The Royal Institution of Naval Architects

Energy Efficient Ships

International Conference

Energy Efficient Ships
23-24 November 2016,
RINA HQ, London, UK

www.rina.org.uk/EES_2016

For further information:
Call Catherine on +44 (0) 20 7235 4622 or email conference@rina.org.uk

08.30-08.55 **COFFEE AND REGISTRATION**

09.00-09.35 **APPLICATIONS OF HOLISTIC SHIP THEORY FOR THE SIMULATION DRIVEN OPTIMIZATION OF THE DESIGN AND OPERATION OF LARGE BULK CARRIERS,** *Lampros Nikolopoulos, Evangelos Boulougouris, University of Strathclyde, UK.* The methodology herein presented is built within the computer aided engineering (CAE) software CAESES that integrates in the design process CFD codes. It can be successfully used for the optimization of either of the basic design of a vessel or the operation of an existing vessel with regards to the maximization of the efficiency, safety and competitiveness of the final design. The model is created based on the design of a large bulk carrier and a simulation model consisting of modules that cover most aspects of ship design. Stability, strength, powering and propulsion, safety, economics, operational and maintenance and in service management considerations are tightly integrated within a fully parametric model. This tight integration enables the user to simulate the response of the model in variations of the geometrical, design variables of the vessel (including its propeller) and investigate the impact of operational parameters such as speed, loading condition and route. Using this model, on this two case studies are considered.

09.35-10.10 **QUANTIFYING ENERGY EFFICIENCY GAINS IN INTERNATIONAL SHIPPING,** *Markus Aarnio, Foreship, Finland.* In this presentation, naval architecture and engineering company Foreship will offer insight into the energy efficiency gains it has identified that will make a tangible differences in optimising vessel design and shipboard systems installations. Drawing on its cruise ship design experience and a unique database covering modifications made to existing ships, Foreship will present an independent review of the true impact on energy efficiency and the environment offered by a range of techniques. Foreship will demonstrate that energy savings equivalent of up to 25% may be possible through a series of realistic modifications, in each case outlining the implications for vessel design. Areas under consideration will include: hull optimisation for real wave conditions; weight reduction; heat recovery; optimised HVAC systems; new technology in elevators, fresh water production, galley systems and advanced waste treatment, piping and ducting design, lighting, etc.

10.10-10.45 **SYSTEMATIC RATIONAL FOR ASSESSING ENERGY FLOW ACROSS ENTIRE VESSEL OPERATION,** *Lim S., Pazouki K., Murphy A.J., Newcastle University, UK, Younessi S., Graham N, Royston Limited, UK.* Information on the complete, yet complex, energy flows throughout whole-ship systems is generally sparse and fragmented. This leads to a lack of understanding of how ship operations could be optimised for maximum energy efficiency. A complete integration of energy flow information and an understanding of how energy is stored, converted, distributed, consumed and lost across ship systems under different operational condition is therefore an important step towards managing energy efficiently on ships. However, there is a knowledge gap in how this can be achieved holistically and robustly across the entirety of complete ships systems, applicable to a wide variety of ship types. A set of systematic recommendations and criteria are therefore proposed to map systems architecture and hence energy distribution, based on which, the energy flow across an entire vessel could be assessed. This provides a good understanding of the direct and indirect link of energy consumption for different operational modes of ships, taking into account the frequency of specific operations. This intellectual understanding will allow judicial decisions to be made on operational strategies when managing energy efficiently. Ultimately, this will enable the identification of specific areas, components and systems where technological and operational interventions might be made for improved energy efficiency.

