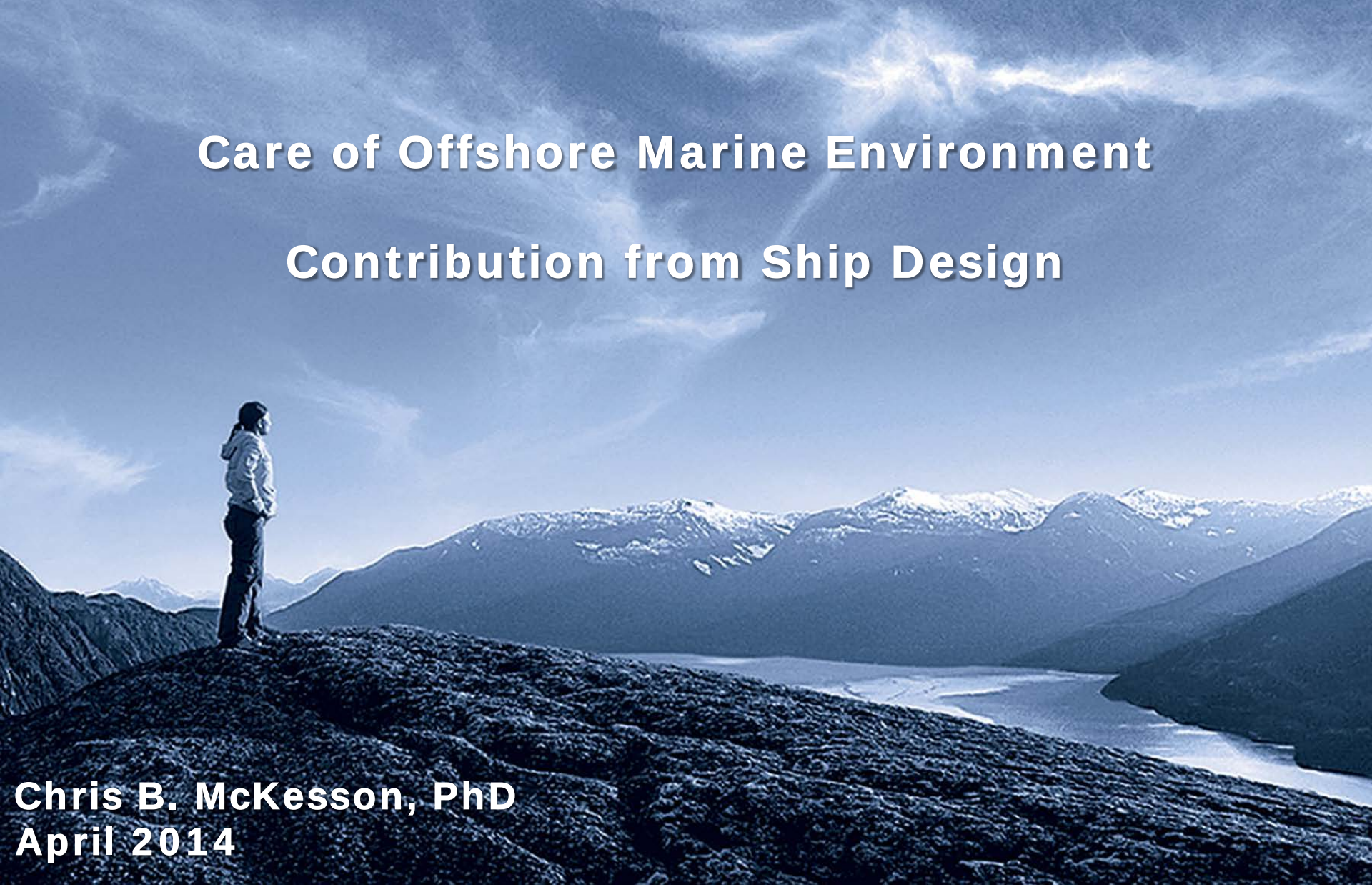
Care of Offshore Marine Environment

Contribution from Ship Design



Chris B. McKesson, PhD
April 2014

Conclusion:

Environmental Stewardship is as much a part of ship design as Hydrodynamics, Logistics, or Cost Estimation

The Ship Lifecycle

- Design
- Construction
- Operation
- Disposal

The Ship Lifecycle

- Design
- Construction
- Operation
- Disposal

Ocean care is relevant at all stages

Influence Opportunity

	Designer	Constructor	Operator	Disposer
Design				
Construction				
Operation				
Disposal				

Influence Opportunity

	Designer	Constructor	Operator	Disposer
Design				
Construction				
Operation				
Disposal				

Ship Design

- Designers are taught to consider
  - Hull efficiency
  - Safety
  - Economics
- Ocean Care is not explicit

