



SPS Presentation to US Navy National Shipbuilding Research Program 6 May 2009

"...the revolutionary Sandwich Plate System is a new generation building material bringing shipbuilding and civil engineering to the threshold of a new era..."

Lloyd's Register



We believe SPS is to steel what iron was to wood - a revolutionary advance in the level of protection against blast, ballistics and fragmentation for Military applications.

SPS can be incorporated in both current ships and platforms as Overlay and new construction using steel or aluminium.

SPS Benefits to US National Shipbuilding

SPS - “Sandwich Plate System”

SPS Structural Enhancement

Approvals and Track Record

Military Uses and Examples

Way forward

Summary

Protection Benefits



Blast

SPS is superior to conventional designs in absorbing the energy of an explosion and less likely to compromise structural integrity



Ballistics

SPS stops projectiles at shorter strike ranges (higher velocities) and higher angles of attack



Impact

SPS provides superior resistance to extreme accidental impacts

Fire

Uninsulated SPS meets all the relevant safety objectives and considered as equivalent to a conventional insulated stiffened steel plate of A60 fire rating



Protection Benefits - Today

Blast belts - Retrofitted blast protection at sea level

Ships have been a target of seaborne terrorist attack
ISPS Code - risk assessment and mitigation

- blast protection, Structural integrity, Watertight integrity

Vulnerability of warships

- increased littoral role
- prime target
- small nimble suicide zodiac teams



SPS Overlay belt on outer skin of hull

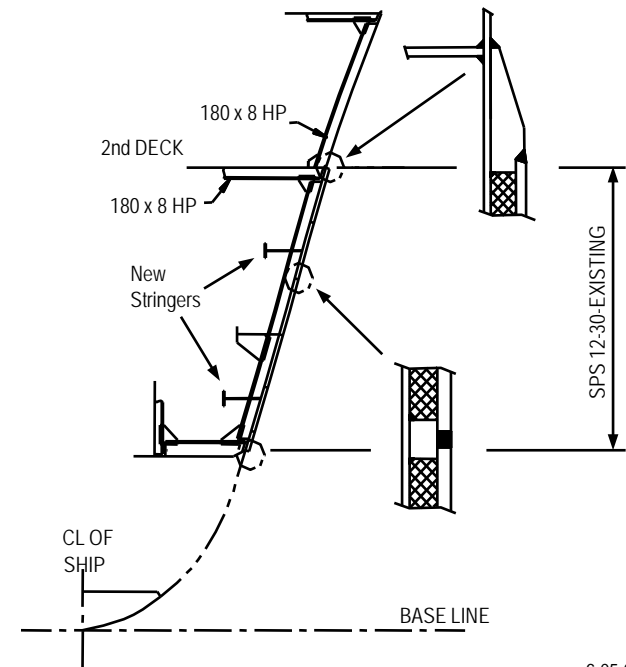
2m above and below waterline

Fast fit-out with no interior structural work required

Could be fitted during typical drydocking period

Negligible impact on speed, displacement or endurance

Conventional alternative complex and lengthy installation, with lower performance



SPS Overlay

75% reduction in repair time

60% saving on repair materials

80% reduction in the labour hours (fewer components, less welding, improved dimensional accuracy, less coatings)

25% lower life cycle operation and maintenance costs

SPS New Construction

~20% saving on construction costs

~40% reduction in the labour required (fewer components, less welding, improved dimensional accuracy, less coatings)

Lower life cycle and operations costs

Simplified construction enabling greater volumes for stowage

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Intelligent Engineering

The SPS Team



Intelligent Engineering

Owner of the Sandwich Plate System (SPS) technology

Global commercialisation and delivery of SPS to the civil and marine industries

Support design and approval of SPS structures

Offices in Europe (HQ), North America & Asia

BASF - Elastogran:

Partner in SPS technology development

Supply SPS polyurethane on a worldwide basis

World's largest chemical company

Dedicated team supports development and testing of SPS

Sandwich Plate System

Patented* composite materials construction technology

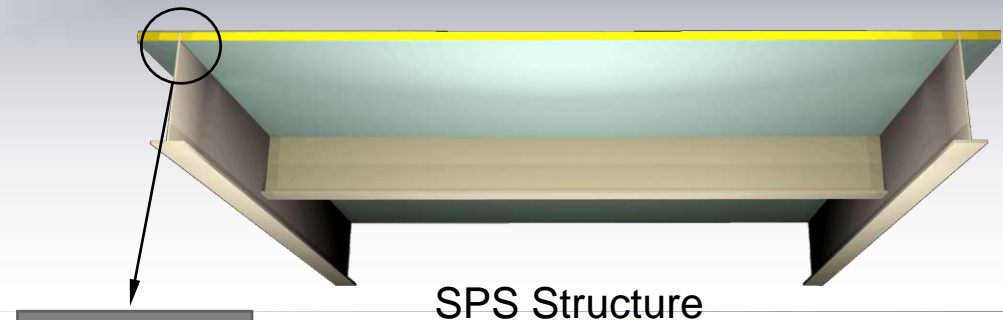
- metal plates integrally bonded to solid elastomer core

Characteristics

- simplified structure
- global behaviour
- composite properties

Benefits

- performance
- safety
- economics



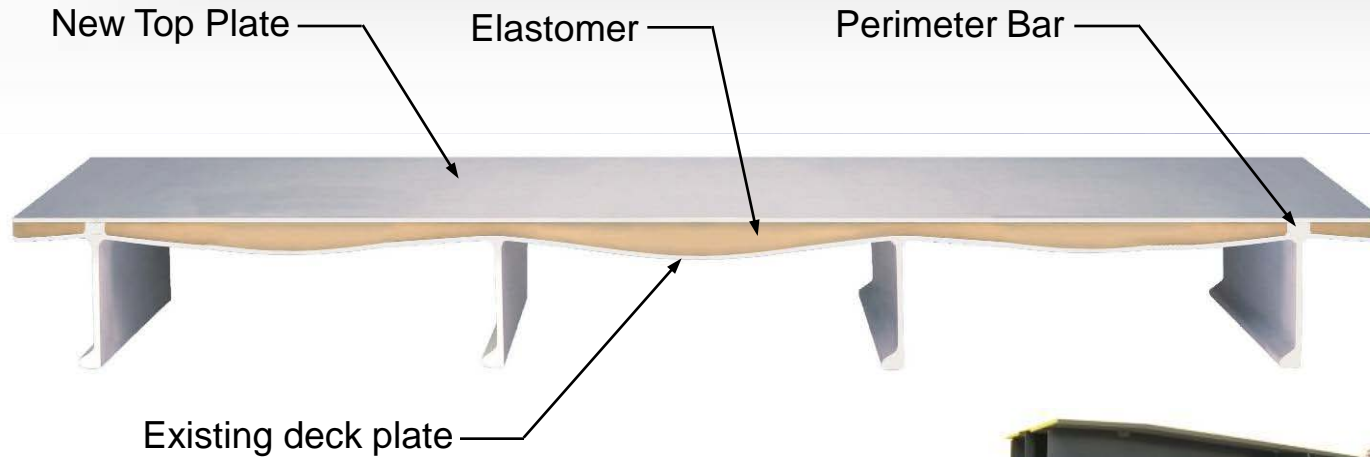
Conventional Structure

* 76 families in 73 jurisdictions

Two Ways to Build SPS Structures

- **SPS Overlay**

- straight forward reinstatement/strengthening/protection of existing plating



- **Prefabricated SPS Plates**

- for more efficient assembly
- simpler structures
- reduced maintenance



SPS Overlay



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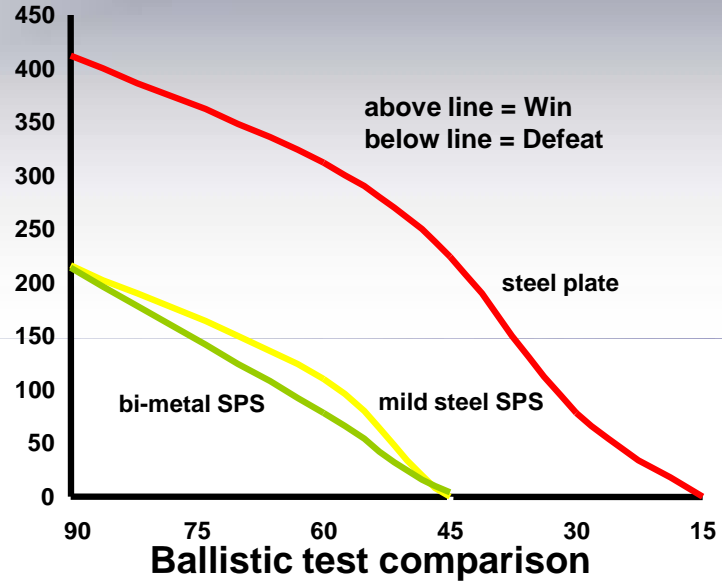
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Protection from blast, ballistics and fragmentation:



Mine blast test
(800g C4 at 75mm standoff)



SPS Benefits



Superb impact resistance - protection against collision or grounding:

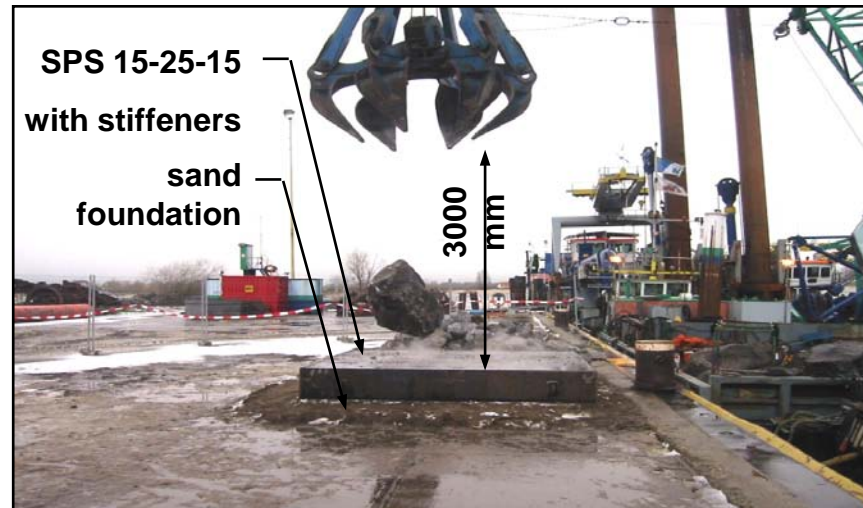


SPS



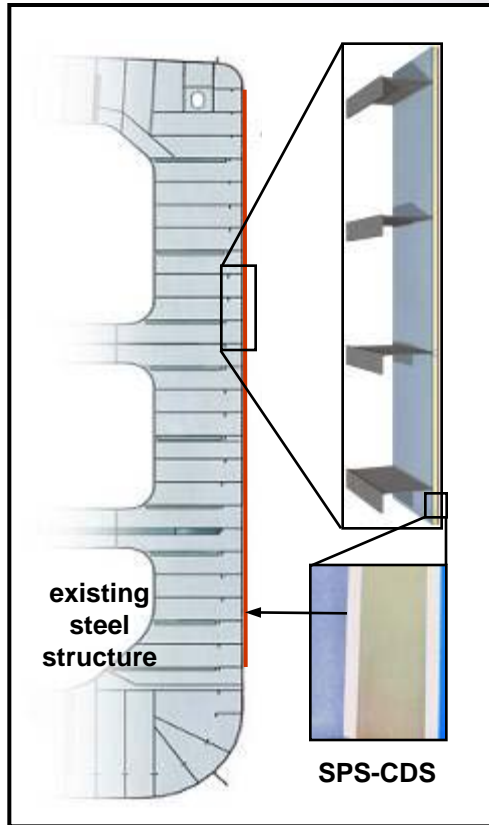
all-steel

20 impacts from 3000 mm with rocks weighing 280 kg to 2100 kg resulting in 8 kJ to 62 kJ of impact energy with minimal plastic deformation

