

# Coating of Ships: The Design Challenge

NSRP, February 2010

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# Introduction

- ✦ Background
- ✦ IMO PSPC
- ✦ Appreciation of the Coating Process
- ✦ Design for Coating
- ✦ Current Design Guidelines
- ✦ DISPRO Project
- ✦ Conclusions

17th February 2010



# Background

- ▶ 654 lives lost between 1990 – 1997
- ▶ IACS enhanced surveys
- ▶ Tanker Structure Cooperative Forum 2002:
  - ‘Guidelines for Ballast Tank Coating Systems and Surface Preparation’.
- ▶ Much of what was outlined in this document has been included in the IMO PSPC regulations that are in force today

# Background

- ✦ Majority of coating failures where attributed to poor surface preparation and application.
- ✦ Evidenced by the introduction of the Marintek B1 test in the late 80's early 90's.
- ✦ Majority of ballast tank coatings passed:
  - Laboratory success no guarantee of in-service performance.

# Performance Standard for Protective Coatings

- ◆ Adopted in July 2007
- ◆ Aims to achieve a 15 years coating life
- ◆ It is now an amendment to SOLAS:
  - New builds cannot put to sea unless the WBT coatings have been applied in accordance with the PSPC.

# IMO PSPC

- ✦ The regulations are very prescriptive as to the processes involved in coating ships structures:
  - Selection of the coating system;
  - Coating Type;
  - NDFT;
  - Surface preparation;
  - Ventilation and environmental conditions;
  - Inspection;
  - Record keeping;
  - Testing.

# IMO PSPC

- ▶ Section 3.3.2 states

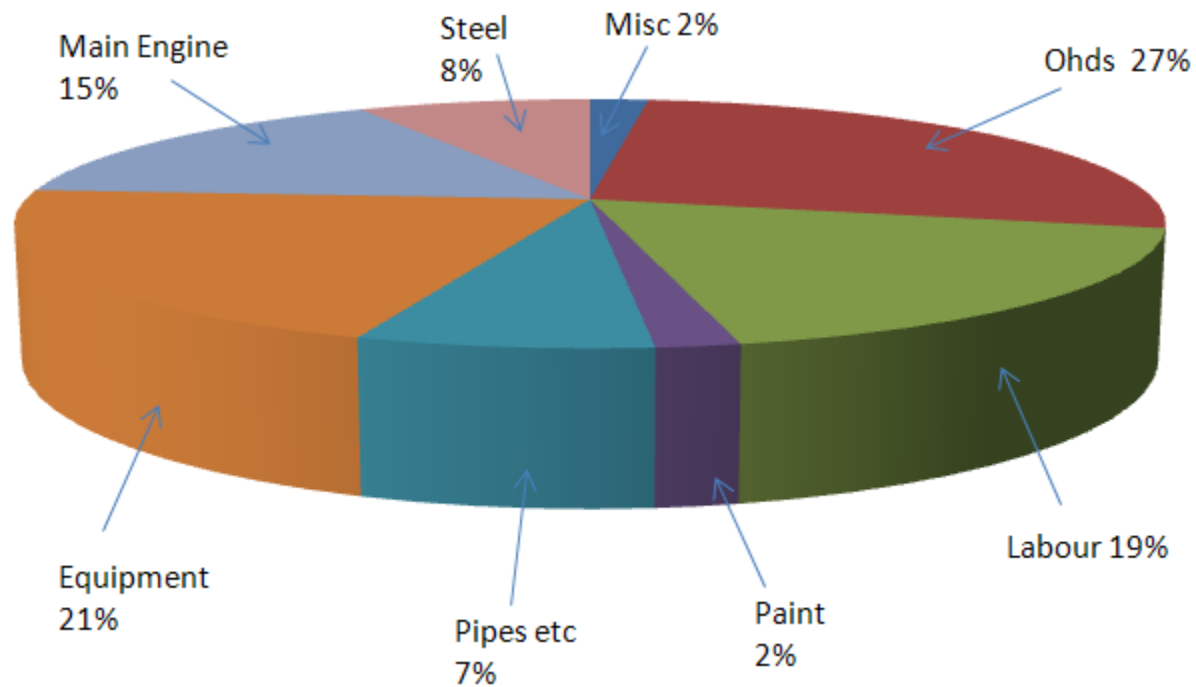
*“the coating performance can be improved by adopting measures at ship design stage such as reducing scallops, using rolled profiles, avoiding complex geometric configurations and ensuring that the structural configuration permits easy access for tools and to facilitate cleaning, drainage and drying of the space to be coated”*

- ▶ Regulations seek to improve the process and procedures.

