Navigating through rough seas

Tackling safety in the design and operation of wind farm support vessels

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White paper

Abstract

As wind farms move further offshore to satisfy renewable energy generation targets, the distance of such installations represent significant safety challenges for both Wind Farm Support Vessel (WFSV) manufacturers and those within the wind farm development project chain, including investors, developers, contractors and site operators.

Many sea-going vessels are already pushed beyond both the limits of their design and crew's capability, yet they represent the majority of craft that are currently available to wind farm operators. This white paper identifies the issues such work boats face regarding crew qualifications, effective manning of vessels to meet service demand and the part that fatigue may play in accidents and incidents.

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Contents

About TÜV SÜD experts

David Cantello
Marine Safety Consultant at TÜV SÜD PMSS
David has been involved with offshore marine safety management in both the oil & gas and renewable industries for more than 13 years, after leaving the Royal Navy where he was a Command Qualified Seaman Officer. He has been responsible for examining and assessing risks across a range of marine activities, from vessel surveys to lifting operations. David has also conducted a number of accident investigations on vessels involved in offshore renewables activities.

Andrew Wilde
Marine Safety Consultant at TÜV SÜD PMSS
Andrew has a long track record of supporting safety and risk management activities for the construction of several offshore wind farms throughout the UK and Europe. Roles have included marine coordinator/work vessel coordinator, offshore and quayside site safety management, personnel, contractor and crew management, offshore client HSE representative for survey and installation vessels, and workboat vessel auditor.

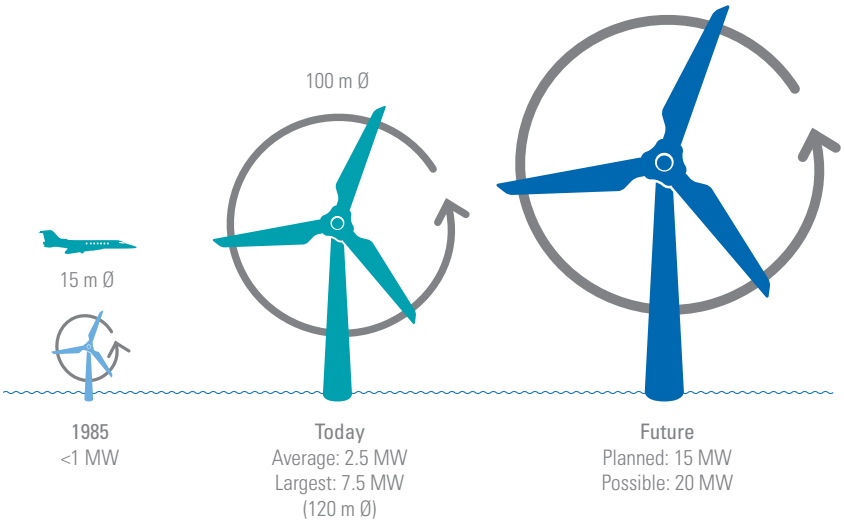
Andrew's experience as a lifeboat crewman and coxswain for the RNLI (Royal National Lifeboat Institution) also brings an excellent understanding of the search and rescue implications of offshore wind farm installations, and the challenging conditions inclement weather brings to the working environment.

1. Introduction

Economies of scale

More than 20 years have passed since the world's first offshore wind farm was built in Denmark. Since then turbine size has increased from 450 kW to 7-8 megawatts (Figure 1), costs have reduced by approximately 30 per cent per decade, and projects have moved to water depths of over 40 meters and up to 100 km from shore[1].

FIGURE 1: GROWTH IN TURBINE SIZE



Source: European Wind Energy Association, Wind Energy Facts

Initially, offshore wind power capacity was approximately 50 per cent more expensive than onshore wind power. Consequently, larger wind turbine designs and more extensive offshore sites have been developed to deliver the required economies of scale. The global wind energy sector is therefore currently witnessing the development of installations at greater distances offshore to accommodate this growth.

This has created a challenge for WFSV as the environmental conditions faced are now more challenging than those encountered in earlier developments that were constructed closer inshore. While rapidly increasing global investment in extensive offshore wind farms has created the need for more support vessels, several key industry figures and the media have raised concerns about the potential for accidents in the WFSV industry.

