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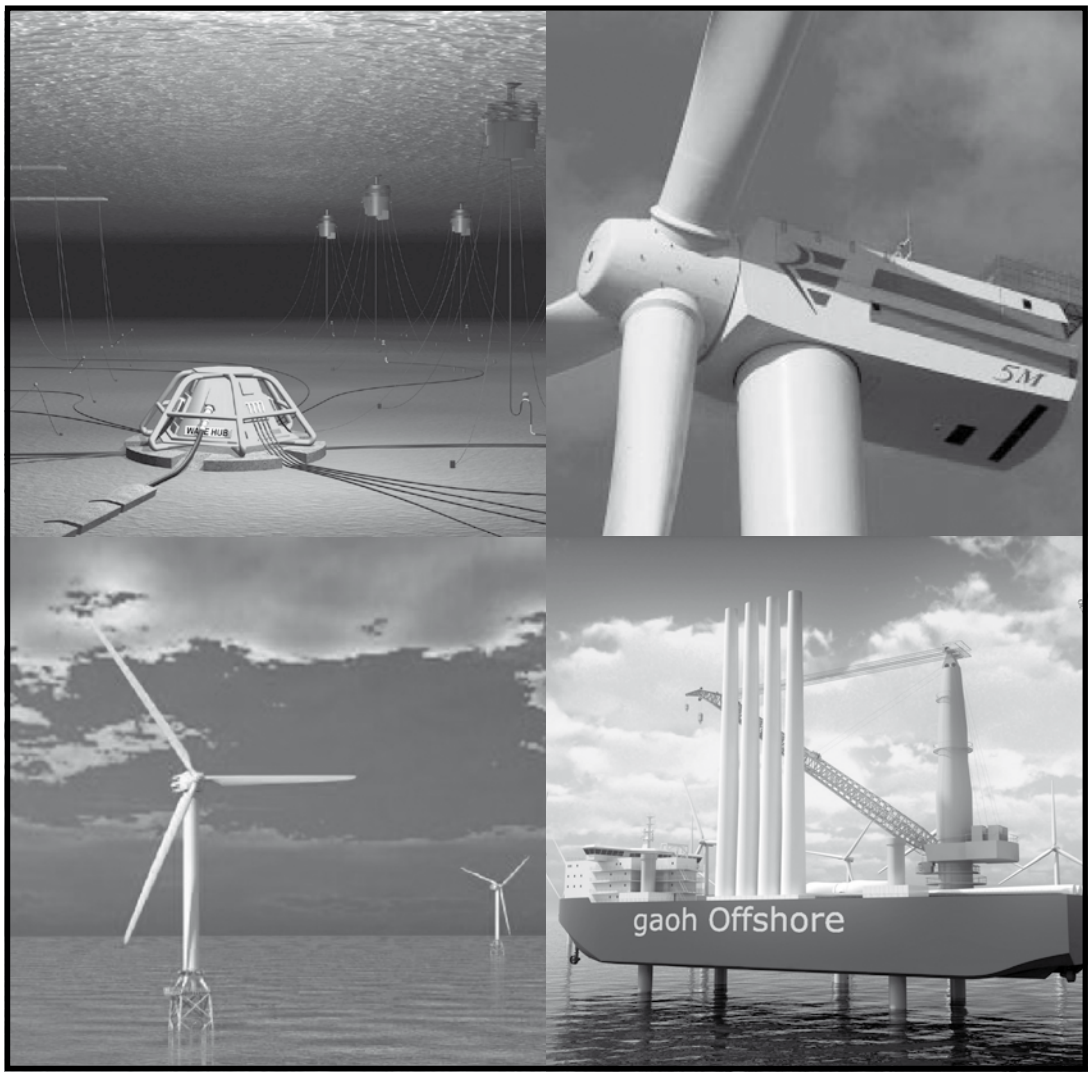

International Conference

MARINE RENEWABLE ENERGY

19 - 20 NOVEMBER 2008

RINA HQ, LONDON

MARINE RENEW

19 - 20 November 20

In November 2008 the Royal Institution of Naval Architects will be holding its first conference on Marine Renewable Energy. During these times of increasing environmental awareness and diminishing oil and gas reserves, many countries are now seeking to utilise their renewable marine resources; wind, wave and tidal will be significant energy sources of the future. At the spring European Council the EU agreed a target of 20% of all energy should be sort from renewable sources by 2020. Renewable energy is a key element of sustainable development, is vital in reducing greenhouse gas emissions and creates diversity of energy supply and security.

