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Alstom inaugurates the largest offshore wind turbine in the world, near Saint-Nazaire

On 19 March, Alstom inaugurated the largest offshore wind turbine in the world, at Carnet in the Loire-Atlantique. The ceremony was attended by Eric Besson, Minister of Industry, Energy and the Digital Economy, and Patrick Kron, Chairman and CEO of Alstom.

The 6 MW Haliade 150 wind turbine has been developed in response to a call for tenders launched by the French government in July 2011 that aims to install 3 GW of wind turbine power off French shores by 2015. In preparation for its certification, the first Haliade 150 will undergo a series of year-long tests on land at the Carnet site, before a second turbine is placed in the sea off the Belgian coast in autumn 2012. Pre-series production is planned for 2013 with production in series due to start in 2014.

The Carnet site, located near Saint-Nazaire on the shores of the estuary, was chosen for its geological characteristics that are very similar to the submarine environment in which the wind turbines will eventually be installed. The 25 metre sub-structure (known as the jacket) was installed on pillars driven more than 30 metres into the ground on which the 75 metre high tower was then gradually mounted. The nacelle soars over the landscape 100 metres above the ground. The wind turbine and its support structure have a total combined weight of 1,500 tons.

Alstom is the exclusive supplier to the consortium led by EDF Energies Nouvelles which includes Dong Energy, the Danish energy specialist and world leader in offshore wind farms, as well as the developers Nass & Wind and wpd Offshore. The consortium's agreement with Alstom offers a unique opportunity to develop a wind turbine based on French technology, built and assembled in France, employing a substantial number of local industrial contractors and benefiting from technological partnerships with various bodies. This project will involve nearly 200 suppliers to the offshore wind turbine sector.

If the consortium's response to the tender is successful, Alstom plans to establish up to 4 factories to produce components for these offshore wind turbines and for their assembly, in the port areas of Saint-Nazaire (Loire-Atlantique) for the nacelles and alternators, and in Cherbourg (Manche) for the blades and towers. These French sites will be the first Alstom sites in the world entirely dedicated to offshore wind power and will permit the creation of 5,000 permanent qualified jobs, including 1,000 direct jobs.

Leading edge technology for the most powerful wind turbines

Each of these next generation offshore wind turbines will be able to supply the equivalent of the electricity consumption of 5,000 households.

To meet the severe challenges posed by the marine environment, Alstom has developed a 6 MW wind turbine which is simple, robust and efficient, to improve the competitiveness of offshore wind power. Simple, this wind turbine will function without a gear box (by direct drive) and is fitted with a permanent magnet generator, to reduce operating and maintenance costs. Robust, the Haliade 150 is fitted with Alstom PURE TORQUE^R technology which protects the generator by diverting unwanted stresses from the wind safely to the turbine's tower, thereby optimizing performance. Lastly, the Haliade 150 offers more efficiency with its 150 m rotor (the 73.50 m blades are the longest in the world) ensuring an improved load factor.

To date, Alstom has built or installed about 2,300 wind turbines that generate more than 3,000 MW, in a dozen countries (Spain, Brazil, United Kingdom, France, Italy, Portugal, Morocco, United States...). Alstom's engineering innovations have made it possible to increase the size and power rating of these wind turbines. Alstom's onshore turbines have ratings of between 1.7 and 3 MW.

Onshore and offshore product certification tests

Onshore tests allow easier access to the turbine to carry out the numerous measurements and manipulations required for the certification of the first unit, a procedure which necessitates the installation of a measurement tower close by.

Analysis of the turbine's power curve to determine its capacity to produce electricity efficiently according to wind availability, is central to this certification procedure. These tests will also enable, once additional sensors have been installed, validation for the various simulations (stress, temperature, life span ...) carried out during the Haliade 150's research and development.

The electrical equipment installed in the tower (converters, transformers, low-voltage electricity network, computer networks and calculators) will undergo advanced validation tests.

The generator will be subjected to tests which measure operating temperature, vibrations, current and voltage.

Then, the turbine's different mechanical components will be tested for vibrations, stresses (notably for the blades) and reaction times.