Ship Design

- Designers are taught to consider
  - Hull efficiency
  - Safety
  - Economics
- Ocean Care is not explicit
- *SNAME, and schools like UBC and Strathclyde, are trying to change that*

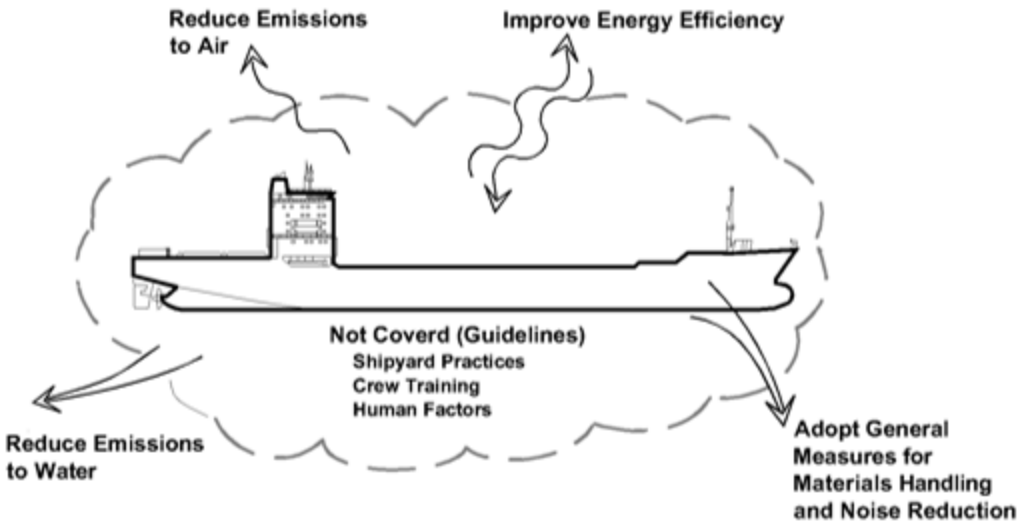
THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community

Marine Vessel Environmental Performance
MVEP: Assessment Methodology
Ship Survey and Impact Calculations

Author: Eleanor Kirtley, PhD, LEED AP, PE The Glosten Associates

Why, What, and Who is MVEP?

The Marine Vessel Environmental Performance Assessment (**MVEP**) is being developed to provide vessel designers, owners, operators, and other governing bodies with a standard methodology to **measure** and to **reduce** the environmental impact of their ships.