From initial research and development through to site planning, construction, installation and operation; the marine renewable energy industry covers a wide range of disciplines, expertise and industrial sectors. This conference will bring together the industry stakeholders to provide a forum for discussion and a means of professional development for those involved with marine renewable energy.

day 1

09.30 - 10.00 **Coffee & Registration**

10.00 - 10.35 **Numerical simulations of a cross flow Darrieus-type vertical axis marine current turbine**
Y Dai, University of Plymouth, UK

This paper presents the progress made in the numerical simulations of a cross flow Darrieus-type vertical axis marine current turbine (VAMCT) with particular emphasis on the rotor performance prediction and their hydrodynamic loads for design calculations. The paper describes current research efforts and examines the hydrodynamic performance of this turbine design. Furthermore, we estimated a proposed full scale turbine hydrodynamic performance, blade loads and the flow behaviour. This work demonstrates that the developed CFD model can provide a useful tool for the investigation of the hydrodynamic performance and design of a VAMCT.

10.35 - 11.10 **DESIGN & DEVELOPMENT OF A VERTICAL AXIS, TIDAL POWER DEVICE**
J Hardisty, University of Hull, UK
W Peiris, IMT Marine Consultants,

There is considerable interest at the present time in tidal stream power devices, and most systems utilise developments of the horizontal axis, Kaplan rotor with blades driven by lift forces. The principles of the alternative, low head cross flow Ossberger drag rotor for hydro-power schemes are described and the governing equations are derived. The problems of adopting the cross flow into a fully submerged, tidal stream power device are discussed and the results from numerical experiments are presented. The associated problems in designing this new type of device for the marine environment is presented with regard to the structural make up and loading.

11.10 - 11.40 Coffee

11.40 - 12.15 **A Risk-Based Decision-Making Framework for Marine Renewable Energy Installations**
G Mermiris & N Hifi, Universities of Glasgow and Strathclyde, UK

Although minor disagreements still exist, all forecasts converge to the fact that oil reserves are diminishing fast and the time for action has arrived. Thus, renewable energy devices that take advantage of the wind, wave, currents and tides of the sea are in the front line as alternative energy sources. However, harnessing the available energy from the ocean is not free of price: only with planning and rational choices cost-effective and efficient solutions can be achieved. The only way to avoid the mistakes of the past and allow hope for the future is to manage all the risks entailed through the life-cycle of these devices. The work presented here is a concise risk assessment framework that is based on conventional quantitative risk analysis and it is tailored to meet the needs of marine renewable energy sector.

12.15 - 12.50 **A Competitive Solution for Marine Renewables**
T Whitten, Strachan & Henshaw Ltd, UK

Designing a power plant to exploit the energy in waves and tidal flow requires consideration of the cost of delivered power, perhaps more than any other factor. A methodology is presented for selecting and sizing appropriate marine renewable energy systems, supported by statistical and dynamic analysis of energy collection potential and performance. The results of using this methodology in scoping the Neptune Horizontal Axis Tidal Turbine demonstrator are explored.

12.50 - 13.50 **Lunch**

13.50 - 14.25 **Getting personnel out to, and onto, Wind Turbines at Sea**
N Warren, Ad Hoc Marine Designs, UK

This paper will examine the current methods of taking maintenance personnel out to windfarm sites. In particular it will describe the South Boats catamarans designed especially for this purpose and how these boats are performing. The issues of seakeeping and in particular the transfer of personnel onto the turbine towers will be discussed. The designs of these craft are gradually evolving as future windfarms are being anticipated for deeper more hostile waters and in consequence further from the nearest port. A number of innovations currently being researched by South Boats will be discussed.

14.25 - 15.00 **Advantages of Numerical Modelling for Development of Marine Renewables**
N Baker, C Higgins & G Bathurst, TNEI Services Ltd, UK

This paper will give an overview of some of the areas in which TNEI has recently applied its multi-discipline skills in numerical modelling. These range from energy yield estimation for a wave energy site on a range of wave energy converter technologies using typical in-situ wave energy data, computational fluid dynamics modelling on a wave energy converter to improve the performance of the second stage prototype and estimate the power matrix, mechanical and electrical modelling of a resonant linear generator suitable for wave devices, and the techno-economic optimisation of the electrical network for a proposed wave energy farm.