10.45-11.15 **COFFEE**

11.15-11.50 **WITH NUMERICAL SIMULATIONS TO MORE EFFICIENT SHIP DESIGNS,** *Dr Norbert Bulten, Wartsila, Netherlands.* The design process of ships has been always a cooperation of the hull design by the naval architect and the propeller design. The overall vessel performance was established in the self-propulsion model test. The propeller-hull interaction factors were regarded as outcome, which can hardly be controlled or steered. With the implementation of numerical flow simulations (CFD), better understanding can be obtained of the occurring phenomena. Therefore it will become possible to understand the interaction phenomena. Since the achievable performance gains are often in the range of a few percent, it is necessary to have excellent repeatability. With the CFD analysis this is well within reach. Another important issue is the impact of the Reynolds scaling effects. Full scale CFD simulations can reveal energy saving solutions which do not seem beneficial when analysed at model scale. This is actually the other side of the coin, where high potential solutions from the model basin fail in the actual full scale implementation.In the paper the implementation process of the CFD self-propulsion methodology, including the very important validation part, will be discussed as well as various examples, where the added value of the approach will be shown. A detailed analysis of the flow provides knowledge which is essential to understand the actual working principles of various Energy Saving Devices (ESD) as they are nowadays on the market. Moreover, it helps understand why some devices do not provide the expected gains as well.

11.50-12.25 **ENERGY EFFICIENCY SIMULATION-BASED SHIP DESIGN AND SYSTEM ENGINEERING,** *Sabah Alwan, Norwegian University of Science and Technology (NTNU), Norway.* This paper explores the use of simulation-based framework for early stage design and verification of vessel performance with reference to particular mission requirements. This framework is intended as a complementary approach to system engineering and to focus the design towards energy efficiency and low emission outcomes. The influence of numerous design parameters, operational concepts and weather condition (wind/waves) on the vessel's performance is taken into consideration. This was achieved through the utilization of virtual models to simulate the behaviour of the ship and its systems in operation, and models to compute the sea-state along the sailing routes and the anticipated operational scenarios. The current focus of this paper will remain on life-cycle energy efficiency analysis of deep-sea vessels, but in principle, this approach can be applied to many types of vessel and trade. As an alternative approach to the existing design methodologies, a discussion on how the total ship performance can be evaluated over extended periods is presented, and how this framework support system verification and communication with requirements' generators and stakeholders.

12.25-13.30 **LUNCH**

13.30-14.05 **TIME DOMAIN PREDICTION OF ADDED-RESISTANCE FOR ENERGY EFFICIENT SHIPS,** *Fuat Kara, Cranfield University, UK.* International Maritime Organization has introduced a new mandatory regulation in 2013 for new built ships, aligned to the Green House Gas emissions of the maritime transport. This new regulation, focused on reducing emission from ships, includes the use of the Energy Efficiency Operating Index and Energy Efficiency Design Index of ships. These indexes are linked to ship added-resistance and are closely related to the performance of the ships in the context of fuel consumptions. Besides, the extra power required to maintain the service speed in a seaway needs to be quantified at the design stage of the vessel. This extra power requirement is the added resistance of the ship due to the responses of the ships to a wave system and this added resistance in a seaway for a ship travelling at a given speed will usually be greater than the calm water resistance. A ship can experience a 15-30% resistance increase in a seaway where the added resistance is the main reason for this increase. If a ship is designed to achieve a given speed in a seaway, then its propulsion capacity must include a margin for added resistance. The accurate prediction of the added resistance is very important for the design of both commercial and naval ships as it affects the economic performance and greenness of the vessels. The present proposal will use an efficient and accurate three-dimensional transient state-of-the-art numerical simulation tool for the prediction of the added-resistance of the different ship types in complex sea environments.

14.05-14.40 **PREDICTION OF SEA MARGIN ON THE SPECIFIC ROUTE FOR A VLCC IN DESIGN STAGE,** *Yurim Cho, Korean Register, Korea.* The issue of predicting the 'Sea Margin' (Service Margin) is very important for ship-owners to operate ships economically. In this paper, the method of 'Sea Margin' calculation is proposed using 3D Rankine panel method for regular wave resistance and the Probabilistic Operating Condition on the specific route for Sea Margin. The prediction method of Sea Margin for wave and wind are as follows : - • Wave Margin, - Regular wave resistance in head wave, rAW : 3D Rankin panel method, - The short-term of increased resistance, RAW : Irregular wave resistance (wave spectral density), - The long-term of increased resistance, RAWL: for the Probabilistic Operating Condition, (Loading condition, sea route and service speed day), • Wind Margin, - ITTC Chart (ISO15016:2015), • Speed-Power Estimation, - ITTC Resistance & Thrust Identify Method. The Sea Margin is calculated at different sea state and over Probabilistic Operating Condition. They are compared with typical sea margin 15%.