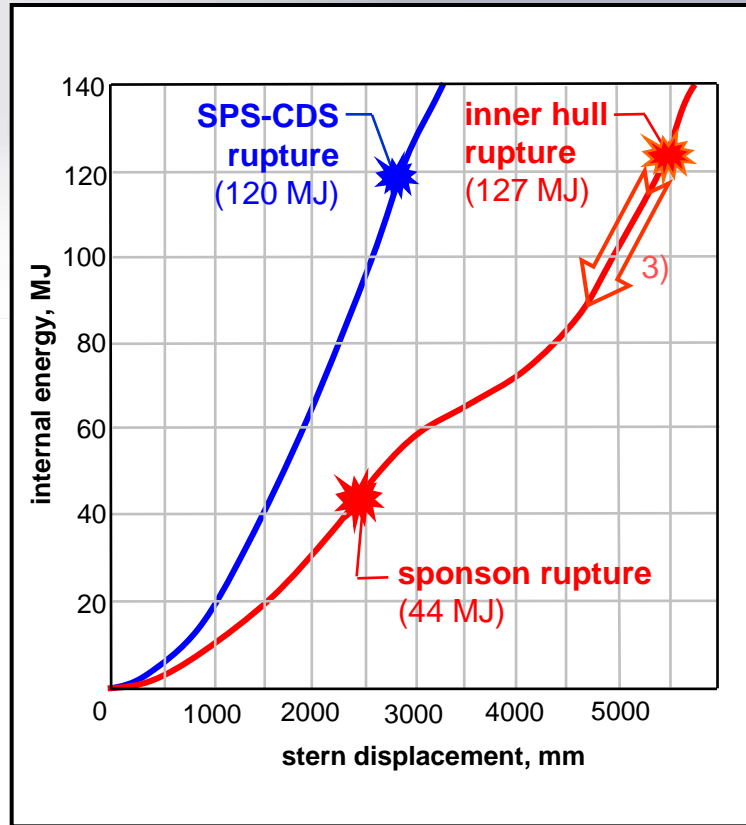


Side Impact Protection

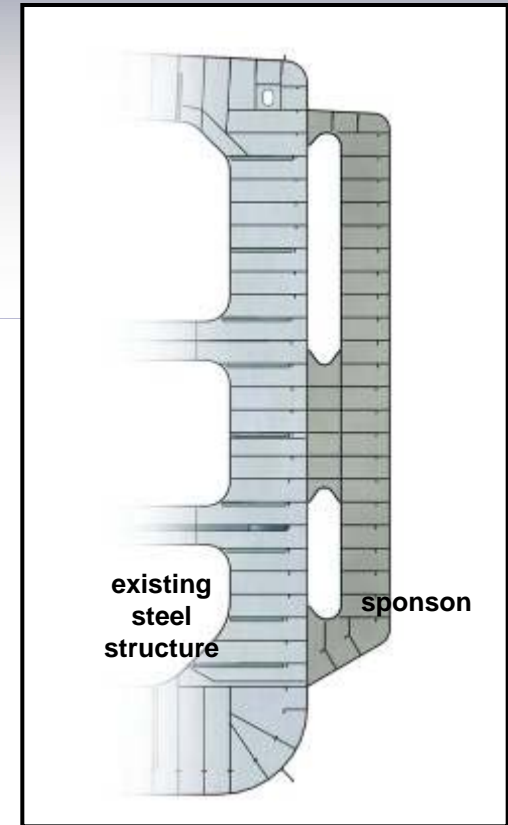
SPS-CDS



energy absorbed



steel sponson

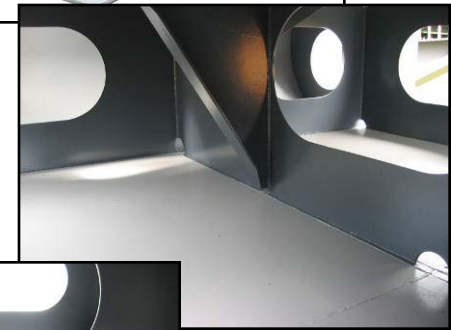
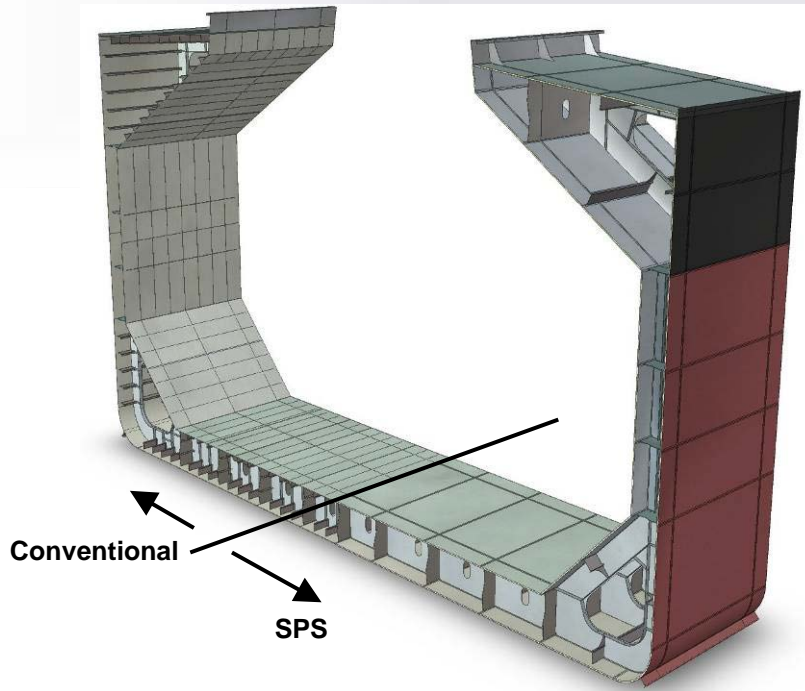


