

# 50 MW TEST SCHEME FOR NEW OFFSHORE WIND TECHNOLOGIES

Benoît Bizet, *Danish Energy Agency, Denmark*

## ABSTRACT

The global wind market has been asking for opportunities to develop offshore test projects. Offshore test facilities can potentially reduce production costs of electricity from offshore wind farms; hence keep offshore wind energy competitive. As part of the 2012 Energy Agreement, Denmark has established a support scheme for offshore test projects with a capacity of up to 50 MW. State aid for offshore test activities will supplement the many existing onshore test facilities, as offshore tests will usually be the final step in development of a new turbine or new components for a turbine.

The Danish Energy Agency published in July 2015 a call for applications for tests of new technologies to establish and operate wind energy production offshore. The applicants must comply with a number of minimum criteria such as the technical and financial capacity and these assessment criteria were used to ensure a potential for development and the commercial perspective. Turbines in the test scheme will receive a CfD of approximately GBP 0.08 per kWh for a production period corresponding to about 50,000 full-load hours and then only market price until decommissioning. The aid has been granted in February 2016 to I/S Nissum Bredning Vind. The commitment was finalized in June 2016.

## NOMENCLATURE

DEA: Danish Energy Agency  
NBV: I/S Nissum Bredning Vind  
EIA: Environmental Impact Assessment  
SWP: Siemens Wind Power  
kWh: Kilowatt hour  
MW: Megawatt  
CfD: Contract for Difference  
PSO: Public Service Obligation  
GBP: Great-Britain Pound  
CAPEX: Capital Expenditure  
OPEX: Operating Expenditure  
LCOE: Levelized Cost of Energy

## 1. INTRODUCTION

Wind energy and offshore wind turbines in particular are to contribute a minimum of 50 pct. of the total Danish electricity consumption in 2020. Offshore wind farm projects such as Horns Rev 3 (400 MW), Kriegers Flak (600 MW) and the nearshore projects (400 MW) mean that Denmark has planned total additional capacity of 1400 MW. As part of realisation of the 2012 Energy Agreement, 50MW out of a total of 400MW nearshore wind turbines have been earmarked for offshore test projects. In summer 2015, the DEA called for tenders for the 50 MW pool via the “Call for tenders” [1]. The projects in the test scheme will be supported with a CfD of approximately GBP 0.08 per kWh, where the aid element will be the difference between the GBP 0.08 per kWh and the current Nord Pool spot power price. The aid is provided for a period of

around 50,000 full-load hours corresponding to 11-12 years.

## 2. ABOUT THE SCHEME

The scheme provides aid for tests that can contribute to reducing production costs of electricity produced from offshore wind farms. It is important that tests include a strong development element and that they have commercial potential.

The turbines installed under the test scheme will be receive a CfD of approximately GBP 0.08 per kWh for the sum of electricity production for 15,000 hours at the installed capacity (full-load hours) of the wind turbine plus electricity production at 12.7 MWh per square meter of rotor area. This corresponds to a weight of 30 percent for the installed capacity and 70 percent for the rotor area. This model has originally been developed and implemented for onshore wind projects. Weighting the rotor areal and the specific power in the calculation of the supported full-load hours limit extensive aid resulting from the installation of overpowered wind turbines. Supporting projects based on the installed capacity only resulted in the installation of turbines with very large generators in order to achieve an extended supported period. For offshore wind projects, combining rotor size and weighting in the calculation of the supported full-load hours resulted in an average production corresponding to 50,000 full-load hours, which is representative for

most of the offshore wind turbines available on the market.

The main principles for payment of the aid are:

- The aid is a CfD model, which guarantees the project approximately GBP 0.08 per kWh for a production corresponding to approximately 50,000 full-load-hours.
- The aid is financed by the so called PSO, which is paid by the Danish electricity consumers.
- Electricity must be sold on the Nord Pool spot market under relevant market terms.
- No aid will be provided when the spot price is negative.
- No allowances will be granted for balancing costs.

The scheme has been approved as legal state aid by the European Commission for project that has received a commitment of aid before the end of 2016.

Preliminary investigations and grid connection are initially to be financed and established by the applicant. However, it is possible to integrate test turbines on either existing test sites or as part of establishing planned commercial wind farms (hybrid projects).

## 2.1 WHO CAN APPLY FOR THE AID

Any nationality can apply providing they meet the objective of the scheme.

In order to ensure that aid is not given to projects which would be conducted at all events, the applicant must document or provide evidence that the aid has an incentive effect. Projects are therefore excluded which have already received a licence for construction and therefore have demonstrated that they have the necessary financial and economic resources available to complete the project under the aid regulations applicable under the “Open-Door” scheme.

Within the framework of the European Commission state aid approval, it is not possible to supplement state aid with aid for test projects from other development and demonstration programmes. In the event of supplementary aid, the project will have to be reported separately to the European Commission.

## 2.2 CRITERIA

The applicant must comply with a number of minimum and assessment criteria.

### 2.2 (a) Minimum criteria

These criteria are to ensure that the test areas designated are suitable and that the applicant is able to comply with the relevant provisions in the Promotion of Renewable Energy Act which regulate the requirements for EIA preliminary investigation licences and the subsequent construction/establishment and electricity production licences required to establish the project. This is to ensure that commitments are only granted to applicants, which have a realistic expectation of being able to commission, maintain and decommission the project.

