

OFFSHORE USA

The Cape Wind offshore wind farm: a first for the USA?

The Cape Wind proposal for the first US offshore wind farm has become a battleground between the project's proponents and opponents, and may well influence the whole future of renewable energy in the country. Paul Grad reports

First proposed in November 2001 by Cape Wind Associates, of Boston, the proposed site in Massachusetts state waters between Cape Cod and Nantucket Island at Horseshoe Shoals was chosen taking into account the intensity of sustained winds, the water depths and its accessibility to the transmission grid. Prospective owner and operator, Cape Wind is no stranger to the problems associated with such projects and, since its first proposal, has made painstaking but steady progress in obtaining all the necessary approvals.

Milestone

Recently the Massachusetts Energy Facilities Siting Board (EFSB) - the agency charged with ensuring a reliable energy supply at the least cost and environmental impact - has approved the interconnection of the wind farm's buried cables to the electric transmission system in the state. The Board's decision states that: "The power from the wind farm is needed on reliability and economic

grounds, and to meet the requirements of Massachusetts and regional renewable portfolio standards." The decision was a significant milestone for Cape Wind. A spokesman for Cape Wind, Mark Rodgers, said he was pleased and encouraged with the Board's decision. He said the company must still raise capital for the project. He said if all goes well and all necessary approvals are obtained, the wind farm will be producing up to 420MW of electricity for local communities by 2007.

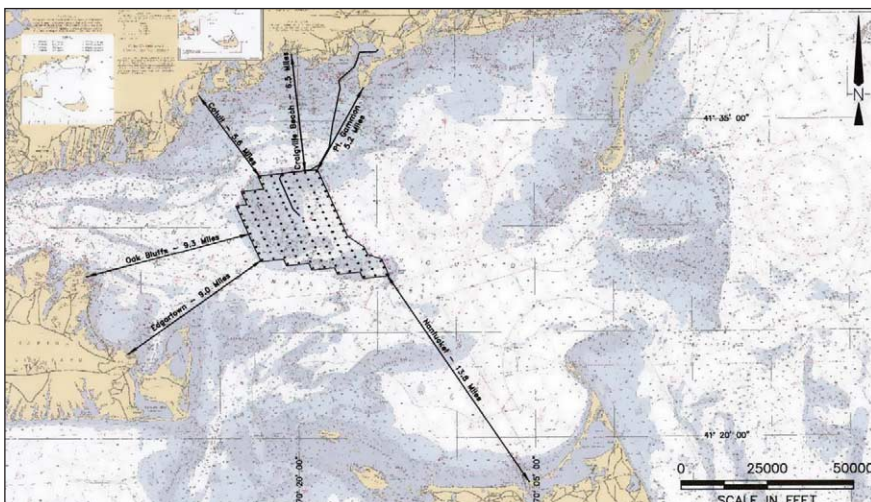
The wind turbines - on monopole structures - would be in an area outside of state waters on the Outer Continental Shelf. Under the Rivers and Harbors Act, the US Army Corps of Engineers regulates all structures and work in navigable waters of the US. The Corps authority includes the Outer Continental Shelf. Late last year, the US Army Corps of Engineers issued a draft environmental impact statement (EIS) for the project. The basic conclusions of the draft EIS are that the project will cause

minimal impact on local marine and bird life, and will not adversely affect commercial or recreational activity in the area. The public had until 10 January to comment on the EIS' findings. The Corps is now preparing a final EIS, which is expected to be available later this year.

Despite the findings of the draft EIS, the proposed wind farm has been the subject of intense debate, partly due to the fact that it will be the country's first offshore wind farm, and partly because it will be a very large installation. It will consist of 130 wind turbine generators (WTGs). The rotors will have an overall tip to tip diameter of about 104m. The WTG nacelle hub height will be about 75m from the mean lower water datum. The turbines will be arranged in parallel rows with appropriate spacing to obtain optimal energy generation (630m [north-south] and 1000m [east-west] between each turbine).

Public concerns

Faced with the prospect of an installation of such dimensions, members of the public were concerned that the wind farm would become an eyesore, and spoil the area. This became one of the main concerns regarding the project. However, proponents of the project noted that, during most of the year, there is fog over the sea near the coast, and the turbines will not be visible from the shore at all. Besides, the nearest distance of the turbines to land will be about 7.6km. A spokesman for AWS Truewind, a research firm that consulted on the project, said photo simulations of what the wind farm would look like from the shore assume the clearest weather conditions (see picture, next page). From the shore, on a clear day, the wind farm will be visible about 1cm above the horizon and should not constitute an eyesore. Greenpeace, which is one of the strongest supporters of the project, also believes there is no need for concern over the turbines' visual impact. Kert Davies, US



Site of the proposed first offshore wind farm in the USA at Cape Cod. Source: Cape Cod Times

research director for Greenpeace, said in some countries where offshore WTGs have been installed, as in Denmark, the wind farm has actually become a tourist attraction. Greenpeace has taken its support for the project to local airwaves in a 30-second television commercial depicting windmills off the coast of England and a snippet from a U2 song.