The Society of Naval Architects & Marine Engineers

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CAL MARITIME

SNAME Technology and Research Bulletin 6-2 MVEP EE-1

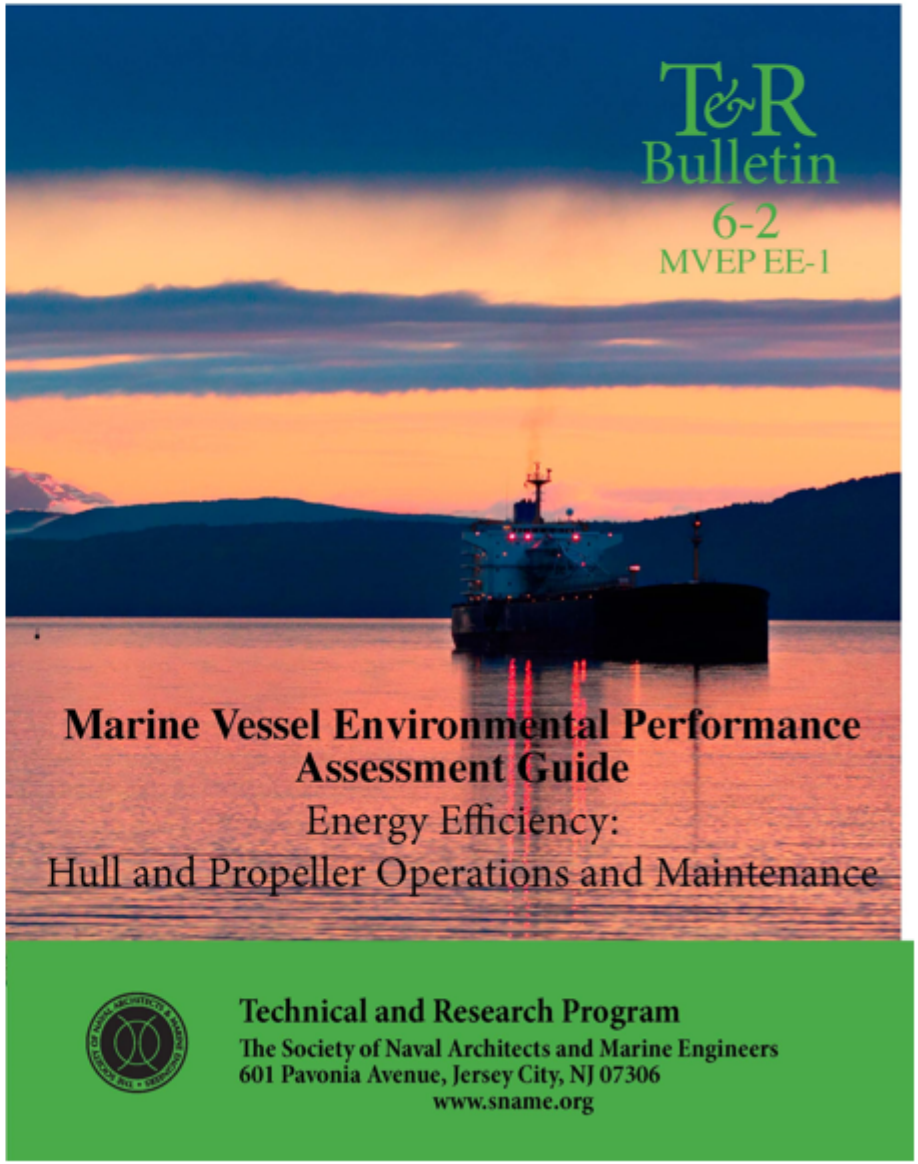
PRESS RELEASE

GUIDELINES FOR ENERG Y EFFICIENCY: HULL AND PROPELLER OPERATIONS AND MAINT ENANCE

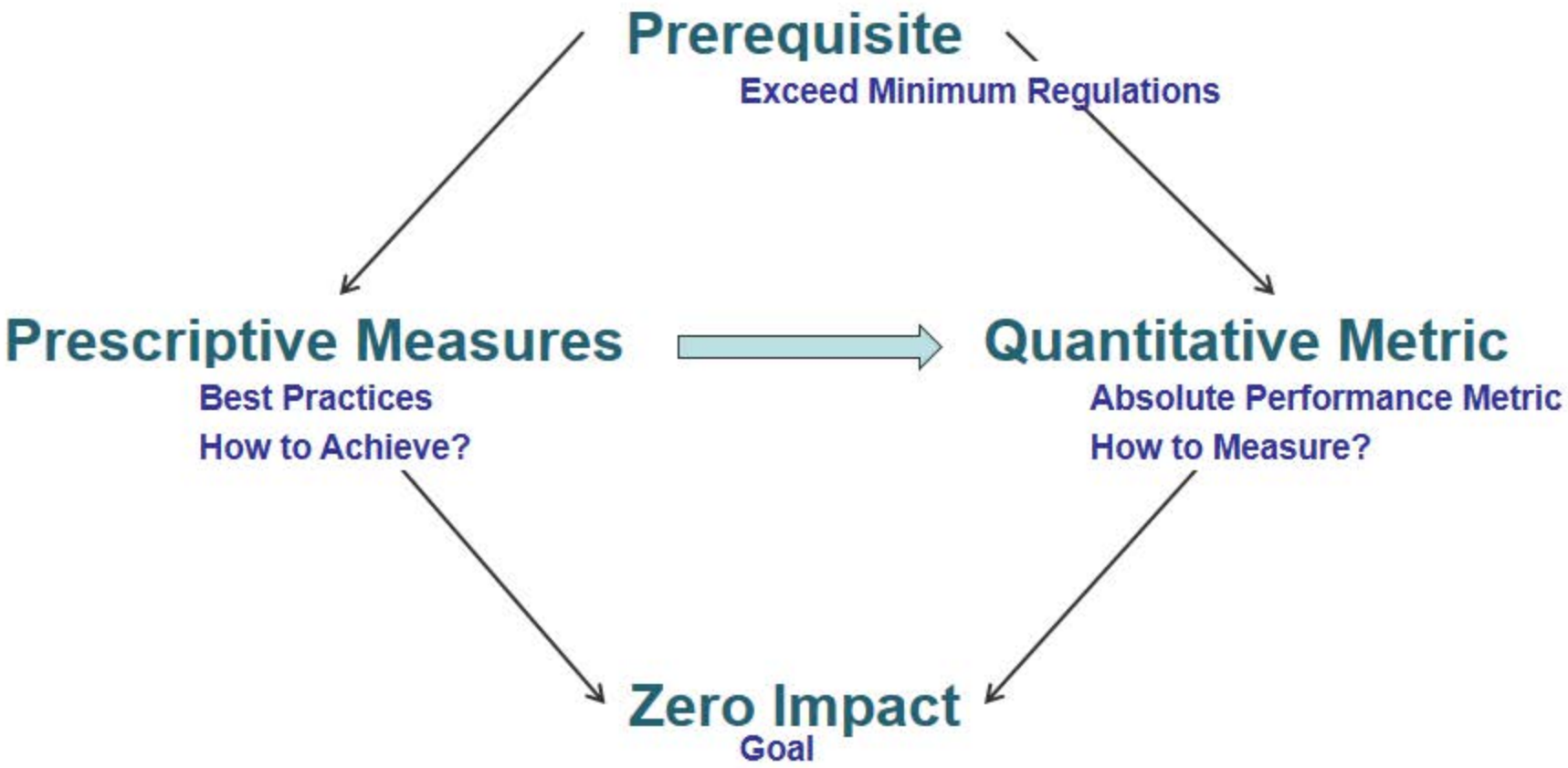
THE SOCIETY OF NAVALARCHITECTS AND MARINE ENGINEERS HAS PUBLISHED THE TECHNICAL REPORT Marine Vessel Environmental Performance (MVEP) Assessment Guide: Energy Efficiency:Hull and Propeller Operations and Maintenance. The bulletin was written by Daniel Kane, reviewed by SNAME Technical & Research Panel EG10; Co-Chaired by Dr. Eleanor K.N. Kirtley, PE, Timothy S. Leach, PE, and Brian M. Ackermanand approvedby the SocietyÕs Environmental Engineering Committee Chaired by Bruce A. Russell.This Guide is the first in a series being developed to address vessel environmental performance.

