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**FOREWORD BY**  
**JOSÉ ESTEVE**

AIMS Project Director



*Renewable Energies have a bright future: they already play a significant role in our planet's energy mix, and it's certain their importance will only increase going forward.*

*Marine Renewable Energy (MRE) technology has its part to play in this growth, but designers and operators first need to overcome some challenges.*

*Bureau Veritas brings its expertise to help the sector's major players with regulatory compliance, technical assurance and specialized services throughout the life cycle. While best known for its conformity assessment and equipment certification, Bureau Veritas also provides digital services. From cyber security support and audits to building a wind farm's full-blown digital twin, Bureau Veritas is there to help clients reduce operational costs.*

**Come and talk to us at WindEurope in Bilbao\*, Spain, on April 2-4 2019 to discuss how we can support your business!**

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## OVERCOMING MRE CHALLENGES

ORE Catapult courtesy

Asset Integrity Management is essential for securing the best possible return on investment throughout the lifetime of your offshore wind farm. It is then the cornerstone of a strategy targeting profits maximizing and life cycle costs control by reducing unplanned downtime and keeping scheduled maintenance inspections to a minimum.

Bureau Veritas Marine & Offshore encountered similar challenges in the marine and oil & gas industries and developed its new "Digital Twin" based Asset Integrity Management solution Veristar AIM3D. It soon became apparent that this powerful digital twin solution could have significant benefits for the marine renewable energy sector as well. In the Digital Twin design data will be available in the platform and compared to the real-world operating data and can be used to set up a risk based approach for the inspection and maintenance activities.

The integrity manager will be then able to monitor the condition of the wind farm thanks to the dashboarded KPIs and also the web 3D visualization highlighting components with identified occurring degradation mechanisms.

The current operating offshore wind farms are designed for an expected lifetime of 20 to 25 years.

These assets are subject to a harsh environment and need to be monitored for a future life extension. Thanks to its Digital Twin, all data necessary to perform them will be available, up-to-date and at hand reach on Veristar AIM3D.

The operator will be then able to save time gathering the data, avoid unnecessary reverse engineering activities and will finally significantly reduce the costs of his life extension project.

Therefore, Bureau Veritas and the Offshore Renewable Energy (ORE) Catapult have entered into a collaboration agreement to jointly develop a Veristar AIM3D "Digital Twin" of ORE Catapult's 7MW Levenmouth Offshore Wind Demonstration Turbine in Fife, Scotland.

Thanks to the data shared by ORE Catapult, Bureau Veritas is developing a Digital Twin of the Levenmouth wind turbine. The work consists in importing the available 3D CAD model into the collaborative VeristarAIM3D platform.

Through this collaboration, Bureau Veritas and ORE Catapult would like to demonstrate how a digital twin can be used for implementing a healthy asset integrity management of wind farms and ultimately share Digital Twin best practices with the industry.

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## AIP RINGS POSITIVE BELLS FOR PENDULUM

Years of experience in a variety of roles for some of the energy industry's biggest names have made **Thierry Delahaye** the perfect person to spearhead Saipem's research and development activities for new technologies in renewable energy.

Building on the company's expertise in EPCI for fixed and floating offshore wind, Thierry is currently working hard to get its innovative pendulum floater technology on the road to commercialization.

"Over the last decade, following extensive research and development as well as studies of our fixed wind activities, Saipem has become aware of a need for new floating solutions. Seeking to address that, we quickly realized we would need to develop our own new floater technology since existing solutions did not fulfill our requirements. We wanted solutions that could be rapidly available for commercial farms across the world. The technology had to offer the best possible stability-to-cost ratio and was developed with the specific aim of reducing leveraged cost of energy. We really started with a blank page."

As work progressed on Saipem's pendulum floater, so named because of the floater's stabilizing pendulum motion, the company turned to Bureau Veritas for Approval in Principle (AiP) of their brand new technology.

"Gaining Bureau Veritas' AiP is the first step towards certification of new technology. The process allowed us to verify that design assumptions corresponded to the market's needs. It also enabled us to conduct a complete design review, getting feedback from experts in several disciplines. Even at the earliest stages, it's crucial to show clients that we have already taken the first steps towards certification. It reassures them and anticipates what often becomes a contractual obligation further down the road."

When choosing to begin the certification journey with AiP from Bureau Veritas, Saipem were swayed by the company's experience with floating wind projects.

"Bureau Veritas has a worldwide network and so offers clients a certain proximity. Their experts were in touch with our needs, and work delivered was of the highest quality. However, what really made a difference was Bureau Veritas' long history of work with floating turbines. They have a wealth of knowledge – including existing technical guidelines – having worked on other projects. We were keen to leverage that expertise and savoir-faire. We did not regret our decision. We learned a lot from Bureau Veritas, and I like to think they learned from us too!"