- 1) IMO MEPC/Circ. 406, MARPOL Annex I requires impact protection for FPSOs and FSUs
- 2) chart shows displacement and energy at failure for critical load case (OSV stern impact at 45°)
- 3) inner hull (sponson) failure likely to occur at lower energy level (due to local puncture & crack propagation)

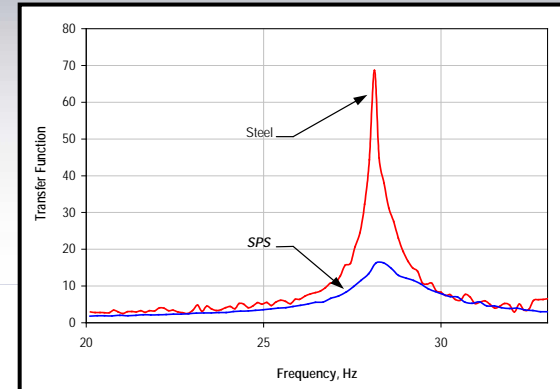
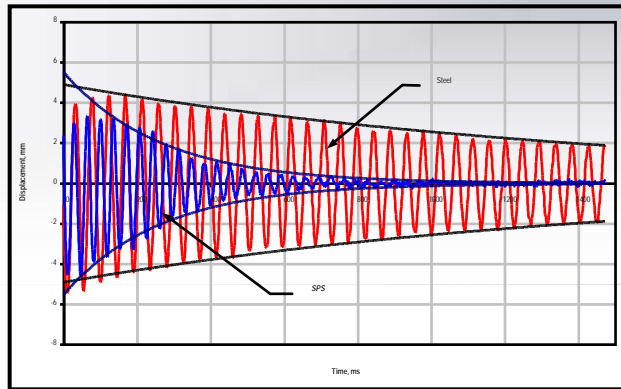


SPS Benefits

Reduced fatigue and corrosion:



Built-in vibration and acoustic damping:



Fire protection:

Steel



plate is red hot and loses strength

SPS



top plate remains cool & retains strength

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SPS - Ship Repair and Shipbuilding

Classification Approvals and Industry Adoption

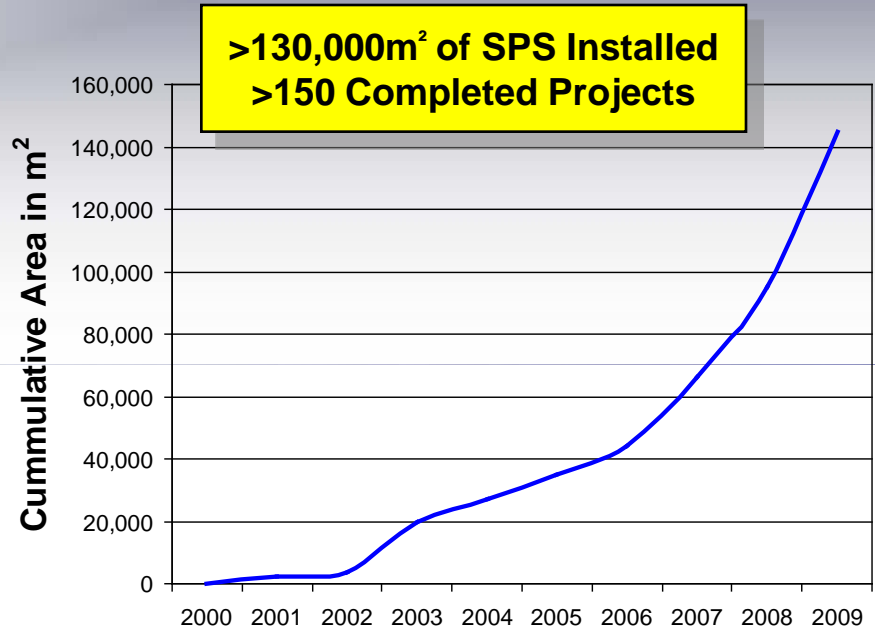


Innovators (1999 – 2005)