Burgeoning global offshore industry

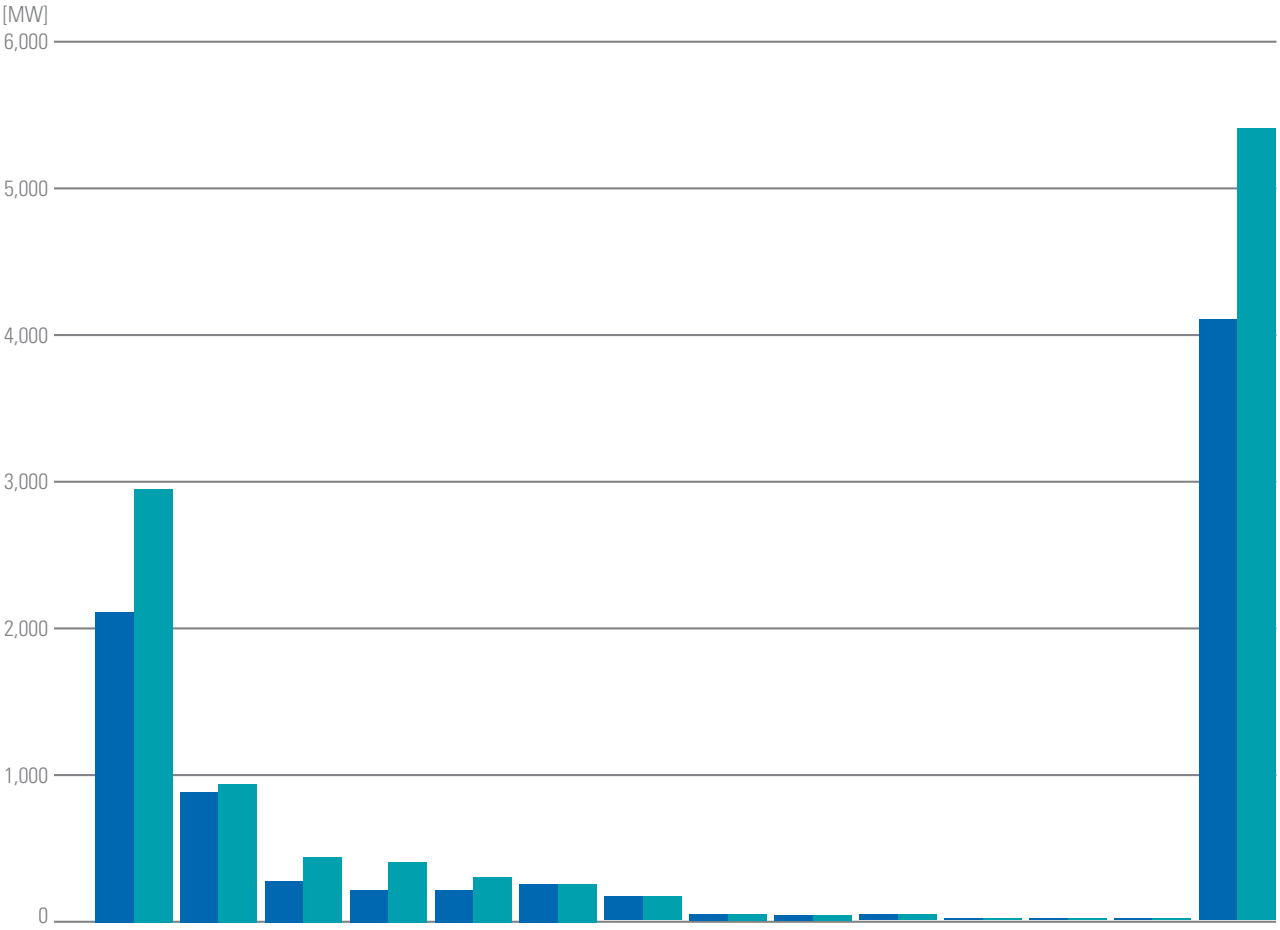
The most recent Global Wind Energy Council figures[1] show that 5,415 MW of offshore wind power has been installed globally (Figure 2), representing about two per cent of total installed wind power capacity. More than 90% of these installations are in European waters: in the North Sea, Baltic Sea and in the Atlantic Ocean. However, offshore development in China is starting to take off, followed by Japan, South Korea, Taiwan and the USA.