- ▶ How much can design improve the performance of coatings ?

# The Coating Process at New-Build

- Often seen as the poor relation



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# The Coating Process

## ✦ Consider the problem like this:

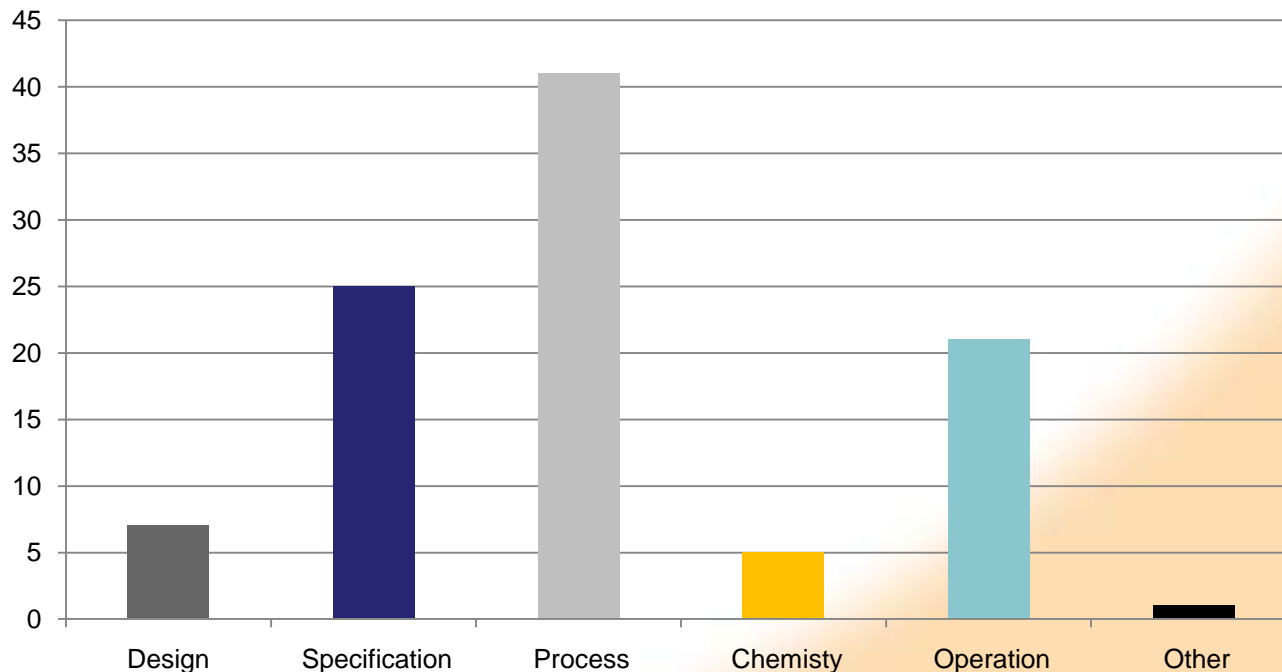
- A small flat plat is relatively easy to paint;
- A large panel will require some form of access;
- Addition of stiffeners increase complexity.

## ✦ Water Ballast Tanks some of the most complex structures on board a vessel.



# The Coating Process

- Majority of coating failure generally attributed to the process stage



- Why did the process fail to provide the required quality of surface finish ?



- Adequate access ?

# Design for Coating

- ▶ Structural design negatively impacting the physical activities of the coating process
- ▶ Reduction of the complexity may provide significant benefits:
  - Reduction in first costs;
  - Improved through life performance;
  - Possible routes to automation.