Applicants must document or provide evidence that they have sufficient technical, economic and financial resources to receive the three types of licence necessary pursuant to the Promotion of Renewable Energy Act:

- A licence to conduct preliminary investigations
- A licence for construction/establishment
- An electricity production licence and possibly an electricity production grant (if the application is for more than 25 MW).

Applicants must primarily document a convincing financing plan for the entire project, including the decommissioning phase, and document that they, or an appointed operator, have relevant experience in operating technical installations for electricity production.

### 2.2 (b) Assessment criteria

The applicants which are deemed to meet the above minimum criteria will be assessed qualitatively on the basis of the objective criteria stipulated in the Act, the potential for development and the commercial perspective.

There is special emphasis on the test having significant potential to reduce production costs of electricity from offshore wind turbines.

Therefore, the DEA will prioritise applications containing the following elements:

- The test addresses an innovative technological development compared with existing technologies and solutions
- The test is well-defined and technically feasible
- The test is at full scale. Aid will not be provided for tests in the research phase or tests which are not fully scalable.

There is special emphasis on the test project having a clear commercial perspective. Therefore, the objective should be to test new solutions which can subsequently be sold as commercial projects. Therefore, priority will be on applications with the following elements:

- The test meets a demand in the market and has a well-defined customer aim.
- There is an economic growth potential and prospect of a competitive product.
- The test enables certification or some other relevant type of verification.
- Diversity in the test: The more technologies to be tested, the more the project will be assumed to promote the long-term commercial perspective.

These elements should be documented or evidenced in the application.

### 2.3 RECEIVED APPLICATIONS

In response to the call for tenders, the DEA has received four applications from three different consortia.

2.3 (a) European Energy Offshore A/S applied in collaboration with Bilfinger Marine and Offshore Systems GmbH and Siemens Wind Power A/S for a 44 MW project called “*Monopiles & Turbines – Life Cycle Improvements*” [2]. The project’s main test elements were the vibro-driving technology for installation of the monopile foundations combined with a noise mitigation system and some new concepts of scour and corrosion protection systems.

2.3 (b) European Energy Offshore A/S applied in collaboration with Per Aarslef A/S and Siemens Wind Power A/S for a 32 MW project called “*GBF Enhanced – Ver. 2 and O&M Optimization*” [3]. The project’s main test

elements were the gravity based foundation installation including automated seabed preparation, innovative ballasting and transition piece preinstalled in the foundation. Moreover, a couple of other elements on the wind turbine such as rotor synchronisation and power boost mode were to be tested.

2.3 (c) Frederikshavn Offshore Wind Demo ApS (part of EDF EN Denmark A/S) applied for a 40 MW project called “*Frederikshavn Offshore Wind Demo*” [4]. The project’s main test elements were the suction bucket monopile, the commissioning methods and a comprehensive monitoring campaign to the operational phase of the project.

2.3 (d) I/S Nisum Bredning Vind applied in collaboration with Jysk Energi A.m.b.a. and Siemens Wind Power A/S for a 28 MW project called “*Testbed for new technologies and integrated design*” [5]. The project’s main test elements were the new type of SWP gravity jacket foundation, a slender wind turbine tower concept, a 66 kV cables and switchgear solution and an optimized use of sensors and limitations of loads through reduced output from the turbine.

## 3. EVALUATION AND GRANTING OF AID

The four projects have been assessed based on the above described criteria by both the DEA and selected external evaluators. There was a general good agreement between the parties that NBV’s project should be granted the aid in February 2016. The project is now rolling out according to the agreed set of rules and is expected to be commissioned during summer 2017. The project has been assessed by the applicant to lead to cost reduction of about 12.5 pct. on both CAPEX and OPEX. The main contributors to these potential savings are:

- The cable types and the installation method
- The jacket foundation concept with a concrete pre-prepared transition piece
- The slender wind turbine tower
- The turbine sensors and corresponding algorithm

#### **4. ABOUT THE REMAINING 22 MW OF THE TOTAL 50 MW POOL**

From the 50 MW allocated to the test scheme, only 28 MW have been awarded. As mentioned above, the scheme is only valid if the commitment is found in 2016. A combination of a political strategy and a relatively short time frame did not allow the call of tenders for the remaining 22 MW.

#### **5. CONCLUSIONS**

With this 28 MW test pilot project in the Nisum broad will Denmark be an exposition window to the global wind industry. The progress of the project can be followed on the DEA's [web page](#).

#### **ACKNOWLEDGEMENTS**

Thanks to all applicants for their efforts, their applications, which all contained elements which may be seen in future projects. Offshore test facilities are crucial for the global wind industry in order to reduce LCOE for offshore wind energy in order to increase competitiveness with the other renewable energy sources.

#### **REFERENCES**

1. [DEA],[2015] '[Call for tenders]'
2. [European Energy Offshore A/S],[2015] '[Monopiles & Turbines – Life Cycle Improvements]'
3. [European Energy Offshore A/S],[2015] '[GBF Enhanced – Ver. 2 and O&M Optimization]'
4. [Frederikshavn Offshore Wind Demo ApS],[2015] '[Frederikshavn Offshore Wind Demo]'
5. [I/S Nisum Bredning Vind],[2015] '[Testbed for new technologies and integrated design]'