Ballast Water Treatment Retrofit

A Case Study and Reality Check

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September 11, 2001

Outline of Topics

- Review of Design Study
- Planned Installation
- Installation Time Line and Difficulties/Realities of shipboard work on the fly
- Cost and Schedule drivers
- Equipment issues
- Cost to date/status

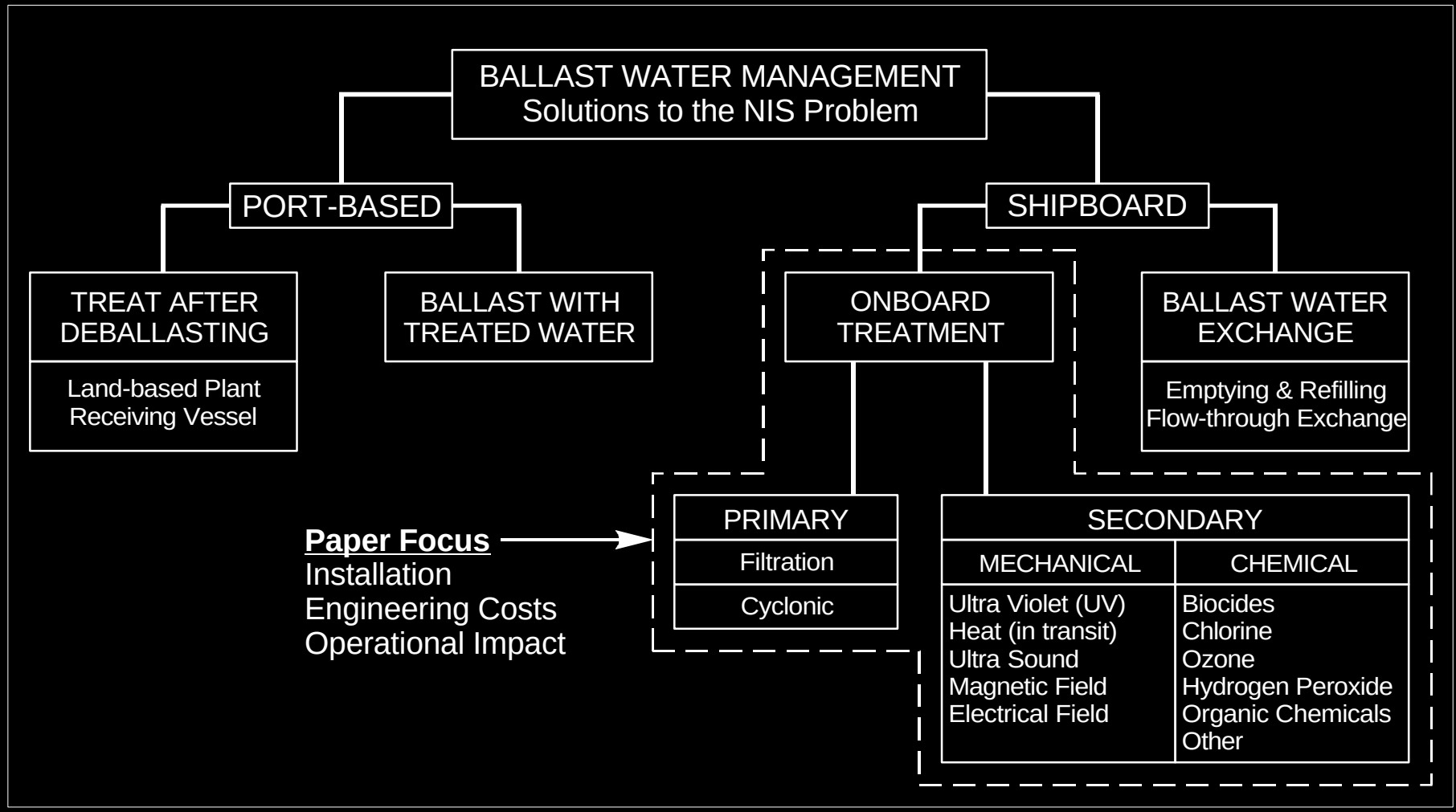
Full Scale Design Studies of Ballast Water Treatment Systems