This guide discuss es three main areas that relate to measuring and improving the energy efficiency of thehull and propellerin operations and maintenance.The first area describes the factors that cause an increase in hull resistance and the relative fuel consumption consequences of each. The next area reviews the current measurement and monitoring means of hull roughness. Lastly, prescriptive measures that minimize hull resistance and maximize propeller efficiency are provided. Tehmeasures include operational best practices before, during, and after drydocking,guidance on selecting a coating system, monitoring and measuring performance, and scheduling inspections and cleanings. A comparison of different hull coating systems is provided . Current regulations, initiatives, and future developments are presented. Integration of the proposed measures into an overall environmentalstrategy to reduce emissi ons is introduced.

The new publication is identified as Technical and Research Bulletin 6-2 MVEP EE-1. It is a 25-page report issued electronically. It may be ordered through the SNAME web site (http://www.sname.org/SNAME/Go.aspx?c=ViewDocument&DocumentKey=ded3b7b0-d044-44c9-ac1f-45a1840f8b03) or by con tacting TommieAnne Faix (tfaix@sname.org or 201-499-5068 for $40 ($20 for SNAME members).



Assessment Methodology



MVEP Assessment Methodology
Ship Survey and Impact Calculations

Metrics formulated for 10 air and effluent emissions

Calculation **tool**

Two day **survey** onboard the *TS Golden Bear*

Reference: http://www.csum.edu/web/about/tsgb

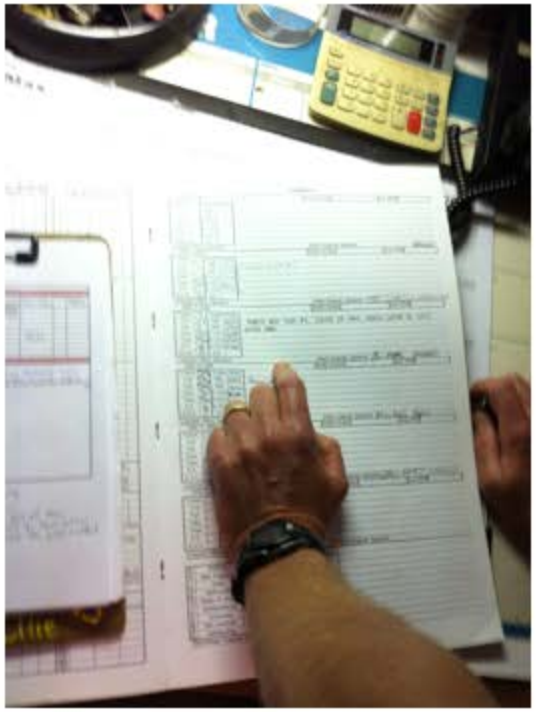
Metric Development

Constraints

- Inputs can be gathered from readily available data sources
  - < Two-day survey

