Ballast Water Risk Management
Compliance Monitoring and Contingency Treatment

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

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

BALLAST PIPE
- 200 m³/hr
- ~1000 zooplankton/m³
- ~500 phytoplankton/m³

TRI-PITOT

GLOSTEN FILTER

GBF SAMPLING STATION
- Low Flow: 8.8 gpm (3 m³/90 min)
- High Flow: 13.2 gpm (3 m³/60 min)
- Duration: ~30 min filtering/trial

TO DRAIN

ANALYSIS REGIMEN
- >50 µm – live/dead ratio, total organism concentration
- 10-50 µm – no sampling
Compliance Monitoring and Sampling System
True Isokinetic

Results

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

System Testing, Aft Deck and Shaft Alley

- Ballast Pipe
  - GBF Sampling Station
  - Carboy 22 L
  - 1-1/8" Pitot
    - 38.8 L/min (ETV sub-isokinetic)
  - Analysis Regimen
    - Zooplankton: live/dead ratio, total organism concentration
    - Phytoplankton: live/dead ratio, total organism concentration
  - Duration: 90 min/trial

Zooplankton

- Graph showing data for trials 4, 5, 6, and mean with error bars for TGA Total, TGA Live, GBF Total, and GBF Live.

Phytoplankton

- Graph showing data for trials 4, 5, 6, and mean with error bars for TGA Total, TGA Live, GBF Total, and GBF Live.
Results

- Zooplankton mortality increased
- Phytoplankton samples are comparable!
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

Next Steps
• Smaller, Lighter, Simpler
• Smaller, Lighter, Simpler
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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

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

Funding and Project Management

Ship Platforms
Ranger III, MV Indiana Harbor, and TS Golden Bear

Peer Review
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 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 |
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)
Prepare Chemicals for FULL Ballast Tanks

Dose One Method

Dose Subsequent Methods
### Results

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<td>Date</td>
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<tr>
<td>Tank</td>
<td>3-174-2</td>
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<tr>
<td>Volume (tonnes)</td>
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<tr>
<td>Dye Added (mL)</td>
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<td>Expected Concentration (µg/L)</td>
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<td>Pre-Trial Aft Conc. (µg/L)</td>
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<td>Pre-Trial Fwd Conc</td>
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<td>Trial Start Time</td>
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<td>Trial Finish Time</td>
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<th>Aft Lower</th>
<th>Aft Upper</th>
<th>Aft Top</th>
<th>Fwd Bottom</th>
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<tbody>
<tr>
<td>Aft Airlift Average (µg/L)</td>
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**Fwd Main Sonde**

**End Time Readings**

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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)
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Ballast Water Risk Management Summary and Thoughts