- P&O First 6 projects
- Ro-Ro applications proven
- First Bulk Carrier
- Technology demonstrations

Early Adopters (2005 to present)

- RoRos
- Bulk Carriers
- Offshore (rigs, platforms and OSVs)
- LNG
- Repeat Clients
 - P&O, Stena
 - Premuda, SMT
 - SBM, Transocean,
 - VShips, Korea Line



Classification approvals

- LR, DNV, ABS, BV, GL, RINA, KR, IRS, CRS, CCS, ClassNK

Flag State Administration approvals

- Danish MA, Swedish MA, UK MCA, USCG, Transport Canada, Marshall Islands, Bahamas

Project Portfolio

Over 150 projects and 130,000m²



Customers

AP Møller
Brittany Ferries
Caledonian MacBrayne
Canadian Coast Guard
ConocoPhillips
Cunard
DFDS Tor Line*
Dobson Fleet Mgt*
Euroship Mgt
GlobalSantaFe
Haniel
Lindholm Shipping*
Marine Atlantic
MISC
P&O*
Quebec MoT
Scandlines
Seacor Marine
SMT*
Stena Line*
TechMarine
TECO*
Torvald Klaveness*
Transocean*
US Govt NOAA
Van Oord
Wallenius*

* repeat customers

Fabricators

A&P (UK)
ASMAR (Chile)
Bodewes (NL)
Bollinger (USA)
Cosco (China)
Flensburger (GER)
Garvel Clyde (UK)
Gryfia (PL)
Halifax Shipyard (CAN)
H&W (UK)
Hyundai Vinashin (Viet)
Izar (ESP)
Jurong (SING)
Keppel (SING)
Keppel AMFELS (USA)
Kiewit (USA)
Lloyd Werft (GER)
Malta Shipyard (Malta)
Myklebust (Nor)
Norfolk (USA)
NWSS (UK)
Pan United (SING)
PPL (SING)
Remontowa (PL)
Richards (UK)
Sandrin (CAN)
Sembawang (SING)
Sobrena (FR)



"... we are very happy with both the result and the performance of the Intelligent Engineering team."

Pim de Lange, Area Director North Sea, Stena Line



"We are delighted with the end result and the speed with which the strengthening took place."

Guy Cantwell, Transocean

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USN Potential Applications

SPS Overlay and New Construction

Warships/RoRos

- increased fatigue and corrosion resistance in typically light-weight structures
- reduced noise and vibration signature
- built-in fire, ballistics and blast resistance across whole ship

Landing Craft and Logistics Vessels

- increased ballistics resistance above waterline and in bow doors
- increased robustness of bottom structure for beaching
- superior vehicle decks



Flight Decks/Helidecks

- lighter flight decks
- simpler construction
- helidecks can be strengthened in-situ



Blast Belts/Side Shell Protection

- fast fit-out with no interior steelwork required
- enhanced protection and reduced risk from collision
- enhanced blast protection



SPS Overlay - Case Study

FPSO P-57



Side shell impact protection

installed to satisfy IMO MEPC 139(53)
equivalent impact resistance as double
hull (sponsons)

elimination of void spaces that require
regular inspection and maintenance



Technical details

3,111m²

15-30-E

early 2009

ABS

SBM

Keppel, Singapore



SPS Overlay - Case Study

Norcape RoRo

Deck reinstatement

- completed simultaneously with routine maintenance
- steel renewal schedule substantially reduced
- 20 SPS Overlay projects completed with P&O

Technical details

2,291m²

8-20-E

May 2008

Lloyd's Register

P&O North Sea Ferries

A&P Tyne, UK (with Navikon)



SPS Overlay - Case Study

Wallenius Wilhelmsen Car Carriers

Deck strengthening

- three DNV-classed pure car and truck carriers (PCTC) – Don Carlos, Don Quijote and Don Pasquale
- increased load from 25 tonne to 60 tonne bogie
- 1,900m² of steelwork and polymer injection completed in just 15 days



