The Royal Institution of Naval Architects

Design & Construction of Wind Farm Support Vessels

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International Conference on Design & Construction of WFSVs

30-31 March 2016

Park Plaza County Hall, London, UK

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DAY 1 PAPERS:

09.00-09.30 **COFFEE & REGISTRATION**

09.30-10.05 **KEYNOTE, TBC, DONG ENERGY, DENMARK**

10.05-10.40 **CLASSIFICATORY AND STATUTORY CERTIFICATION OF CREW TRANSFER VESSELS IN LIGHT OF NEWLY AVAILABLE NATIONAL CODES**
TOBIAS FUNK, DNV GL, GERMANY

With the draft UK and the adopted German codes for offshore service craft (or crew transfer vessels) carrying > 12 industrial personnel available and further such national codes in the pipeline, we find an update of the industry on how statutory and class requirements are related is necessary. Until recently, statutory requirements for non-convention service craft varied significantly between jurisdictions and allowed only for cargo craft carrying up to 12 passengers. In addition, conventional regulations imposed over-the-top requirements on service craft which might be carrying more than 12 trained and physically fit industrial personnel. The regulatory situation is thankfully starting to improve, with clearer requirements for non-convention craft carrying up to 12 and the first national regulations for carriage of industrial personnel even facilitating total numbers of persons onboard of up to 60. While still helpful for certification of service craft flying the flags of administrations not having clear and established codes, statutory requirements in class rules (as introduced by DNV GL) will stand back behind the statutory requirements in the new national codes. Our paper will: Introduce the current landscape of existing and upcoming national codes, Provide clarity on how those codes and class requirements align for the design and later in-service surveys of offshore service craft, Summarize the new challenges introduced by operation with industrial personnel and, Look at possible future steps for regulation of the industry in light of recent vessel incidents.

10.40-11.15 **CLASSIFICATION CONSIDERATIONS FOR FREEBOARD AND STABILITY OF THE WIND FARM INSTALLATION UNIT - MAY FLOWER**
Xiaoming Deng, ABS, CHINA

The 'May Flower' is a self-elevating unit with primary function of offshore wind farm installation which was classed by ABS. This paper is to share the class concerns and case studies on the subject unit's freeboard and stability. The following aspects will be specially considered and discussed, the hull forms and lines, door and window arrangement, the ventilation system, the inclining test, the unit's transit motion, the stability criteria of MODU Code and SPS Code if applicable.

11.15-11.45 **COFFEE**

11.45-12.20 **GOING FURTHER OFFSHORE - ASSESSMENT OF WIND TURBINE INSTALLATION VESSELS**
Mark Hayward, Manager, Jack Up & Geotechnical Dept. Noble Denton marine services, DNV GL - Oil & Gas, UK

As windfarms move further offshore into deeper water with longer transit times the philosophy of the earlier near-shore ventures of return to, or not leaving, port in bad weather is no longer appropriate. Increased waterdepths, exposure to harsher environmental conditions and more complex foundation conditions all contribute to the challenges that jack-up windfarm installation vessel operators now face. This paper outlines the current requirements for marine warranty approval with focus on addressing the risks appropriately and the basis on which this should be made, and provides example of the potential efficiencies and benefits that site-specific assessment offer in both installation times going on and departing from location, and addressing the survival condition on-site.

12.20-12.55 **GORILLAS NOT REQUIRED. THE WIND INDUSTRY NEEDS HERONS**
Ian R Brown, Celtic Design Consultants, UK