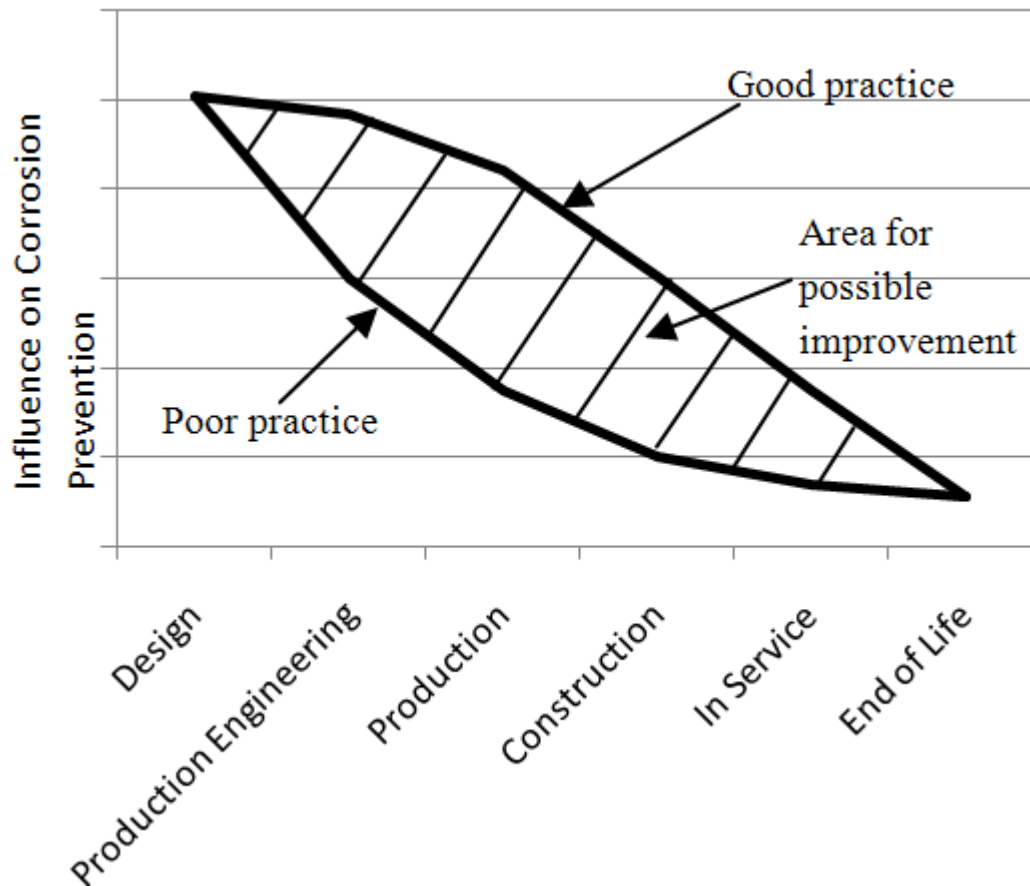


# Design for Coating

- ✦ How can we quantify complexity?
  - Perhaps by degree of shadowing or by edge length.
- ✦ Reduction of complexity will offer opportunities to control the coating process, to provide a consistent standard and will reduce the number of coating failures
- ✦ Extend the through life performance of the coating and reduce cost at new build and in-service