The European Wind Energy Association estimates that approximately a quarter of Europe's wind energy could be produced offshore in 2020[2]. The European Environment Agency also estimates that Europe's offshore wind potential is able to meet its energy demands seven times over[3], with the UK being the world leader in offshore wind since October 2008[4], having as much capacity already installed as the rest of the world combined.

Increasing safety concerns are therefore set against a rapidly expanding global wind industry. As projects move into deeper water, to meet growth demands, health and safety will come into sharper focus. Indeed, the International Maritime Organization (IMO) has recognised that: "Safety and efficiency have now, more than ever before, become two sides of the same coin: accidents are not only undesirable outcomes in themselves; they also have a negative impact on the supply chain that is at the heart of the global economy." [5]

Offshore development in China is starting to take off, followed by Japan, South Korea, Taiwan and the USA.

FIGURE 2: GLOBAL CUMULATIVE OFFSHORE INSTALLED CAPACITY IN 2012



	UK	DENMARK	PR CHINA	BELGIUM	GERMANY	NL	SWEDEN	FINLAND	IRELAND	JAPAN	NORWAY	PORTUGAL	S. KOREA	TOTAL
Total 2011	2,093.6	874.3	262.6	195.0	200.3	246.8	163.7	26.3	25.2	25.2	2.3	2.0	2.0	**4119.3**
New 2011	854.2	46.8	127.0	184.5	80.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	3.0	**1,295.6**
Total 2012	2,947.9	921.1	389.6	379.5	280.3	246.8	163.7	26.3	25.2	25.3	2.3	2.0	5.0	**5,415.0**

Total 2011 Total 2012

Source: Global Wind Energy Council

2. Stakeholder Challenges

Operating in a high risk environment

The offshore renewables sector is still relatively immature and has little accident data, making it difficult to anticipate safety hazards. Potential hazards must also be addressed in extreme weather conditions, as well as isolated, remote and difficult-to-reach areas.

A report from the European Agency for Safety and Health at Work[6] anticipates that the combination of these hazards and the inexperience of some of the workers in this immature sector, means that hazards may not be controlled or managed appropriately.

The European standard EN 50308:2004 'Wind turbines: Protective measures — Requirements of design, operation and maintenance' is currently being updated and it is expected that this standard will ensure that health and safety is considered from the start of the turbine's life cycle. However, as technologies have evolved, standards have failed to keep up with the pace of product development, and we are already ten years advanced from when this last Standard was issued.

There is a lack of recognised standards and guidelines for the safe operation of wind farms around the world, particularly for offshore facilities. The Global Wind Organisation, a non-profit organisation of wind turbine owners and wind turbine manufacturers, has set some common standards relating to safety training and emergency procedures, but these are still very basic. The onus is therefore on employers to ensure that workers who conduct installations, routine operations and maintenance procedures do so under the safest possible conditions.

The changing operating profiles of WFSV

The UK is the world's most mature wind farm market, and therefore provides a useful reference for anticipating the growing pains that other countries can expect with the evolution of offshore wind worldwide.

Approximately 87 per cent of vessels in the UK are not best suited for many future areas of operation as wind farm projects expand further offshore, clearly hinting at the potential international scale of this issue.

Rough seas

The sea conditions further offshore will prove challenging for many vessels. Also, loiter times will generally be longer for sites further offshore, as the operator will seek to reduce the number of transits undertaken by each vessel. This will become an increasingly common scenario worldwide as wind farms are pushed further offshore to satisfy increasing renewable energy generation targets.

Increased demands upon vessel personnel

Taking into account the likely operational profiles of WFSV while they are at sea, there is a possibility that a restricted crew size will mean that they exceed recommended working hours and suffer the effects of fatigue.

Offshore wind farm operators have tried to address this issue by providing relief crews. Even allowing for conducting crew changes offshore, the extensive preparations for sailing will mean that the sole qualified person with charge of a vessel may have spent a significant part of their day at work before getting to the most challenging part of their job - transferring cargo and personnel from a moving platform to a stationary one.