The Oil Industry ventured offshore over 70 years ago and has developed specialist vessel types to permit continuous work activity in increasingly harsh environments. The Gorilla-class of Jack-Up was cutting edge technology in 1980's – 300ft operating water depth. Now Jack-Ups are designed for 500ft water depth. Offshore Wind Farms have been driving the demand for specialist vessels to install and maintain infrastructure offshore and the offshore wind industry can benefit from looking at the historical development of the oil and gas solutions in the offshore environment. A myriad of vessels have been pressed into service; floating monohulls predominate with some Jack-Ups. Installing and accessing Wind Turbines at height is a technical challenge that none of the vessel types in use to date can perform without being affected by offshore environmental factors and creating significant safety risks and Non-Productive Time (NPT). Floating vessels experience relative motion to the Wind Tower causing NPT. The Jack-Up vessels in use suffer NPT when crane operations are limited by poor weather conditions. Celtic Design Consultants (CDC) have produced a patented, self-propelled , double-deck Jack-Up design that permits continuous, safe access at height in all weathers and considerably minimizes downtime compared to all other vessel types. The Heron class of Jack-Up has 4 legs permitting immediate pre-loading and the upper deck can ascend, descend and extend under full load. The Heron provides a step-change method of work for the Offshore Wind Industry.

12.55-13.55 **LUNCH**

13.55-14.30 **FAST CTV - TRANSIT AND TRANSFER PERFORMANCE RESEARCH**
S.Phillips, I.Shin, C.Armstrong, H.Maclean, Seaspeed Marine Consulting Ltd., UK

This paper summarises the findings of recent research into the transit and transfer performance of fast Crew Transfer Vessels when operating in rough water. The research was funded by The Carbon Trust and undertaken by Seaspeed over the past 12 months using computer simulation, physical model testing and full scale sea trials in order to explore the performance of monohull, catamaran and Swath designs ranging from 16 to 24 metres in waterline length. The primary purpose was to characterise the typical seakeeping performance of existing craft with the objective of developing a benchmark performance guideline for CTV transit and transfer operations. Much of the work focussed on the conventional push-on fender step-across mode of transfer used by the vast majority of fast CTV, with the aim of contributing to a better understanding of the physical mechanisms involved in such a transfer method and thus to improving transfer safety via better informed design and operational procedures.

14.30-15.05 **OPTIMAL SUPPORT VESSEL AND ACCESS SYSTEM SELECTION FOR OFFSHORE WIND FARMS**
M. Asgarpour (ECN) and J.W. Serraris (MARIN), E. de Ridder (MARIN) and H.J. Mijle Meijer (TNO), THE NETHERLANDS

Operation and maintenance (O&M) costs contribute to a significant part of Cost of Energy produced by offshore wind. In order to reduce the O&M costs and to guarantee safety and wellbeing of the maintenance technicians, for each individual wind farm an optimal set of support vessels and access systems should be selected. This selection should lead to the lowest O&M costs, highest safety and comfort for technicians and highest wind farm availability. In this paper an operation and maintenance cost model optimized for support vessel and access system selection is described. The model calculates the maintenance costs and downtime associated with each O&M strategy, support vessel and access system. This model is generic and allows different scenario's, consisting of different wind park sizes, distances to shore and different support vessels, to be represented and analyzed. This model can be used as a long-term and short-term decision support tool to optimize the baseline O&M strategy including optimal set of support vessels and access systems. Furthermore improvements to the model are introduced. As part of the "Offshore Maintenance Joint Industry Project", environmental conditions such as wind and current speed, wave height, wave period, wave direction are translated to vessel seakeeping behaviour. Next the seakeeping behaviour is translated to human wellbeing and operability, which is reflected in the risk of failures of maintenance jobs.

15.05-15.35 **COFFEE**

15.35-16.10 **TUNING HULL OPTIMIZATION AND TRANSFER SYSTEM IN DESIGN OF W2W VESSEL FOR BEST HABITABILITY AND WORKABILITY ABOVE 3 M SIGNIFICANT WAVE HEIGHT**
Guus van der Bles MSc, Conoship International BV, THE NETHERLANDS