Study by: Glosten - Herbert LLC and Hyde Marine for the

Great Lakes Ballast Technology Demonstration Project

Sponsors: Northeast-Midwest Institute and the Lakes Carriers Association

Study Focus


BALLAST WATER MANAGEMENT
Solutions to the NIS Problem
PORT-BASED
SHIPBOARD
TREAT AFTER DEBALLASTING
Land-based Plant
Receiving Vessel
BALLAST WITH TREATED WATER
ONBOARD TREATMENT
BALLAST WATER EXCHANGE
Emptying & Refilling
Flow-through Exchange
Paper Focus
Installation
Engineering Costs
Operational Impact
PRIMARY
Filtration
Cyclonic
SECONDARY
MECHANICAL
CHEMICAL
Ultra Violet (UV)
Heat (in transit)
Ultra Sound
Magnetic Field
Electrical Field
Biocides
Chlorine
Ozone
Hydrogen Peroxide
Organic Chemicals
Other

Scope of Study

- Develop flow-through on-board treatment systems for Two “Target Vessels:”
- Develop Life Cycle Costs
- Use currently available technologies

Target Vessels

Design Study #1

"Vessel of at least 10,000 MT Displacement"

POLAR ENDEAVOUR

Design Study #2

2000 TEU or Greater Containership

Regularly Calling on U.S Port

R.J. PFEIFFER

Treatment System Requirements

- Maximizes kill and/or inactivation rate
- Minimizes adverse effects on environment
- Minimizes changes to the vessel's existing ballast system and process
- Minimizes initial and life-cycle costs
- Designed for shipboard marine environment
- Meets existing safety standards

Selected Treatment Systems

- Cyclonic Separation
- Ultra-violet (UV) Light Irradiation
- Filtration with Backflush
- Chemical Biocide Injection

Polar Endeavour

Type:	125,000 Dwt Crude Oil Carrier in TAPS Trade
Owner:	Polar Tankers, Inc.
L x B x D:	273m x 46m x 25.3m
DWT:	127,005 MT
Ballast Cap:	60,700 m^3
Ball. Pumps:	2 @ 2,860 m^3/hr mains, 2@1,000 m^3/hr aft
No. Ball Tks:	6 pairs + 1 fo'c'sle + 4 aft tanks

Polar Endeavour
Ballast Treatment Systems

- Primary System - Cyclonic Separator
- Secondary System - UV Radiation on intake and discharge
- Alternate System - Chemical Treatment
  - Use in addition to or instead of Primary and Secondary
  - SEAKLEEN Biocide

R.J Pfeiffer

R.J. Pfeiffer

Type:	2,420 TEU Container Ship
Owner:	Matson Navigation
L x B x D:	217m x 32m x 20m
DWT:	28,758 MT
Ballast Cap:	14,600 m^3
Ball. Pumps:	2 @ 350 m^3/hr
No. Ball Tks:	26

R.J. Pfeiffer
Ballast Treatment System Options

- Option 1:
  - Primary System - Cyclonic Separator
  - Secondary System - Ultraviolet Radiation
    - UV irradiation on intake and discharge
- Option 2:
  - Primary System - Filtration with Backflush
  - Secondary System - Ultraviolet Radiation
    - UV irradiation on intake and discharge

R.J. Pfeiffer
Selection of Treatment Type
Cyclonic Separator over Filtration with Backflush