Debates and battles

Nevertheless, the sometimes acrimonious debate between those for and against the project continues. While the US Army Corps of Engineers is the principal agency reviewing the project, the wind farm is also being scrutinized by 9 state agencies. For the most part, state oversight is limited to the effects of the underwater cables since that is the only part of the project in state waters. EFSB chairman Paul Alfonso drew attention to the fact that the situation became somewhat clouded when the federal government altered the boundary of federal waters earlier this year. A slice of the Cape Wind footprint - where 8 to 10 turbines would be built - was suddenly in state waters. Several other state hurdles remain, with several more approvals expected from various state agencies. Meanwhile, a contentious battle has been waged in court between Cape Wind and the "Alliance to Protect Nantucket Sound". According to a report in the Cape Cod Times, the battle is about the more than 400 files containing Alliance strategy memos, donor lists, and emails on computers used by former alliance staff member, John Donelan. Cape Wind is fighting for access to the files as part of its ongoing libel suit against Donelan. The alliance, which has spearheaded opposition to the wind farm, hopes to keep the files under wraps.

According to the report a Suffolk Superior Court judge ruled that the files should be turned over to Cape Wind for review. A few days later, attorneys for the alliance successfully petitioned the court to keep them from Cape Wind until the alliance appealed the decision to a higher court. A spokesperson for the alliance said the files contained sensitive information about the alliance operations and financial backers that is proprietary. The Cape Cod Times report says critics of the alliance have charged that the

group is bankrolled by wealthy summer home owners with houses overlooking Nantucket Sound. Of the \$1.7 million the alliance raised in 2003, \$1.3 million came from 56 donors who gave \$5000 or more. The top 20 contributors gave more than \$1 million, the report says.

Design and engineering

Despite the fighting, however, the design and engineering details of the project have been well established. The WTGs will be arranged so as to maximize the wind farm's energy generating capacity of 454W. This capacity is based on the design wind speed of at least 14m/s, up to the maximum operational speed of 25m/s. Based on an average wind speed of about 9m/s, the net energy production delivered to the regional transmission grid will be about 1.5GWh/a. The project will use pitch-regulated upwind WTGs with active yaw and a three-blade rotor. The rotor blades will be pitched to prevent rotation when the wind speed exceeds 25m/s and will also engage the disk brake system to positively lock the rotor.

There are two basic foundation systems for existing offshore wind turbines: the gravity based foundations, which use a prefabricated, large diameter concrete and steel



Computer simulation of a view from the shore about 10km away from the Nantucket Sound wind farm (from a place called Cotuit)

caisson placed on the seabed to support the WTG; and the monopole foundations, which are either prefabricated steel or concrete pile systems driven or augured into the seabed. The gravity foundation system has been used for several European WTG installations where the soil or rock characteristics at the bottom preclude the use of monopoles. It requires a shipyard and dry dock near the site to construct and allow the foundation structures to be floated out to the site and sunk. It is an environmentally more "brutal" system due to the foundation structures' large diameter. The monopole system is the best suited and preferred solution for offshore applications being a large diameter pile driven 15.2m to 27.4m into the seabed, depending on the load bearing characteristics of subsurface marine sediments. At Nantucket Sound the main support tower will have a base diameter of



Blyth offshore wind farm: the first in the UK. Photo: AMEC Border Wind

about 5m at the mean low water datum plane. The monopole structures will be spread throughout an ocean area of about 50km² and the electricity generated by each turbine will be transmitted via a 33kV submarine transmission cable system to the Electric Service Platform, centrally located within the WTG array. The platform will then take the energy from each turbine and transform and transmit this electric power to the Cape Cod mainland via two 115kV alternating current submarine cable circuits. The cable systems will make landfall in the town of Yarmouth. From this landfall, an upland transmission system will be installed in an underground conduit system within existing roadways and right-of-way.

Environmental impacts

According to the draft EIS prepared by the US Army Corps of Engineers, the project will not adversely affect ferry operations, commercial and sport fishing, boating, aviation or any other activity. The draft EIS, however, presents a long list of possible environmental effects and, while stating these will all be minor, also presents a list of mitigation measures for each of them. It says there will be no major impact on tidal or wind-driven currents because of the small cross sectional area of the WTGs and the wide spacing between them. It says installation of the submarine cables by jet plow embedment will minimise sediment disturbance and suspension. The submarine cable system will be buried to a minimum of 2m below the seabed to avoid conflict with fishing vessels and gear operation. During installation of the monopoles, impact from pile driving equipment will be minimised by using a "soft start" of

the pile driving equipment, to allow fish to move away from the area. To minimise impact on protected marine species, the draft EIS recommends that ships transporting materials and crew to the project site travel at speeds well below 14 knots and that project vessels follow National Oceanic and Atmospheric Administration (NOAA) whale watching procedures while travelling to and from the project area. Underwater sound monitoring will be carried out during initial monopole construction.

Prior to construction, an erosion and sedimentation control barrier will be installed to protect the adjacent salt marshes. Erosion and sedimentation, dewatering and storm water management plans will be developed, which will incorporate applicable best management practices for erosion and water management during construction.

The piles will be driven mechanically into place, minimising seabed disturbance and turbidity associated with the foundation installation. To mitigate the potential impact on visual, archaeological and cultural resources, the draft EIS proposes that the 115kV marine transmission route be shifted to the west to avoid several reported shipwrecks. The upland transmission route will be located entirely below ground within paved roads and existing utility right of ways to avoid visual impacts and impacts on potential archaeological resources.

It will be interesting to see how the project progresses, considering that the US wind energy potential is estimated by the American Wind Energy Association (giving the Pacific Northwest Laboratory as the source) at nearly 11,000 billion kWh annually - more than twice the electricity generated in the US today.