Last year the Walk-to-Work (W2W) Vessel MV Kroonborg was delivered in The Netherlands to Royal Wagenborg to work for SHELL-UK. This innovative Conoship design was awarded 'Ship of the Year' in the Netherlands and is a new type of Offshore Maintenance Support vessel, specifically designed to service unmanned oil/gas platforms in the Northsea in a completely new way: technicians are accommodated on the vessel in the field and "walk-to-work" on the platforms over an Ampelmann bridge. Experience with the KROONBORG-design is translated in the design of Wind Farm Support Vessels: 1. obtaining the best possible comfort and habitability levels on board is important to keep the technicians as fit as possible, to improve the efficiency of the maintenance process. 2. Tuning the ship-motion-characteristics of a ship design and the motion-compensation-system of a W2W system, can result in workability up to 3,5 m significant wave height (proven in practice on the Northsea). Conoship International focused for the design of the W2W (Walk-to-work) vessel MV Kroonborg on the optimization of main dimensions and hull form design, which is strongly related to seakeeping behaviour and stability issues. The process of Hull Optimization of W2W vessel-designs will be presented: Optimized 'Habitability' to maximize comfort and wellbeing for persons living and resting on board that are not trained seafarers and will be at sea for periods of 2 weeks; Optimized 'Workability' to ensure best performance of a W2W-transfer system up to Significant wave heights above 3 m in the North Sea, to increase the operational window of the transfer system; How to meet these goals in an optimal design will be presented in a holistic design approach, since all design aspects are strongly interconnected.

16.10-16.45 **A NEW ERA IN LOCAL POSITION REFERENCING**
Sasha Heriot, Business Development Manager, Guidance Marine, UK

Standard navigation techniques used in offshore oil and gas are not optimised for navigating inside a Wind farm. Unlike an offshore supply vessel servicing an oil platform which may have 1 or 2 approaches per day, a wind service vessel may visit as many as 12 wind turbines in a single day. This requires fast and efficient turnaround times without compromising safety. Typically a vessel approaches a wind turbine on DP at a distance of 100m and station keeps at a distance of around 10m whilst walk to work bridges are deployed and crew is transferred. Despite laser systems being the local position reference senor of choice, these are often considered a secondary system to DGPS due to specific challenges associated with the architecture of the wind turbine in acquiring the target. A further consideration is the number of physical targets required to access all the turbines on an offshore wind farm. This increases both cost and maintenance requirements. This paper discusses the challenges of existing position reference systems including laser and DGPS systems and considers the use of new sensors that use the physical environment rather than discrete targets to navigate from. Data is presented which demonstrates the use of such sensors on a wind farm service vessel as a viable alternative to current systems.

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

DAY 2 PAPERS:

09.00-09.30 **COFFEE AND REGISTRATION**

09.30-10.05 **THE HOUR OF POWER - HYBRID MARINE TECHNOLOGY FOR WFSV APPLICATIONS**
John Haynes, Shock Mitigation Ltd., UK

Hybrid technology is being utilised by many transport sectors and industries around the world. The marine industry is now recognising the potential of utilising hybrid power and innovative propulsion systems for vessels in the sub IMO / sub 24 metre professional sector. The Hour of Power concept enables vessels to run in and out of port for an hour on electric with battery power - then carry out their open sea work on diesel power. The aim of this innovative hybrid solution is to enhance conventional power and propulsion systems. Vessels can reduce emissions and improve fuel consumption whilst extending engine maintenance periods and engine life. The Hour of Power focuses on viable hybrid solutions linked to vessel work cycles and engine duty cycles. For commercial and professional organisations the concept of running vessels with zero emissions at up to 10 knots for one hour will shape decisions that lead to improvements of in-service systems and procurement of next generation vessels. The overall objective is fuel saving, reduced emissions, additional redundancy and improved efficiency by all means. Certain maritime sectors are potentially well suited to hybrid diesel / electric systems. These include ferries, harbour tugs and pilot boats that have relatively consistent duty cycles. If wind, wave and tidal energy installations are striving for genuine 'green' credentials it is logical to reduce consumption of fossil fuels wherever possible. The Hour of Power concept lends itself to Wind Farm Support Vessels operating in the ongoing wind farm maintenance phase.