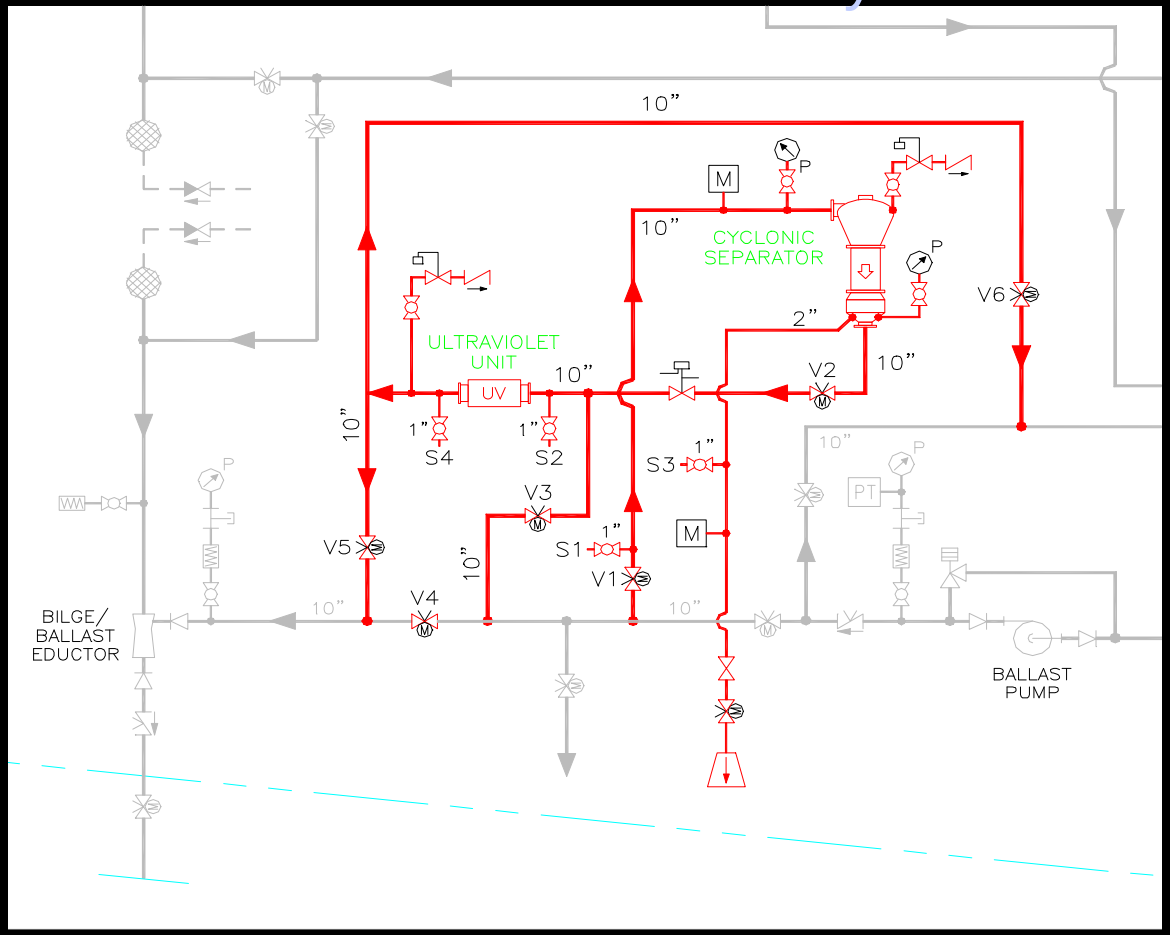
- Shipboard service experience with automatic backflushing filters limited
- Crew maintenance/monitoring req’ts
- Capital and lifetime costs
- Filters require more space in ER
- No current efficacy standards

R.J. Pfeiffer
System Equipment and Installation

- Cyclonic Separator - Microkill HRN 350
  - 265-490 m^3/hr
- UV Unit - Microkill LP400-16-200
  - 350 m^3/hr, 16 lamps, 24 VAC 3A
- Installed on starboard ballast pump only
- Installation at ER floor plate level, outboard of Main Engine
- 10” ballast lines & valves, 2” sludge overb’d
- Controls/monitoring integrated with ballast control system

R.J. Pfeiffer
Main Ballast System Diagram

Starboard Side Only



To ballast main

From ballast main or sea suction

R.J. Pfeiffer
System Operation & Monitoring

- Designed for unattended ER operation
- All control / monitoring in ballast control office
- Open/close (3-6) additional motor operated valves
- Turn UV system on and monitor performance
- Use UV at intake and discharge
- Avoid deep ocean exchange

R.J. Pfeiffer
Life Cycle Cost Summary

Item	Installation Cost	Life Cycle (LC)Cost	Present Value of LC Cost	Uniform Equivalent Annual Cost (AAC)	Tons of Ballast Pumped/year	Cost / Ton
Cyclonic Separator and UV Treatment	$358,000	$596,000	$429,000	$44,000	13,000	$3.38
Filter and UV Treatment	$375,000	$832,000	$511,000	$52,000	13,000	$4.00

R.J. Pfeiffer
Planned Installation

- Matson Agreed to go forward with the installation as a test platform
- The R. J. Pfeiffer was successfully and easily carrying out ballast exchange
- Partial funding form the State Land Commission was provided $100,000
- Matson budgeted an additional $250,000 and committed crew time and other resources

Original Time Line
Equipment Installation
2001

- May 1 - Decision to proceed
- June 26 - ship at shipyard for piping work
- August / October - complete installation while ship in service
- November - System Efficacy Testing

Schedule drivers

- June 6, 2001 – last port call before shipyard, valves/piping ordered and on board
- Installation work to be accomplished while ship in service during 1-2 day port calls every 2-5 weeks or during 1 day coastal run
- October 2001 U/V and Separator arrive in LA, some equipment still tied up in customs

Achieved Milestones

- July 16, 2001 – only about 20% of pipe installed at shipyard
- Aug. 2, 2001 – 1st port call, ship in 5 week service
- Oct. 8, 2001 – U/V and Separator arrive, must be loaded from barge because stores crane outboard only
- Oct. 11, 2001 – decide to move U/V unit
- Oct. 17, 2001 – meet with ABS regarding equipment approvals