[www.saipem.com](http://www.saipem.com)



**Thierry Delahaye**  
Offshore Renewables and Technology  
Intelligence R&D Manager  
Saipem

## NI 572 UPDATE OFFERS OFFSHORE FOWT GUIDANCE

In January 2019, Bureau Veritas released an update of NI 572, its Guidance Note for Classification and Certification of Floating Offshore Wind Turbines (FOWT). The Guidance Note details technical guidance for overcoming design challenges due to FOWT-specific technical and operational factors. It serves as a supplement to the Certification Scheme for Marine Renewable Energy Technologies (NI 631).

The Guidance Note responds to current industry demand, particularly in relation to wind farm pilot project certification and design evaluation certification. Examples of ongoing projects include Provence Grand Large and Les Eoliennes Flottantes du Golfe du Lion in the Mediterranean, as well as Groix & Belle-Île in the West Atlantic. NI 572 also introduces detailed requirements in relation to corrosion protection. The Guidance Note further clarifies design load cases for different operational conditions, while taking into account various elements (J-tubes, boat landing, hull, mooring system, towing foundation, partial structure during installation and maintenance, etc.). It also lays out the necessary technical requirements for floating offshore wind turbines, so they can meet design principles and stability needs.

Bureau Veritas is an active contributor to the International Electrotechnical Commission (IEC) Technical Committee (TC) 88, developing international standards for FOWT designs. NI 572 offers guidance to developers in line with internationally recognized IEC 61400 series standards.

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## ADVANCED CFD PUT TO NEW MRE USE

Chantiers de l'Atlantique courtesy



Bureau Veritas Solutions – Marine & Offshore provides solutions for the marine renewable energies market to address challenges such as complex hydrodynamic behavior, structural design and mooring systems thanks to in-house developed software and proven methodologies.

BV Solutions – M&O recently provided its expertise in advanced CFD to study the scouring issues that affect the offshore foundations of offshore wind and tidal turbines. Due to the velocity of the flow at seabed level, sediments around the foundation may be washed away, decreasing stability.

Together with Chantiers de l'Atlantique, BV Solutions – M&O was involved in a research and development project that aims to improve industry understanding of the

phenomenon and to find a numerical solution to model it.

Scouring around a circular pile exposed to a steady current in cohesionless sediment, such as sand, was simulated with ICARE. This is a RANSE (Reynolds-averaged Navier-Stokes equations) solver using the finite differences method and is, by consequence, a relatively fast CFD code. The numerical results have been successfully validated using experiment data from reference papers on scouring issues (Roulund et al, 2005).

Further developments are now planned to numerically evaluate several scouring protection systems including mats and riprap to advise clients on the best solution for their challenges.

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**BUREAU VERITAS**  
**SOLUTIONS**  
Marine & Offshore

## TURNING THE TIDES... INTO ENERGY

Franck Sylvain is a convincing advocate for EEL Energy's tidal energy converter. A financier by trade, he discovered EEL in 2012 when he was hired to raise capital to develop the company's fledgling technology. Franck was so convinced of the technology's potential that he quit the world of finance to become the company's CEO.

"Tidal power is completely predictable, making it the greatest potential source of energy available. It's an emerging sector, offering huge potential."

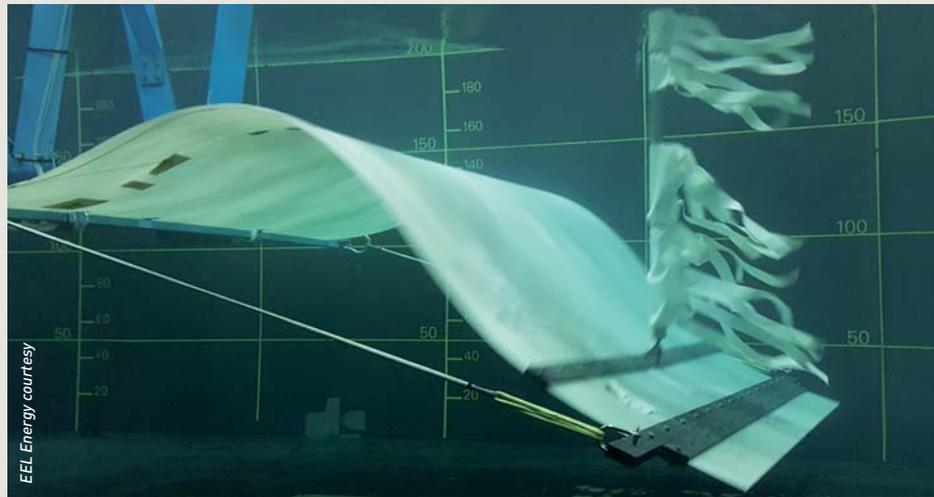
Instead of relying on a spinning turbine, EEL Energy's tidal energy converter features a membrane that undulates under moving fluid pressure. It is this motion that is transformed into electricity.

In 2015, the company chose Bureau Veritas to certify the convertor's power curve and confirm performance. "We have to prove that our machines are robust and durable. As a recognized independent certification body, Bureau Veritas helped us gain credibility, when we were the first in the world to certify the power curve on our onboard generator tidal energy converter. We chose Bureau Veritas for extensive experience in marine and offshore classification, which we saw as a real plus."