Objectives

- Applicability
- Accuracy



Air emissions: CO_2, NO_X, SO_2, PM, VOC Inputs

Pull down menus

yes	Is fuel consumption estimate data available for each device? (yes/no)											
Vessel Engine & Boiler Data												
Engine/Boiler	Engine/Burner Hours			Consumption by device (LT)			Device	Device	Emission	Rated Power /	Units	Cylinder
Name	Start	End	Annual	ULSD			Use	Type	Standard	Therm. Output		Disp. (l)
PME	42247	42725	478	137			Prop	M/HSD	Base	12500	HP	78
SME	41722	42479	757	218			Prop	M/HSD	Base	12500	HP	78
SSDG_1	46588	47353	765	85			Aux	M/HSD	Base	900	kW	15
SSDG_2	49052	50089	1037	115			Aux	M/HSD	Base	900	kW	15
SSDG_3	47682	48877	1195	132			Aux	M/HSD	Base	900	kW	15
Boiler_1*	0		0	56			Aux	B	Base	400	HP	
Boiler_2*	0		0	131			Aux	B	Base	200	HP	
	0		0									
			0									

BSFC, EF_{NOx}, EF_{PM}, EF_{HC} lookup from Device Use, Type, Displacement, Emission Standard

Air emissions: CO_2, NO_X, SO_2, PM, VOC Metrics (tonnes / yr)

Emission (tonnes/yr) = Fuel Consumed x Emission Content

CO_2 = FC (tonnes) x C_f (tonnes-CO2/tonnes-fuel)

SO_2 = 2.0 x FC (tonnes) x $S_{\%}$ (%)

NOx = FC / BSFC (g-fuel / kW-hr) x EF_{NOx} (g-NOx / kW-hr)

PM = FC / BSFC x EF_{PM} - 7.0 x FSC ($S_{\%EPA\ Base}$ - $S_{\%}$)

VOC = 1.053 x FC / BSFC x EF_{HC}

Effluents / Discharges: Oily water

WD1: Oily Water		
OWS Performance		
Treatment Level	15 ppm, 107(49)	
Discharge Date	Volume (m3)	Type
19-Sep-11	5.1	To Shore
20-Sep-11	7.1	To Shore
22-Sep-11	2.3	To Shore
26-Sep-11	8.5	To Shore
27-Sep-11	6.7	To Shore
29-Sep-11	8.2	To Shore
30-Sep-11	5.5	To Shore
3-Oct-11	2.5	To Shore
4-Oct-11	4.9	To Shore
6-Oct-11	5.4	To Shore

Instructions

1. Enter Period Start Date.
2. Select OWS Treatment Level:
   - 15 ppm, 60(33)
   - 15 ppm, 107(49)
   - 10 ppm, 107(49)
   - 5 ppm, 107(49)
3. Use Oil Record Book to enter first oily water discharge date, volume (in cubic meters), and type:
   - To Shore
   - To Sea
   - To Other Tanks
4. Enter subsequent oily water discharges below first line.
5. To add additional entry lines, insert new row at row labeled 'INSERT THIS ROW'.

Effluents / Discharges: Ballast water

WD1: Oily Water		
OWS Performance		
Treatment Level	15 ppm, 107(49)	
Discharge Date	Volume (m3)	Type
19-Sep-11	5.1	To Shore
20-S		
22-S		
26-S		
27-S		
29-S		
30-S		
3-Oc		
4-Oc		
6-Oc		

Instructions

1. Enter Period Start Date.
2. Select OWS Treatment Level:
   15 ppm, 60(33)

WD2.1: Ballast Water and Sediment		
Discharge Date	Treatment, ID	Volume, IA (m3)
17-Jan-12	No Management	220.0
17-Jan-12	No Management	185.0
20-Mar-12	No Management	248.0
20-Mar-12	No Management	248.0
3-Apr-12	No Management	91.0
3-Apr-12	No Management	153.0
9-Apr-12	No Management	96.0
9-Apr-12	No Management	96.0
9-Apr-12	No Management	102.0
9-Apr-12	No Management	126.0
16-Apr-12	No Management	115.0

Instructions

1. Enter Period Start Date.
2. Use Ballast Water Record Book to determine first discharge in past year.
3. Enter date, treatment type, and volume in first line. Treatment types are:
   - No Management
   - Exchange
   - IMO D2/USCG Phase 1
   - USCG Alternate 3
   - USCG Alternate 4
   - Discharge to shore
4. Enter subsequent discharges below first line.
5. To add additional entry lines, insert new row at row labeled 'INSERT THIS ROW'.

