

Next Generation Floating Wind Farm

We first introduced WindSea to *Scandinavian Oil-Gas Magazine* readers in early 2008, following our visit to the Force Technology Norwegian office in Sandvika. Since then, Force has spun off WindSea AS, and a share of the new company is owned by engineering and fabrication services provider, NLI. We spoke once again to Managing Director Henning Arnøy about the progress with WindSea concept development.

According to the European Wind Energy Association (EWEA), there is enough wind around Europe's coasts to power Europe seven times over, and harnessing the sustainable power of wind is one of the most positive developments to result from factors such as escalating oil prices, climate change and dwindling fossil fuel reserves.

The EWEA notes that the European Union has set a binding target of 20% of its energy supply to come from wind and other renewable sources by 2020. In order to achieve this 20% energy target, more than one-third of the European electrical demand would have to come from renewables, with wind power expected to deliver 14 to 18%.

The timing seems perfect for ventures such as WindSea AS, as Mr. Arnøy relates.

Looking back at the concept in 2008, there seem to have been some design changes – some refining of the design.

“That's right. When we talked last time, it was in the starting phase

of the development of the concept, and during 2008, and to some extent in 2009 and 2010, we have actually performed a tremendous amount of work. We have done some refining of the construction – we have done many model tests in wind tunnel, in the wave tank, and even the combination of wind and wave in the wave tank. And based on that experience, we have refined the design of the concept as much as it can be at the present stage.”

You could say the design has been proven?

“I was at a conference in Liverpool – Renewable UK Offshore Wind 2010 in June. It was quite a big conference and the presentation I made received quite a bit of interest – there was a fair amount of feedback. In our presentation at the conference we're saying that we have proven the concept. We started validation of the concept entering into in the second half of 2008, and now that the proof-of-concept has been met.”

“In addition, we have tested in the

wind tunnel tests and the wave environment test and the combination of the two. We have completed a third-party verification by external companies, for example Risø (Risø DTU National Laboratory for Sustainable Energy – Technical University of Denmark), which is an important institute when it comes to calculation of wake effect and efficiency of our windmills.”

When did NLI join WindSea AS?

“NLI came in when we established the company. We established WindSea AS in April 2008, and in June 2008, NLI joined as co-owner. They now own 49.5% and Force Technology holds 50.5% – it's almost a 50-50 ownership of the company.”

What sort of expertise does NLI bring to the company?

“NLI is a fairly substantial company in the Norwegian context. They have over 1,000 employees, and they have a revenue in 2009 of approximately 250 million US dol-

lars. In addition, NLI owns a company called Rainpower – a hydropower turbine manufacturer that they bought from GE. So they are heavily involved in renewable energy.”

You've reached a plateau – and now you're looking towards building a prototype?

“Right now we are in the phase of refining the design slightly more – in fact, that's going to take place in 2010 and 2011. We are out in the market trying to get funding from other companies – or stakeholders, if you like – and we are in the market to get approximately NOK 30 to 35 million. And the total aim of spending that money is to do the requirements meeting and the analysis work and engineering required before we start the building of a prototype, which is planned to take place sometime in 2012.”

A full-size prototype?

“That is a key question. Should we actually build full-size with three

The WindSea Concept

WindSea AS – owned by Force Technology and NLI– is developing, testing and plans to commercialise a new, innovative offshore wind turbine platform.

WindSea is a three-sided semi-submersible vessel with corner columns, each supporting one wind turbine. Moored to the sea bottom, the mooring lines as connected to the vessel's geometric centre, allowing the vessel to rotate. The vessel is therefore always able to orient the turbines optimally towards the incoming wind. This self-orienting rotation means the vessel does not need a traditional yaw system, which also reduces cost.

Due to the large diameters of the mills and the relative small dimension of the vessel, one of the mills will be partly in the shadow of the other two. To minimise this shadow effect, the tower of the downwind mill is higher.

Characteristics

- Semi submersible platform with 3 columns
- Three turbines
- The platform orients itself towards wind
- Mooring lines connect to a detachable turret
- Cable for power transmission is guided through the turret to the seabed

Advantages

Construction

- flexible layout – scalable.
- Easy fabrication – all construction is performed at yard, including installation of the turbines.
- Easy installation – the floater is tugged to offshore destination, connected to the mooring lines and ready for operation (plug and play).

