
- Able to administer chemicals into ballast tanks
- Practical for two people to deploy mobile kit

Next Steps

- Efficacy trials planned for Fall 2014 with Golden Bear Facility funded by California State Lands Commission to establish treatment level for various dose concentration to holding times
- Toxicity testing on NEUTRALIZED effluent
- US West Coast Demonstration Trial (Tanker, Containership, Cruise Ship)
- Great Lakes Demonstration Trial (Bulkers)



Ballast Water Risk Management
Summary and Thoughts