Effluents / Discharges: Wastewater

WD1: Oily Water		
OWS Performance		
Treatment Level	15 ppm, 107(49)	
Discharge Date	Volume (m3)	Type
19-Sep-11	5.1	To Shore
20-S		
22-S		
26-S		
27-S		
29-S		
30-S		
3-O		
4-O		
6-O		

Instructions

1. Enter Period Start Date.
2. Select OWS Treatment Level:
   15 ppm, 60(33)

WD2.1: Ballast Water and Sediment		
Discharge Date	Treatment, ID	Volume, IA (m3)
17-Jan-12	No Management	220.0
17-Jan-12		
20-Mar-12		
20-Mar-12		
3-Apr-12		
3-Apr-12		
9-Apr-12		
9-Apr-12		
9-Apr-12		
9-Apr-12		
16-Apr-12		

Instructions

1. Enter Period Start Date.
2. Use Ballast Water Record Book to determine first discharge in past year.

WD3: Sanitary Systems	
Level 2 BOD_5	Level 2 Not Used
Black Water	Level 1
Gray Water	None
Ground Food	None
People on Voyage	346
Days on Voyage	63
Vessel Loading	
Annual Person-Days	21798

Instructions

1. Enter Period Start Date.
2. If Level 2 treatment (AWT) is used on a wastewater stream, select equipment rated performance for Level 2 BOD5:
   - 0 mg/L
   - 5 mg/L
   - 10 mg/L
   - 15 mg/L
   - 20 mg/L
   - 25 mg/L
   - 30 mg/L

   If not, select "Level 2 not used".
3. Select treatment type for Black Water waste streams, Grey Water waste streams, and Ground Food waste streams:
   - Level 1
   - Level 1D
   - Level 2
   - None
   - No Discharge
4. Use vessel sign-in log to enter total annual Person-Days.

Annual Sanitary Waste Impact	Result
Kilograms BOD5	1333

Effluents / Discharges: Solid waste

WD1: Oily Water

OWS Performance		
Treatment Level	15 ppm, 107(49)	
Discharge Date	Volume (m3)	Type
19-Sep-11	5.1	To Shore
20-S		
22-S		
26-S		
27-S		
29-S		
30-S		
3-O		
4-O		
6-O		

Instructions

1. Enter Period Start Date.
2. Select OWS Treatment Level:
   15 ppm, 60(33)

WD2.1: Ballast Water and Sediment

Discharge Date	Treatment, ID	Volume, IA (m3)
17-Jan-12	No Management	220.0
17-Jan-12		
20-Mar-12		
20-Mar-12		
3-Apr-12		
3-Apr-12		
9-Apr-12		
9-Apr-12		
9-Apr-12		
9-Apr-12		
16-Apr-12		

Instructions

1. Enter Period Start Date.
2. Use Ballast Water Record Book to determine first discharge in past year.

WD3: Sanitary Systems

Level 2 BOD_5	
Black Water	
Gray Water	
Ground Food	
People on Voyage	
Days on Voyage	
Vessel Loading	
Annual Person-Day	

Instructions

WD4: Solid Waste

Instructions

1. Enter Period Start Date.
2. Use Garbage Record Book and/or vessel garbage receipts to enter first solid waste reception facility discharge date, quantity (Mass or Volume), if recycled (Yes or No), if compacted (Yes or No), and select waste type:
   - Wood/dunnage
   - Plastics
   - Food Waste
   - Cooking Oil
   - Incinerator Ash
   - Mixed Waste/Other
3. Enter mass when possible. Otherwise, enter approximate volume.
4. Enter subsequent discharges below first line.
5. To add additional entry lines, insert new row at row labeled 'INSERT THIS ROW'.

Discharge Date	Type	Quantity Mass (MT)	Quantity Vol (m3)	Recycled (Yes/No)	Compacted (Yes/No)	
2-May-12	Food Wastes	0	4	No	No	Sea
2-May-12	Mixed Waste/Other		1	No	No	Sea
30-Apr-12	Mixed Waste/Other		18	No	Yes	Port
3-May-12	Mixed Waste/Other		12	No	Yes	Port

Metrics: Oily water, ballast water, wastewater, and solid waste

Impact = Quality x Quantity

Oil (mL) = T (ppm) x ($V_1 + V_2 + V_3$) (m^3)