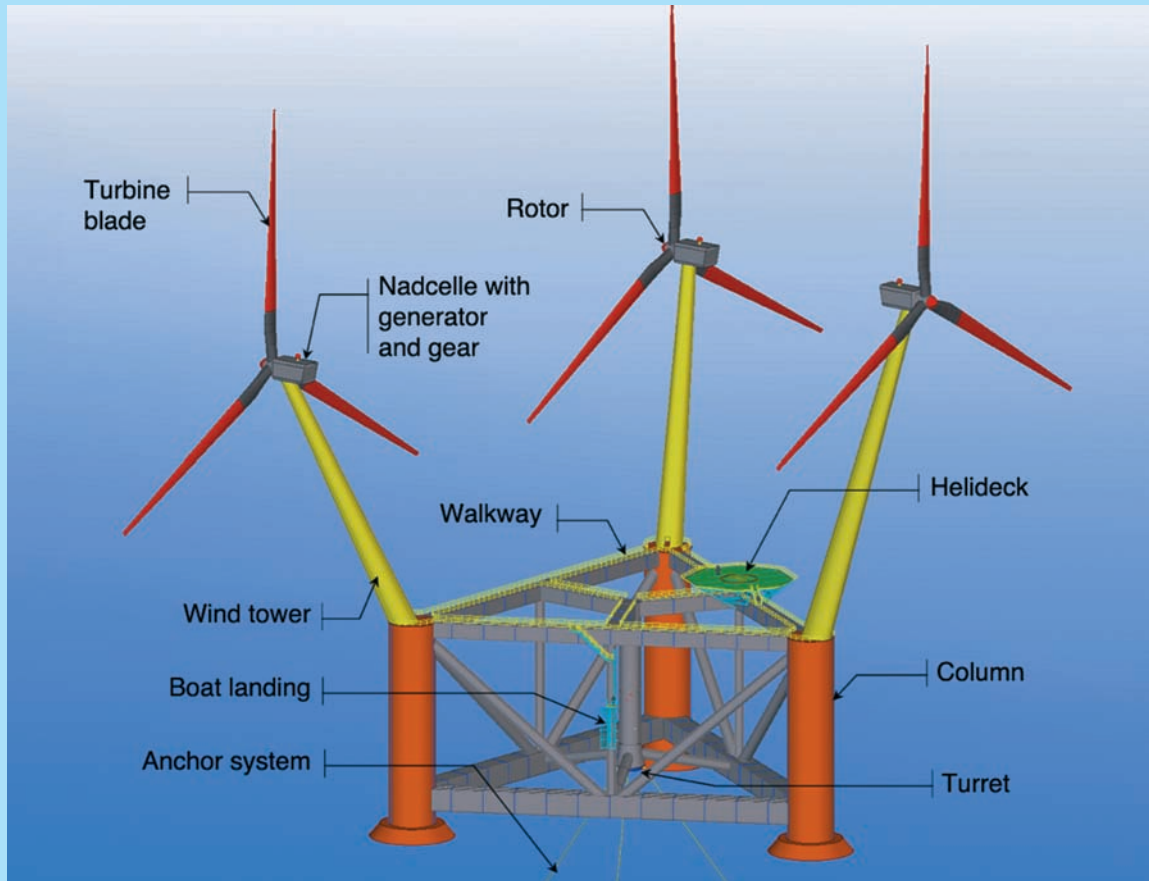
Maintenance

- Easy access for inspection and maintenance as well as space to perform such tasks.
- Easily disconnected from the turret and tugged to the yard for modification or more extensive maintenance.

Dimensions

- Height upwind turbines above sea level: 71 metres
- Height downwind turbines above sea level: 90 m
- Distance between upwind turbines: 103 m
- Turbine rotor diameter: 104 m
- Turbine power (3.6 MW each): 10.8 MW (total)
- Vessel draft: 23 m (in operation)
7m (at yard)

For additional background information about the WindSea concept, visit www.winsea.no



turbines, with a rating of 3.6 megawatts each – or should we scale it down to let's say 1 MW? We have stated that we feel it is beneficial from a technical point of view – but also from an economic point of view – to build actual size, because we believe the test period is going to be a success. And then we actually could use the prototype in the commercial phase in a wind farm later on.”