15.00 - 15.35 **The Advantages Of Composite Material In Marine Renewable Energy Structures**
M Mohan, Gurit Ltd, UK

Composite materials can have many advantages when they are used in marine renewable energy structures. These advantages will be demonstrated in this paper with an example of a 2m prototype of an underwater turbine that was engineered and built at Gurit using composite material. The novel design features of the turbine presented challenges to the structural engineering and will be discussed in this paper.

15.35 - 16.05 **Coffee**

16.05 - 16.40 **Development of Evopod tidal stream turbine**
G Mackie, Ocean Flow Energy Ltd, UK

The paper describes the development of an innovative floating tethered tidal stream turbine. This will include the development and testing of the semi-submerged hull form and the development and modelling of the mooring system. The paper will discuss the special environmental operating conditions for tidal stream and ocean current turbines. Results from 1/40th scale and 1/10th scale model tests carried out at Newcastle University and at a tidal test site will be presented.

16.40 - 17.15 **Using GIS to Identify Opportunities for Tidal Technology Deployment: A Case Study of the DeltaStream Tidal Stream Device**
J Moore, ABP Marine Environmental Research, UK
C Williams, Tidal Energy Limited, UK

ABP Marine Environmental Research Ltd. (ABPmer) was commissioned by Tidal Energy Limited (TEL) to complete an assessment of suitable locations for the potential deployment of the DeltaStream tidal energy technology. The project provides an assessment of tidal currents and depth to identify all sites that potentially offer suitable resource conditions for the tidal energy turbine. These sites are assessed against a range of potential Marine Spatial Planning (MSP) considerations to highlight likely issues that may arise when planning potential technology deployments. The study area encompasses all UK territorial waters including those surrounding the Isle of Man and the Channel Islands and the project outputs provide a characterisation of potential development opportunities using a robust, repeatable methodology.

17.15 - **Generl Discussion & Evening Drinks Reception**

This represents a preliminary progra

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08, RINA HQ, London

day 2

10.00 - 10.35 **Development and Assessment of Performance Prediction Tools for Wind and Tidal Turbines**
F Salvatore, Luca Greco, INSEAN, Italy

The development and assessment of computational models to predict the performance of wind and tidal energy conversion systems is addressed. The continuously increasing demand for renewable energy production yields the necessity to develop highoutput/ large-scale systems and to investigate new unconventional concepts. Furthermore, environmental issues as well as operational cost reduction introduce severe multi-disciplinary constraints into design. In the proposed paper, the experience matured at INSEAN, the Italian Hydrodynamics Research Center, in developing and validating performance prediction tools targeted to multi-disciplinary design is presented. The theoretical/computational model proposed is valid for both vertical axis as well as horizontal axis turbines. The methodology is derived from well established approaches for the analysis and design of marine propulsion systems.

10.35 - 11.10 **Development of Vertical Axis Marine Current Turbine Rotor**
O Yaakob, Universiti Teknologi Malaysia, MALAYSIA

Universiti Teknologi Malaysia (UTM) has embarked on research work in ocean renewable energy to find a suitable device for Malaysian sea conditions. This paper presents current progress on development of devices to extract one of the potential sources of ocean energy in Malaysia viz. marine current energy. Marine current turbines devices normally uses either vertically or horizontally mounted rotating rotors. Most of these devices are unsuitable for Malaysian sea condition, by virtue of its low current speeds and shallow water. The work reported in this paper involves the development of a Vertical Axis Marine Current Turbine (VAMCT) rotor using a concept similar to those used in other applications but hitherto never used in VAMCT. A vertically rotating rotor is developed by parametric simulation studies using a proprietary Computational Fluid Mechanics Software. The configuration and parameters giving maximum torque for typical current speeds are identified. The design of various mechanisms to increase the marine current speeds are also investigated. Results of simulation as well as model experiments carried out at Marine Technology Laboratory Universiti Teknologi Malaysia will be presented.