10.05-10.40 **DESIGNING FOR SAFETY – HYBRID COMMERCIAL VESSEL BATTERY SAFETY VESSEL DESIGN AND CONSTRUCTION PARAMETERS FOR LITHIUM BATTERIES**
Brent Perry, CEO, C Rate Solutions, CANADA

An increasing number of commercial vessels are being deployed in hybrid form. These hybrids range from new builds to retrofits of existing twenty year old vessels. Each installation type and size presents a unique safety and performance challenge. Most rely on a common format; diesel electrical generation, supported by high power lithium batteries to provide a reserve of power. Use of energy storage in the form of a large battery fills three roles: Increased safety in the form of instantly accessible spinning reserve; Decreased costs in the form of reduced fuel consumption and maintenance; Reduced local pollution from low load operation of diesel engines. Several vessel design considerations must be implemented to ensure a safe, reliable and long-lasting hybrid vessel: Battery location: how does battery weight distribution affect the performance of the vessel? What location makes the most sense?; Racking for batteries; strength, weight and thermal considerations; Fire mitigation systems – reduces the risk of cascading thermal runaway; Fire suppression systems – adjacent systems must be protected adequately; Management systems and controls - keeps the system operating in the safest, most efficient mode; Charging infrastructure – onboard generation and shore power infrastructure; Cooling systems – increases lifespan of battery and eliminates thermal runaway; Remote monitoring systems – analyze data and optimize systems. Learn how some of the largest fleet operators in the world are converting their vessels to hybrid. A review of systems being deployed on new build hybrid OSV's and hybrid ferries will be discussed.

10.40-11.10 **COFFEE**

11.10-11.45 **STRATEGIES AND TECHNIQUES FOR WEIGHT REDUCTION IN FAST CRAFT (A CASE STUDY)**
Jules Morgan, KPM Marine, UK

11.45-12.20 **PRELIMINARY WEIGHT ESTIMATES FOR WIND FARM SUPPORT VESSEL**
Oleksandr Bondarenko, Admiral Makarov National University of Shipbuilding, UKRAINE

The issue of the determination of weight estimates of wind farm support vessels (WFSV) is considered. The algorithm of determination of components of the lightship weight is suggested. The hull weight of the ships suggested to be calculated through the surface area of the principal structural elements using the parametrical model. The formula for calculation of weight and volume of the superstructures was obtained by making the 3D model of the superstructures of the most widespread projects of WFSV. Using the statistical data processing the dependences were obtained for the determination of engine, gearbox and waterjet weights, which are used in WFSV. The results of the comparative analysis of the lightship weight of WFSV are given.

12.20-13.20 **LUNCH**

13.20-13.55 **TOTAL COST OF OPERATION OF AN IPS POD DRIVE SYSTEM IN A 26M CREW TRANSFER VESSEL**
Gerard Törneman, AB Volvo Penta, NORWAY

Cost of operation of offshore wind farms are in focus today, as the energy prices are low. Different initiatives have been taken to reduce costs and one of many is to reduce the cost of maintenance and support with more efficient service vessels. The paper will present the operational cost of Volvo Penta IPS Pod drive systems in 26 m Crew Transfer vessels, based on true experience in the German Bite and Irish Sea. The service and maintenance cost will be highlighted as well as the fuel economy. With the quadruple drive arrangements fuel consumption can be optimized and the redundancy of the system minimizes the risk of downtime and connected extra costs. With Volvo Penta Quadruple IPS installation the active maneuvering in high seas and the high bollard push against the wind farm pylon will ensure that the downtime due to bad weather is minimized and the safety for the crew and technicians are kept on a high level. Facts and figures of operational duty cycles and costs will be presented. The building of the catamaran vessels will also be presented, with installation time and installation cost based on information from the building shipyards. The paper will give a good insight in the performance and the flexibility of the IPS system, the cost related to a tough 3000 hour operation in open seas and the cost of installation compared with other drive systems.