Lastly, the turbine's global performance and piloting software parameters will be analyzed during this onshore test phase.

Offshore testing will begin in autumn 2012 and will permit testing of aspects of maintenance and connection under real operating conditions.

A first wind turbine built like a series one

The first nacelle for the Haliade 150 was assembled at Saint-Nazaire, in a temporary pre-series workshop which will produce about 40 units over the next three years. The second unit is currently being assembled there. About 40 Alstom engineers and operators are employed on these assembly operations.

The assembly begins with the turbine's *central block* which forms the interface between the tower and the nacelle. This block contains the direction drive system (which includes a direction bearing) that permits adjustment of the nacelle's position in relation to the tower, allowing the turbine's nacelle and blades to instantly be re-directed to capture the wind. To facilitate maintenance operations, the central block is equipped with a helipad so that response personnel can be winched up into a helicopter.

At the same time, the *intermediate block* is fitted to the permanent magnet generator which will be driven directly by the blades' rotation to produce electricity. These two blocks - central and intermediate - represent a total weight of nearly 300 tons. They are then fitted together to receive *the turbine rotor* to which the 3 blades are in turn fitted. This rotor with its 150 m diameter is in direct mechanical linkage with the *generator rotor*.

The pre-series workshop at Saint-Nazaire will play an important role in the future production process of the offshore wind turbines. A certain number of rules and procedures will be applied right from the first units and subsequently implemented for commercial production.

5,000 permanent qualified jobs, including 1,000 direct jobs at Saint-Nazaire and Cherbourg

The tender being submitted by the consortium led by EDF EN concerns the sites of Saint-Nazaire, Saint-Brieuc, Courseulles-sur-Mer and Fécamp. The choice of these 4 zones was based on wind and environmental studies conducted over a period of about four years, as well as on detailed geotechnical campaigns conducted at each site to determine the nature of the seabed. Consultations held over a period of months with different local stakeholders – fishermen, municipalities, elected representatives, residents – have already produced a wide consensus.

The project's industrial scale will depend upon the results of the call for tenders to be announced in April. Alstom may invest up to 100 million euros. Alstom plans to assemble the nacelles and build the alternators at Saint-Nazaire. With capacity for 100 units per year, the two factories will be operational in 2015 (for the alternators) and 2016 (for the nacelles) and will represent 300 direct jobs.

The blades, in partnership with LM Wind Power, will be produced at Cherbourg as well as the towers. With production planned to start in 2016, these two factories will represent 500 direct jobs for an annual production of 100 series of 3 blades.

In addition to this, an engineering and R&D centre employing 200 people and dedicated to offshore wind power, the first and only centre of its kind in France, will be established in the Pays de la Loire region.

The ports of Saint-Nazaire and Cherbourg were chosen after a phase of detailed consultation, in the light of a combination of criteria that included the quality of their infrastructure, ease of access to the wind farms envisaged in the tender, the investment support mechanisms proposed by local authorities, the existence of industrial know-how and the capacity to form a complex industrial fabric geared to offshore wind power.

Besides the industrial cluster to be developed by Alstom, the consortium plans to establish, in the ports of Saint-Nazaire, Brest, Cherbourg and Le Havre, up to eight sites at which the foundations for the wind turbines will be built, as well as four operation-maintenance centres in the nearby ports of La Turballe, Saint-Quay-Portrieux, Caen-Ouistreham and Fécamp, thereby creating an additional 2,500 jobs. The entire project will create a total of nearly 7,500 jobs.

About Alstom

Alstom is a world leader in power generation and transmission infrastructure, and in rail transport infrastructure. The Group is a reference for innovative technologies that respect the environment. It builds the fastest trains in the world and the highest capacity automated metros. Alstom supplies integrated turnkey power stations, equipment and a range of related services for different sources of energy, including thermal (nuclear, gas, coal...) or renewable (hydro, wind, solar...). It offers a wide range of solutions for power transmission, in particular in the field of smart grids. Alstom employs about 92,000 people in a hundred countries and posted a turnover of more than 20.9 billion euros in 2010/11.

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