Technical details

1,900m² per vessel

8-20-E

Nov 2006 - Feb 2007

Lloyd's Register

Hyundai Vinashin and Nha Trang,
Vietnam



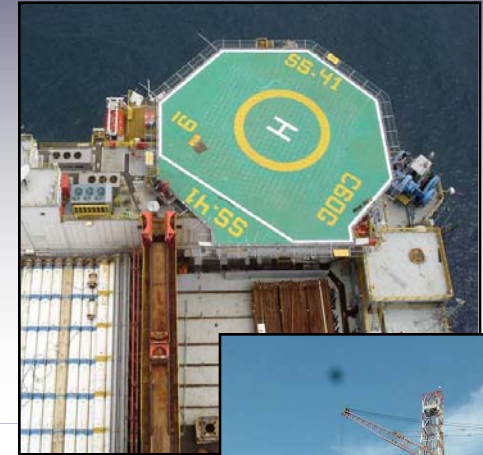
SPS Overlay - Case Study

Transocean Legend - Helicopter Deck Strengthening



Helideck strengthening

strengthened for heavier Russian Mi17 helicopters
lightweight aluminium alloy repair
no removal of existing deck was required
designed to CAP437 standards for dynamic loads
project completed in 17 days



Technical details

485m²

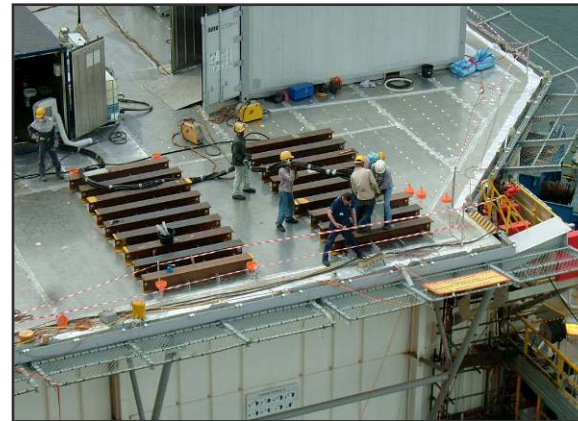
8-20-E (5083-0 Alloy)

May 2005

ABS

Transocean Deepwater Drilling Inc

Jurong Shipyard, Singapore



New Construction

Partnership with DSME

JV Agreement with DSME

- signed November 2008
- develop SPS for mainstream new construction market



Initial Applications

- hatch cover
- bulk carrier inner bottom
- liftable car deck
- container HFO tank BHD
- accommodation



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Potential SPS Applications for USN



Near term:

- Install SPS Overlay for side/bottom shell protection
 - tankers (collision protection)
 - landing craft (beaching/grounding)
- Retrofit to existing structures to create blast belts
- Strengthen/reinstate helidecks
- SPS Overlay repair to decks on existing RoRos

Longer term:

- In the medium term SPS could be integrated into the USN new construction programmes.

Next Steps...

1. IE will transfer knowledge base and experience gained on commercial projects and with Classification Societies to NAVSEA.
2. Instigate a preliminary review of USN assets to identify potential projects for SPS Overlay.
3. Execute an SPS Overlay reinstatement / repair project (MSC ship?) to demonstrate the economic and project schedule benefits.
4. IE and USN to discuss suitable SPS Overlay trial retrofit project (helideck, RoRo, tanker) to demonstrate strengthening and /or passive protection benefits.
5. Based on the initial project outcomes, expand the project portfolio to include other SPS Overlay applications with a long term view of incorporating SPS into the new construction programme

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a proven technology for Maritime and Civil applications with 10 years of in-service experience

routinely applied to reinstate/strengthen/protect existing bulkhead, shell and deck plating

structurally superior to standard construction techniques

approved by all the major Classification Societies

over 150 projects & 130,000m² in service

entering mainstream new construction market through JV agreement with Daewoo Shipyard in Korea

particular benefits in Military applications

immediate and long-term opportunities to deliver value to USN

“since the change from wood to iron and steel ... the first major advance in materials technology for heavy engineering in 150 years”

Michael Grey, The Sea

“SPS promises major improvements that should benefit the whole shipbuilding industry. The potential value to our customers is enormous.”

Young-Youl Koh, Chief Strategy Officer, DSME

"The revolutionary Sandwich Plate System is a new generation building material bringing shipbuilding and civil engineering to the threshold of a new era”

Alan Gavin, Marine Director, Lloyd's Register

A fleet of five modern naval ships, likely frigates, sailing in a line on the open sea. The ships are white with dark hulls and feature complex superstructures with radar masts and various antennas. The sea is a deep blue, and the sky is clear.

SPS

TM

Sandwich Plate System

ie

**intelligent
engineering**