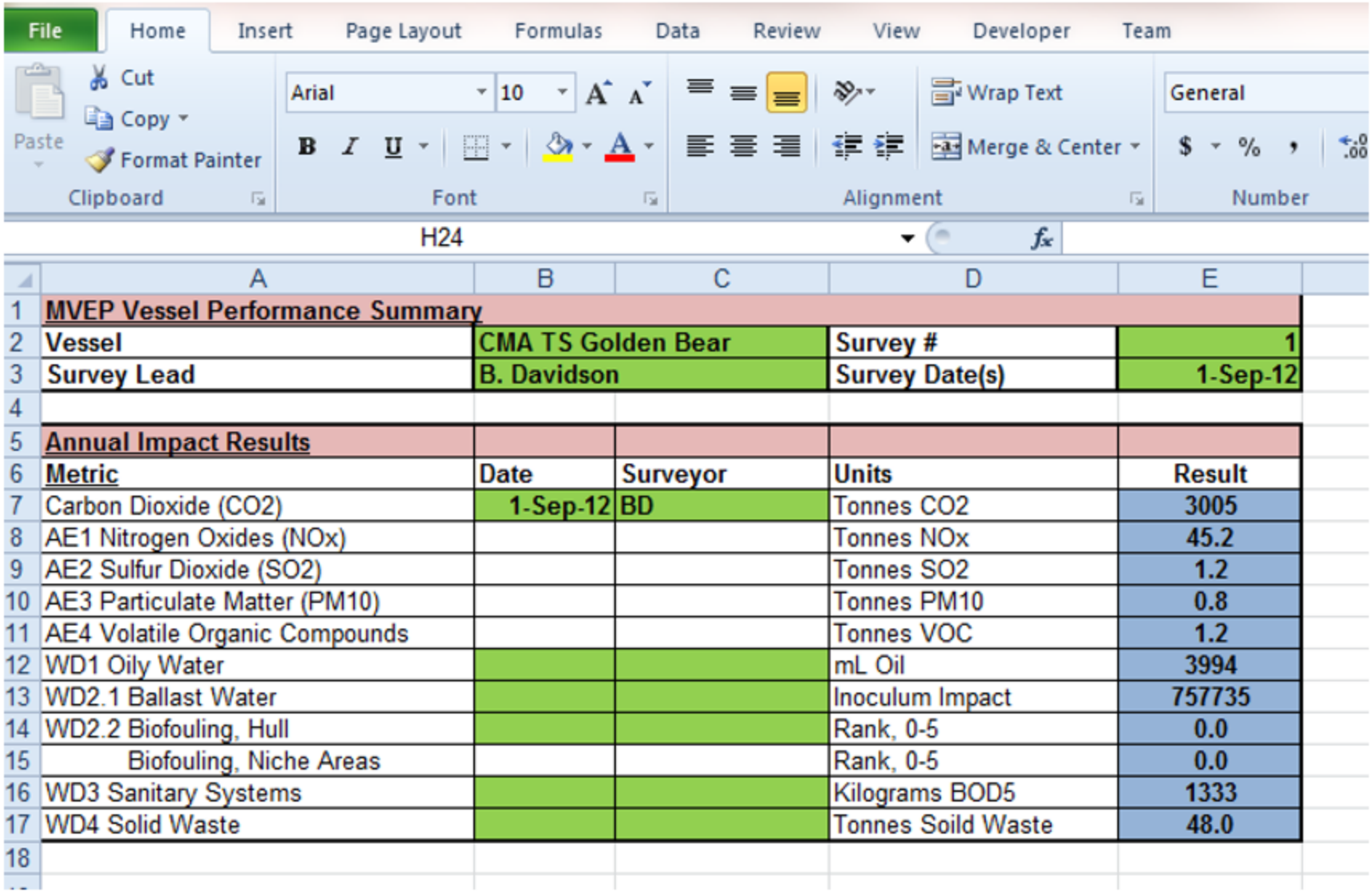
BW (Inoculum Impact) = ID (density) x IA (abundance, m^3)

Wastewater (g-BOD5) = ($C_B T_B + C_G T_G + C_F T_F$) x PD

= $CT_{B=Black,\ G=Grey,\ F=Food}$ (g-BOD5 / PD) x PD (person-days)

Solids (tonnes) = $M_{uncyclable} + \rho V_{uncompacted} + 5x\rho V_{compacted}$

Performance Summary



	A	B	C	D	E
1	**MVEP Vessel Performance Summary**				
2	**Vessel**	**CMA TS Golden Bear**		**Survey #**	**1**
3	**Survey Lead**	**B. Davidson**		**Survey Date(s)**	**1-Sep-12**
4					
5	**Annual Impact Results**				
6	**Metric**	**Date**	**Surveyor**	**Units**	**Result**
7	Carbon Dioxide (CO2)	1-Sep-12	BD	Tonnes CO2	3005
8	AE1 Nitrogen Oxides (NOx)			Tonnes NOx	45.2
9	AE2 Sulfur Dioxide (SO2)			Tonnes SO2	1.2
10	AE3 Particulate Matter (PM10)			Tonnes PM10	0.8
11	AE4 Volatile Organic Compounds			Tonnes VOC	1.2
12	WD1 Oily Water			mL Oil	3994
13	WD2.1 Ballast Water			Inoculum Impact	757735
14	WD2.2 Biofouling, Hull			Rank, 0-5	0.0
15	Biofouling, Niche Areas			Rank, 0-5	0.0
16	WD3 Sanitary Systems			Kilograms BOD5	1333
17	WD4 Solid Waste			Tonnes Soild Waste	48.0
18					

How is MVEP used?