Achieved Milestones (cont'd)

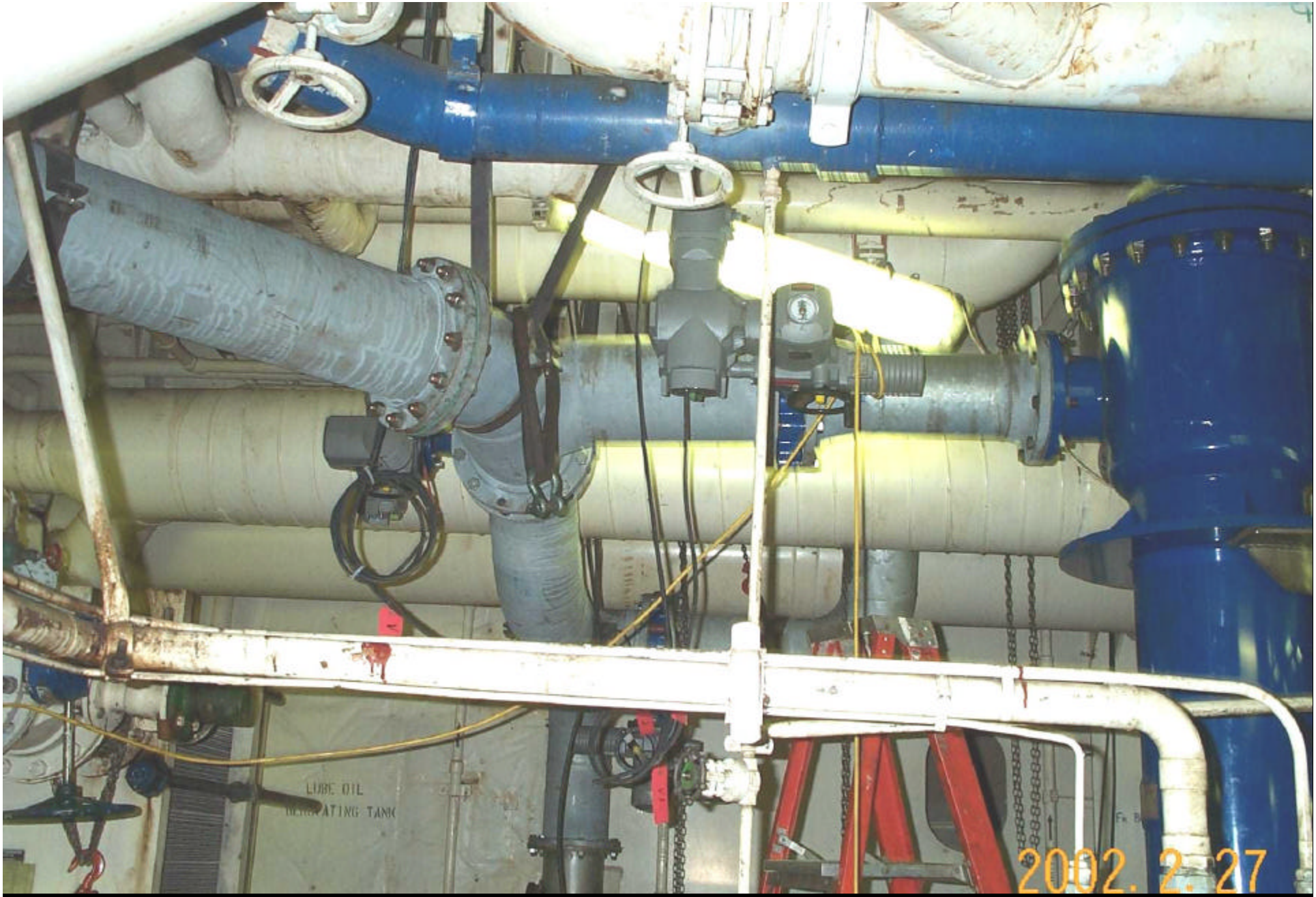
- Oct. 2001 – ship enters 2 week HI service
- Dec. 12, 2001 – about 85% of piping fitted and removed for galvanizing
- Feb. 13, 2002 – start cabling for valve controls and automation
- Mar. 25, 2002 – finished piping
- Apr. 10, 2002 – first system tests
- Apr. 22, 2002 – scientists on board for efficacy testing, seal leaks and tube breakage stop tests

Achieved Milestones (cont'd)

- June 19, 2002 – manufacturer completes modifications
- July 2, 2002 – scientists load test gear, system still not functioning and tests canceled
- July 31, 2002 – manufacturer decides to remove U/V unit and replace with different design.
- Dec. 2002 – expected availability of new U/V unit