Space constraints

The carriage of additional crew members on WFSV also raises design and operating issues, as most only have accommodation for two or three persons. There is also the working environment on the bridge of the vessel itself to take into consideration. The latest WFSV designs have comprehensive banks of screens surrounding the Officer of the Watch (OOW) position, including navigational information, radar/AIS plotters and vessel system information (Figure 3). Hence, the OOW often has a multiplicity of screens to monitor. In addition, a busy wind farm environment requires monitoring of several communications channels.

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While another crew member may also have the appropriate qualifications to use the radio, frequently the bridge layout does not allow easy delegation of tasks as access to equipment for more than one person can be restrictive.

FIGURE 3: THE BRIDGE OF A 24 METER WFSV BUILT IN 2013

Crew capabilities

Whilst the demands of a normal operation may be achievable, the real test comes when things go wrong. Wind farm operators expect the WFSV to be a key resource in any serious offshore incident. The risk is that the Master of a WFSV may become overwhelmed by the workload demanded in such a situation.

Scarcity of available qualified and competent crew are likely to become an increasing problem as manpower surveys continue to predict officer shortages in particular. The most recent Manpower Study [7] from the Baltic & International Maritime Council (BIMCO) and the International Shipping Federation (ISF), which is updated every five years, shows that the worldwide supply of seafarers in 2010 was estimated to be 624,000 officers, against an estimated worldwide demand for 637,000 officers (Figure 4).

Given the current and anticipated increasingly demanding operating profiles and manning levels for WFSV, it is unlikely that the current status quo will be able to comply with legislation and guidance on manning and watchkeeping in waters across the world. The effect of this is to increase the likelihood of fatigue in a potentially unqualified crew, bringing with it the risk of serious incidents.

FIGURE 4: GLOBAL SEAFARER SUPPLY BY BROAD GEOGRAPHICAL AREA

AREA	CURRENT SUPPLY			
	OFFICERS (1000'S)	%	RATINGS (1000'S)	%
OECD Countries	184	29.4	143	19.2
Eastern Europe	127	20.3	109	14.6
Africa / Latin America	50	8.0	112	15.0
Far East	184	29.5	275	36.7
Indian Sub-Continent	80	12.8	108	14.5
All National Groups	624	100.0	747	100.0

Source: BIMCO/ISF estimates

3. A safe future demands WFSV changes

The demands placed on WFSV, their crews and the people which they carry require the operational environment to be properly identified and appraised to ensure that operations are conducted as safely as is reasonably practicable.

Vessel design

Until recently, vessels designed and developed for other purposes were modified for service in the offshore renewables industry. As the offshore market matures, and wind farms are sited further offshore, so manufacturers of WFSV have recognised these changes in conditions and the new demands that will be put upon both vessels and their crews.

While their latest designs acknowledge the operational profiles and the conditions in which the vessels are likely to be used, there is a compromise between:

- transit performance
- stability during the transfer of personnel to the Wind Turbine Generators (WTGs) and
- sea-keeping performance during loiter times on station.

All three activities have differing design requirements and the degree of compromise between each performance requirement will affect personnel in the vessel.

Competent crew

It is clear that there are a number of issues associated with the manning of WFSV and the qualifications of their crews which may contribute towards overload and fatigue, thereby increasing risk in both the current and future operating profiles of these vessels.

The evidence shows that vessel manning levels are such that under present operating procedures operators are not following best practice guidance or specific country regulations on watchkeeping. For example, the current practice whereby the Master/OOW is in many cases the only fully qualified watchkeeper and expected to be

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on-watch for 12 to 14 hours continuously is contrary to both common sense requirements of safety and specific UK guidance.

The qualifications held by many of those operating WFSV are also not well matched for sophisticated, complex, passenger-carrying vessels operating in the challenging conditions experienced further offshore. Until the point where operators man vessels with such qualified and experienced personnel, there will be a significant, and a potentially life-threatening skill gap. However, providing more appropriate manning levels in WFSV then raises the additional issue of matching vessel design to accommodate those extra crew numbers.