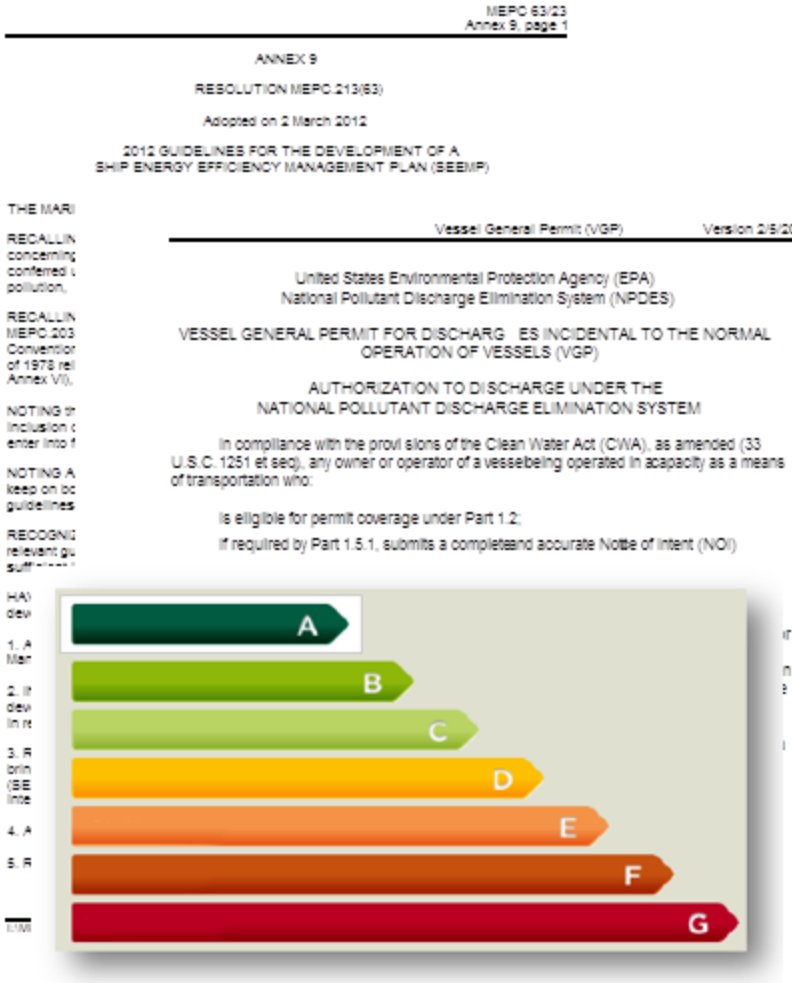
Tool for monitoring and demonstrating progress

Pathway to compliance and recognition

Cooperative **Guidelines**

with your input, shared challenges, shared tools

at low cost, with no commitment to a program



MEPC 63/23
Annex 9, page 1

ANNEX 9

RESOLUTION MEPC.213(63)

Adopted on 2 March 2012

2012 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)

THE MARI

RECALLIN concerning conferred pollution,

RECALLIN MEPC.203 Convention of 1978 rel Annex VI),

NOTING th inclusion enter into f

NOTING A keep on loc guidelines

RECOGNI relevant gu

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I/M

Vessel General Permit (VGP) Version 2/6/2009

United States Environmental Protection Agency (EPA)
National Pollutant Discharge Elimination System (NPDES)

VESSEL GENERAL PERMIT FOR DISCHARG ES INCIDENTAL TO THE NORMAL OPERATION OF VESSELS (VGP)

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provi sions of the Clean Water Act (CWA), as amended (33 U.S.C. 1251 et seq), any owner or operator of a vesselbeing operated in acapacity as a means of transportation who:

Is eligible for permit coverage under Part 1.2;

If required by Part 1.5.1, submits a completeand accurate Notice of Intent (NOI)

References:
http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Technical%20and%20Operational%20Measures/MEPC.213(63).pdf
http://www.epa.gov/npdes/pubs/vessel_vgp_permit.pdf
http://shippingefficiency.org/userfiles/files/Data-Methodology.pdf

Next steps, Lessons Learned
Thank you, Questions?

Implement Cal Maritime feedback and Re-survey

Expand assessment

- Metrics, Vessel types, Automation

Rating System

- Normalize, weight, & sum
- Relate environment and health impacts to fiscal cost, $

Contact:

Eleanor Kirtley

The Glosten Associates

enkirtley@glosten.com

206-624-7850

Summary and Conclusions

1. Ships have environmental impact
2. Environmental Impact is broad enough, and important enough, to be granted a seat in the Design Team
3. Ship designers have not traditionally had the tools to do this
4. SNAME is trying to change that

Thank you

Chris B McKesson, PhD, PE

www.mckesson.us