2002.1.30

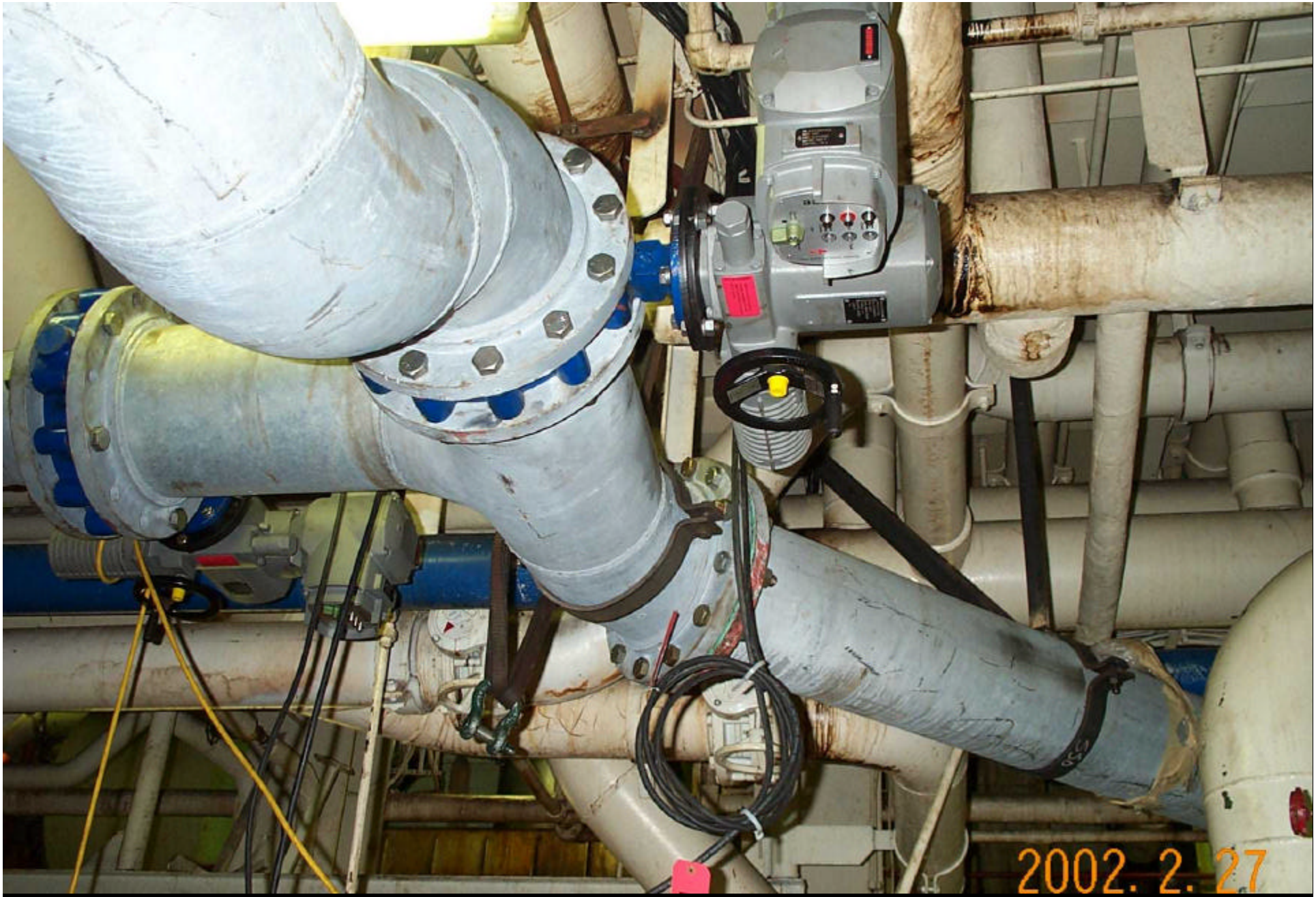

2002.1.30


LUBE OIL
2002. 2. 27


2002. 2. 27


2002. 2. 28


MicroKill
MicroKill
2002. 2. 28


2002. 2. 27


FW-V-126
GENERATOR CLG PRESS
CONTROL
2002. 2. 27


2002. 2. 27


2002. 4. 11

Costs To Date

- Total Budget about $350k
- Spent to date about $385k

Summary

- Even “currently available” technology isn’t
  - Still in prototyping stage
- Retrofits can be complex, costly and time consuming
  - Even when space is available – piping and controls are not trivial
  - Difficult to do when ship in service
- Class Societies do not provide oversight of these non-essential systems

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