As the cost of marine renewable energies started to drop, EEL realized they needed to simplify the technology to make it more cost-effective.

"We modified the tidal energy convertor to externalize energy generation. Our new solution is simple, effective and robust.

Power transformation now occurs outside of the water, which solves the problem of an overdose of force on the membrane. Our 3-kW prototype is capable of generating electricity with a leveraged cost of energy under 150 euros per MW. It is particularly suitable for use in waters



with relatively low current – it becomes optimal at around 2.5m/second. This means it can be used in a large number of applications, including rivers. Furthermore, it creates no visual pollution, nor does the undulating motion harm marine life."

EEL is pursuing its goal of developing a 30-kW machine by the end of the year and a 1-MW machine by the end of 2020. Franck believes that Bureau Veritas' services have a valuable role to play in demonstrating the commercial viability of the technology.

"Certification will enable us to demonstrate that our updated technology is reliable and that our figures are accurate. We are confident working with Bureau Veritas as their engineers really know what they're doing. Their reputation for quality is well deserved, and we know their seal of approval truly means something in our industry."

[www.eel-energy.fr](http://www.eel-energy.fr)



**Franck Sylvain**  
Directeur General, EEL Energy



## BRINGING OIL AND GAS TECHNOLOGY TO OFFSHORE WIND

The oil and gas industry has used offshore platforms such as TLPs, semi-submersibles and spars for years. MatthewsDaniel, a Bureau Veritas Group Company, is now taking its cues from advances in such oil and gas offshore technology, and helping Offshore Wind producers apply it to their industry as well.

Responding to a great need within the Offshore Wind renewables sector to innovate in order to increase commercial viability, wind energy producers are seeking ways to push into deeper water and more challenging environments. Now no longer bound by land or by shallow waters, the offshore wind sector is capitalizing on conceptual designs based on oil and gas platforms.

MatthewsDaniel's teams of master mariners, engineers, naval architects, meteorologists and OVID- and CMID-qualified surveyors bring added-value Marine Warranty Surveying services to Offshore Wind product teams, their subcontractors and service providers. Its areas of expertise include monopods, jacket foundations, power cable installation, self-elevating units and truck transports, as well as TLPs, spars and semi-submersibles. Bureau Veritas acquired MatthewsDaniel in 2014, enhancing Bureau Veritas's scope of services to clients through geographical diversification and offering access to a greater depth of resources that range from in-house laboratories to engineering expertise. MatthewsDaniel has offices around the world and is headquartered in London, UK.

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## MRE MARKET SET TO MAKE GREAT STRIDES

The Marine Renewable Energy (MRE) market should see consistent development and growth over the coming decades, with the potential to produce 101 GW from tidal sources and 236 GW from wave by 2050. A commercial tidal array and river tidal farm are already operational in the UK and France. Last year, Ghana became the site of the first tender for a 100MW commercial wave power plant.

A major development factor will be the industry's ability to achieve cost reduction, thus moving to commercial and utility-scale arrays. According to a May 2018 ORE Catapult study, the levelized cost of energy (LCOE) for tidal energy in Europe could drop from €170 per MWh by 100MW installed to €100 per MWh by 1GW and €90 per MWh by 2GW. Key investor nations at the forefront of this growth include Australia, Canada, Chile, China, France, Indonesia, Japan, Netherlands, Portugal, South Korea, the UK and the US. Many more countries have already established national policies or are on their way to adopting new laws favorable toward MRE development.

Today MRE technologies lack of addressable market, and remote populated areas remain the key target. But by continuing to innovate and expand supply chain and improving the environmental knowledge base, more markets will open up. At this stage, research and innovation are keys to increasing the readiness level of these technologies as the march toward commercialization continues. Bureau Veritas Marine &



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Offshore plays an active role in many MRE projects, helping minimize risk in innovative design solutions for energy capture, power conversion or mooring -challenges that the industry is addressing.

## R&D TO BRING FUTURE MRE SUCCESS



Aiming for large-scale commercialization, the Marine Renewable Energy (MRE) industry is conducting intense and robust R&D to overcome technical barriers in areas such as offshore floating wind turbines, tidal, river, wave and ocean thermal energy converters. In Europe, ambitious programs such Horizon2020 and Interreg are providing MRE stakeholders with the resources they need. Bureau Veritas works alongside industry players involved in numerous R&D projects at national and international levels. Projects currently in the pipeline run the gamut when it comes to MRE technologies: extreme sea state, dynamic cable behavior, anchorage systems, farm architecture optimization, MRE design and safety factors, composite materials, fatigue impact on design, and system reliability.

Bureau Veritas is involved in the i4Offshore project, which aims to break down the cost barriers of large-scale offshore developments, offering innovative, cost-saving solutions at highly challenging sites before 2025. In the tidal and wave sectors, Bureau Veritas is aiding in the development of open source design tools for the selection, development, deployment and assessment of ocean energy systems in DTOceanPlus project. In addition, Bureau Veritas is currently participating in important R&D projects such as Imagine, Polyamoor and Omdyn II, coordinating RealTide and as observer in MET-Certified.

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