As the operating profiles change and vessels become larger and more complex, the design and competences required to operate in these more challenging environments must be continually and carefully examined. It is not satisfactory for operators to assume that just extending what has been done before will be enough to ensure safe and efficient operation of vessels.

Investment in new vessels that are designed for a specific capability in offshore wind will, over time, eliminate some practices that induce increased risks to safety and health, with training, education and drills paying for themselves by reducing incident rates.

4. Expert support to minimise risk

As wind farms move further offshore, so the safety of WFSV operations will be brought into sharper focus as many vessels currently being used are inadequate to meet the challenging conditions they face. Such projects therefore require a thorough, professional approach to safety in design, as well as operations safety management.

TÜV SÜD is able to support developers and contractors with expert third-party support to ensure that WFSVs comply with QHSE objectives:

RISK ASSESSMENT	RESOURCE SELECTION	TRAINING SOLUTIONS

■ Evaluation of specific risks to your organisation and responsible individuals	■ Procurement or operational requirements
	■ Includes:
	  ■ Vessels and crew
	  ■ Emergency repairs of equipment
	  ■ Suppy of vital essentials on board
		■ Specific, relevant and customised solutions that cover both accredited and bespoke courses
		■ To improve staff competence

5. Business benefits

It is essential to all parties involved in the offshore wind farm industry (investors, manufacturers, project developers, operators, etc.) that the health and safety risks are minimised, while maximising the return on investment. They therefore require specialist support to ensure that activities are compliant with local legislation, international standards and industry best practices.

By harnessing the experience gained from a wide range of global projects, TÜV SÜD's experts can apply lessons learned to ensure maximum design safety, including:

- support to develop a competent in-house QHSE team through effective assessment and training of staff.
- effective management across the entire project chain, from design through to construction and operation, to ensure that all parties implement an effective and compliant QHSE management processes.

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6. Conclusion

There is a clear need for the enforcement of, and in some cases further development of, the international standards or guidelines for occupational health and safety management offshore. Turbine operators must develop their own stringent practices and procedures to identify and mitigate risks in order to protect both their employees, suppliers and reputation.

TÜV SÜD's experts provide safety and quality management and support during all stages of the project lifecycle for both onshore and offshore renewable energy technologies. We support developers and contractors by either taking on a defined role as a construction safety manager or by being fully involved in all aspects of the project.

TÜV SÜD's experts are uniquely qualified to provide support in this area as our interdisciplinary team has extensive experience from working with a diverse range of clients and contractors on renewable energy projects around the world. Our presence in key locations worldwide ensures that we can provide services locally, while maintaining premium industry quality.

We are also widely recognised as an independent solutions provider capable of delivering reliable and in-depth assessment services. We have long-standing experience and comprehensive knowledge in supporting a wide range of wind farm projects throughout their lifecycle.

GLOSSARY OF ACRONYMS

WFSV	- Wind Farm Support Vessel
RNLI	- Royal National Lifeboat Institution
IMO	- International Maritime Organization
OOW	- Officer of the Watch
BIMCO	- Baltic & International Maritime Council
ISF	- International Shipping Federation
WTG	- Wind Turbine Generators

FOOTNOTES

[1] Global Wind Energy Council, Global Wind Report
[2] European Wind Energy Association, Wind Energy Facts
[3] European Environment Agency (EEA) estimates
[4] RenewableUK
[5] International Maritime Organization - International Shipping Facts and Figures,
Information Resources on Trade, Safety, Security, Environment. © Maritime Knowledge Centre 6 March 2012
[6] European Agency for Safety and Health at Work, Occupational safety and health in the wind energy sector, a European Risk Observatory Report
[7] BIMCO/ISF - Manpower 2010 Update - The Worldwide Demand for and Supply of Seafarers

Find out more about TÜV SÜD's services for the renewable sector

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TÜV SÜD is a trusted partner of choice for safety, security and sustainability solutions. It specialises in testing, certification, auditing and advisory services. Since 1866, the company has remained committed to its founding principle of enabling progress by protecting people, the environment and assets from technology-related risks. Through 24,000 employees across 1,000 locations, it adds tangible value to customers and partners by enabling market access and managing risks. By anticipating technological developments and facilitating change, TÜV SÜD inspires trust in the physical and digital world to create a safer and more sustainable future.

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