14.40-15.15 **COMPARISON OF METHODS FOR MODEL TESTING AND ANALYSIS OF ADDED WAVE RESISTANCE IN HEAD SEAS. IMPLICATIONS FOR THE PERFORMANCE OF A CONVENTIONAL AND A NOVEL AFRAMAX TANKER,** *Thomas Dinham-Peren, BMT Defence Services Ltd, UK, Hans Richard Hansen, Low Carbon Shipping AS, Norway.* The paper examines the results of an extensive series of model tests in waves for a conventional and a novel Aframax tanker. The tests were done in both regular and irregular waves for both resistance and propulsion. The paper looks at two aspects: -The different ways of performing the tests and analysing the results. This is looked into in detail and comments on the different analysis and test methods used and what they mean in terms of predicted power increase and the effect of waves on the propulsion factors are given. -The differences in performance in waves between the two designs. This highlights the fact that some energy saving designs that have improved calm water performance (and hence EEDI) as compared with conventional vessels can have worse speed loss in adverse weather. This contrasts to a novel Aframax design of revised dimensions which has both excellent calm water performance and improved seakeeping performance. The paper concludes by summarising in which directions ship designs need to develop in order to combine low EEDI with effective in-service performance and safe heavy-weather performance.

15.15-15.45 **COFFEE**

15.45-16.20 **TOWARDS MODERN ENERGY EFFICIENT FISHING SHIPS,** *S. Birgisson, B. Sævarsson, Skipasýn Ltd., Iceland, S.D. Dudin, Norwegian University of Science and Technology, Norway.* This paper is presenting some sets of practically proved in in designed by Skipasyn Ltd. and and constructed modern fishing vessels decisions improving energy efficiency in comparison to the evaluated previous cases. The presented solutions are applicable to propelled large-scale and distant waters fishing vessels operating in marine waters. According to Maritime Knowledge Centre statistics (IMO, 2012) the total amount of such fishing vessels of no less than 100 GT is 22 831 ships with average age of 26 years. It should also be mentioned that energy efficiency of a fishing vessel is the more complicated concept in comparison to the common transport vessels, as soon as there is a necessity to consider several operational scenarios along with lack of confidence in a final result of fishing activities. Developed to face all possible challenges the considered proposals are related to constructional decisions, propulsion system, construction materials, vessels architecture and are presented base on the whole range example cases of a 24-m multipurpose fishing vessel, a 51-m fresh fish trawler and a 99-m freezer factory trawler. These innovative for the fishery industry elements are further on partly included (in a form of possible positive effects) into the System Based Design (Levander, 2012) of Fishing Vessels (Dudin and Gaspar, 2016) – a system engineering instrument of concept design and decision support for strategies of fleets development.

16.20-16.55 **ECO TUNA FISHING VESSEL,** *Cesar Aizpuru Arregi, Murueta Shipyard, Spain.* ECO Tuna Fishing Vessel Project has been developed in cooperation between: Murueta Shipyard, MAN Diesel & Turbo, and VACON-DANFOSS. Keeping as main targets of vessel Fuel-Saving and Greenhouse Effect reduction at Searching Mode, several optimizing had been necessary to implement it, such as: • Electrical generation driven only by Main Engine, • Propulsion Efficiency (Combinatory VS Constant), •Fuel Maps. Since electricity is generated during running ME on Combinatory, project key is variable frequency electrical generation. Because ME available power limitation for electric generation at some vessel operation profiles, while running on Combinatory, improvements have been implemented. Propulsion Curve Selection is done via exclusively developed PMS. Sea trials measurements carried out. Results validation / confirmation.

