Title: Preliminary Environmental assessments for four French offshore wind farms

Abstract. In its Bid for tender of 11 July 2011, the French State proposed five areas enabling the development of offshore wind generator farms. Indeed, these areas meet the technical and environmental requirements for wind power electricity production, with: a high quality wind resource ; naturalistic and landscaping stakes and local activities which seem to be compatible with the implantation of wind generators ; rather shallow waters (minimum: -5.7 m. maximum: - 42 m) a few km off the coast (up to 28 km from the coast) ; a relative proximity of the high voltage power grid with capacities to accommodate a high power wind generator farm. The bid also specifies that all electrical connection cables will be embedded (buried in the marine floor), at a depth of 1.5 metre, to avoid interfering with fishing activities. Finally, the power levels installed in each farm is mentioned (500 MW or 750 MW). The presentation discusses the preliminary environmental assessments which were conducted by TRACTEBEL ENGINEERING – (FRANCE)/COYNE ET BELLIER and included within the financial and technical proposals of investors.

1. Requirements of the Government's bid

Within the framework of the bid for tender, the candidates were required to present, besides economic and financial matters, a technical description of the installation they intended to operate, including:

- Number, type, power and manufacturer of the wind generators and their main components;
- Type of foundations;
- Electrical links within the installation up to the offshore delivery power station;
- Electrical part of the delivery;
- Annual operating time in full power equivalent planned for the installation;
- Optimisation of the choice of wind generators, considering local conditions;
- Main characteristics of the operating and maintenance plan devised for the installation;
- Global optimisation study of the project aiming at minimizing the cost of energy produced.

About the environment, the candidates were required to provide a preliminary environmental assessment, summarizing the marine baseline conditions, and considering the potential impacts of offshore wind farms on the natural environment, from the design stage up to full rehabilitation of the site, in the environmental conditions of the French coast. Finally, the candidates were required to present a comprehensive environmental management plan, including monitoring activities.

2. Content of the preliminary environmental assessment

Based on available environmental data at the time of application as well as field investigations and surveys conducted on behalf of the proponent, the preliminary assessment was intended to demonstrate the compatibility of the project with the environmental sensitivity of the sites. In this respect, it was required:

- To identify the main environmental stakes of the site, and in regard of the characteristics of the installation, the main impacts expected from the installation;
- To present the measures considered to prevent, reduce and whenever possible, compensate the noticeable negative effects of the project on the environment, particularly on birds, bats, benthic and pelagic species, the sea-bed, landscape, throughout the lifetime of the installation, from the construction phase up to dismantling. These measurements may be based on observations and analyses performed in operating offshore wind generator farms, provided their application can be justified as being appropriate for the project and site involved;
- To present the dismantling and site rehabilitation plan, which the candidate commits to apply at the end of life of the installation (as later determined by the formal environmental impact assessment[1])
- To specify the terms of environmental monitoring the candidate commits to perform over the lifetime of the installation and site rehabilitation;
- To indicate the state of progress of administrative procedures required in this field and appends any justification of the performance of these procedures.

[1] A specific 18 months period was planned after the bid to complete a full environmental impact assessment

3. Characterization of the environmental baseline

Impact assessment of wind generation farms projects was led by TRACTEBEL ENGINEERING – (FRANCE)/COYNE ET BELLIER on behalf of the GDF SUEZ – CDC Infrastructure – VINCI investor group on four of the five sites proposed in the bid for tender. In these sites, offshore investigations and technical expertise were carried out to produce an initial environmental baseline and characterize the physical and biological environments as well as cultural heritage sites and the landscape: bathymetric measurement campaign, seismic reflection campaign, bio-sediment and geochemical expertise of the sea bed, modelling of the underwater acoustic environment, expertise on marine hydrodynamics, analyses of marine mammals stranding and observation databases, expertise on avifauna and bats, fishery resources, landscape stakes.

These assessments allowed establishing the main naturalistic and landscaping stakes of the proposed projects' areas, which were identified as follows:

- Sites are located inside or in close proximity of marine environments remarkable in terms of biodiversity (created to protect avifauna and habitats), and are all national and/or international magnitude tourist sites;
- Sensitivity of the coast (North Brittany and Normandy) is rather strong in terms of bird migration, marine mammals, and fishery resources;
- Local stakes are related to the existence of marine protected zones within European Directives (Natura 2000 network) and to specific landscape issues.

4. Main impacts on marine and coastal environments

For marine mammals, the construction phase of a wind generator farm creates nuisance of different magnitude. The most important impacts appear with underwater acoustic emissions when installing the metallic structure of the foundations (the drilling method has a lesser acoustic impact than beating). Within the perimeter of the wind generator farm, the operating phase generates a low impact in terms of noise, and many authors consider that the sound levels are not likely to disturb marine mammals. According to the simulations made, this impact fades away rapidly with the distance (inaudible beyond 5 km). The risk level is also negligible for electromagnetic and collision issues.