# Influence of Design

- ▶ The ability to influence corrosion prevention diminishes through time



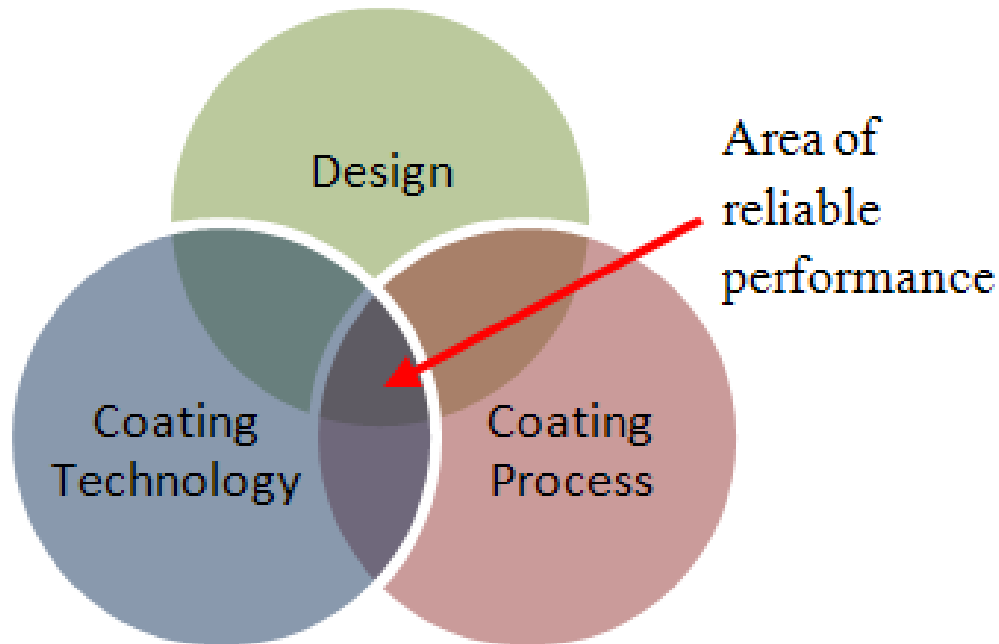
# Influence of Design

- ▶ The average cost of maintaining a coating increases with time



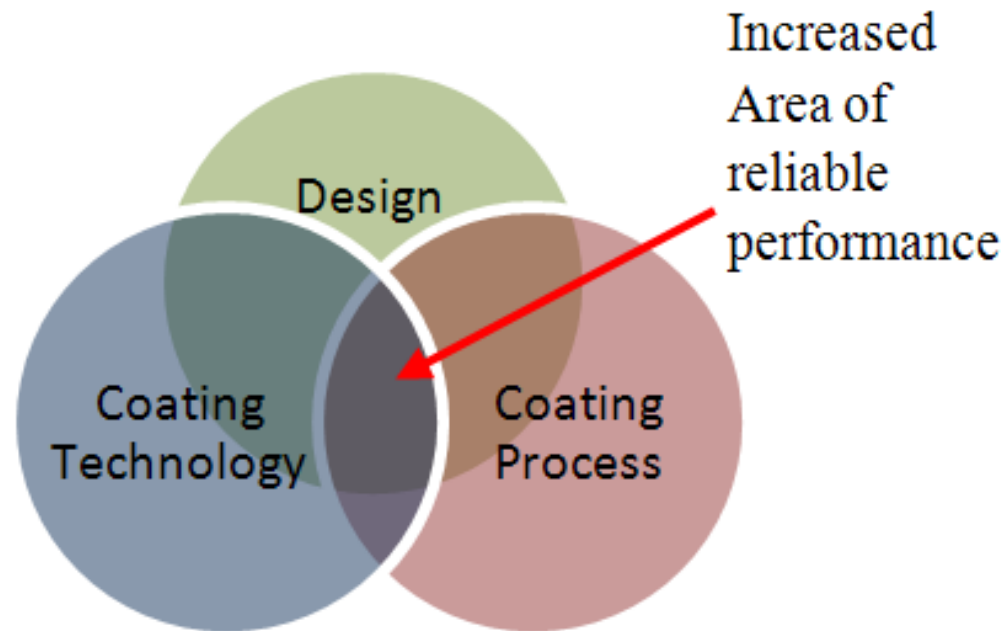
# Influence of Design

- ✦ The design phase has perhaps the greatest influence in terms of corrosion and the cost of preventing it



# Influence of Design

- ▶ Possible to increase the area of reliable performance by optimisation of the design



# Current Design Guidelines

- ✦ ISO 12944:
  - Part 3 – Design Considerations.
- ✦ Marine Paint Forum:
  - Guidance Information on Design for the Preservation and Corrosion Control for Steel Hulled Vessels.

# Test of ideas on complex profiles

- ▶ Cable/pipe tray system
- ▶ Client offered free choice of material
  - But production processes ultimately dictated mild steel
- ▶ Client offered choice of cross sections
  - Variety of cross sections requiring different production processes.

Ref	Dimensions overall	Approx Internal area	Approx External area	Approx area of Edges/holes*	Total area sqm per metre length	Rank
a	About 4 x 4 cm	0.138	0.138	0.062	0.338	4
b	4 x 4 cm	0.120	0.120	0.093	0.333	=2
c	4 x 4 cm	0.120	0.120	0.093	0.333	=2
d	4 x 4 cm	0.160	0.160	0.062	0.382	5
e	Not relevant					
f	4 x 4cm	None	0.240	0.093	0.314	1
g	6 x 3 cm	0.126	0.126	0.062	0.754	7
h	4 x 4 cm	0.146	0.146	0.093	0.385	6

Option	Dimensions overall	Approx Internal area	Approx External area	Approx area of Edges/holes*	Total area sqm per metre length	Rank
AA	4cm dia	0.126	0.126	0.062	0.314	3
BB	4 x 4 cm	0.120	0.120	0.062	0.302	2
CC	4 x 4 cm	None	0.160	0.093	0.253	1

# *Design to Improve Structural PROtection*

- ◆ A three year project with input from:



- ◆ Optimise structural design for coating:
  - Simpler design leads to reduced costs;
  - Not only reduced first costs but through life too;
  - Opportunities to improve productivity

# DISPRO

- ✦ Benchmark current designs to provide a complexity index;
  - Provide a threshold value.
- ✦ Identify areas for potential cost savings:
  - Higher probability of industry ‘buying in’.
- ✦ Possibly opens the door for future automation.
- ✦ To push ‘coatings engineering’ to the forefront of naval structural designers minds.

# Conclusions

- ✦ Improve safety of ships by adopting a new approach to ship design.
- ✦ As ship building technology continues to advance, the coating process remains the bottleneck in the production process.
- ✦ The aim is to integrate and embed coatings and their application into the ship design process.

# Thank you

- ◆ Still looking for a ship owners to provide their input to the project.....