16.55- **GENERAL DISCUSSION & EVENING DRINKS RECEPTION**

DAY 2 PAPERS:

08.30-09.00 COFFEE AND REGISTRATION

09.00-09.35 OPTIMIZATION FOR MINIMUM PROPULSIVE POWER – MODEL SCALE VERSUS FULL SCALE, *Claudio Cairoli, John Richards, Christian Schack, American Bureau of Shipping, USA.* Traditionally, hull forms have been designed for a single draft and speed. With the advent of the EEDI and the drive to reduce fuel OPEX due to high fuel price, hull forms are now developed for an operational profile that incorporate multiple drafts and speeds representative of the actual operation of the vessel. This has been made possible by the recent advances in Computational Fluid Dynamics (CFD) and High Performance Computing (HPC). A hull form with high energy efficiency is synonymous with minimum propulsive power and fuel consumption for a given operational profile. It is well known that the characteristics of the wake flow at model scale are very different from those at full scale. The paper compares the CFD full form optimization results computed at model and full scale for a 3,600 TEU container carrier. The optimization of the rudder and the rudder bulb configuration to achieve minimum propulsion power is also presented. In addition, the CFD bulbous bow optimization for a 4,400 TEU container vessel is presented, together with the model test results, and the actual full scale operational data before and after conversion.

09.35-10.10 MODELLING OF DIESEL-ELECTRIC PROPULSION, *Ioannis Karakitsos, Mott MacDonald, UK.* Diesel electric propulsion (DEP), the concept of conventional internal combustion engines driving electrical generators to provide the energy necessary to meet the demand in mechanical and electrical loads of a ship, is gaining ground in marine applications. The scope of this paper is to establish a comprehensive model for the diesel electric propulsion system that can be used for research applications and simulation studies. Firstly, a model for the power generation module of DEP, which comprises of diesel engines and synchronous generators is constructed. Different types of short-circuits are imposed in the electrical load in order to stretch the boundaries of the modelling and assess the response of the diesel engine. Secondly, the development of a detail model of the overall DEP system, that includes variable speed drives and propulsion motors has been implemented. Scenarios that correspond to realistic ship operating conditions have been simulated. The system's parameters are based on the arrangement of a diesel electric propulsion system in an offshore supply vessel. The software tool deployed to model analytical electromechanical models of the ship's system is Simulink®.

10.10-10.45 ASSESSMENT OF SMART MATERIAL BASED PROPULSORS, ENERGY SAVING DEVICES AND CONTROL SURFACES FOR MARINE APPLICATIONS, *Ishaq S Makkar, Dr Sitikantha Roy, IIT Delhi, Lalitya Tatavarthi, Shreya Banerjee, IIT Delhi, India.* Optimisation of propulsors and control surfaces on ships and submarines for efficient operation has always been a challenge for Naval architects. Designers dream of materials exhibiting structural properties in-line with ship building quality materials, along with geometric morphing capabilities. With the advent of smart materials and recent heightened research activity, this dream will soon be a reality. Usage of smart materials primarily based on Piezo-electrics and Shape Memory Alloys (SMAs) have already been proven at full-scale in the aerospace industry. The present study explores the possibility of using such smart material embedded structures for ship propulsion, control and energy saving devices. The study primarily focuses on the current trends, research contributions and challenges for such applications in ship propulsion. Further, research findings of studies on Smart Pitched Propeller (SPP) – Hybrid 'Smart propellers' concept being researched at Indian Institute of Technology Delhi based on Individual Blade Control(IBC) are also being discussed. The study highlights the requirement of multi sectional/patched surfaces for higher distortions and shape control. If dedicatedly researched, these materials have the potential to help design and operate cleaner, greener and energy efficient ships.

10.45-11.15 COFFEE

11.15-11.50 COMMERCIAL WIND PROPULSION SOLUTIONS: PUTTING THE 'SAIL' BACK INTO SAILING, *Gavin Allwright, International Windship Assocation (IWSA), UK.* Firstly, outlining the current state of commercial wind propulsion and how we have reached this point from a technical point of view (sail design, rotors, kites and new hull designs), detailing the financial and policy drivers and the market barriers and how those will likely affect uptake of wind propulsion in the future. The setting up of the International Windship Association (IWSA) is a key development and it is the first association dedicated to the promotion and facilitation of commercial wind propulsion solutions in cooperation with the shipping industry and other major stakeholders. The core wind projects are supported by an increasing number of international industry experts, engineers, designers, researchers and seafarers that are aiming to create a single point of reference for wind related propulsion information and a key focus is on the work streams tackling barriers and generating solutions in the policy, technical standards, finance, communication and cargo/market transformation fields. Finally, a more in depth outline of 2-3 wind propulsion projects that are at an advanced stage of development will provide the audience a clearer understanding of the potential for change, rating performance and outlining the expected costs, returns and other commercial considerations.