And you still see the possibility of using WindSea to provide power to oil and gas platforms?

“The production platform would have to be at a water depth of at least 45 metres. There's no limitation at deeper depths from a technical point of view, but we do require a minimum of 45 metres of water depth for the semi-submersible to work.”

So, the same depths as typical semi-submersible platforms?

“Exactly so – there's no big difference. In addition, we believe that if you do have the water depth of let's say 35 to 40 metres, then most likely a fixed substructure like a monopile or a jacket will be more competitive than a floater. But when you reach the 54 to 50 metres, and you have a large turbine on top of a fixed structure, we believe that the floater can start to compete when you have a water depth of approximately 50 metres.”

“Our concept only requires 45 metres depth, while Sway and Hywind require 100 metres plus. Actually, they are spar platforms, with a turbine on top, and hence, we do believe that WindSea is complementary to Hywind and Sway – not in any real competition before the water depth reaches 110 metres.”

What about controls for ballasting and keeping the turbines facing the wind?



Proof of concept – model tests in wave basin have shown that the WindSea concept is up to the task of performing in the harsh offshore wave environment (photo: WindSea)

“That's a good question. The ballasting is done only once. When you deploy the unit at location, then you ballast the system and then you have the draft of approximately 23 metres and that's stable. The whole unit is actually rotating up against the wind, so it's facing headwind all the time. That is done automatically – and that has been tested in the water tank, where we actually exposed the unit for the wind and then we pushed it to the side to see if it would move back again to see the headwind 90° onto the two front turbines. And it did actually, so it's actually self-controlled, rotating up against the wind at all times. We were positively surprised, because basically all our anticipations and thoughts about the design proved to be correct in the water tank and in the wind tunnel as well.

“It's very important to remember that the total efficiency of the system, we believe, is quite extremely high because it is 93% efficiency

up against a theoretical maximum. Obviously, then a slightly bigger reduction in power production on the aft turbine is fully weighted up against the total efficiency of the system as such.”

How has the response been? Have negotiations begun for possible financing?

“Obviously, we would have wished that the response should have been even bigger, but I think it's fair to say that the response is at least fairly good. The one thing we see and recognise particularly over in the UK, is that there is heavy focus on more shallow water and fixed installations. While our system will be available for the market sometime in 2015, the fixed platforms are available on the market tomorrow.”

“The focus in the market is very much on the fixed installations, but every time we present the floaters, we get positive responses.

According to the EWEA:

In 2008, the value of wind turbines installed in Europe was 11 billion Euros. In 2020, the annual market for wind energy in the EU is expected to reach 17 billion Euros. About 160,000 people in the EU were in wind energy-related employment in 2008. The wind industry could create up to 368,000 new jobs in the EU from 2000 to 2020.

Europe's 65 gigawatts (GW) of wind power installed by the end of 2008 will annually avoid 108 million tonnes of CO₂ – the equivalent of taking over 50 million cars off the road. This also translates into an annual avoided CO₂ cost of about 2.4 billion Euros.

Source: the European Wind Energy Association (EWEA)

Everyone says it is exciting. Everyone seems to recognise that sometime in the near future – five or six years ahead – the floater will be a part of the offshore development of wind farms.”

Other than the design and technology, what sort of interest is the market showing?

“Very often we get the question, ‘Are you really able to produce electricity at competitive prices?’ And we believe that based upon all the calculations we have done, we can say, ‘Yes, we are’. We believe that with a power price of let's say 0.6 NOK per kilowatt hour, then we believe that the a wind farm based on our concept will be profitable. Some may say that they need more than 1 NOK, but we don't believe that – we believe that based upon the calculations and assumptions we have, we will be profitable at 0.6 NOK per kilowatt hour.”

So, what about financing and the way forward toward a prototype?

“We are not in any negotiations with anyone in particular for the time being, but we are out in the market talking with various potential stakeholders – strategic alliance partners – and we do hope that when the autumn comes, before the winter sets in, the required financing should be in place.”

Is government funding an option?

“It is important that we are able to attract government funding from the various funding possibilities – for instance, from The Research Council of Norway programme RENERGI – Clean Energy for the Future. We will apply for funding from them this autumn. For us, it's important that we get some kind of funding from the government at this stage.”