13.55-14.30 **AN INNOVATIVE HULL DESIGN FOR AN OFFSHORE WIND FARM SUPPORT VESSEL**
M Shanley, MaREI, ERI, University College Cork, Ireland
S Balke, Bremen University of Applied Sciences, Germany
J Murphy, MaREI, ERI, University College Cork, Ireland

A crucial issue for the maintenance of an offshore wind farm is safe access and egress to the wind turbine by the service crew. Current transfer limits are not suited to sites located in more exposed locations further from shore, which are continually being explored by new projects. Weather days will increase in these sites if current vessels are utilised. A ship that can operate safely for a greater percentage of the year is required. This study discusses a new vessel design to meet the changing demand of the offshore wind sector. Optimised hydrodynamic characteristics allow the innovative vessel to access wind turbines significantly above current limits, thus addressing crew health and safety, and comfort by creating a very stable vessel. It utilises narrow catamaran hulls to minimise waves load and has a heave plate at a deep draught to restrict heave and pitch motions. The design was numerically modelled in ANSYS AQWA and experimental trials to evaluate the operational aspects of the design were carried out in Lir, Ireland's National Ocean Test Facility at 1:25 scale. Demonstrating that the design can access wind turbines up to a Hs of 3.5m at an estimated cost that is less than that of a SWATH.

14.30-15.00 **COFFEE**

15.00-15.35 **CARBON FIBRE WIND FARM CATAMARANS**
Graham Pfister, Trawlercat Marine Designs, CANADA

Carbon fibre is ten times stronger than aluminium, less than half its weight and it doesn't rust or corrode making it the perfect material choice to build OWF Carbon-Cats. Add our unique carbon fibre Dynamic/Hydraulic hydrofoil system to raise the cat up reducing water and wave resistance and mitigating vertical shocks; then you also have a cat that will burn 50% less fuel than similar size aluminium cats. THE NEXT GENERATION OF OWF VESSELS. Carbon-Cats will be built in production moulds in 20m, 25m, 30m and a 40m sizes in nine different models as Crew Transfer Vessels, Windfarm Service Vessels, Windfarm Guard Vessels, Emergency Breakdown Vessels and a 40m x 14m Quad Deck Installation, O&M Accommodation Vessel. Carbon-Cats are capable of 40 to 50 knots depending on the model. The faster, more comfortable ride means Technicians will arrive on site sooner, fitter and can go straight to work improving productivity. The 50% lower fuel burn from 400 vessels running 800 engines will result in millions of dollars saved in a year. In 20 years it will amount to billions of dollars saved and these savings should bring down charter costs which will bring down the cost of Offshore Wind Energy. 50% less fuel being burned will also reduce carbon emissions by 50%. A foredeck mounted Walk-to-Work System is an available option.

15.35-16.10 **THE ULTIMATE OFFSHORE WIND FARM SUPPORT VESSEL**
Dennis Knox, OSSeas Consulting, NEW ZEALAND

Wind farm support operations offshore are beset by many problems. Wind farms are by their nature set in the areas with the most wind and consequently with the most waves. Access is a major issue, all-weather operability is essential with transits minimised. The SHC Windancer™ (Submersible Hull Catamaran™) overcomes this and more. The SHC design allows the vessel to transform from a high speed surface displacement vessel to a semi-submersible. This provides exceptional transit times, the ability to remain on site for extended periods and operability on site in weather conditions that other conventional ships would find unworkable. Incorporating a host of innovative design features, composite materials, metals technologies, DP thrusters as yet unseen by the shipping industry and a high dynamic control ballast system with miniscule control over submersion and trim. It is the greenest vessel afloat with prime movers that have the lowest carbon emissions possible and a unique propulsion system that allows exceptional manoeuvrability with shallow draft making many coastal ports accessible. Its maintenance capabilities are way beyond the technician's tool belt, extending to servicing multiple wind tower installations, from the seabed to the tip of the blades, simultaneously and in safety. Add to that an abundance of space inside the vessel providing every crew member with spacious individual cabins, large lounges, gymnasium, sauna, galley and recreation room. Facilities that would compete with a top class hotel. SHC Windancer™, maximum operability, minimal impact and a work environment any technician or crew member would love to work in.

16.10- **GENERAL DISCUSSION**

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

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