11.10 - 11.40 Coffee

11.40 - 12.15 **Wave energy in the UK - the lessons of 30 years**
C Palmer, Wind Prospect Group Ltd, UK

In 1978, oil prices exceeded $80/barrel in real terms, having risen suddenly from $15 in 1973. At around the same time, the Club of Rome published The Limits to Growth, which predicted severe oil shortages before the end of the century. One response was to research alternative sources of energy. The then Labour government in the UK financed a research and development initiative to investigate the feasibility of a 2GW wave farm off the Outer Hebrides. University researchers and commercial consultants teamed up to develop different devices, grant financed in a quasi-competitive programme, managed by the civil servants of the Department of Energy. In 1979 this program was cancelled following a change of government. Recriminations followed and conspiracy theories abounded. Wave energy research then almost stopped until in the late 1990s a few entrepreneurial companies started to develop new concepts, under very different policy and financing environments. These new companies are market driven start-ups, mostly financed by private equity. State intervention is mainly legislation to ensure adequate prices are paid for the power generated, coupled with modest and targeted research investments. The result is a very different industry and a very different range of technologies. The paper will compare these two phases, highlighting the effects of different policy approaches and market structures on technology development and discussing the lessons that can be learned. It will conclude with a review of the current status of wave energy technology development and its future potential.

12.15 - 12.50 **Real Option Approach to Offshore Wind Energy Project Valuation**
S Yasseri, KBR- Energy and Chemicals Services, UK

Significant expectations have been put on renewable energy, especially on offshore wind energy. The number of offshore wind farms has grown rapidly during the last few years, but the success of the industry is uncertain. Risks in renewable energy arise from many sources including state of knowledge, public attitude, sitting, regulations etc. The value of an asset lies not only in the amount of direct revenues that it is expected to generate, but also in the options that it creates for flexible decision making in the future. Few investment opportunities, whether they strengthen core capabilities or access new technology, exist in a vacuum, and they should therefore be considered in their strategic and competitive context. The current valuation methods include net present value, internal rate of return, decision trees and real options. The expected net present value (ENPV) technique, which is a type of decision tree model, is also employed. ENPV adjusts the value of projects for their technological risk (represented by probabilities of success) but ignores their economic risk and the value of managerial flexibility, which can be analysed using the real option approach. The focus of this paper is twofold: first, it examines the risks and success factors in the energy sector so that the determinants of successful business can be identified. Then, it describes how real option analysis can be applied for the valuation of offshore wind energy projects. A hypothetical case of a 50 MW offshore wind farm is used to comparison purposes.

12.50 - 13.50 Lunch

13.50 - 14.25 **The Fluid Structure Interaction of Wave Energy Devices: Some Old and Some New Theoretical and Experimental Challenges.**
G Hearn & J Chaplin, University of Southampton, UK

In 1976 Hearn and Standing (based at BSRA and NMI respectively) were asked to review the state of art of hydrodynamic and dynamic analysis of the then current UK wave energy devices sponsored by the UK Department of Energy and to indicate the feasibility of their theoretical analysis. Reports were prepared under contract for the Department of Energy through the Fluids and Structure Technical Advisory Group (TAG3) formed by the Wave Energy Steering Group (WESC). Anaconda in particular exhibits physical boundary conditions not discussed in the earlier cited feasibility reports and in fact also produces the challenge of requiring their simultaneous solution with the global solution of the hydrodynamic analysis. The structure is essentially hydroelastic and requires an approach quite distinct to all the other devices. Reverting to the Clam there are related extensions to the analysis of this device analogous to the Anaconda device novel analysis to be developed. Anaconda also provides interesting experimental challenges and these will be discussed with reported experimental measurements taken from different scale experiments. These experiments indicate some of the key parameters affecting device performance.

14.25 - 15.00 **Orecon – Design and Model Testing of a Wave Energy Buoy**
J Lye & D T Brown, BPP-TECH, UK
F Johnson & P Bromley, Orecon Ltd, UK
CBittencourt, DNV, Norway

This paper will discuss the design process and model testing programme required to build a full scale prototype wave energy buoy. The paper shall cover the technical program underway, identifying what the program has drawn upon existing DNV marine classification and design practices. In order to generate the maximum amount of energy, the designated operating location is characterised by high energy waves. The ability of the buoy to survive these waves is paramount, as any downtime results in a loss of revenue. The challenges of designing a novel device will be discussed, from initial concept, through tank testing, to detailed design and certification. A brief review shall be given of the design philosophy, system operation and an indication of storm and operating loads.

15.00 - General Discussion

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