As for avifauna, the impacts expected are related with collisions (against the blades or towers of the wind generators), loss or modification of habitat (space occupied by the infrastructures), and modification of paths. However, the studies remain to be refined on the implantation sites, over longer periods, and according to local species present. Generally, we noted that wind farms areas were far enough from the coast to avoid impacting the main migration path, along the coast, named Atlantic migration path.

For the benthos, the impact of the construction of the foundations and burying of the cables on benthic population is direct and temporary. The level of the impacts (mainly loss of habitat) is considered to be very low due to the surfaces involved (less than 0.1 % total surface of the projects, case of metallic foundations). On the physical marine environment, the first evaluations do not foresee any notable negative effects, or modification of the surrounding hydrodynamic conditions during the works phase (tide, current, swell). The impact of the structures on swell, currents and sediment transport will be rather low and localised in the operating phase.

For the fishery resource, the impacts will be low, rather limited in time and space. The species potentially impacted are mobile species which can flee or those with a destroyed habitat, such as flat fish. In the construction phase, the main impact will result from the emission of noise in the works zone. Therefore, mobile fish will flee by leaving their habitat. In the operating phase, permanent and direct sound impacts will be very low on fish.

As for the landscape, the integration of an offshore wind farm in the landscape depends essentially on the geometry of the farm, which will determine its visibility from the shore, the proximity with remarkable view points, protected and/or recognized, and visibility conditions. However, in our

case, the distance between the projects and the coast is significant, and photomontages made show the conditions of integration, even more sensitive as the local landscape stakes are close.

5. Consideration of environmental stakes: design options

The way environmental sensitivity has been considered when designing the project is an important point. These are the design choices, or design preventive measures to avoid and/or reduce potential impacts of wind farm projects. The design choices which were highlighted are:

- A high power wind generator model was chosen (5 and 6 MW power per unit). This choice minimizes the number of units implanted in the maritime public domain and the global footprint on the sea-bed.
- The implantation of the wind generators was designed in order to minimise the impacts on fishery and maintain the practice of certain fishing activities. The implantation lines follow a heading defined jointly with the fishermen, allowing for continuity of fishing practises.
- The implantation chosen includes no wind generators in the zones most favourable to biodiversity;
- The wind farm is implanted farther out than planned initially (distance from the first generator);
- All electrical connection cables will be buried in the sea-bed, at a depth of 1.5 metre.

6. Other measures to reduce or compensate the expected impacts of the projects

At the bidding process stage, the measures proposed to reduce the impacts of the construction and operation phases of the farms remain to be refined. For marine mammals, this means reducing sound emissions during the construction works with, on the one hand, gradual beating (to allow the animals to have enough time to leave the zone) and, on the other hand, the implementation of bubble curtains or « anti-noise » barriers to reduce propagation of underwater noise. In addition to these measures, in the risk zones and periods, checking will be performed to ensure the absence of all marine mammals within a 2 km radius by visual surveillance and chasing off any individuals present by means of a scaring system. In certain sites, geographical zones must be preserved in priority, and a marine mammal circulation corridor will be protected from any acoustic excess, hence guaranteeing an escape route is provided.

As a support, we proposed to favour the development of biodiversity and renewal of the fisher resource by controlled implementation of artificial reefs, jointly with fishery professionals. The idea is to immerse artificial habitats on mellow sea-beds to increase biological productivity and diversity, while providing appropriate rocky-type shelter/habitats necessary to many fish species sedentarisation.

Research and development programmes were also being considered, such as the SIMEO program (Station Instrumentale de Monitoring Ecologique dans l'Océan), aiming at designing and developing a range of floating and instrumented stations. The technical objectives aim at integrating on a same buoy innovating and powerful instruments such as radar, depth-finder and video camera, associated with passive acoustic measurements, weather parameters and water mass characteristics (currents, temperature, salinity, density, etc.). The buoy must be self-powered and transmit data to land.

7. Benefits expected from the Environmental monitoring program

This means monitoring the state of the physical and natural environments, as well as potential impacts of offshore wind generator projects. The idea is to create a partnership instance for environmental management and monitoring of wind generator farms, covering all components of the environment (physical environment, natural environment, landscape, socio-economic impacts and public acceptance for offshore wind farms…). The results of scientific monitoring would be covered by reports, edited at appropriated reference years of the environmental monitoring, and made public to participate in the improvement of scientific knowledge, particularly on the following aspects:

- Marine environments in the Eastern Channel (morpho-dynamism, bathymetrics, quality of water and sediments, ambient noise, benthic population, migrations and presence of fish, birds, bats, marine mammals) ;

- Environmental impacts of the construction, operation and dismantling of an offshore wind generator farm (as feedback is still insufficient about environmental impacts of wind farms).

Therefore, environmental monitoring of offshore wind farms should allow a significant improvement of scientific knowledge on the marine environment. The production of a large number of data will be useful to understanding the marine environment in the Channel zone, as well as understanding the environmental impacts, including cumulative impacts of multiple wind farms.

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