11.50-12.25 SENSITIVITY STUDY ON CHOOSING PROPELLER TYPE AND VESSEL POWER SYSTEM TOPOLOGY, *Miikka Jaurola, Tampere University of Technology, Finland.* In early design phase of vessel power system the interesting questions are a) which components should be selected for the power system, b) how should they be coupled to form the power system and c) how to operate the system? Previous research studies have shown the money saving potential from more complex power systems is dependent on the duty cycle, the chosen machinery and the usage of the components on-board. This study focuses on the choice of the propeller type and propeller operating with different power system topologies. The sensitivity in money savings is studied with three system topologies (diesel-mechanical, diesel- electric and hybrid) and two propeller types (fixed pitch and controllable pitch). Two different vessel types with distinctively different duty cycles are investigated: 55-ton bollard pull harbor tug and a 70-meter trawler type fishing vessel. Savings are estimated by defining power source operating points using backwards calculation and brute-force optimizing the usage of machinery. The comparison will show if money is saved by building a more complex system topology and how choice of propeller type affects the costs when using a set of given prime movers.

12.25-13.30 LUNCH

13.30-14.05 SHIP POWERING PERFORMANCE - LEARNING FROM THE CHALLENGES FACED BY OWNERS, *L Karaminas, T Shen, F Violette, American Bureau of Shipping, USA.* Depending on the stakeholder's focus, the term performance can be identified with single or multiple criteria, such as powering, stability, comfort, vibrations, motions, propulsion in ice and more. This paper focuses on the powering performance aspect. It describes and illustrates the application of a decision support system and its associated complexities as well as the shipping company's needs and typical actions. The paper explores the recent challenges that have been faced by owners. In the context of this paper, the owners infers ship owners, managers and operators. Leveraging the lessons by Greek ship owners, it provides an overview of the best practices and recommendations regarding technical specification, model tests, construction and trials, after trials, service, retrofit, modifications and supporting tools. The need for calibrated performance reference values (baseline) for use in service is discussed. The importance of model test specifications, verification of powering performance upon delivery, periodic in-service evaluation/calibration and in-service reliable performance measurements is discussed together with the need for a set of common standards to be applied.

14.05-14.40 AN INNOVATIVE APPROACH TO CONTINUOUS DIESEL ENGINE PERFORMANCE ANALYSIS CAN PROVDE 5% FUEL SAVINGS, *Malcolm Habens, Joshua Lamb, Datum Electronics, UK, Peter Mantel, BMT SMART, UK.* Marine vessel efficiency heavily relies on the performance of diesel engines. The ability to continuously monitor performance is paramount to a highly efficient system and to maintain a high level of reliability. The "DIESEL HAWK" system is an innovative technology that provides permanent real time monitoring of cylinder power and engine condition. The approach is different in that it uses the crankshaft output power as its primary measurement point. With recent developments in technology we are able to look at the crankshaft output torque and power signatures to a much greater resolution and frequency. With analysis tools developed by Datum the individual cylinder power levels and power cycle profiles can be extracted from the engine power signature and fuel flow data. This provides a valuable insight into the operating condition and efficiency of the engine. Identifying and correcting poor cylinder power and engine balance will save in excess of 5% of fuel cost and considerable maintenance cost. The analysis of historical trends throughout engines in a fleet will greatly enhance the value of predictive maintenance. Datum's presentation will show the systems key methodology, the cylinder analysis, and a range of data sets from engines with systems installed.

14.40-15.15 PRESSURISED SOFT-GT ELECTRIC PROPULSION POWER PLANT FOR LNG VESSELS, *Tsougranis E.L., Pazouki K., Norman R.A., Almutairi A., Newcastle University, UK.* According to the international regulations, the shipping sector is required to reduce sulphur content of fuel to only 0.1% while trading in ECAs and to 0.5% globally by 2020. There is also a need to address a stricter cap on NOx and PM emissions from shipping at localised and international levels. In addition, following the EU 2020 climate and energy package, a 20% cut in greenhouse emissions and 20% improvement in energy efficiency must be achieved by 2020. To respond to these challenges, the shipping sector is exploring a range of mitigating measures and technologies to control emissions, including design-based approaches. The varieties and uncertainty in the performance of these mitigating technologies results in a demand for more efficient and novel methods of powering ships using clean alternative fuels. Natural gas has proven to be a potential and promising fuel; thus, this study proposes a new, novel approach of using hydrogen Solid Oxide Fuel Cells (SOFC) utilizing the Boil-Off gas from the cargo tanks of LNG vessels. The proposed SOFC power plant demonstrates 49% electrical efficiency and when combined with a Gas Turbine, the hybrid power plant exhibits around 72% electrical efficiency for producing power in the range between 26MW and 36MW. The economic viability of this study under various scenarios was further investigated.

15.15-15.45 COFFEE

15.45-16.20 THE ROLE OF DISTRIBUTED COGNITIVE SYSTEMS FOR OPERATIONAL ENERGY EFFICIENCY, *Martin Viktorelius, Chalmers University of Technology, Sweden.* The human element has a crucial role to play in operational energy efficiency because the activity and decision making of crew members has a great influence on the fuel consumption of a vessel. Areas directly related to operational energy efficiency where crew performance is important include, but is not exhausted by, voyage planning, effective cargo handling, reduced time in port, trim optimization, voyage execution, ballast water optimization and weather routing. Operational energy optimization requires processing a vast amount of real-time and aggregated data. Informed decisions as well as improvements over time require a functioning distributed cognitive system, incorporated by humans and technology onboard, which can process the information and adapt its behavior on the basis of that. The offered paper presents the results from the first study investigating energy efficiency and crew performance onboard ships. It analyses operational energy efficiency as the result of the functioning of the distributed cognitive system onboard and identifies a number of barriers for improvement. The research reported in the paper was based on a 1 year multiple-case study of five RoPax vessels operated by one of the biggest ferry companies in the world. The results have implications for the design of decision support tools as well as policy, management, maritime education and training (MET).

16.20-16.55 SETTING THE INDUSTRY BENCHMARK IN DRIVING SUSTAINABILITY AND OPERATIONAL EFFICIENCY THROUGH PROVEN TECHNOLOGY, *Silverstream Technologies.* Silverstream Technologies, pioneers of air lubrication technology, has built on the success of the landmark sea trial of its Silverstream™ System, funded by Shell and conducted in collaboration with Lloyds Register, Dannebrog Rederi and other leading industry partners. The results of the trial, combined with on-going monitoring, proved that the fully optimised system will produce a net efficiency gain in excess of 5%. This paper will go beyond the landmark sea trials and reveal how this unique technology is being operated commercially – offering the shipping industry an insight on the opportunities of implementing a technology that delivers over 5% fuel and emissions savings with a short payback period.

16.55- GENERAL DISCUSSION

International Conference

Energy Efficient Ships

23-24 November 2016, RINA HQ, London, UK

To register, simply complete all sections of this form and return it with your payment to:

The Conference Department, RINA
8-9 Northumberland Street
London, WC2N 5DA
TEL: +44 (0)20 7235 4622
FAX: +44 (0)20 7259 5912
E-MAIL: conference@rina.org.uk

TITLE (Dr, Mr, Eur Ing):

NAME (as it should appear on name badge):

POSITION:

COMPANY (as it should appear on name badge):

INVOICE ADDRESS:

POSTCODE:
COUNTRY:
TELEPHONE:
FAX:
E-MAIL:

CONTACT MAILING ADDRESS (if different):

POSTCODE:
COUNTRY:
TELEPHONE:
FAX:
E-MAIL:

PLEASE INDICATE YOUR PREFERRED METHOD OF PAYMENT:

I enclose a cheque for: (made payable to RINA) £

Please send me an invoice for : £

Bank Transfer details enclosed for: £

Please debit my credit card by: £

Card Number: (Visa/Amex/Mastercard)

Expiry Date: **Signature:**

How did you hear about this conference?

REGISTRATION FEE (Inc VAT*)	**By 24/10/16**	**After 24/10/16**
RINA MEMBERS:	£625+VAT= **£750**	£725+VAT= **£870**
NON-MEMBERS:	£725+VAT= **£870**	£825+VAT= **£990**

CONCESSIONS: *(Retired/Students etc.)*	£320+VAT= **£384**
PRINCIPAL AUTHOR:	£130+VAT= **£156**
ADDITIONAL AUTHOR:	£625+VAT= **£750**

The registration fee includes printed conference papers, lunch, refreshments, reception, a CD of the papers and presentations after the conference, and VAT

CONFERENCE PAPERS
Delegates will receive a copy of the conference CD-ROM which will include the presentations, this will be posted out around 10-12 weeks after the conference.

Aditional copies of the conference papers will also be for sale after the event in both print and CD ROM versions. If you would like to order copies, please fill in the relevant sections.

I am unable to attend the conference, please reserve me _____ set(s) of Conference proceedings

Papers @ **£115** (members) ☐ **£135** (non-members) ☐

CD ROM **£115** (members) ☐ **£135** (non-members) ☐

For a full list of the Institution's Conference papers, CD-ROM's and other technical publications please contact the Bookshop Assistant on +44 (0)20 7235 4622 or via e-mail at: publications@rina.org.uk

PAYMENTS
Payment must be made in pounds sterling by Eurocheque, cheque drawn on a bank with a UK branch address, credit card (VISA/Amex/Mastercard) or bank transfer. Please note RINA requires payment before the conference date.
Account Name: The Royal Institution of Naval Architects;
Account Number: 10042127; **Account Code:** 160016
Bank Address: Royal Bank of Scotland PLC, Belgravia Branch, 24 Grosvenor Place, London, SW1X 7HP, UK.
IBAN No: GB14RBOS16001610042127
SWIFT No: RBOSGB2L

*VAT: Under UK Customs and Excise regulations delegates from all countries are required to pay VAT on any course taking place in the UK. Delegates from outside the UK may be entitled to reclaim this cost.

VENUE
The conference will take place at RINA HQ: 8-9 Northumberland Street, London, WC2N 5DA, United Kingdom.

EVENING DRINKS RECEPTION
Following the end of day one (23/11/16), delegates are invited to attend an evening drinks reception at the conference venue.

ACCOMMODATION
Upon registration you will be provided with details of a hotel booking service offering reduced rate accommodation for conference participants.

CONTINUING PROFESSIONAL DEVELOPMENT
RINA Certificates of Attendance will be issued at the event, which contributes towards the Institution's Continuing Professional Development Scheme. For further details regarding the scheme please contact Giuseppe Gigantesco, Director, Professional Affairs on Tel: +44 (0)20 7235 4622 or e-mail: membership@rina.org.uk

STUDENT SPONSORSHIP
A number of sponsored places at this conference are available for Student Members of RINA. For more information, please contact Nick Cox, Assistant Professional Affairs, RINA on Tel: +44 (0)20 7235 4622 or e-mail:ncox@rina.org.uk.

PROMOTIONAL OPPORTUNITIES
Why not use this conference to promote your company's products and services? It provides an excellent opportunity to increase your profile and to network with a highly focused audience. We offer a number of cost effective options, including various conference sponsorship packages, exhibition space and literature distribution. If you are interested in any of these promotional opportunities please contact the Conference Organiser to discuss your individual requirements.

CANCELLATION CHARGES
Cancellations received in writing two weeks before the event takes place will be subject to administration charge of £200+VAT. Cancellations received after this time cannot be accepted and are subject to the full event fee. Delegates may be substituted; however, this must be sent in writing and confirmed with the conference Co-ordinator. It may be necessary for reasons beyond our control to alter the content and timing of the programme. In the unlikely event that RINA cancels the event for any reason, our liability is limited to the return of the registration fee.

DATA PROTECTION
Personal data is gathered in accordance with the Data Protection Act 1998. Your details may be passed to other companies who wish to communicate with you offers related to your business activities. Please tick the box below where appropriate:

☐ Please do not pass my information to any third party.

☐ I wish to receive email notification of future RINA events or publications

If you have any questions regarding this or any other RINA event please contact, our Conference Organiser, on:

Tel: +44 (0)20 7235 4622 Fax: +44 (0)20 7259 5912
E-Mail: conference@rina.org.uk www.rina.org.uk/events